Prepp

Your Personal Exams Guide

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RRB JE 2019 (CBT 2) (ME) Previous Year Paper (29 Aug 2019)

Total Time: 2 Hour **Total Marks:** 150

Instructions

Sl No.	Section Name	No. of Question	Maximum Marks	Negative Marks	Positive Marks
1	2nd Stage CBT	150	150	0.33	1

1.) A total of 120 minutes is allotted for the examination.

2.) The server will set your clock for you. In the top right corner of your screen, a countdown timer will display the remaining time for you to complete the exam. Once the timer reaches zero, the examination will end automatically. The paper need not be submitted when your timer reaches zero.

3.) There will, however, be sectional timing for this exam. You will have to complete each section within the specified time limit. Before moving on to the next section, you must complete the current one within the time limits.

2nd Stage CBT

1. Which of the following materials has nearly zero coefficient of expansion? **(+1, -0.33)**

   a. Selenium

   b. Invar

   c. Silver

   d. Stainless steel

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2. The distance from the joint root to the toe of the weld is called- **(+1, -0.33)**

   a. Leg

   b. Face

   c. Effective throat

   d. Actual throat

---

3. Which of the following statements about Ozone is true? **(+1, -0.33)**

   a. All of the options

   b. Ozone is highly reactive

   c. Ozone protects us from the harmful UV radiation of sun

   d. Ozone is the major constituent of photochemical smog

---

4. Which network is able to connect to each computer through a common central line? **(+1, -0.33)**

a. Star

b. Bus

c. WAN

d. Router

---

5. Which of the following is endothermic process? **(+1, -0.33)**

a. Sublimation of dry ice

b. Dilution of sulphuric acid

c. Evaporation of water

d. Both Sublimation of dry ice and Evaporation of water

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6. Pre-planning stage in production planning and control includes which of the following activities? **(+1, -0.33)**

a. Inventory control

b. Quality control

c. Demand forecasting

d. Dispatching

---

7. What is the shortcut key to insert a new slide into the current presentation? **(+1, -0.33)**

a. Ctrl + N

b. Ctrl + F

c. Ctrl + M

d. Ctrl + O

---

8. The demand rate for a particular item is 12000 units/year. The ordering cost is Rs.100 per order and the holding cost is Rs.0.80 per item per month. If no shortages are allowed and the replacement is instantaneous, then the economic order quantity is **(+1, -0.33)**

a. 1500 units

b. 2000 units

c. 500 units

d. 1000 units

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9. How long should a steel component be heat treated before nitriding? **(+1, -0.33)**

a. 100-200 hours

b. 300-500 hours

c. 5-20 hours

d. 21-100 hours

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10. The process of splitting up of white light into seven constituent colours is called- **(+1, -0.33)**

a. Dispersion

b. Refraction

c. Interference

d. Photosynthesis

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11. Abdul Kalam served as the President of India during- (+1, -0.33)

a. 2007–2012

b. 1997–2002

c. 2002–2007

d. 1992–1997

---

12. The amount of time elapsed from the moment an inventory replenishment order is placed and the moment the supplier delivers the goods is (+1, -0.33)

a. lead time

b. cycle time

c. take time

d. order time

---

13. Thermit is a mixture of fine aluminium powder and iron oxide in the ratio of about _ _ _ _ _ by weight. (+1, -0.33)

a. 2 : 1

b. 3 : 1

c. 1 : 3

d. 1 : 2

---

14. Creep, a high temperature progressive deformation, occurs in _ _ _ _ _ stages. (+1, -0.33)

a. Five

b. Four

c. Three

d. Two

---

15. Which of the following is used to check the diameters of holes? (+1, -0.33)

a. Plug gauge

b. Standard screw pitch gauge

c. Fillet gauge

d. Slip gauge

---

16. Where is Vansda National Park located? (+1, -0.33)

a. Assam

b. Punjab

c. Uttarakhand

d. Gujarat

---

17. Ryder Cup is associated with which sport? (+1, -0.33)

a. Golf

b. Table Tennis

c. Cricket

d. Hockey

---

18. Which of the following forces act(s) in a moving fluid? (+1, -0.33)

a. Inertia force

b. Viscous force

c. Gravity force

d. All of the options

---

19. What is the full form of EBCDIC? (+1, -0.33)

a. Extended Binary Control Decimal Interchange Code

b. Enhanced Binary Control Data Interchange Code

c. Extended Binary Coded Decimal Interchange Code

d. Enhanced Binary Coded Data Integration Code

---

20. Bagasse is used to produce- (+1, -0.33)

a. Manures

b. Fertilizers

c. Papers

d. Soaps

---

21. Pascal's law states that pressure at a point is equal in all directions in a/an- **(+1, -0.33)**

a. Laminar flow

b. Inviscid flow

c. Fluid at rest

d. Turbulent flow

---

22. Which of the following gases is NOT used as shielding gas in arc welding? **(+1, -0.33)**

a. Helium

b. Argon

c. Carbon dioxide

d. Carbon monoxide

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23. The strain energy stored in a body, when the load is gradually applied, is : (where σ = Stress in the material of the body, V = Volume of the body, and E = Modulus of elasticity of the material) **(+1, -0.33)**

a. σE/V

b. σ 2E/2V

c. $\sigma^2 V/2E$

d. $\sigma V/E$

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24. The Hoop stress developed in the thin cylinders is given by- (where P = Internal pressure, d = Internal diameter and t =wall thickness) **(+1, -0.33)**

a. Pd/4t

b. Pd/3t

c. Pd/2t

d. Pd/t

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25. The unit of modulus of rigidity is the same as those of- **(+1, -0.33)**

a. Stress, force and modulus of elasticity

b. Strain, force and pressure

c. Stress, pressure and modulus of elasticity

d. Stress, strain and pressure

---

26. How many types of optical flats are present? **(+1, -0.33)**

a. 1

b. 2

c. 3

d. 4

27. Montreal protocol is related to- (+1, -0.33)

a. Nuclear weapons

b. Protection of Wild Life

c. Protection of Whales

d. Protection of Ozone layer

28. Who was the captain of the West Indies team that was defeated by the Indian Cricket team in 1983 to win the Prudential World Cup? (+1, -0.33)

a. Viv Richards

b. Malcolm Marshall

c. Richie Richardson

d. Clive Lloyd

29. The moment of inertia of a rectangular section 3 cm wide and 4 cm deep about X-X axis passing through center is _ _ _ _ (+1, -0.33)

a. 20 cm^4

b. 12 cm^4

c. 9 cm^4

d. 16 cm^4

30. Three forces acting on a rigid body are represented in magnitude, direction and line of action by the three sides of a triangle taken in order. The forces are equivalent to a couple whose moment is equal to_ _ _ (+1, -0.33)

a. Thrice the area of the triangle

b. Twice the area of the triangle

c. The area of the triangle

d. Half the area of the triangle

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31. The algebraic sum of the resolved parts of a number of forces in a given direction is equal to the resolved part of their resultant in the same direction. This is known as _ _ _ (+1, -0.33)

a. Principle of independence of forces

b. Principle of transmissibility of forces

c. Principle of resolution of forces

d. All of the above

---

32. Which of the following is/are a ferromagnetic material ? (+1, -0.33)

a. Nickel

b. Copper

c. Tungsten

d. Aluminium

---

33. Which of the following cells have bold boundary in MS-Excel? (+1, -0.33)

a. Active cell

b. Passive cell

c. Mixed cell

d. Relative cell

---

34. Which of the following is likely a characteristic of hazardous waste? (+1, -0.33)

a. Ignitability

b. Reactivity

c. Corrosivity

d. All of the options

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35. Litmus, a natural dye, is an extract of- (+1, -0.33)

a. China rose

b. Lichen

c. Beet root

d. Blue berries

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36. An XYZ television supplier found a demand of 200 sets in July, 225 sets in August and 245 sets in September. Find the demand forecast for the month for the month of October using simple average method. (+1, -0.33)

a. 224

b. 200

c. 175

d. 150

---

37. The gas in the cooling chamber of a closed cycle gas turbine is cooled at (+1, -0.33)

a. Constant volume

b. Constant temperature

c. Constant pressure

d. None of these

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38. Where does the bubble rest on the scale when spirit level is placed horizontally? (+1, -0.33)

a. Right most

b. Centre

c. Left most

d. Bottom

---

39. Inventory control and quality is involved in which of the following phases of production planning and control (+1, -0.33)

a. Pre-planning stage

b. Monitoring stage

c. Planning stage

d. Action stage

---

40. Which of the following terms is NOT related to the Internet? **(+1, -0.33)**

a. Browser

b. Search engine

c. Link

d. Mouse

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41. _ _ _ _ _ _ _ _ _ _ is a beam with one end fixed and the other end simply supported. **(+1, -0.33)**

a. Fixed beam

b. Continuous beam

c. Propped cantilever beam

d. Over-hanged beam

---

42. How many divisions are graduated on the thimble of micrometer? **(+1, -0.33)**

a. 15

b. 50

c. 25

d. 40

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43. Gauge pressure at a point is equal to _ _ _ _ _ _ _. **(+1, -0.33)**

a. Absolute pressure - atmospheric pressure

b. Vacuum pressure + absolute pressure

c. Vacuum pressure - atmospheric pressure

d. Absolute pressure + atmospheric pressure

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44. Which of the following is the hardest constituent of steel ? **(+1, -0.33)**

a. Austenite

b. Ledeburite

c. Bainite

d. Martensite

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45. Temperature inversion is a condition in which the temperature of the atmosphere- **(+1, -0.33)**

a. Either increases or decreases with altitude

b. Remains same

c. Always decreases with altitude

d. Always increases with altitude

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46. In which state is the Tuirial Hydroelectric Power Project set up? (+1, -0.33)

a. Nagaland

b. Manipur

c. Meghalaya

d. Mizoram

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47. What is the angle between the two surfaces of an angle plate? (+1, -0.33)

a. 45°

b. 180°

c. 90°

d. 120°

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48. An ammeter requires a change of 3 A in its coil to produce a change in deflection of the pointer by 12 mm. Its sensitivity is (+1, -0.33)

a. 15 mm/A

b. 9 mm/A

c. 4 mm/A

d. 36 mm/A

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49. The amount of time by which an activity can be delayed without affecting project completion time is (+1, -0.33)

a. Free float

b. Total float

c. Independent float

d. Activity float

---

50. Which of the following materials has the maximum ductility? **(+1, -0.33)**

a. Tungsten

b. Iron

c. Nickel

d. Aluminium

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51. Which of the following is NOT related to a spark ignition engine? **(+1, -0.33)**

a. Ignition coil

b. Spark plug

c. Fuel injector

d. Carburettor

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52. Grinding is used for- **(+1, -0.33)**

a. Surface finishing

b. Lancing

c. Forming

d. Enlarging the holes

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53. Slack represents the difference between the- (+1, -0.33)

a. Proposed allowable time and the earliest expected time

b. Normal allowable time and the latest expected time

c. Latest allowable time and the normal expected time

d. Latest allowable time and the earliest expected time

---

54. If the line of action of all the forces are along the same line, then the forces are said to be- (+1, -0.33)

a. Collinear forces

b. Coplanar concurrent forces

c. Coplanar parallel forces

d. Non-coplanar non-concurrent forces

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55. The clearance ratio for a single stage compressor lies between (+1, -0.33)

a. 15% and 20%

b. 1% and 2%

c. 20% and 30%

d. 4% and 10%

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56. The frequency of a sound wave is 50 Hz and its wavelength is 4 m. What is the distance travelled by the sound wave in 3 s? (+1, -0.33)

a. 100 m

b. 600 m

c. 200 m

d. 300 m

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57. A tool has the signature form as 8, 8, 5, 5, 6, 6, 1 as per American Standard Association. In this, 1 represents- (+1, -0.33)

a. Side relief angle

b. Back rake angle

c. Side cutting edge

d. Nose radius

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58. Grain size ranging between 6 and 24 is considered- (+1, -0.33)

a. Coarse grain

b. Normal grain

c. Very fine grain

d. Fine grain

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59. _ _ _ _ _ _ _ _ _ _ _ is the process of making flat surfaces on a lathe. (+1, -0.33)

a. Facing

b. Boring

c. Reaming

d. Drilling

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60. The phenomenon of weld decay occurs in- (+1, -0.33)

a. Stainless steel

b. Aluminium

c. Brass

d. Bronze

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61. What is the full form of CSIR? (+1, -0.33)

a. Council for Science and Industry Research

b. Center for Scientific and India Research

c. Centre for Science and Industry Research

d. Council of Scientific and Industrial Research

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62. The imaginary line drawn in the fluid in such a way that the tangent to any point gives the direction of motion at that point, is known as- (+1, -0.33)

a. Potential line

b. Streak line

c. Stream line

d. Path line

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63. _ _ _ _ _ _ _ _ _ _ is fitted on the top of cross slide and is used to support the tool post and the cutting tool. **(+1, -0.33)**

a. Tail stock

b. Compound rest

c. Carriage

d. Saddle

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64. What is the expansion of PWHT in welding? **(+1, -0.33)**

a. Postal Weld Horizontal Treatment

b. Post Weld Heat Treatment

c. Pre Weld Heating Torch

d. Post Weld Heating Torch

---

65. Which of the following properties is desirable in parts subjected to shock and impact loads? **(+1, -0.33)**

a. Brittleness

b. Strength

c. Toughness

d. Stiffness

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66. A static fluid can have (+1, -0.33)

a. Positive normal stress and zero shear stress

b. Zero normal stress and non-zero shear stress

c. Non-zero normal stress and non-zero shear stress

d. Positive normal stress and non-zero shear stress

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67. The vertical and uniformly spaced lines on a psychrometric chart indicate (+1, -0.33)

a. Dry bulb temperature

b. Wet bulb temperature

c. Specific humidity

d. Dew point temperature

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68. What is the magnification produced by a spherical mirror? (+1, -0.33)

a. Ratio of height of the image to the height of the object

b. Ratio of height of object to the height of image

c. Ratio of object distance to the image distance

d. Ratio of focal length to radius of curvature

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69. Doberiener's system of classification into Triad was NOT found to be useful (+1, -0.33)

as he could identify only:

a. Four triads

b. Five triads

c. Three triads

d. Two triads

---

70. G-ratio varies from _ _ _ _ _ _ _ _ in very rough grinding. **(+1, -0.33)**

a. 11.0 to 15.0

b. 6.0 to 10.0

c. 1.0 to 5.0

d. 16.0 to 20.0

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71. A steel with 0.8% carbon and 100% pearlite is called- **(+1, -0.33)**

a. Pro eutectoid steel

b. Hypo-eutectoid steel

c. Eutectoid steel

d. Hyper eutectoid steel

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72. Lathe bed is made up of- **(+1, -0.33)**

a. High alloy steel

b. Cast iron

c. Mild steel

d. High carbon steel

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73. Which comparator is generally used to measure small displacement of spindles? (+1, -0.33)

a. Reed type comparator

b. Sigma comparator

c. Optical comparators

d. Electric comparators

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74. Cyaniding involves the addition of _ _ _ _ _ _ _ _ _ _ _ for the hardening of surface. (+1, -0.33)

a. Nichrome

b. Niobium

c. Neon

d. Nitrogen

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75. Which of the following is a kind of impact printers? (+1, -0.33)

a. Line printers

b. Plotter

c. Laser printers

d. Ink-jet printers

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76. E6010 is a _ _ _ _ _ _ tensile strength electrode. **(+1, -0.33)**

a. 10,000 psi

b. 60,000 psi

c. 7,000 psi

d. 61,000 psi

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77. The center of gravity of a semi-circle lies at a distance of _ _ _ _ _ _ _ _ _ _ from its base measured along the vertical radius. **(+1, -0.33)**

a. 4r/3π

b. 3r/4π

c. 3r/8π

d. 8r/3π

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78. An example of rotational motion is **(+1, -0.33)**

a. Movement of a car on a straight road

b. Spinning of earth

c. Movement of drawer of a table

d. Motion of earth around the sun

79. The process of maintaining the speed of a steam turbine constant for various load conditions is known as- (+1, -0.33)

a. Reheating

b. Bleeding

c. Cooling

d. Governing

80. Corundum is composed of about 85 percent of (+1, -0.33)

a. Steel

b. Aluminium oxide

c. Iron oxide

d. Silicon

81. What is the Moment of Inertia of a Quarter circle about its Diametral Axis? (+1, -0.33)

a. $\pi d^4/64$

b. $\pi d^4/36$

c. $\pi d^4/128$

d. $\pi d^4/256$

82. Which of the following inventory costs represents the cost of loss of (+1, -0.33)

demand due to shortage in supplies?

a. Stockout cost

b. Unit cost

c. Procurement cost

d. Carrying cost

---

83. In a four-stroke engine, the working cycle is completed in- **(+1, -0.33)**

a. One revolution of the crankshaft

b. Two revolutions of the crankshaft

c. Four revolutions of the crankshaft

d. Three revolutions of the crankshaft

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84. The weight of an object on the Moon is W_m and its weight on the Earth is W_e. Which of the following formulas is CORRECT? **(+1, -0.33)**

a. $W_m = (1/6) \times W_e$

b. $W_m = 6 \times W_e$

c. $W m = (1/3) \times W e$

d. $W m = 3 \times W e$

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85. Which of the following is an in-situ conservation measure taken by India? **(+1, -0.33)**

a. Project Lion

b. All of the options

c. Project Rhino

d. Project Elephant

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86. 'Kimono' is the traditional dress of- (+1, -0.33)

a. China

b. Japan

c. New Zealand

d. Korea

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87. _ _ _ _ _ _ _ _ _ _ _ is the intersection of the flank and the base of the tool. (+1, -0.33)

a. Face

b. Heel

c. Shank

d. Nose

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88. The heat generated (H) in resistance welding is expressed by- (where I = current, R= resistance of area being welded and t= time for the flow of current) (+1, -0.33)

a. IRt^2

b. IRt

c. IR ^{2}t

d. I ^{2}Rt

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89. Which of the following is referred to as MRP II? (+1, -0.33)

a. Materials Requirement Planning

b. Materials Resources Policy

c. Manufacturing Resources Planning

d. Maximum Retail Price

---

90. What is the name of the sources of energy which are being produced continuously in nature and are inexhaustible? (+1, -0.33)

a. Exhaustible source of energy

b. Renewable source of energy

c. Nonrenewable source of energy

d. Conventional source of energy

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91. In 2019, who was appointed the Indian men's football team coach? (+1, -0.33)

a. Steve Cooper

b. Savio Medeira

c. Kushal Das

d. Igor Stimac

92. Paper pulp can be regarded as (+1, -0.33)

a. Bingham plastic fluid

b. Dilatant fluid

c. Newtonian fluid

d. Pseudo plastic fluid

93. Feeler gauges are used to- (+1, -0.33)

a. Check and set the spark plug gaps

b. All of the options

c. Check and measure the bearing clearance

d. Check the gap between the mating parts

94. A concentration of 100 means _ _ _ _ _ _ carat of grit per 1 cm of grinding wheel volume. (+1, -0.33)

a. 4.4

b. 3.3

c. 2.2

d. 5.5

95. What does 'V' represent in this conventional abrasive wheel given by "51 A (+1, -0.33)

60 K 5 V 05"?

a. Grit size

b. Bond type

c. Abrasive type

d. Grade

---

96. Back rake of a turning tool is measured on its **(+1, -0.33)**

a. Normal plane

b. Orthogonal plane

c. Machine transverse plane

d. Machine longitudinal plane

---

97. The maximum bending stress in a curved beam having symmetrical section always occurs at the **(+1, -0.33)**

a. Neutral axis

b. Centroidal axis

c. Inside fibre

d. Outside fibre

---

98. The product of area and square of distance of centre of gravity of the area from that axis is known as- **(+1, -0.33)**

a. Second moment of mass

b. Second moment of area

c. First moment of area

d. Mass moment of inertia

---

99. Which of the following is a slow rise of plastic deformation under the action of stresses? (+1, -0.33)

a. Ductile fracture

b. Brittle fracture

c. Fatigue

d. Creep

---

100. What is the maximum allowable concentration of fluorides in drinking water ? (+1, -0.33)

a. 1.0 milligram per liter

b. 1.25 milligram per liter

c. 1.50 milligram per liter

d. 1.75 milligram per liter

---

101. The capacity of a lathe is expressed as (+1, -0.33)

a. Tool post size and lathe travel

b. Swing and distance between centres

c. Horsepower and chuck diameter

d. Bed length and spindle speed

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102. Kanishka followed which of the following religions? **(+1, -0.33)**

a. Jainism

b. Christianity

c. Buddhism

d. Sikhism

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103. The operations executed on data stored in registers are known as- **(+1, -0.33)**

a. Bit operations

b. Micro operations

c. Macro operations

d. Byte operations

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104. _ _ _ _ _ _ _ consists of a mixture of clay, feldspar, flint and frit in varying proportions. **(+1, -0.33)**

a. Silicate bond

b. Vitrified bond

c. Rubber bond

d. Shellac bond

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105. What is the expansion of UDL in the beams? **(+1, -0.33)**

a. Uniformly Distributed Load

b. Under Depending Load

c. Uneven Distributed Load

d. United Decreasing Load

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106. What is the binary representation of 35? **(+1, -0.33)**

a. 101010

b. 101000

c. 100011

d. 100100

---

107. What is the electron distribution in an aluminium atom? **(+1, -0.33)**

a. 2, 8, 3

b. 8, 2, 3

c. 2, 3, 8

d. 2, 8, 2

---

108. A block weighing W = 20 kN is resting on an inclined plane which makes an **(+1, -0.33)**

angle of 30° to the horizontal. The component of gravity force parallel to the inclined plane is

a. 5 kN

b. 17.32 kN

c. 10 kN

d. 14.14 kN

---

109. Which V block is used for checking triangle effect? **(+1, -0.33)**

a. V block with 30-degree angle is used

b. V block with 120-degree angle is used

c. V block with 90-degree angle is used

d. V block with 60-degree angle is used

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110. Coulomb friction is the friction between **(+1, -0.33)**

a. Two dry surfaces

b. Two lubricated surfaces

c. Bodies having relative motion

d. Solids and liquids

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111. Who took charge as the Managing Director and CEO of the Multi Commodity Exchange of India (MCX) in May 2019? **(+1, -0.33)**

a. Chittaranjan Rege

b. P.S. Reddy

c. Pareshnath Paul

d. Deepak Mehta

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112. Find the tool life equation, if a tool life of 80 min is obtained at a cutting speed of 30 m/min and 8 min at 60 m/min. (+1, -0.33)

a. $VT^{0.4} = C$

b. $VT^{0.3} = C$

c. $VT^{0.5} = C$

d. $VT^{0.7} = C$

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113. The distance that fusion extends into the base metal or previous pass from the surface melted during welding is known as (+1, -0.33)

a. Cold lap

b. Depth of fusion

c. Deposition thickness

d. Dilution

---

114. Which of the following bonds is represented by the letter 'E' in grinding wheel? (+1, -0.33)

a. Oxychloride

b. Rubber

c. Silicate

d. Shellac

---

115. When a body is subjected to two equal and opposite pulls, as a result of which the body tends to extend its length, the stress and strain induced are (+1, -0.33)

a. Tensile stress and compressive strain

b. Compressive stress and compressive strain

c. Compressive stress and tensile strain

d. Tensile stress and tensile strain

---

116. Which of the following is/are the objective of Normalising? (+1, -0.33)

a. To remove internal stresses

b. To improve the machinability

c. To enhance the mechanical properties

d. All of the options

---

117. According to the law of moments, if a number of coplanar forces acting on a particle are in equilibrium, then- (+1, -0.33)

a. The algebraic sum of their moments about any point in their plane is zero

b. Their lines of action are at equal distances

c. The algebraic sum of their moments about any point is equal to the moment of their resultant force about the same point

d. Their algebraic sum is zero

---

118. The length of the slot weld can be obtained from the ratio of (+1, -0.33)

a. Allowable stress to load

b. Weld area to allowable stress

c. Allowable stress to weld area

d. Load to allowable stress

---

119. The metals can be beaten into thin sheets, the property is called _ _ _ _ _ _ _. (+1, -0.33)

a. Sonority

b. Malleability

c. Ductility

d. Lustre

---

120. In a four-stroke cycle, the minimum temperature inside the engine cylinder occurs at the (+1, -0.33)

a. Beginning of exhaust stroke

b. End of exhaust stroke

c. Beginning of suction stroke

d. End of suction stroke

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121. Where is the headquarters of the World Bank located? **(+1, -0.33)**

a. San Francisco

b. Boston

c. Philadelphia

d. Washington, D.C

---

122. The PSLV-C45 was launched from the second launch pad of the- **(+1, -0.33)**

a. Thumba Equatorial Rocket Launching Station

b. Satish Dhawan Space Centre

c. Vikram Sarabhai Space Centre

d. Abdul Kalam Island

---

123. _ _ _ _ _ _ _ _ _ is a memory management scheme that permits the physical address space of a process to be noncontiguous. **(+1, -0.33)**

a. Segmentation

b. Paging

c. Fragmentation

d. Swapping

---

124. In reverse polarity welding, electrode holder is **(+1, -0.33)**

a. Earthed and work is negative

b. Connected to the negative and work to positive

c. Connected to the positive and work to negative

d. Earthed and work is positive

---

125. The process of enlarging the holes to accurate sizes is called- **(+1, -0.33)**

a. Knurling

b. Reaming

c. Drilling

d. Counter boring

---

126. The chemical formula of refrigerant R11 is **(+1, -0.33)**

a. $CClF_3$

b. CCl_3F

c. CHF

d. CClHF

---

127. Which of the following is the softest abrasive? **(+1, -0.33)**

a. Al_2O_3

b. CBN

c. Diamond

d. SiC

---

128. Who among the following was appointed the Chief Minister of Goa in March 2019? (+1, -0.33)

a. Nitish Kumar

b. Pramod Sawant

c. Pema Khandu

d. Bhupesh Baghel

---

129. Which of the following is INCORRECT in the laws of dry friction? (+1, -0.33)

a. The magnitude of the limiting friction bears a constant ratio to the normal reaction between the two contacting surfaces

b. The force of friction is dependent of the area of contact between the two surfaces

c. The frictional force always acts in a direction opposite to that in which the body tends to move

d. The force of friction depends upon the roughness/smoothness of the surfaces

---

130. Which among the following is the unit of measurement of the "Ecological Footprint"? (+1, -0.33)

a. Cubic meter

b. Gallon Per Capita

c. Man Hour

d. Global Hectare

---

131. Which annealing process is carried out in a heavy casting to make austenitic grains homogeneous? (+1, -0.33)

a. Full annealing

b. Spherodise annealing

c. Diffusion annealing

d. Process annealing

---

132. Mercury does NOT wet the glass. This is due to the property of the liquid known as (+1, -0.33)

a. Viscosity

b. Surface tension

c. Adhesion

d. Cohesion

---

133. The constellation Ursa Minor contains the group of stars commonly called the- (+1, -0.33)

a. Little lion

b. Big dipper

c. Hunter

d. Little dipper

---

134. The compressor performance at higher altitude compared to sea level will be (+1, -0.33)

a. Dependent on other factors

b. The same

c. Higher

d. Lower

---

135. What is the unit of pressure? (+1, -0.33)

a. Pascal

b. Newton

c. Kilogram

d. Kelvin

---

136. The minimum angle made by an inclined plane with the horizontal such that an object placed on the inclined surface just begins to slide is called- (+1, -0.33)

a. Angle of friction

b. Angle of Repose

c. Angle of latitude

d. Angle of elevation

---

137. What is the approximate freezing point of sulphur dioxide? (+1, -0.33)

a. -87.7°C

b. -56.6°C

c. -75.2°C

d. -135.8°C

---

138. _ _ _ _ _ _ _ _ _ _ _ _ is a small opening of any cross section on the side or bottom of the tank on which fluid is flowing. (+1, -0.33)

a. Weir

b. Notch

c. Mouth piece

d. Orifice

---

139. In which of the following ways does acid rain affect plants? (+1, -0.33)

a. By nourishing the nutrients from the soil

b. By limiting nutrients from the soil

c. By balancing the nutrients in the soil

d. By increasing the nutrients from the soil

140. To which of the following countries did Alexander the Great belong? **(+1, -0.33)**

a. Italy

b. Greece

c. Egypt

d. Mesopotamia

141. Which of the following is NOT an artificial resin? **(+1, -0.33)**

a. Alkyl

b. Phenolic

c. Shellac

d. Vinyl

142. With which state is the art form 'Patachitra' associated? **(+1, -0.33)**

a. Gujarat

b. Tamil Nadu

c. Odisha

d. Andhra Pradesh

143. If (R) is the base rate guaranteed per hour, (S) is the standard time for the job and (T) is the actual time, then according to Rowan plan, wages for the job will be- **(+1, -0.33)**

a. $TR + (S - T) \times R$

b. $TR + [(S - T)/2] \times R$

c. TR

d. $TR + [(S - T)/S] \times R$

---

144. Continuity equation can take the form - (where A = Area, V = Velocity, ρ = Density and P = Pressure) **(+1, -0.33)**

a. $A_1V_1 = A_2V_2$

b. $P_1V_1 = P_2V_2$

c. $\rho_1A_1 = \rho_2A_2$

d. $P_1A_1V_1 = P_2A_2V_2$

---

145. The largest diameter of work that can be carried between the centers of a lathe is known as- **(+1, -0.33)**

a. Spindle

b. Saddle

c. Swing

d. Socket

---

146. When a fluid is at rest, the shear stress is- **(+1, -0.33)**

a. Very large

b. Zero

c. Undefined

d. Finite

---

147. What is the number of moles for 52 g of He? (+1, -0.33)

a. 11

b. 13

c. 14

d. 12

---

148. Which of the following is NOT an example of hardware? (+1, -0.33)

a. Mouse

b. Printer

c. Interpreter

d. Scanner

---

149. What is the full form of N.P.L. Gauge interferometer? (+1, -0.33)

a. Nikon Pulsed Laser

b. Nuclear Plasma Laboratory

c. Nuclear Physics Laboratory

d. National Physics Laboratory

---

150. All eco-systems begin with energy input from- **(+1, -0.33)**

a. Firewood

b. Water

c. Air

d. Sun

Answers

1. **Answer: b**

Explanation:

Explanation:

Co-efficient of expansion:

- The coefficient of expansion of a material is numerically equal to the ratio of increase in length, area or volume to its original length, area or volume when the material is heated by 1 °C.

Unit - $°C^{-1}$ or K^{-1}

Material	Co-efficient of thermal expansion (10^{-6} $m/m°C^{-1}$)
Invar	1.5 (≈ 0)
Stainless steel	10-17
Silver	19-20
Selenium	37

⭐ Important Points

- **Invar** – It is an alloy of **Nickel (36%)** and **Iron (64%).**

2. **Answer: a**

Explanation:

Explanation:

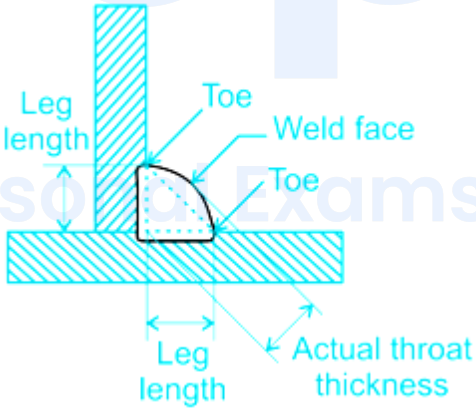
Nomenclature of butt and fillet weld:

Throat thickness: The distance between the junction of metals and the midpoint on the line joining the two toes.

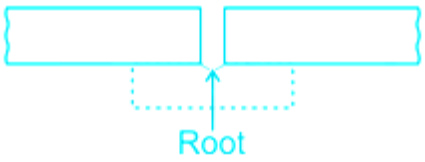
Leg length: The distance between the junction of the metals and the point where the weld metal touches the base metal 'toe'.

The length of the leg is the distance from the root of the weld to the toe of the weld.

The theoretical throat is the perpendicular distance between the root of the weld and the hypotenuse joining the two ends of the length. It is the shortest distance from the root to the face.

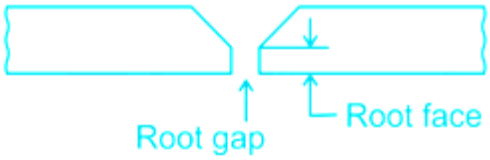


Root: The parts to be joined that are nearest together.



Root gap: It is the distance between the parts to be joined.

Root face: The surface formed by squaring off the root edge of the fusion face to avoid a sharp edge at the root.

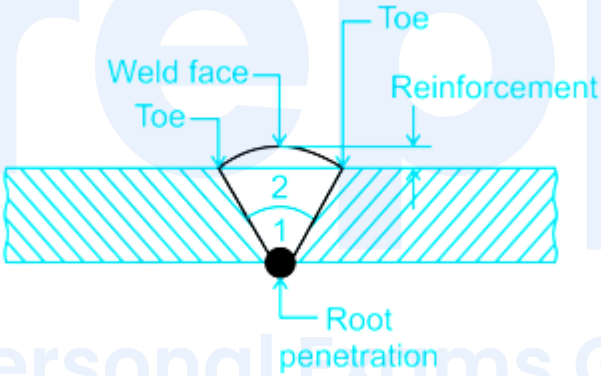


Reinforcement: Metal deposited on the surface of the parent metal or the excess metal over the line joining the two toes.

The toe of weld: The point where the weld face joins the parent metal.

Weld face: The surface of a weld seen from the side from which the weld was made.

Root penetration: It is the projection of the root run at the bottom of the joint.



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3. **Answer: a**

Explanation:

Concept:

- Ozone is mainly formed by the chemical reaction between the oxygen molecules and the UV Rays of the sunlight .
- The Ozone layer is mainly present in the Stratosphere of the atmosphere and it absorbs most of the UV rays of the sun.

- The rise in the temperature in the stratosphere is caused by the absorption of Ultraviolet radiations
- The ozone is capable of absorbing radiations from the Sun and this causes an increase in temperature towards the upper part of the stratosphere while the lower part shows less temperature; this is called temperature inversion.
- The ozone layer protects life on earth by not permitting harmful radiations present in the sunlight to penetrate through it.

---

4. **Answer: b**

Explanation:

Concept:

Network topology is the arrangement of the various elements (links, nodes, etc.) of a computer network. Two or more devices connect to a link; two or more links form a topology. The topology of a network is the geometric representation of the relationship of all the links and nodes to one another.

There are four basic topologies are possible: mesh, star, bus, ring.

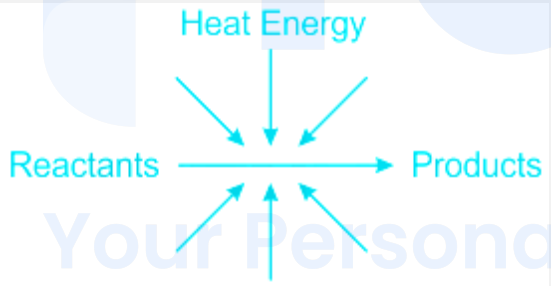
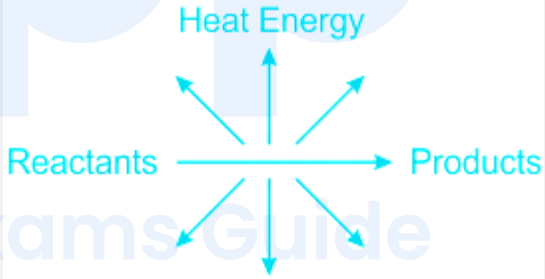
- In a **bus topology,** a long cable acts as a backbone to link all the devices in a network. Nodes are connected to the bus cable by drop lines and taps. A drop line is a connection running between the device and the main cable.
- In a **star topology,** each device needs only one link and one I/O port to connect it to any number of other devices
- In a **ring topology,** each device has a dedicated point-to-point connection with only the two devices on either side of it
- In a **mesh topology,** every device has a dedicated point-to-point link to every other device

---

5. **Answer: d**

Explanation:

Explanation:

Endothermic Process	Exothermic Process
The **endothermic** process is a term that describes a reaction where the system **absorbs** the energy from its surrounding in the form of heat.	The **exothermic** process is a term that describes a reaction where the system **releases** the energy to its surrounding in the form of heat.
Eg. **Evaporating liquids, Sublimation, Photosynthesis, etc.**	Eg. **Neutralization reaction, Dilution of concentrated acids, etc.**
	

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6. **Answer: c**

Explanation:

Explanation:

Production Planning & Control consist of three different stages.

1. **Planning**
2. **Action**

3. **Monitoring** .

Planning Stage: Planning stages include activities such as planning the resources, facilities, etc. They are further divided into two stages.

- **Pre-planning Stage:** This stage deals with the activities such as **product planning** ,**forecasting of the demand** on the basis of the past trend, inputs planning, plant and facility planning related to location and layout.
- **Planning Stage:** After the pre-planning, the quantity, level of quantity, process capacity, production planning like **routing** ,**scheduling** materials, tools planning, etc. are carried out in the planning stage.

Action Stage: It is the real implementation of the plan. It begins with **dispatching** functions, which deals with the progress of work or job.

Monitoring: In this stage, the planned activities are controlled and monitored by using various techniques such as **inventory control** , tool control, cost control, **quality control,** etc.

---

7. **Answer: c**

Explanation:

Concept:

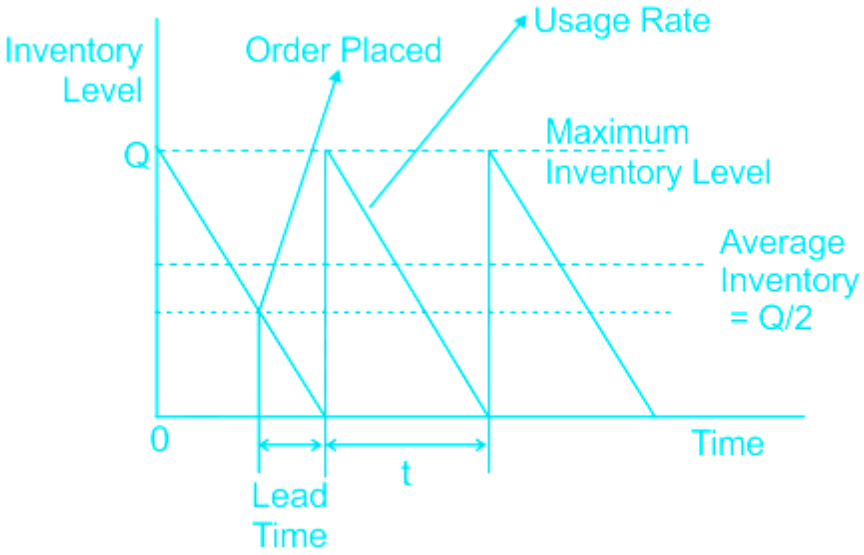
The following shortcut keys are used in MS Power Point:

Keys	Shortcut
Ctrl + M	**Insert a new slide**
Ctrl + S	Save a presentation
Ctrl + A	Select all text in a text box
Ctrl + N	Create a new presentation
Ctrl + O	Open an existing presentation
Ctrl + F	Search in a presentation or use Find and Replace

8. **Answer: c**

Explanation:

Concept:



Basic EOQ Model

This model is used when the replacement is instantaneous and no shortage is allowed. The Economic Order Quantity for this model is given by Wilson Formula .

$$Q^* = \sqrt{\frac{2DC_o}{C_h}}$$

where Q^* = Economic Order Quantity (Units), D = Demand rate (Units/month or Units/year), C_o = Ordering cost/order (Rs.), C_h = Handling cost (Rs./unit/year)

[**Note:** Time unit of Demand & Handling Cost must be same i.e. units/year or units/month]

Calculation:

Given:

D = 12000 units/year, C_o = Rs. 100, C_h = Rs. 0.80/unit/month ⇒ Rs. 0.80 × 12/unit/year

$$\because\ Q^* = \sqrt{\frac{2DC_o}{C_h}}$$

$$\Rightarrow Q^* = \sqrt{\frac{2\times 12000\times 100}{0.80\times 12}}$$

⇒ Q^* = 500 units.

9. **Answer: d**

Explanation:

Concept:

There are five heat treatment processes.

1. Annealing
2. Normalizing
3. Hardening
4. Tempering
5. Case hardening

Case hardening is a method used to harden the outer surface of low-carbon steel while leaving the center or core soft and ductile. Case hardening involves heating the metal to its critical temperature in some carbonaceous material. The following methods are commonly used:

1. Carburizing
2. Cyaniding
3. Nitriding
4. Induction Hardening
5. Flame hardening

Nitriding:

- In the nitriding process, the surface is enriched not with carbon, but with nitrogen.
- It consists of heating the part to a temperature of 480° to 650°C inside a chamber through which a stream of NH 3 is passed.

  2NH 3 = 2N + 3H 2

- The atomic nitrogen so formed diffused into α – iron and saturates the metal.
- The nitriding parts acquire a very high surface hardness (730 to 1100 BHN). Nitriding increases the wear resistance, fatigue limit, and corrosion resistance in air, water, and water vapor.
- **The parts are heat treated for a period of 40 to 100 hours.**

Carburizing:

It is one of the most widely used surface hardening processes. The process involves diffusing carbon into low carbon steel to form a high carbon steel surface.

Cyaniding: In this process of surface hardening, both carbon and nitrogen are added to the surface layer of steel (ferrous material, usually **low carbon grade**). The process is based on the decomposition of cyanide compounds that easily release the cyan group (CN). Cyaniding involves heating the steel in a liquid or solid medium.

⭐ Important Points

Hardness level: Nitriding > Cyaniding > Carburizing

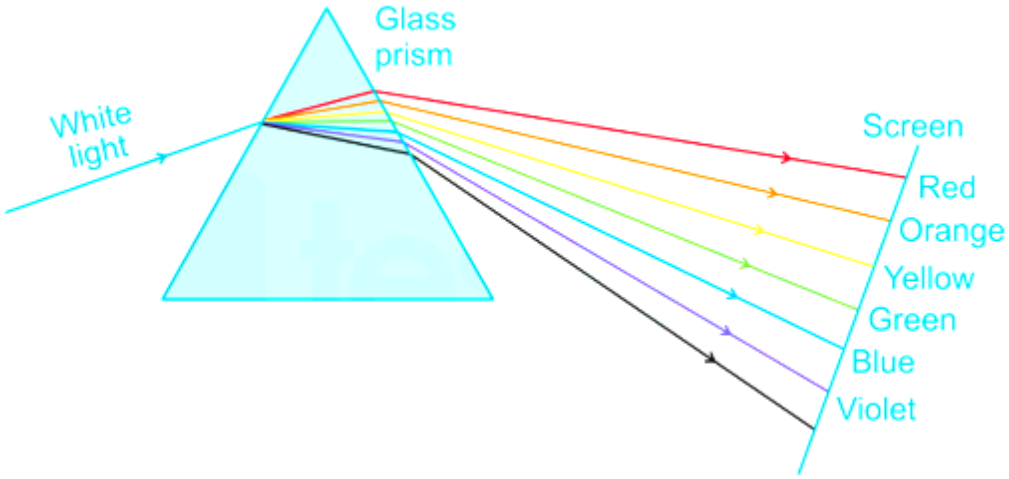
---

10. **Answer: a**

Explanation:

Concept:

- Dispersion of light: The phenomenon in which a white light ray when falls on a prism get separated into its component colors is called dispersion of light .



- The seven constituent colors are **Violet, Indigo, Blue, Green, Yellow, Orange,** and **Red.**

- Some examples of Dispersion of light are the formation of the rainbow, dispersion of white light in a prism, dispersion of light on a CD, etc.
- The diamond act like a prism . The splitting up of white light into its 7 constituent colors is called dispersion of light . So option 1 is correct.

Phenomenon	Examples
Reflection of light	When one sees in a mirror, sunlight casts sharp shadows, etc
Interference of light	A film of oil floating in the water, a thin film of a soap bubble, etc
Total Internal Reflection	Mirage, Optical fiber

⭐ Important Points

Photosynthesis: It is the process by which green plants and some other organisms use sunlight to synthesize nutrients from carbon dioxide and water. In this process, plants use chlorophyll , carbon dioxide, water, sunlight, and release oxygen.

---

11. **Answer: c**

Explanation:

Concept:

- Avul Pakir Jainulabdeen "A. P. J." Abdul Kalam was the **11th President of India.**
- Kalam was born and raised in Rameswaram, Tamil Nadu.
- While delivering a lecture at the Indian Institute of Management Shillong, Kalam collapsed and died from an apparent cardiac arrest on 27 July 2015, aged 83.
- **He served as the President of India from 2002 - 2007.**

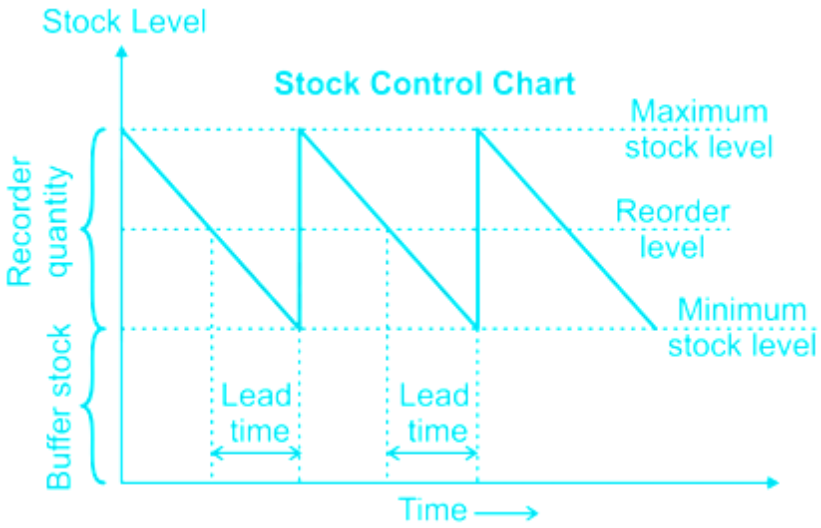
⭐ Important Points

Year duration	President of India
1992 – 1997	Shankar Dayal Sharma
1997 – 2002	K. R. Narayanan
2002 – 2007	**A.P.J Abdul Kalam**
2007 – 2012	Pratibha Patil
2012 – 2017	Pranab Mukharjee
2017 - ...	Ram Nath Kovind

12. **Answer: a**

Explanation:

Explanation:



Lead Time:

- The time gap between the **placing of an order and its actual arrival** in the inventory is known as Lead Time.
- **Lead Time** can be greater, less, or equal to Order Cycle.

Order Cycle:

- The time period between two successive orders is called **Order Cycle** .

Re-order Level (ROL):

- The quantity in hand while placing the order.
- ROL = Lead Time × Demand.

---

13. **Answer: c**

Explanation:

Concept:

- In thermit welding, heating and coalescence is by superheated molten metal obtained from a chemical reaction between a metal oxide and a metallic reducing agent.
- Temperature around 2750°C produced in 30 seconds. Thus it involves highly exothermic chemical reaction for developing high temperature.
- In the mixture **one part of aluminium** and **three parts of iron oxide** are used and ignited by a magnesium fuse.
- The molten metal, produced by the reaction, acts as a filler material joining the work-pieces after Solidification.
- Thermit Welding is mainly used for joining steel parts.
- It is used for repair of steel casings and forgings, for joining railroad rails, steel wires and steel pipes, for joining the large cast and forged parts.

---

14. **Answer: c**

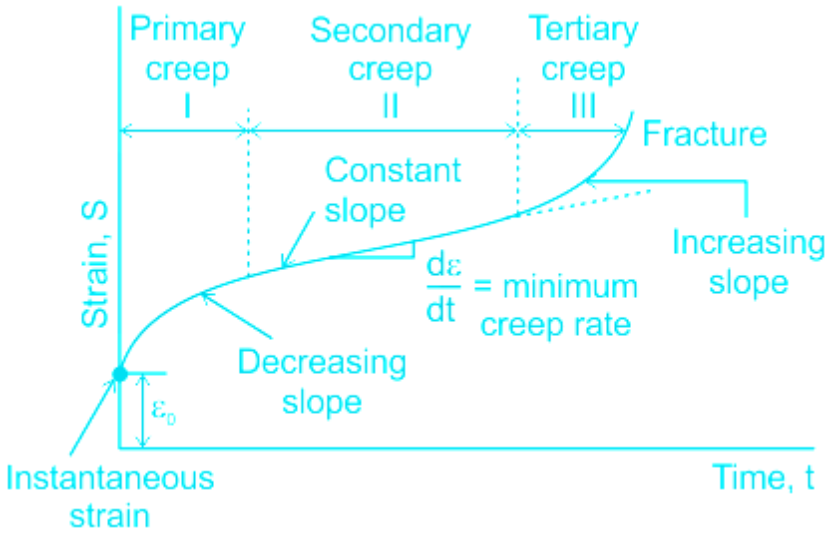
Explanation:

Explanation:

Creep:

- Materials subjected to **constant load** at an elevated temperature (> 0.4 - 0.5 times of Melting Temperature) will Creep i.e **exhibit time dependant deformation** .
- It occurs in three steps.

Stages of Creep:



Primary Creep	Secondary Creep	Tertiary Creep
• The creep rate **decreases** with time due to the **strain hardening** process resulting from deformation.	• The creep rate **becomes linear** . • There is a **balance** between **strain hardening** and **recovery** (softening) of the material because of **recrystallization** .	• **Creep rate increases** with time leading to **necking** and finally **fracture** because of the **structural changes** occurring in the material.

Important Point

Factor affecting Creep:

- Material Properties (Melting point, Young's Modulus, Grain size)
- Exposure time

- Exposure temperature
- Structural load

---

15. **Answer: a**

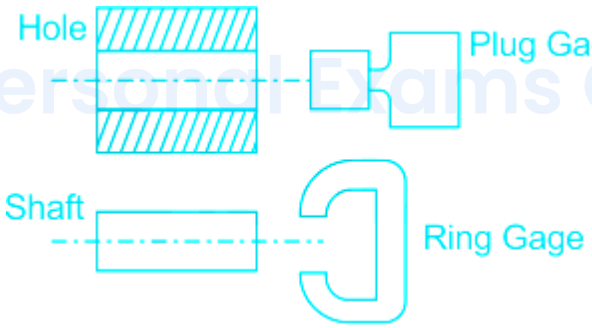
Explanation:

Concept:

Limit gauges are used in inspection because they provide a quick means of checking.

The Go and No-Go principals of gauging are that the GO-end of the gauge must go into the feature of the component being checked and the NO-GO end must not go into the same feature.

Plug Gauges are used for checking **holes** in many different shapes and sizes. There are plug gauges for straight cylindrical holes, tapered, threaded square, and splined holes. At one end, it has a plug of minimum limit size, the 'GO' end, and; at the other end a plug of maximum limit, the 'NOGO' end.

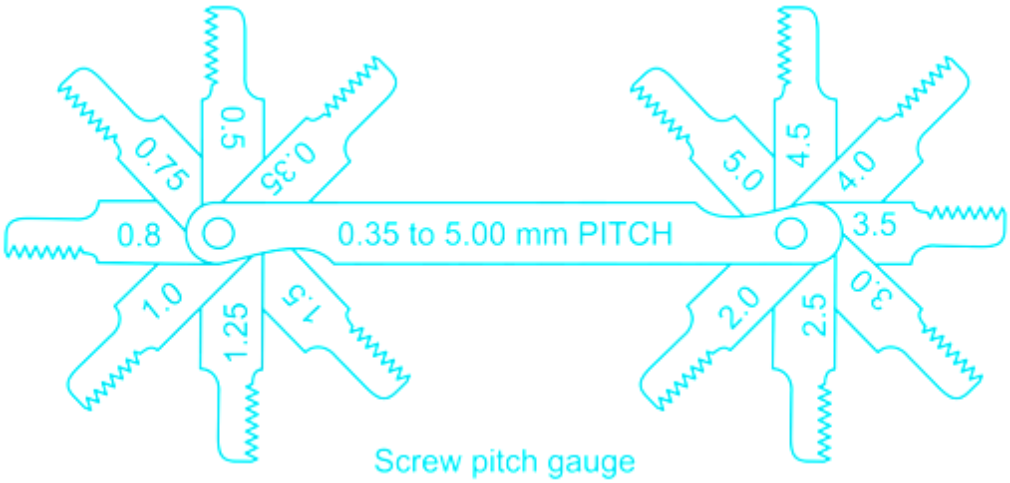


There are different types of cylindrical plug gauges.

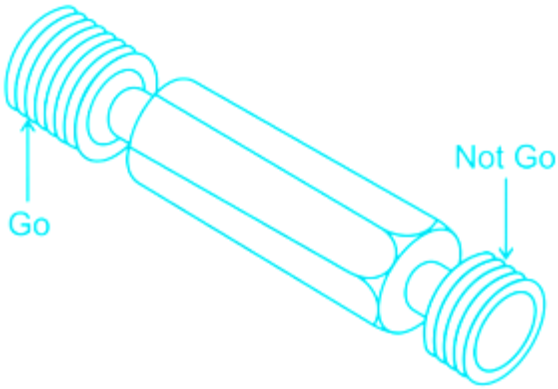
Double-ended plug gauge	Used for checking the diameter of a straight hole. The Go-gauge checks the lower limit of a straight hole and the NO-Go gauge checks the upper limit.
Progressive plug gauge	
Plain Ring gauge	Used to check the **outside diameter of the workpieces.**
Taper plug gauges	Used to check the size of the hole and the accuracy of the taper
Taper ring gauges	Used to check both the accuracy and the outside diameter of a taper
Thread plug gauges	Used to check the form and dimensional accuracy of the internal threads
Thread Ring gauges	Used to check the form and the dimensional accuracy of an external thread
Snap gauges	Used as a quick means for checking sizes within certain limits by comparing the size of the parts with the opening of the gauge.

There are various measuring instruments used for checking different dimensions.

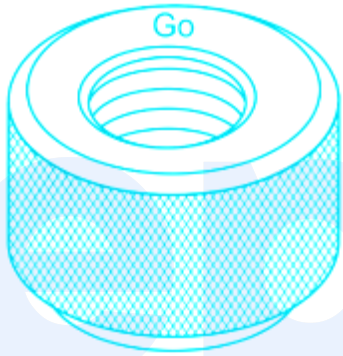
Screw pitch gauge	Used to check the pitch of external and internal threads
Screw thread plug gauge	Used to check the internal threads
Fillet gauge	a tool used to measure the radius of an object
Slip gauge	• For tool-room and other precision work • Transferring the dimension of the unit of length from the primary standard to gauge blocks for the verification and graduation of measuring apparatus. • To measure tolerances in the range of 0.001 to 0.0005 mm very accurately.



Screw pitch gauge



Screw thread plug guage



Screw Thread Ring Guage

16. **Answer: d**

Explanation:

Concept:

- Vansda National Park is located in **Gujarat.**
- Vansda National Park, also known as Bansda National Park.
- Important animals found here are the Indian leopard, rhesus macaque, Hanuman langur, four-horned antelope, wild boar, Indian porcupine, hyena, flying squirrel, etc.

The following National parks are most famous in India:

Famous National parks	Location	Prominent animal
Jim Corbett National Park	Uttarkhand	Royal Bengal Tiger
Kaziranga National Park	Assam	One-horned rhinoceroses
Gir National Park	Gujarat	Asiatic lion
Sunderbans National Park	West Bengal	Royal Bengal Tiger
Sariska National Park	Rajasthan	Royal Bengal Tiger
Kanha National Park	Madhya Pradesh	Swamp deer
Ranthambore National Park	Rajasthan	Tiger
Bandipur National Park	Karnataka	Tigers
Tadoba Andhari National Park	Maharashtra	Tigers
Namdapha National Park	Arunachal Pradesh	Leopard,Clouded leapord,tiger
Manas National Park	Assam	Pygmy Hog, water buffalo
Dachigam National Park	Jammu & Kashmir	Kashmir stag
Hemis National Park	Jammu & Kashmir	Snow leopard
Periyar National Park	Kerala	Elephant

17. **Answer: a**

Explanation:

Concept:

Following chart shows the different games with their respective cups and trophies:

Game	Cups
Golf	**Ryder Cup** , Walker Cup, Canada Cup, Eisenhower Cup, etc.
Football	Subroto Cup, Durand Cup, Santosh Cup, FIFA World cup, La Liga Cup, etc.
Badminton	Thomas cup, Uber cup, European Cup, Malaysian Cup, Harilela Cup, etc.
Basketball	FIBA Basketball World Cup, Eurobasket, NBA, etc.
Hockey	Nehru Cup, Sultan Azlan Shah Cup, Sindhiya Gold Cup, etc.
Cricket	ICC Cricket World Cup, ICC Champions Trophy, T20 World cup, Ashes Series, Asia Cup,etc.

18. **Answer: d**

Explanation:

Explanation:

In a fluid, the following forces are present

Gravity force (F_g) due to gravity

Pressure force F_p due to pressure of fluid

Viscous force F_v due to viscosity

Tension force F_s due to surface tension

Turbulent force F_t due to turbulence.

F_c due to compressibility.

$\therefore F_{net} = F_g + F_p + F_v + F_s + F_t + F_c$

Important Point

- If $F_{net} = F_g + F_p + F_v + F_t$ this is known as **Reynold's equations of motion** .
- If $F_{net} = F_g + F_p + F_v$ this is known as **Navier-Stokes equation of motion** .
- If $F_{net} = F_g + F_p$ this is known as **Euler's equation of motion** .

---

19. **Answer: c**

Explanation:

Explanation:

- EBCDIC stands for **Extended Binary Coded Decimal Interchange Code** is an eight-bit character encoding used mainly on IBM mainframe and IBM midrange computer operating systems.
- It was used for mainframe computers in the United States.
- EBCDIC was devised in 1963 and 1964 by IBM. It is an eight-bit character encoding, developed separately from the seven-bit ASCII encoding scheme.

---

20. **Answer: c**

Explanation:

Explanation:

Bagasse

- Bagasse is the fiber remaining after the extraction of the sugar-bearing juice from sugarcane.
- Bagasse is also called megass.
- The word bagasse, from the French bagage via the Spanish bagazo, originally meant rubbish, refuse, or trash.
- It is used as a biofuel for the production of heat, energy, and electricity, and in the **manufacture of pulp** and building materials.

Manures

- Animal manures are a valuable source of nutrients for crops and grasslands.
- Animal manures are the solid, semisolid, and liquid by-products generated by animals grown to produce meat, milk, eggs, and other agricultural products for human use and consumption.
- They are mixtures of **animal feces, urine, bedding materials** (e.g., straw, sawdust, rice hulls), and other materials

Fertilizers

- The natural or artificial substance containing the chemical elements that improve the growth and productiveness of plants.
- Primary Materials:
    - Nitrogenous Fertilizers:– Natural Gas, Naphtha, Fuel Oil, Coal
    - Phosphate Fertilizers:– Phosphate rock, sulfur
    - Potash Fertilizers:– Naturally occurring salts
- Intermediate Materials:
    - Ammonia
    - Nitric Acid
    - Sulfuric Acid
    - Phosphoric Acid

Soap

- Soap is a combination of animal fat or plant oil and caustic soda.
- Soap requires two major raw materials: fat and alkali. The alkali most commonly used today is sodium hydroxide.
- It is used in a variety of cleansing and lubricating products.

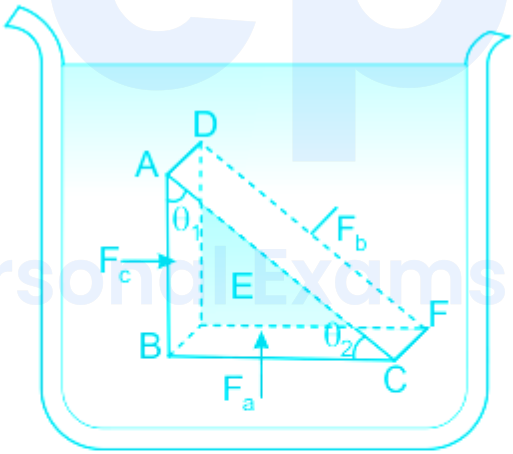
---

21. Answer: c

Explanation:

Concept:

According to Blaise Pascal, a French scientist observed that the pressure in a fluid **at rest** is the same at all points if they are at the same height and it is termed Pascal's Law.



Proof of Pascal's law. ABC-DEF is an element of the interior of a fluid at rest. This element is in the form of a right-angled prism. The element is small so that the effect of gravity can be ignored, but it has been enlarged for the sake of clarity

i.e., the pressure exerted by the fluid on an object at a certain height will be the same in all direction and hence it can be expressed as

$P_a = P_b = P_c \Rightarrow \frac{F_a}{A_a} = \frac{F_b}{A_b} = \frac{F_c}{A_c}$

From the above fig. we can see that the force against area within a fluid at rest will always experience pressure perpendicular to their surface area, and the object will experience equal pressure throughout the surface.

And there are a number of devices, such as hydraulic lift and hydraulic brakes , are based on Pascal's law, these devices used fluids for transmitting pressure.

---

22. Answer: d

Explanation:

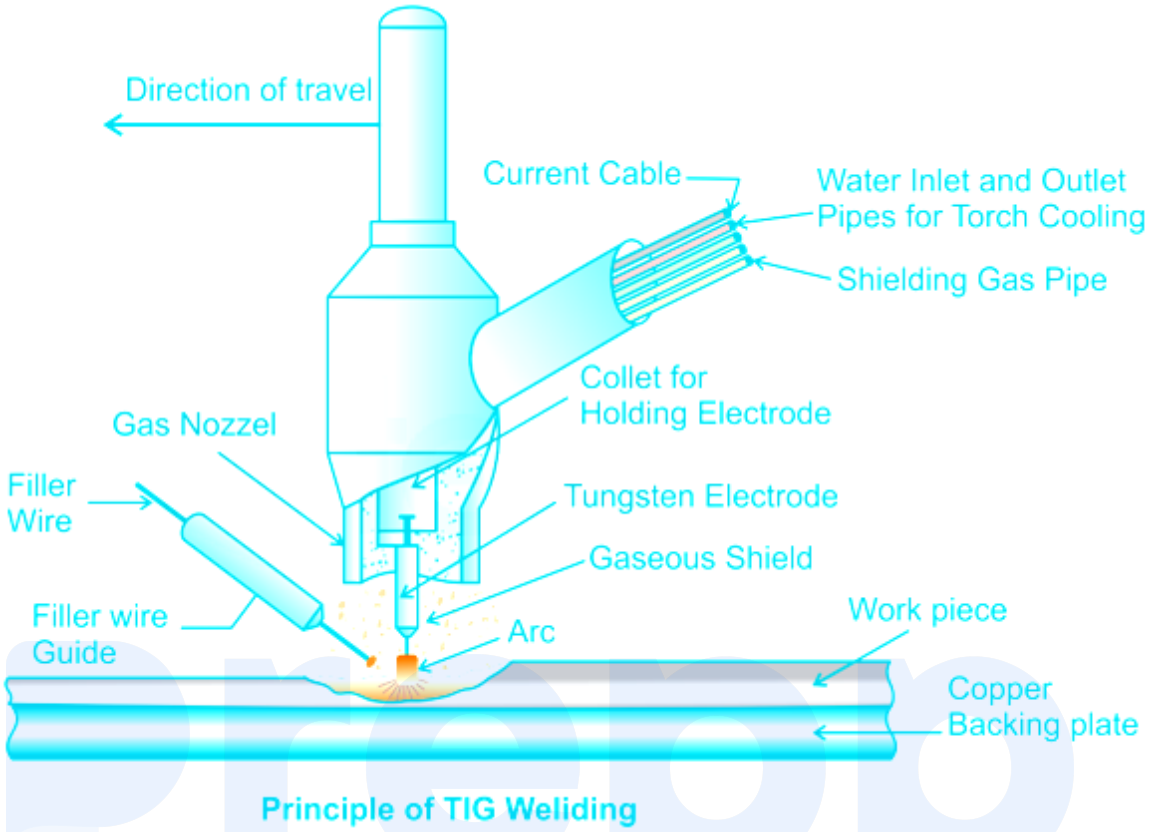
Concept:

Shielded Gas Arc welding is divided into three types:

1. Tungsten Inert Gas welding (TIG)
2. Metal inert gas welding (MIG)
3. Plasma Arc Welding

Tungsten I nert Gas (TIG) or Gas Tungsten Arc W**elding** (GTAW)

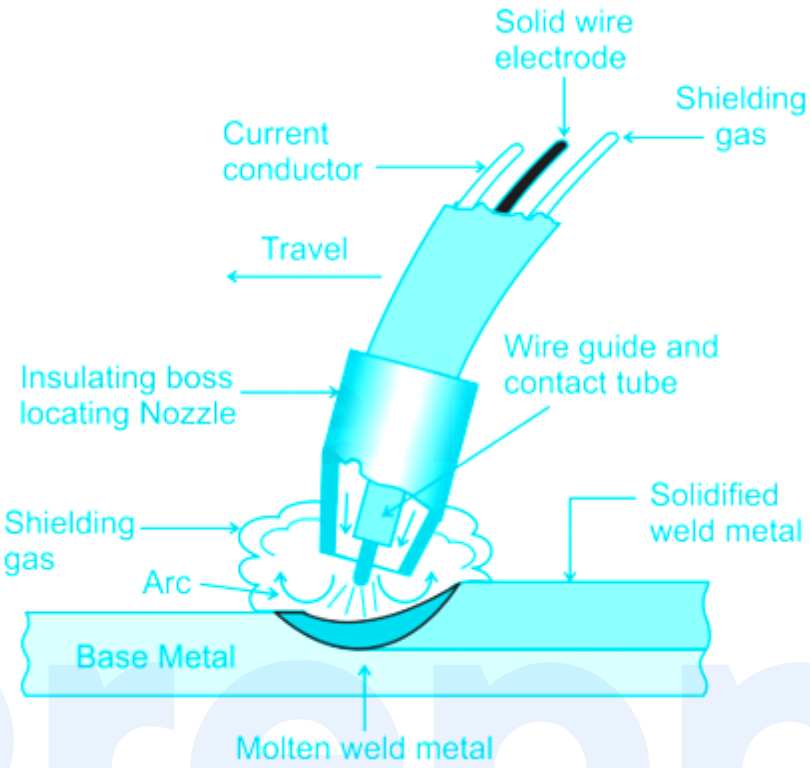
- It is the arc welding process in which arc is generated between a non-consumable tungsten electrode and a workpiece.
- The tungsten electrode and the weld pool are shielded by an inert gas normally **argon and helium.**



Principle of TIG Welding

Gas metal arc welding (GMAW) or Metal inert gas arc welding (MIG)

- In this process, the arc is formed between a continuous, automatically fed, metallic consumable electrode and welding job in an atmosphere of inert gas, and hence this is called metal inert gas arc welding (MIG) process.
- The shielding gases for MIG welding are mixtures of **argon, oxygen, and CO_2, and special gas mixtures may contain helium.**



Plasma Arc Welding

- Plasma Arc Welding is the advanced version of TIG welding. In the Plasma Arc Welding process the arc is being created between the tungsten electrode and the workpiece.
- Plasma is the state of the gas when the gas is heated to high temperature and changes into positive ions, neutral atoms, and negative electrons.
- The plasma is allowed to pass through a very constricted nozzle to get a very high velocity of plasma.
- The nozzle constricts the plasma and arc, thus constriction of the arc will result in the high temperature of the plasma. Thus high velocity and high temperature (30000°C) results in the rapid melting of base metal.
- The PAW is used for welding very thin foils due to very less heat affected area and intense heat generation.
- The heat-affected region in PAW is less than the GTAW process, thus less amount of heat loss and high efficiency as compared to GTAW.
- The energy density in PAW is greater than the GTAW process. This results in deeper penetration in base metal and even thicker metal can be melted rapidly.

- PAW is used in welding stainless steel, titanium, metals having very high melting points and superalloys. Also, in the aeronautical industry, precision instrument industry, and jet engine manufacturing.

---

23. Answer: c

Explanation:

Concept:

- When a body is loaded within the elastic limit, it changes its dimensions and on the removal of the load, it regains its original dimensions.
- So long as it remains loaded, it has stored energy in itself.
- On removing the load, the energy stored is given off as in the case of a spring.
- This energy, which is absorbed in a body when strained within the elastic limit , is known as strain energy.
- The strain energy stored in a body due to external loading, within the elastic limit , is known as resilience and the maximum energy which can be stored in a body up to the elastic limit is called proof resilience.
- Strain energy stored in a body due to tensile or compressive load or resilience:

$U = \frac{\sigma^2 V}{2E}$

- **Modulus of resilience:** The proof resilience per unit volume of a material is known as modulus of resilience .

$U = \frac{\sigma^2}{2E}$

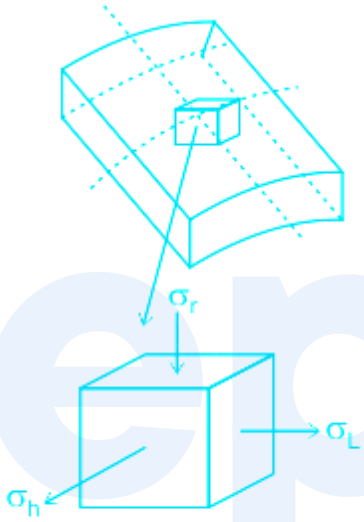
---

24. Answer: c

Explanation:

Concept:

- Consider a thin pressure vessel having closed ends and contains fluid under a gauge pressure P. Then the walls of the cylinder will have longitudinal stress, circumferential stress and radial stress.
- As shown in the figure, a point of the shell having stresses from all sides i.e. tri-axial stresses.
- σ L = longitudinal stress (tensile), σ r = radial stress (compressive), σ h = circumferential stress (tensile).



Tri-axial state of stress at a point on the shell of pressure vessel

As, σ r <<<< σ L and σ h, therefore we neglect σ r and assumed the bi-axial stresses.

Circumferential or hoop stress: $\sigma_h = \frac{Pd}{2t}$

Longitudinal or axial stress: $\sigma_L = \frac{Pd}{4t}$

where d is the internal diameter and t is the wall thickness of the cylinder.

⭐ Important Points

- For the spherical shell, longitudinal stress and circumferential stress both are equal,

σ h = σ L = $\frac{Pd}{4t}$

25. **Answer: c**

Explanation:

Concept:

Elastic Modulus (E)

When the body is loaded within its elastic limit, the ratio of stress and strain is constant. This constant is known as Elastic modulus

$$\mathrm{E} = \frac{\text{Stress}}{\text{Strain}} = \frac{\sigma}{\epsilon}$$

S.I unit: N/m 2

Rigidity modulus (G)

When a body is loaded within its elastic limit, the ratio of shear stress and shear strain is constant, this constant is known as the shear modulus.

$$\mathrm{G} = \frac{\text{Shear stress}}{\text{Shear strain}} = \frac{\tau}{\phi}$$

S.I unit: N/m^2

Stress (σ)

The term stress is used to express the loading in terms of force applied to a certain cross-sectional area of an object.

$$\sigma = \frac{Force}{Cross\ sectional\ area} = \frac{F}{A_c}$$

S.I. unit: N/m^2

Pressure (P)

Itis the force applied perpendicular to the surface of an object per unit area.

$$P = \frac{Pressure}{Area} = \frac{P}{A}$$

S.I. unit: N/m^2 = Pascal

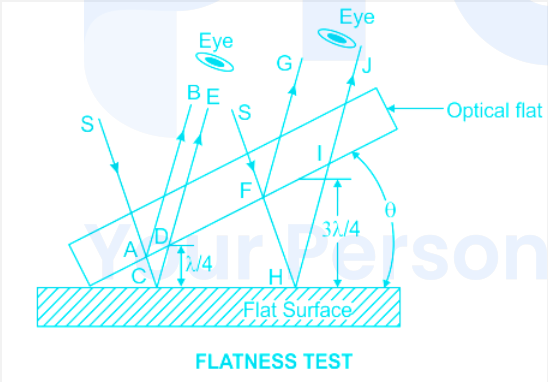
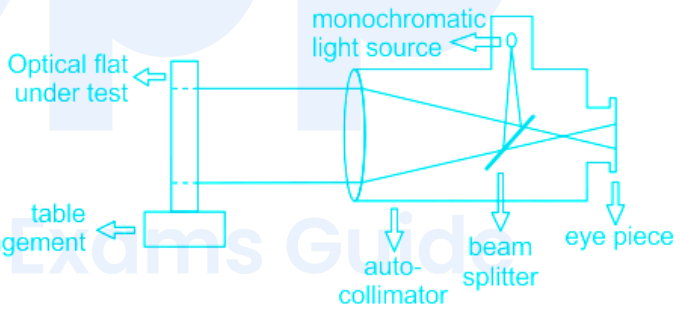
26. Answer: b

Explanation:

<u>Explanation:</u>

Optical Flat:

- It is a measuring instrument that depicts the **flatness** of a surface.
- It works on the **principle** of " **Interference of Light** ". T
- hey are cylindrical in shape with a **working surface flat** . T
- hey are made up of **quartz** and are of **two types** .

TYPE 1	TYPE 2
 FLATNESS TEST	 PARALLELISM TEST
It has only **one** flat surface.	It has **two** flat surfaces and both **parallel** to each other.
Used for testing **flatness** precision measuring surfaces of flat, slips, etc.	Used for testing **parallelism** between measuring surfaces of micrometers, measuring anvils, etc.

27. **Answer: d**

Explanation:

Concept:

Climate change, ozone depletion, and greenhouse emissions are hard-hitting realities and a wakeup call for everyone to leave behind the prejudices and act on it. Various initiatives have been launched and international agreements have been signed for the said purpose.

The Montreal Protocol:

- The Montreal Protocol on Substances that Deplete the Ozone Layer (the Montreal Protocol) is an international agreement made in 1987 .
- The Montreal Protocol is signed by 197 countries – the first treaty in the history of the United Nations to achieve universal ratification – and is considered by many the most successful environmental global action.
- It sits under the Vienna Convention for the Protection of the Ozone Layer (the Vienna Convention).
- It was designed to stop the production and import of ozone-depleting substances and reduce their concentration in the atmosphere to help protect the earth's ozone layer.
- It targets 96 ozone-depleting chemicals in thousands of applications across more than 240 industrial sectors.
- It has also produced other significant environmental benefits. Most notably, it has benefitted the global climate by reducing the amount of greenhouse gas going into the atmosphere.
- The Montreal Protocol is widely considered as the most successful environment protection agreement. It sets out a mandatory timetable for the phase-out of ozone-depleting substances

Non-Proliferation Treaty:

- The NPT is a multilateral treaty aimed at limiting the spread of nuclear weapons including three elements - non-proliferation, disarmament, and peaceful use of nuclear energy.

- The NPT defines nuclear weapon states as those that had manufactured and detonated a nuclear explosive device prior to 1 January 1967. All the other states are therefore considered non-nuclear-weapon states.
- The five nuclear-weapon states are - China, France, Russia, the United Kingdom, and the United States. India has not signed the NPT.

World wildlife fund (WWF)

- World wildlife fund (WWF) is an international non-governmental organization that works for the protection of the diversity of life on earth and the future of nature. It emphasizes the protection of endangered species and the environment.

---

28. Answer: d

Explanation:

The correct answer is**Clive Lloyd**.

- **Clive Lloyd was the captain of West Indies** , who played six Test matches against India.

⭐ Important Points

- **The final of the Prudential Cup was played between India and West Indies at Lord's on 25 June 1983.**
- **It was the first world win for India by defeated West Indies.**
- **Kapil Dev was the captain of Indian team.**

⭐ Key Points

Viv Richards	• He was a former cricketer of West Indies. • In 1994, Richards was appointed an Officer of the Order of the British Empire (OBE) for services to cricket. • In 1999, he was made a Knight of the Order of the National Hero (KNH) by his native country Antigua and Barbuda.
Malcolm Marshall	• He was a former cricketer of West Indies. • He was a great right arm fast bowler.
Richie Richardson	• He was a former captain of the West Indian cricket team.

- **Captains of West Indies (2020): Jason Holder (Test captain), Kieron Pollard (One Day & T20I captain).**

---

29. **Answer: d**

Explanation:

Concept:

Area Moment of Inertia:

- It is a geometrical property of an area which reflects how its points are distributed with regards to an arbitrary axis.
- It is also known as **2^{nd} moment of area** or **2^{nd} Moment of Inertia.**
- Its SI unit is ' **m^4**'
- Mathematically, it is represented as

$I_x = \iint y^2 \, dxdy \;\; and \;\; I_y = \iint x^2 dxdy$

Calculation:

Given :

width(b) = 3 cm, height(h) = 4 cm

For the rectangular section, the Moment of Inertia is given by

$I_{xx} = \frac{bh^3}{12} = \frac{3 \times 4^3}{12} = 16\ cm^4$

⭐ **Important Points**

Mass Moment of Inertia:

It is a measure of the resistance of a body to angular acceleration about a given axis that is equal to the sum of the products of each element of mass in the body and the square of the element's distance from the axis.

It's **SI unit** is **kg-m** ^{2}

Mathematically, \(I = \mathop \sum \limits_{i = 1}^n {m_i}r_i^2\)

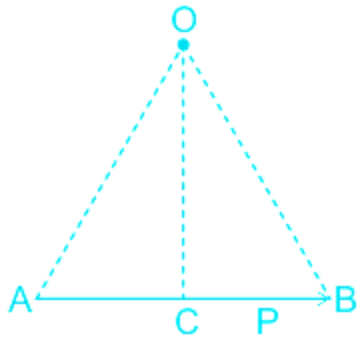
MOI of Some Standard Shapes:

Type of Shape	Moment of Inertia
Rectangle	$I_{xx} = \frac{bh^3}{12},\ I_{yy} = \frac{hb^3}{12}$
Triangle	$I_{C.G} = \frac{bh^3}{36}\ ,\ I_{base} = \frac{bh^3}{12}$
Circle	$I_{xx} = I_{yy} = \frac{\pi}{64}d^4$
Semicircle	$I_{xc} = 0.393r^4\ ,\quad I_{yc} = 0.11r^4$

30. **Answer: b**

Explanation:

Concept:



$Moment = P \times OC$

And

$Area\ of\ triangle = \frac{1}{2} \times AB \times OC$

$= \frac{1}{2} \times P \times OC$

$= \frac{1}{2} \times$ moment

$\therefore$ Moment = Twice the area of a triangle

---

31. **Answer: c**

Explanation:

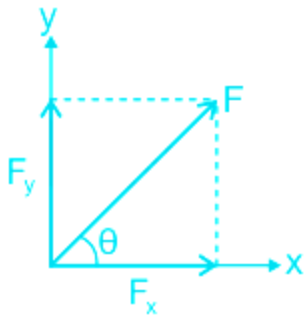
Explanation:

Principle of resolution of forces:

- The **algebraic sum of the resolved parts** of a number of forces in a given direction is equal to the resolved part of their resultant in the same direction.

Method for the resolution for the resultant force:

- Resolve all the forces horizontally and find the algebraic sum of the horizontal components.
- Resolve all the forces vertically and find the algebraic sum of the vertical components.



The resultant of the above both can be given below as,

$$R = \sqrt{(\sum H)^2 + (\sum V)^2}$$

The resultant force will make an angle with the horizontal can be given as,

$$tan\theta = \frac{\sum V}{\sum H}$$

Important Points

Principle of Transmissibility:

- According to it if we transmit a force in its line of action without changing its magnitude and direction then there will not be a change in the effect of a force.

Principle of Independence of force:

- It is defined as vertical motion does not affect by the movement of horizontal motion.

---

32. Answer: a

Explanation:

Concept:

Ferromagnetism:

- Ferromagnetism is a unique **magnetic behavior** that is exhibited by certain materials such as **Nickel ,Iron, Cobalt, Alloys,** etc.
- It is a phenomenon where these materials attain **permanent magnetism** or they acquire attractive powers.
- It is also described as a process where some of the **electrically charged materials attract each other strongly.**
- It is a property that considers not only the chemical make-up of material but it also takes into account the microstructure and the crystalline structure.

⭐ Important Points

Ferrimagnetism:

- In a ferrimagnet, the magnetic moment of one type ion on one type of lattice site in the crystal are aligned anti-parallel to those of ion on another site. Because the magnetic moment is not of the same magnitude they only partially cancel each other and the material has net magnetic moment.
- Ferrimagnetism has several similarities to ferromagnetism in that the cooperative alignment between magnet dipoles leads to a net magnetic moment even in the absence of applied field.
- Ferrimagnetism has lost above the critical temperature.

---

33. Answer: a

Explanation:

The correct answer is**Active cell**.

- **The active cell** is the **current selected cell** which has a **bold boundary for easy identification** .
- By default **initially opened a MS-Excel, the first cell is the active cell.**
- It can be identified by a bold (**typically blue**) outline that surrounds the cell.

⭐ Important Points

- The cell that is not currently selected is called passive cell or passive state of a cell.
- A mixed cell in MS-Excel is either an absolute column and relative row or absolute row and relative column.
- A cell reference or relative cell reference describes how far away a cell or group of cells is from another cell in the same spreadsheet.

---

34. Answer: d

Explanation:

Concept:

Hazardous waste: Hazardous waste is waste that has substantial or potential threats to public health or the environment.

Characteristics: Hazardous wastes are the materials that are known or tested to exhibit one or more of the following hazardous traits:

- Ignitability
- Corrosivity
- Reactivity
- Toxicity

⭐ Important Points

The most common methods for disposing of hazardous waste are:

- Land disposal
- Incineration

If there is abundant land is available for the disposal of waste, land disposal is used. If there is no abundant land is available for disposal of waste, incineration is used.

---

35. **Answer: b**

Explanation:

Explanation:

- Litmus paper test is done to find the solution whether it is Acidic or Basic in nature.
- Litmus paper is a type of pH paper made by treating paper with **natural dyes from lichens.**
- The blue litmus paper turns red or pink when it comes into contact with an acidic solution below the pH 4.5
- It becomes purple if the pH of the solution is between 4.5 and 8.3 and if the pH is above 8.3 it stays blue.
- The solution which is Basic in nature having a pH range between 8.5 and 14 change the color of red litmus paper to blue.

---

36. **Answer: a**

Explanation:

Concept:

Simple Average method:

- It is a **method for inventory valuation** or **delivery cost calculation** , where even if accepting inventory goods with different unit costs, the average unit cost is calculated by multiplying the total of these unit costs simply by the number of receiving.

Calculation:

Given:

$F_{July} = 200, F_{August} = 225, F_{Sep} = 245, F_{Oct} = ?$

$\therefore F_{Oct} = \frac{F_{July} + F_{Aug} + F_{Sep}}{3}$

$F_{Oct} = \frac{200+225+245}{3}$

$\therefore F_{Oct} = 224\ units$

---

37. Answer: c

Explanation:

Concept:

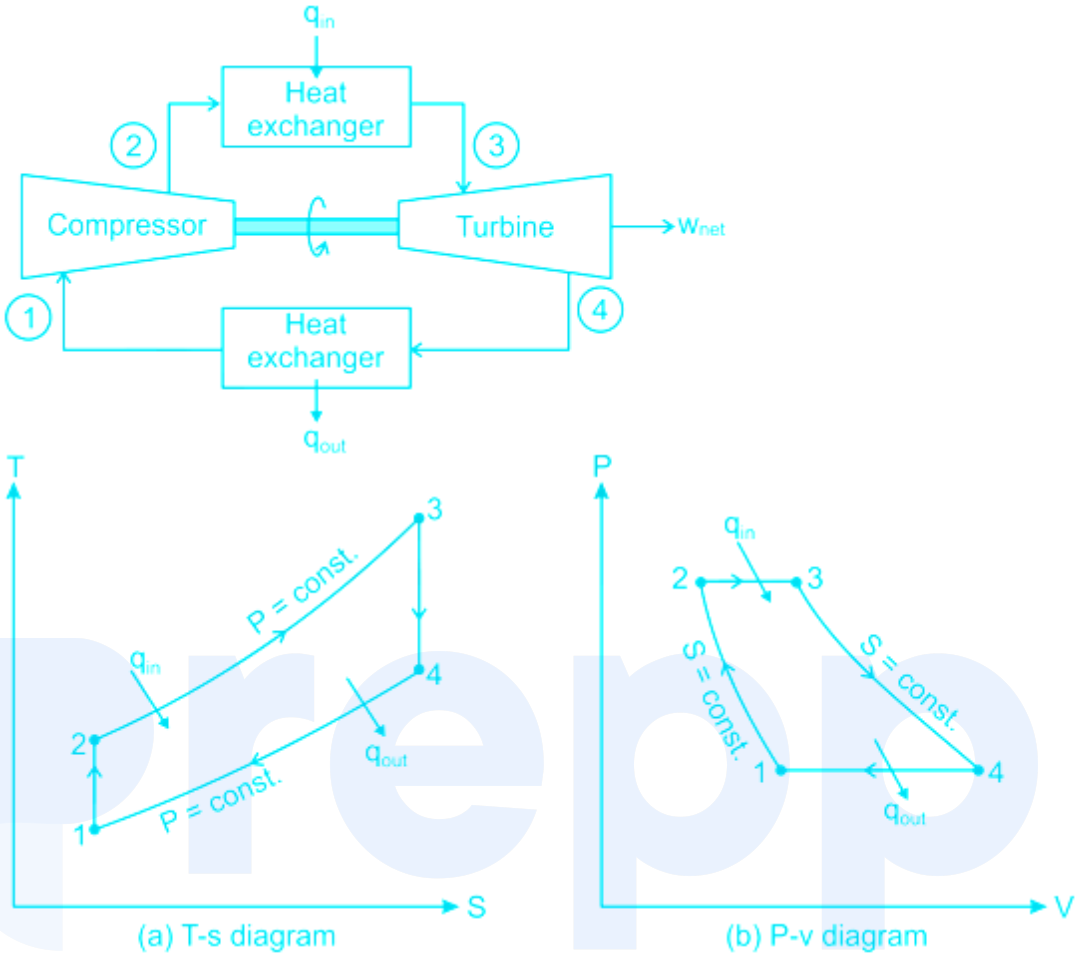
The working of closed cycle gas turbine is as follows

Process 1-2: Isentropic compression of gas takes place in the compressor.

Process 2-3: It denotes the heating of gas in the heating chamber at constant pressure.

Process 3-4: In this process, the expansion of gas takes place isentropically.

Process 4-1: This process shows the cooling of gas **at constant pressure** in the cooling chamber.



⭐ Important Points

- In a closed-cycle gas turbine, the same working fluid is recirculated again and again
- In an open cycle gas turbine, the working fluid is used only one time.

---

38. Answer: b

Explanation:

Concept:

Spirit Level:

- Spirit level, bubble level, or simply a level is an instrument design to indicate whether a surface is horizontal (level).
- Spirit level is used only for horizontal surfaces while autocollimator can be used in any plane
- When the surface of workpiece is exact horizontal, then the bubble of spirit level is placed at the center.

⭐ Important Points

There are different types of spirit level for different uses:

- Surveyor's leveling instrument
- Carpenter's level (either wood, aluminum or composite materials)
- Mason's level
- Torpedo level
- Post level
- Line level
- Engineer's precision level
- Electronic level
- Inclinometer
- Slip or Skid indicator
- Bull's eye level

---

39. Answer: b

Explanation:

Explanation:

Production Planning & Control consist of three different stages.

1. Planning
2. Action
3. Monitoring .

- Planning Stage: Planning stages include activities such as planning the resources, facilities, etc. They are further divided into two stages.
    - Pre-planning Stage: This stage deals with the activities such as product planning , forecastingof the demand on the basis of the past trend, inputs planning, plant and facility planning related to location and layout.
    - Planning Stage: After the pre-planning, the quantity, level of quantity, process capacity, production planning like routing , scheduling materials, tools planning, etc. are carried out in the planning stage.
- Action Stage: It is the real implementation of the plan. It begins with dispatching functions, which deals with the progress of work or job.
- Monitoring: In this stage, the planned activities are controlled and monitored by using various techniques such as inventory control , tool control, cost control, quality control, etc.

---

40. **Answer: d**

Explanation:

The correct answer is**Mouse**.

⭐ **Key Points**

- A mouse is a small **peripheral hardware input device used by hand.**
- It controls the **movement of the cursor on the computer screen and allows users to move, select, copy, cut, paste folders, text, files, and icons on a computer.**
- **In 1963, Douglas Engelbart invented the mouse.**

⭐ **Important Points**

Browser	• It is a software installed on a computer that is used to access the internet. • Example: Mozilla Firefox, Google Chrome, Microsoft Edge, etc
Search engine	• It is a web-based software accessed on the Internet that searches a database of information according to the user's query. • Example: Google, Bing, Yahoo, Duck Duck Go, etc.
Link	• Link or hyperlink is the primary method or reference used to navigate between pages and Web sites. • Encrypted Hypertext markup language. • An HTML object that allows you to jump to a new location when you click or tap it.

⭐ Key Points

- **The founder of the World Wide Web Foundation and W3C Director Tim Berners-Lee developed the first-ever web browser called WorldWideWeb.**

---

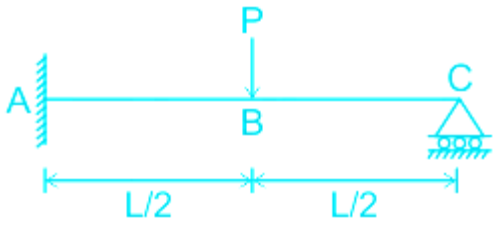
41. **Answer: c**

Explanation:

Concept:

Propped cantilever beam:

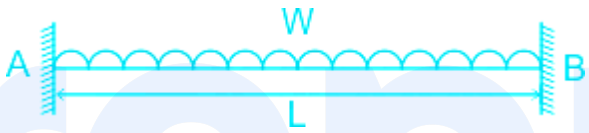
- The propped cantilever beam is a beam with one end fixed and the other end simply supported.
- It comes under statically indeterminate beams.



⭐ Additional Information

Fixed beam:

- It is a beam with **ends restrained from rotation** .
- The figure shows a fixed beam subjected to uniformly distributed load throughout,

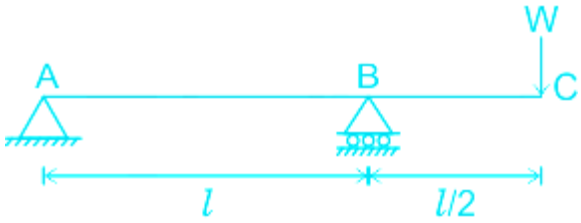


Continuous beam:

- It is a **statically indeterminate multi-span beam on hinged support** .
- The end span may be cantilever, may be freely supported or fixed supported.

Overhanging beam:

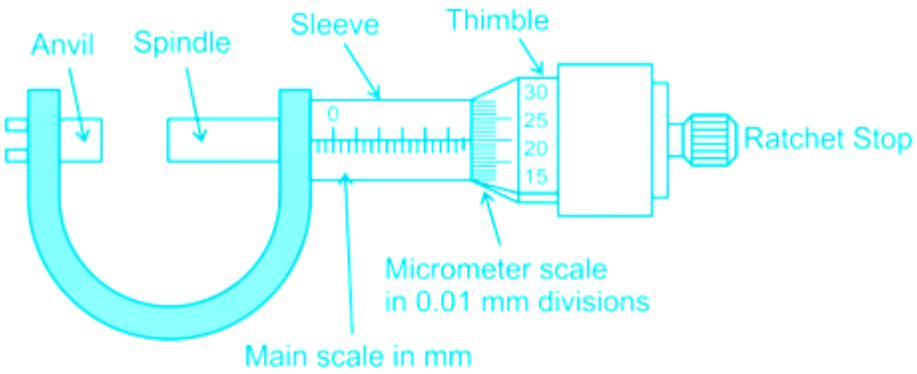
- It is defined as a beam that has **its one or both ends stretching out past its support** .
- It can have any number of supports.



42. Answer: b

Explanation:

Concept:



The micrometer is a precision instrument used to measure a job, generally within an accuracy of 0.01 mm.

Working Principle:

- The micrometer works on the principle of screw and nut
- The longitudinal movement of the spindle during one rotation is equal to the pitch of the screw.

Graduations of metric micrometer:

- In metric micrometer, the pitch of the spindle thread is 0.5 mm
- Thereby, in one rotation of the thimble, the spindle advances by 0.5 mm
- On the barrel/sleeve a 25 mm long datum line is marked
- This line is further graduated to millimeters and half millimeters (i.e. 1 mm or 0.5 mm)
- **The circumference of the bevel edge of the thimble is graduated into 50 divisions** and marked 0 - 5 - 10 - 15.....45 - 50 in a clockwise direction
- The distance moved by the spindle during one rotation of the thimble is 0.5 mm
- Movement of one division of the thimble = 0.5 × 1/50 = 0.01 mm

43. Answer: a

Explanation:

Concept:

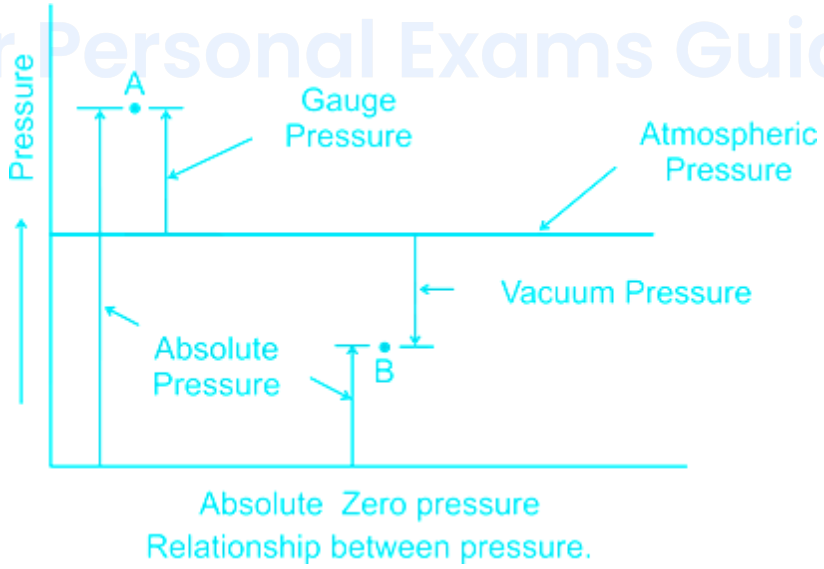
The pressure in a fluid is measured in two different systems.

1. In the first system, it is measured above the absolute zero or zero vacuum which is termed as **Absolute pressure.**
2. In the second system, Pressure is measured above the atmospheric pressure, it is known as **Gauge Pressure.**
    - Gauge Pressure is measured after taking atmospheric pressure as a datum,
    - Thus it can be concluded that on the pressure scale atmospheric pressure is marked as zero.

Mathematically, it can be represented as:

Absolute Pressure = Atmospheric pressure + Gauge Pressure

Therefore, **Gauge Pressure = Absolute Pressure - Atmospheric pressure**



Relationship between pressure.

44. **Answer: d**

Explanation:

Concept:

Martensite:

- It is the hardest constituent of steel. The primary reasons accounting for this could be, the **internal strains** within BCC iron due to the **excess carbon presence** and due to the **plastic deformation of parent FCC iron (Austenite) surrounding the martensitic plate** .
- The rate of cooling and the amount of carbon percentage in steel are directly proportional to the amount of hardness achieved in martensitic transformation.

⭐ Important Points

Bainite:

- It is a **plate-like microstructure** that **forms in steels at a temperature of 125-550** (depending on alloy content).
- **It forms** by **the decomposition of austenite** at a temperature which is above MS but below that at which fine pearlite forms.

Austenite:

- It is also known as **Gamma-phase iron** is a metallic, **non-magnetic allotrope of iron** or solid solution of iron, with an alloying element.
- In **plain carbon steel** ,**austenite** exists above the critical eutectoid temperature of 1000 K.
- **Austenite** is of **FCC** crystal structure.

Ledeburite:

- In iron and steel metallurgy, ledeburite is a **mixture of 4.3 % Carbon in iron** and is a **eutectic mixture of austenite and cementite** .
- **Ledeburite** is **not a type of steel** as the carbon level is too high although it may occur as a separate constituent in some high carbon steel.

45. **Answer: d**

Explanation:

Concept:

- A temperature inversion is a condition in which **the temperature of the atmosphere increases with altitude.**
- When the temperature of the environment increases with altitude ,then the lapse rate becomes inverted or negative from its normal state.
- Negative lapse rate occurs under condition, usually referred to as inversion, a state in which the warmer air lies over the colder air below.
- The radiation inversion is a phenomenon occurring from the unequal cooling rates for the earth and air above the earth.
- Such an inversion in the environment helps in the formation of fog when air is wet, and simultaneously catches gases and particulate matter, as it stops their upward-lifting, thereby creating a concentration of pollutants in our close environment.

---

46. **Answer: d**

Explanation:

The correct answer is**Mizoram**.

- The Project develops in the **Tuirial river (a tributary of the Barak) and is located in the Mizoram.**
- It's capacity is **60 MW (2 x 30 MW).**

⭐ Key Points

- Hydro Projects in **Nagaland: Doyang Hydroelectric Project, Wokha (75 MW), Likimro Hydro Electric Project, Kiphire (24 MW), Lang Hydro Electric Project, Tuensang (1MW), Tehok Hydro Electric Project, Mon (1MW).**

- Hydro Projects in **Manipur: Loktak Power Station (3 x 35 MW), Tipaimukh Hydroelectric Project (1500MW), Pabram Hydroelectric Project (190MW), Irang Hydroelectric Project (60MW).**
- Hydro Projects in **Meghalaya: Wah Umiam projects.**

---

47. Answer: c

Explanation:

Concept:

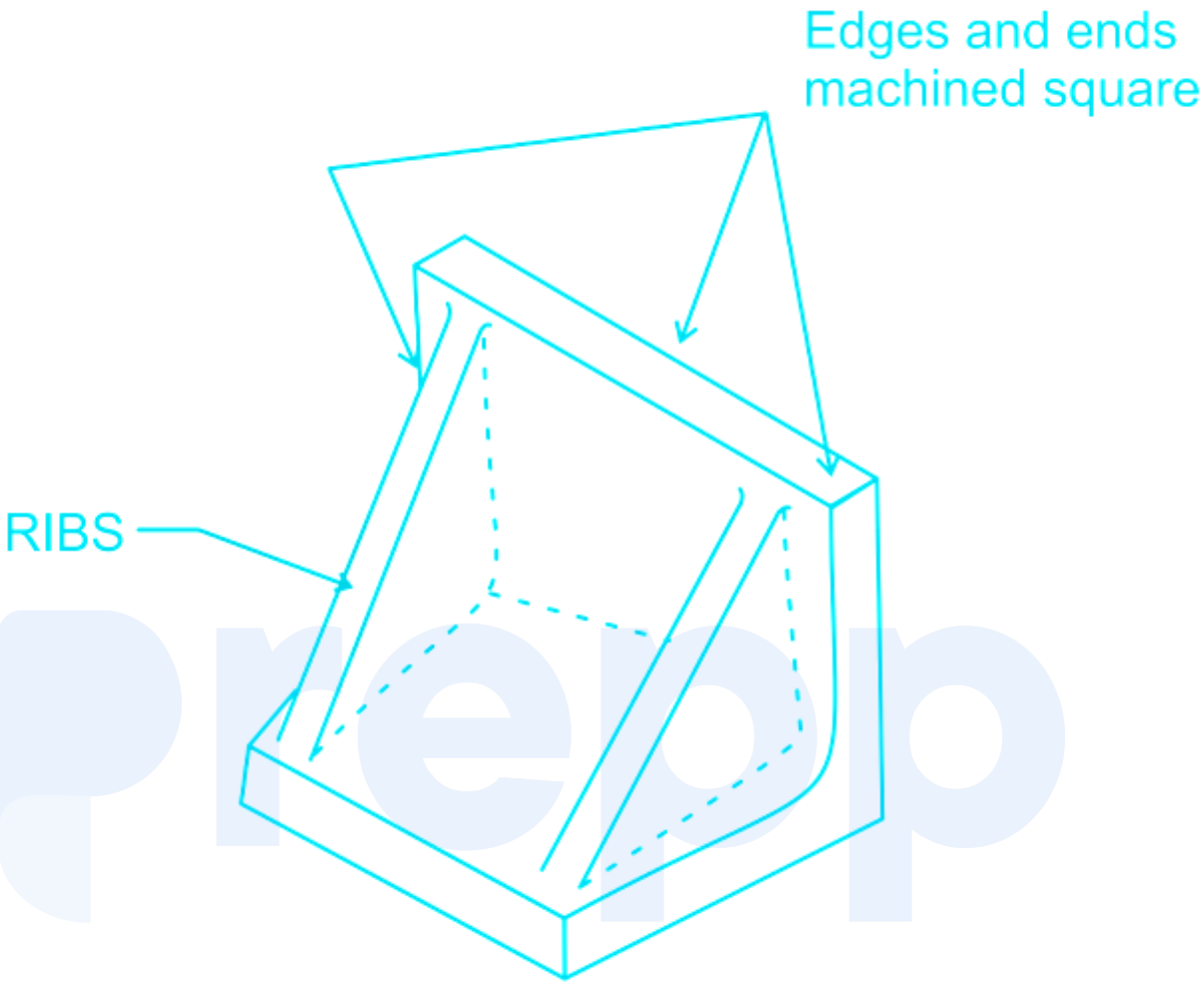
Angle plates

- Angle plates have two plane surfaces, machined perfectly flat and at right angles.
- Generally, these are made of closely grained cast iron or steel.
- The edges and ends are also machined square.
- They have ribs on the unmachined part for good rigidity and to prevent distortion.

Types of angle plates

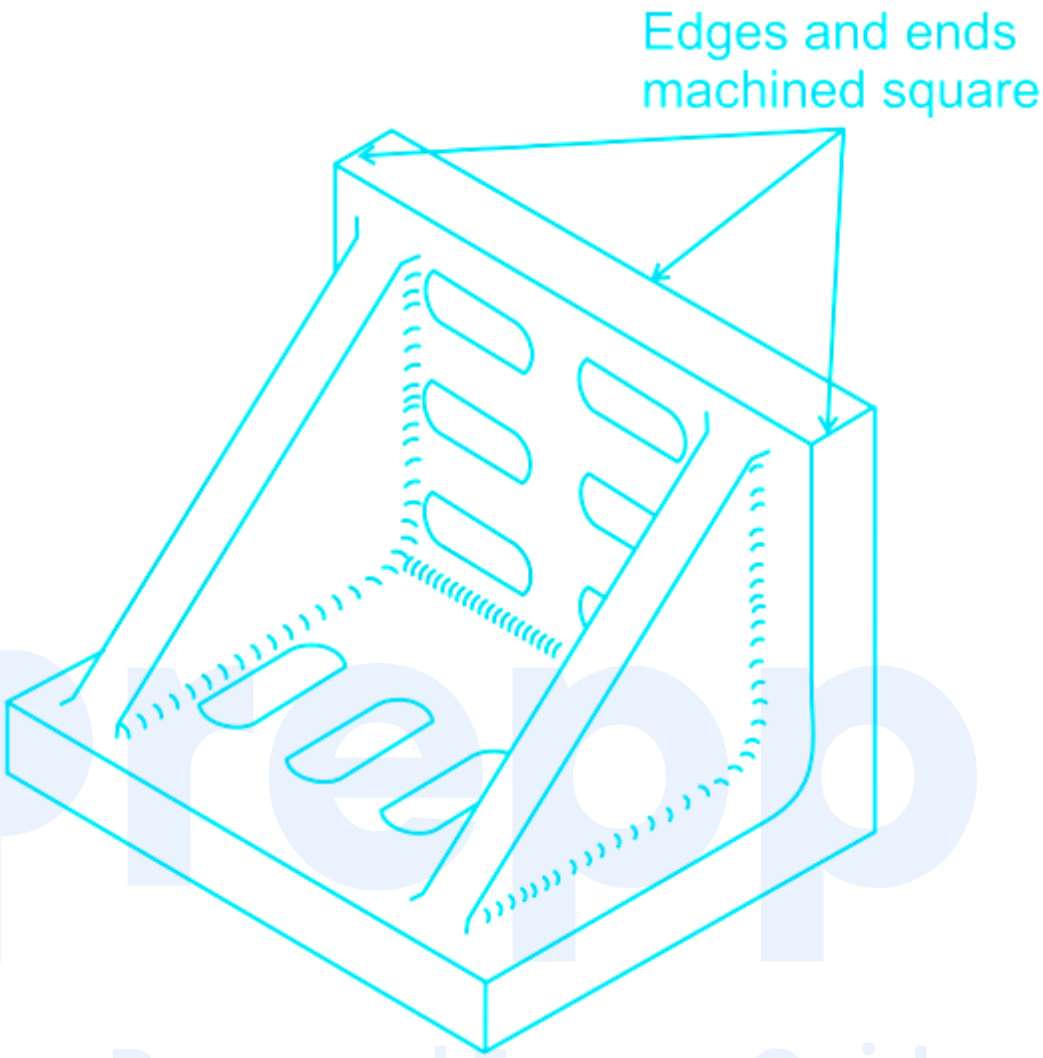
1. Plain solid angle plate:

Among the three types of angle plates normally used, the plain solid angle plate is the most common. It has the two plane surfaces perfectly machined at 90° to each other. Such angle plates are suitable for supporting work-pieces during layout work. They are comparatively smaller in size.



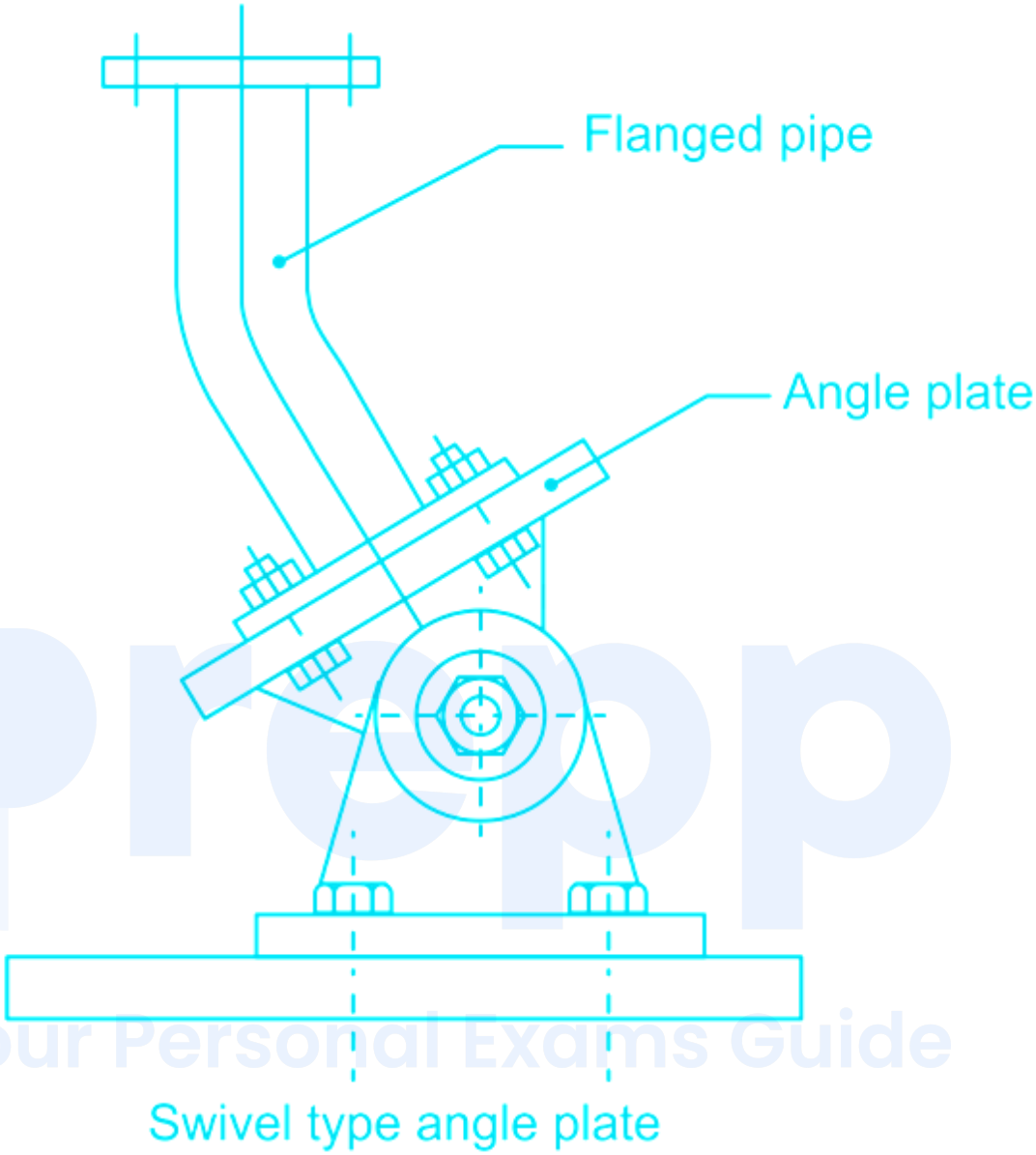
2. Slotted type angle plate:

The two plane surfaces of this type of angle plate have slots milled. It is comparatively bigger in size than the plain solid angle plate. The slots are machined on the top plane surfaces for accommodating clamping bolts. This type of angle plate can be tilted 90° along with the work for marking or machining.



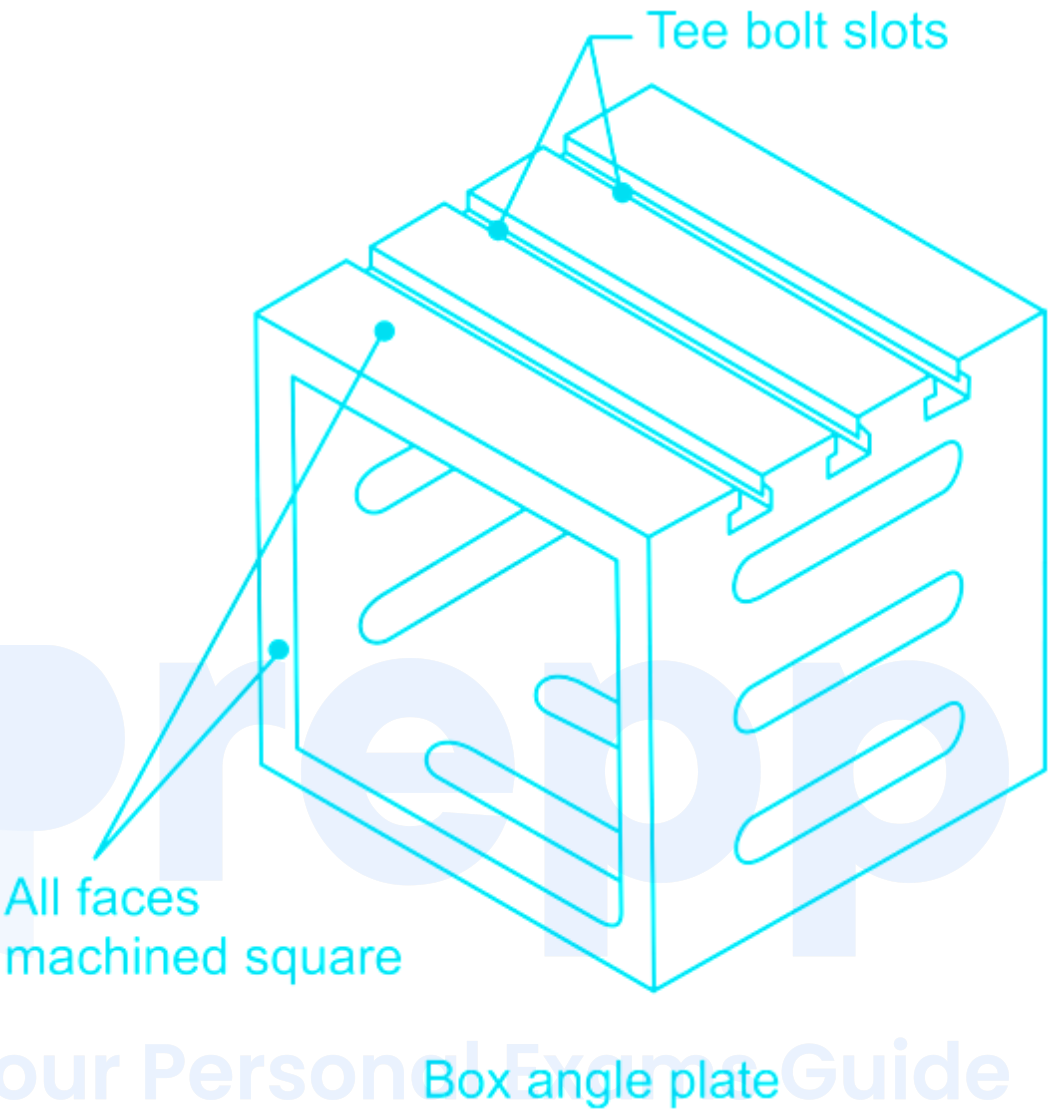
3. Swivel type angle plate:

This is adjustable so that the two surfaces can be kept at an angle. The two machined surfaces are on two separate pieces which are assembled. Graduations are marked on one to indicate the angle of tilt with respect to the other. When both zeros coincide, the two plane surfaces are at 90° to each other. A bolt and nut are provided for locking in position.



4. Box angle plate:

They have applications similar to those of other angle plates. After setting, the work can be turned over with the box enabling further marking out or machining. This is a significant advantage. This has all the faces machined square to each other.



48. **Answer: c**

Explanation:

Concept

The sensitivity of ammeter is defined as the current required for full-scale deflection of the ammeter scale.

$$Sensitivity = \frac{Changeindeflectionofpointer}{Changeofcurrent}$$

Calculation

Given

Change of current = 3 A

Change in deflection of pointer = 12 mm

$Sensitivity = \frac{Change in deflection of pointer}{Change of current}$

$\frac{12}{3} = 4mm/A$

---

49. Answer: b

Explanation:

Explanation

Slack or Event Float

- Slack corresponds to the **event in PERT.**
- Float corresponds **to activity in CPM** .

Slack

- It is defined as the amount of time by which an **event** can be delayed without delaying the project schedule.
- Slack of an event = Latest Start Time – Earliest Start Time OR Latest Finish Time – Earliest Finish Time

There are three types of floats.

Total Float (TF)	• It is the amount of time by which an activity can be **delayed without delaying the project duration.**
	• Extra time available for an activity without delaying the project schedule.
	• If the value of TF is,
	  ○ Positive – Recourses are surplus and can be allocated for other activities.
	  ○ Zero – Resources are just sufficient to complete the activity on time.
	  ○ Negative – Resources are not sufficient and activity may not complete
	• **Total Float = Latest start time – Earliest start time**

Free Float (FF)	· Part of the Total Float, which can be used **without affecting the float of succeeding activity.** · Extra time by which an activity can be delayed so that the **succeeding activity can be started on earliest start time** . • **Free float = Total Float – Head event slack**
Independent Float (IF)	• It is amount of free float time which can be used without affecting **either the head or the tail event.** • **Independent float = free Float – Tail event slack**

50. **Answer: d**

Explanation:

Explanation

Ductility

- The property of a material by virtue of which, it can be drawn into the wire with the application tensile force is known as ductility.
- It is measured as the **ratio of elongation of the material at the fracture during the tensile test to the original length, expressed as a percentage.**
- It may also be expressed as **the ratio of reduction in the cross-sectional area in the fractured specimen to the original cross-section area.**
- Example, **Aluminium,** Copper, mild Steel, etc
- **Brittleness** is the property opposite to ductility. Ex, Iron, concrete, etc

Material	Ductility, % reduction in Area
Cast iron	0
Stainless Steel	75 – 65
Structure Steel	70 – 40
Copper annealed	73
Aluminium Alloys	35 - 39
Monel	75

---

51. **Answer: c**

Explanation:

Explanation

Petrol Engine /Spark Ignition Engine	Diesel Engine/ Compression Ignition Engine
Draws a mixture of **petrol and air** during suction stroke.	Draws **only air** during suction stroke.
The **carburettor** is applied to mix air and petrol in required proportion to supply it to the engine during suction stroke.	The **injector or atomiser** is employed to inject the fuel at the end of compression stroke.
The charge ignited with the help **of spark plug.**	The temperature of compressed air is sufficiently high (600° C and 35 bar) to ignite the fuel.
Has compression ratio of **6 to 10** .	Has compression ratio **15 to 25.**
Combustion of fuel takes place at **constant volume,** works on **Otto cycle.**	Combustion of fuel takes place **at constant pressure, works on diesel cycle** .
Thermal efficiency up **to 26%.**	Thermal efficiency **up to 40%.**
High speed engine	**Low speed engine.**
Generally used in light duty vehicles such as **scooter motorcycle and car,** also used in **Aeroplanes.**	Generally used in heavy duty vehicles such as **buses, trucks and earth moving machines.**

52. **Answer: a**

Explanation:

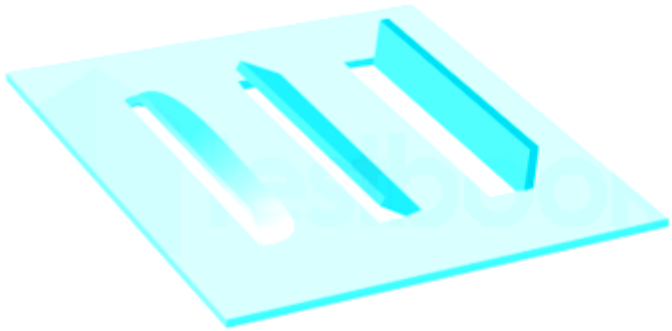
Concept:

Grinding:

- Grinding is an abrasive machining process that uses a grinding wheel as the cutting tool.
- Grinding is used to **finish workpieces** that must show high surface quality and high accuracy of shape and dimension.
- The accuracy in dimensions in grinding is of the order of 0.000025 mm.
- According to the accuracy of the work to be done on a grinding machine, they are classified as Rough grinding machines and precision grinding machines.
- For grinding a job, the right grinding wheel is to be selected. The selection of a grinding wheel will depend on the following factor:
  - Material to be ground
  - Amount of stock to be removed
  - Area of contact
  - Finish required
  - Wheel speed
  - Work speed
- For grinding hard material, a soft wheel and for grinding soft material, a hard wheel is selected

Lancing

- Creating a partial cut in the sheet, so that no material is removed.
- The material is left attached to be bent and form a shape, such as a tab, vent, or louver.



Forming

- Forming can be defined as the process in which the desired size and shapes are obtained thought he plastic deformation of a material.
- The stresses induced during the process are greater than the yield strength but less than the fracture strength of the material.

Boring

- In machining, boring is the process of **enlarging a hole** that has already been drilled by means of a single-point cutting tool.
- Boring is used to achieve greater accuracy of the diameter of a hole and can be used to cut a tapered hole.
- Boring operations can be performed on the Boring machine, lathe, and milling machines.

---

53. Answer: d

Explanation:

Concept:

Slack time

- It is the amount of time a task can be delayed before the project finish date is delayed. Thus, the slack is the difference between event times denoting the range within which an event time can vary.

- The Earliest Expected Time (T E) is the time when an event can be expected to occur earlier.
- The Latest allowable occurrence time (T E) is the latest time by which an event must occur to keep the project on schedule (without delaying the project).
- **Event slack is defined as the difference between the latest event and the earliest event times. i.e. Slack = T L - T E**

⭐ Important Points

Positive slack: When T L > T E. It indicates the project is ahead of schedule meaning thereby the **excess resources.**

Zero slack: When T L = T E. It indicates that the project is going on schedule meaning thereby **adequate resources.**

Negative slack: When T L < T E. It indicates the project is behind schedule meaning thereby the **lack of resources.**

---

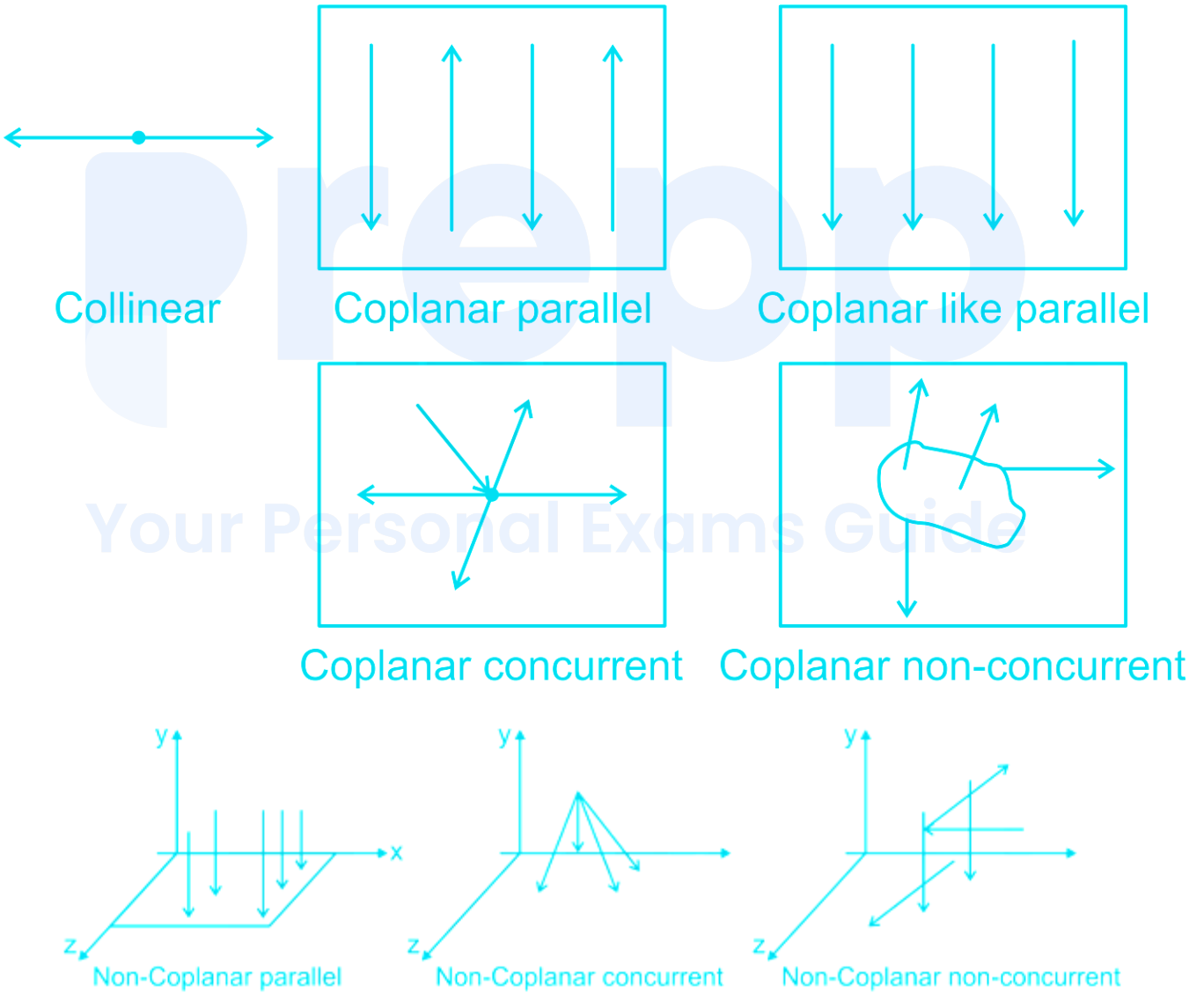
54. Answer: a

Explanation:

Concept:

- Collinear forces: The forces, whose lines of action lie on the **same line,** are known as collinear forces.
- When two or more forces act on a body, they are called to form a system of forces.
- Coplanar forces: The forces, whose lines of action lie on the same plane, are known as coplanar forces.
- Concurrent forces: The forces, which meet at one point, are known as concurrent forces. The concurrent forces may or may not be collinear.
- Coplanar concurrent forces : The forces, which meet at one point and their lines of action also lie on the same plane , are known as coplanar concurrent forces.

- Coplanar non-concurrent forces : The forces, which do not meet at one point, but their lines of action lie on the same plane, are known as coplanar non-concurrent forces.
- Non-coplanar concurrent forces: The forces, which meet at one point, but their lines of action do not lie on the same plane, are known as non-coplanar concurrent forces.
- Non-coplanar non-concurrent forces: The forces, which do not meet at one point and their lines of action do not lie on the same plane, are called non-coplanar non-concurrent forces.



55. **Answer: d**

Explanation:

Explanation

Clearance Volume – The clearance volume is the space left in the cylinder when the piston riches the top dead center.

The clearance volume is provided

- To avoid the piston striking the cylinder head.
- As the valves are located in clearance volume, it allows the valve to operate safely.
- A compressor should have the smallest possible clearance volume, because the compressed air left in the clearance volume, first re-expands in the cylinder during suction stroke, thus reducing the suction capacity.

Clearance ratio/Percentage Clearance

- It is the ratio of clearance volume to the swept volume.
- For the single-stage compressor, it may vary from **2 to 10%.**

Effects of clearance volume

- The volume of air taken is less, thus the volumetric efficiency decreases.
- More power input is required to drive the compressor for the same pressure ratio.
- The maximum compression pressure is controlled by clearance volume.

---

56. **Answer: b**

Explanation:

The correct answer is600 m.

Here given:

- frequency = 50 Hz,
- wavelength = 4 m.

So, **the velocity of wave = Frequency × Wavelength**

= 50 × 4

= 200 m/s.

So the distance travelled by the **sound wave in 3 s is:**

200 × 3

= **600 m.**

---

57. Answer: d

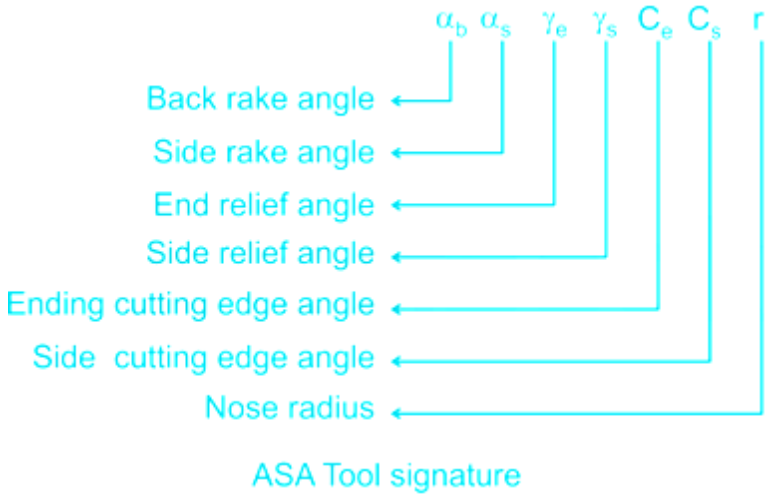
Explanation:

<u>Concept:</u>

A tool has two systems:

1. American Standards System
2. Orthogonal Rake System

ASA tool signature has 7 elements



ASA Tool signature

- American Standards System (ASA) system ⇒ Back rake angle – side rake angle – end relief angle (ERA) – side relief angle – end cutting Edge angle – side Cutting Edge Angle- Nose Radius
- Orthogonal Rake System (ORS) or International system ⇒ I (inclination angle) – an (Normal rake angle) - Side relief angle- end relief angle, end cutting edge angle – Approved angle – nose radius
- **In both, the system nose radius comes in the last.**
- In given system 8 - 8 - 5 - 5 - 6 - 6 - 1, the following notations are indicated
    - 8 shows Back rake angle
    - 8 shows Side rake angle
    - 5 End relief angle
    - 5 Side relief angle
    - 6 End cutting edge angle
    - 6 Side cutting edge angle
    - **1 nose radius**

---

58. Answer: a

Explanation:

Concept:

A grinding wheel consists of the abrasive that does the cutting, and the bond that holds the abrasive particles together.

A standard marking system is used to specify and identify grinding wheels.

The following is the sequence of arrangement:

Abrasive type – Grain size – Grade of bond – Structure – Bond type

51	A	46	H	5	V	8
Position 0	Position 1	Position 2	Position 3	Position 4	Position 5	Position 6
Manufacturer's Symbol for abrasive (Optional)	Type of abrasive grit size	Grain size	Grade	Structure (Optional)	Type of bond	Manufacturer's own mark (Optional)

The number range '6 and 24' specifies the coarse grit size in inch mesh .

For a very large size grit, this number may be as small as 6 whereas for a very fine grit the designated number may be as high as 600.

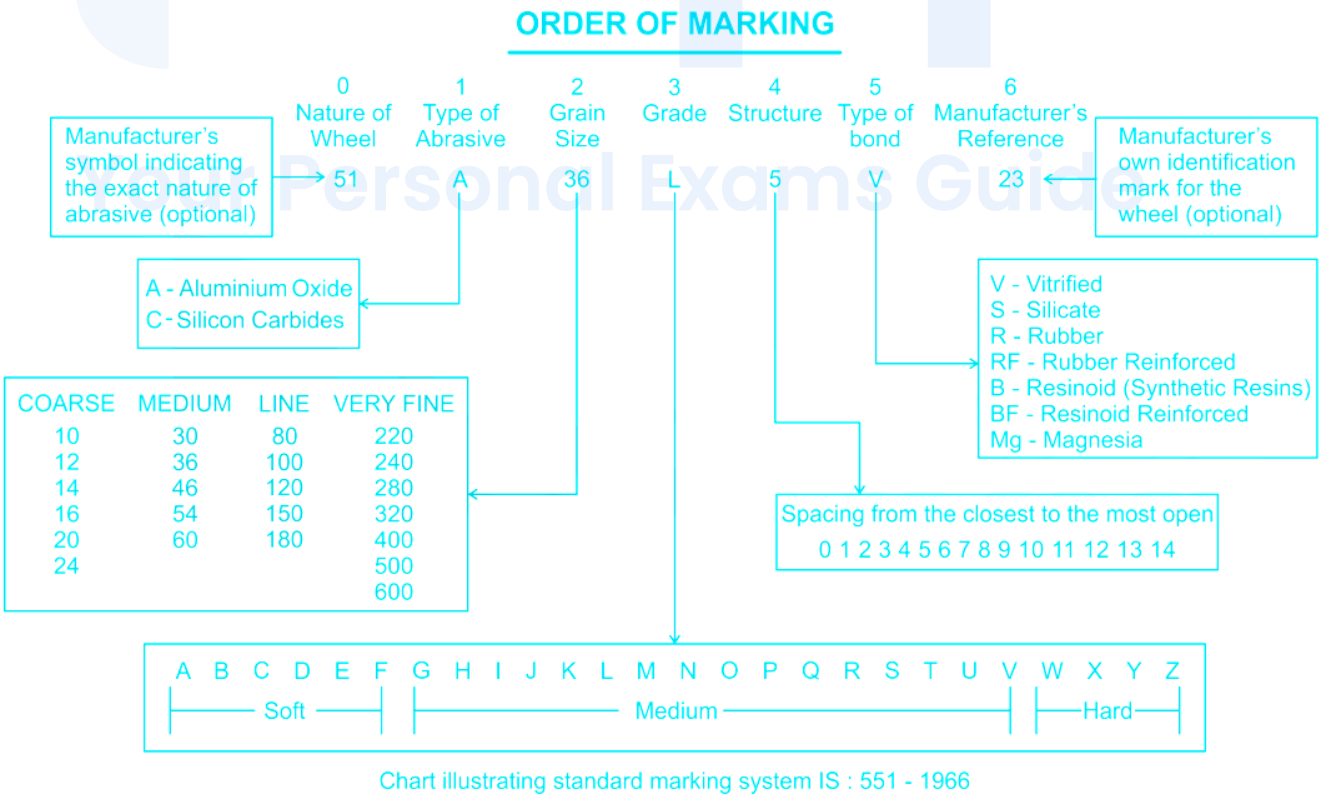


Chart illustrating standard marking system IS : 551 - 1966

- Abrasive type: 'A' for aluminium oxide, 'C' for silicon carbide

- Grain size: They are indicated by a number ranging from 10 (coarse) up to 600 (very fine)
- Grade of bond: The grades range from 'A' indicating light or 'soft' bond to 'Z' indicating a firm or 'hard' bond
- Structure: This structure is indicated by a number from 1 to 12. The higher numbers indicate a progressively more open structure
- Bond type: V – Vitrified, S – Silicate, B – Resinoid, R – Rubber, E – Shellac, O – Oxychloride

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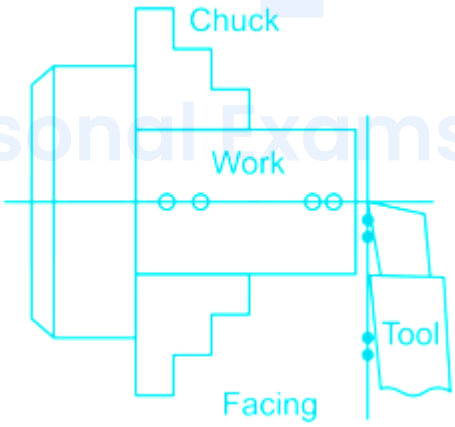
59. Answer: a

Explanation:

Concept:

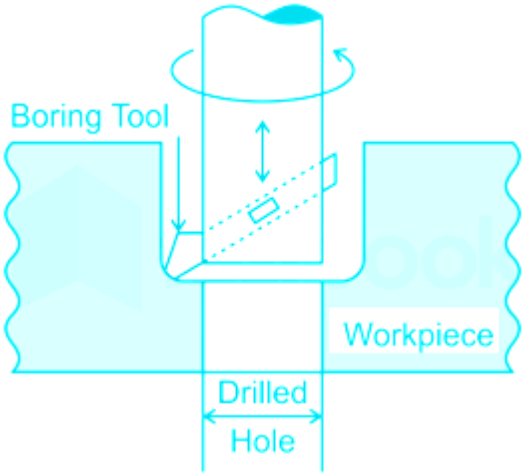
Facing is a machining operation by which the end surface of the work-piece is made flat by removing metal from it.



Boring

- In machining, boring is the process of enlarging a hole that has already been drilled by means of a single-point cutting tool.
- Boring is used to achieve greater accuracy of the diameter of a hole and can be used to cut a tapered hole.

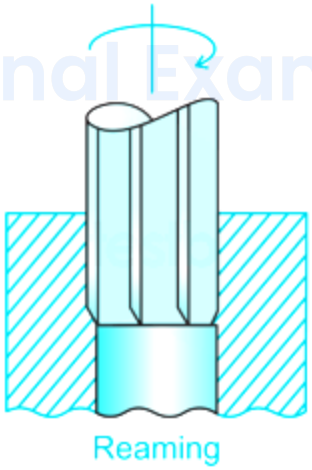
- Boring operations can be performed on the Boring machine, lathe, and milling machines.



Reaming

- Reaming removes a small amount of material from the surface of holes. It is done for two purposes:

1. To bring holes to a more exact size
2. To improve the finish of an existing hole

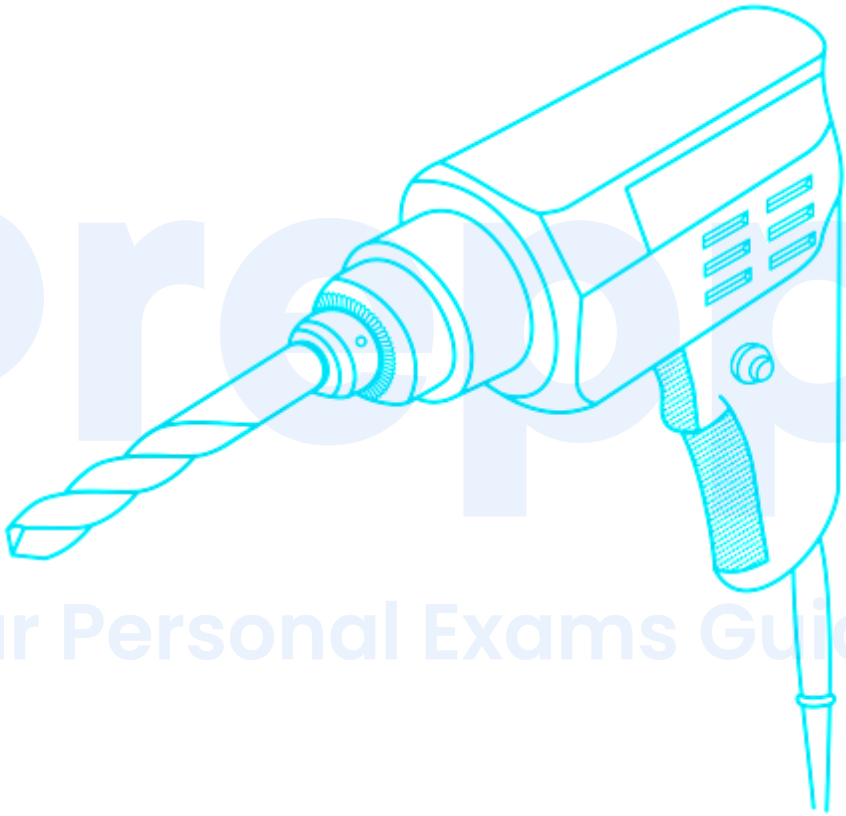


Drilling

- Drilling is a cutting process that uses a drill bit to cut or enlarge a hole of circular cross-section in solid materials.
- The drill bit is a rotary cutting tool.

Mistake Point

- Boring is used to enlarging the diameter.
- Reaming operation is meant to slightly increase the size and to provide a better tolerance and surface finish of an initially drilled hole.



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60. **Answer: a**

Explanation:

Concept:

- Weld decay is a form of intergranular corrosion, usually of **stainless steels** or **certain nickel-based alloys,** that occurs as the result of sensitization in the heat-affected zone during the welding operation.
- In stainless steel welding, **chromium reacts with the carbon** and results in **chromium carbide** precipitation of chromium carbide at **grain boundaries.**
- The carbide precipitation along grain boundaries form chromium depleted zone adjacent to grain boundaries and **results in weld decay.**
- Thus, chromium stabilizing elements such as Columbium and titanium are added in the filler metals to avoid carbide precipitation.

---

61. **Answer: d**

Explanation:

Concept:

- CSIR stands for **Council of Scientific and Industrial Research**
- The CSIR is the largest research and development (R&D) organization in India founded in 1942.
- CSIR has a pan-India presence and has a dynamic network of **38 national laboratories, 39 outreach centers, 3 Innovation Complexes, and 5 units.**
- **The headquarter of CSIR situated in New Delhi.**
- Durgapur-based CSIR lab, **Central Mechanical Engineering Research Institute** has developed **"Hospital Care Assistive Robotic Device", HCARD.**
- It will help frontline health care workers in maintaining physical distance from those infected by **corona virus.**

---

62. **Answer: c**

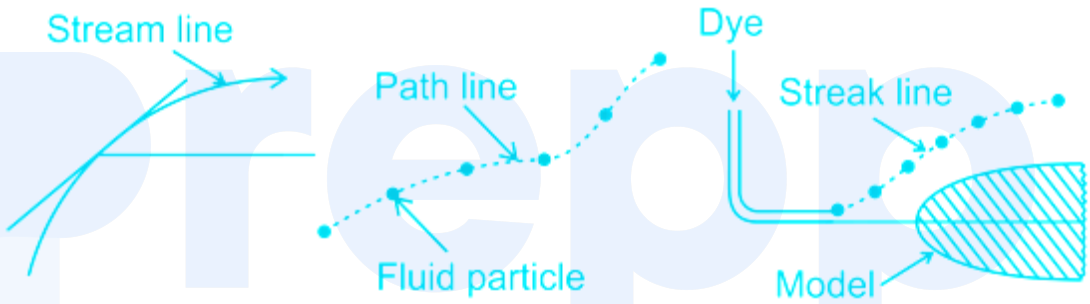
Explanation:

Concept:

Streamlines are a family of curves that are instantaneously tangent to the velocity vector of the flow. These show the direction in which a mass-less fluid element will travel at any point in time

Streaklines are the loci of points of all the fluid particles that have passed continuously through a particular spatial point in the past. Dye steadily injected into the fluid at a fixed point extends along a streak line.

Pathlines are the trajectories that individual fluid particles follow. These can be thought of as "recording" the path of a fluid element in the flow over a certain period. The direction the path takes will be determined by the streamlines of the fluid at each moment in time.



⭐ Important Points

For steady flow, path lines, streamlines and streaklines coincide.

---

63. Answer: b

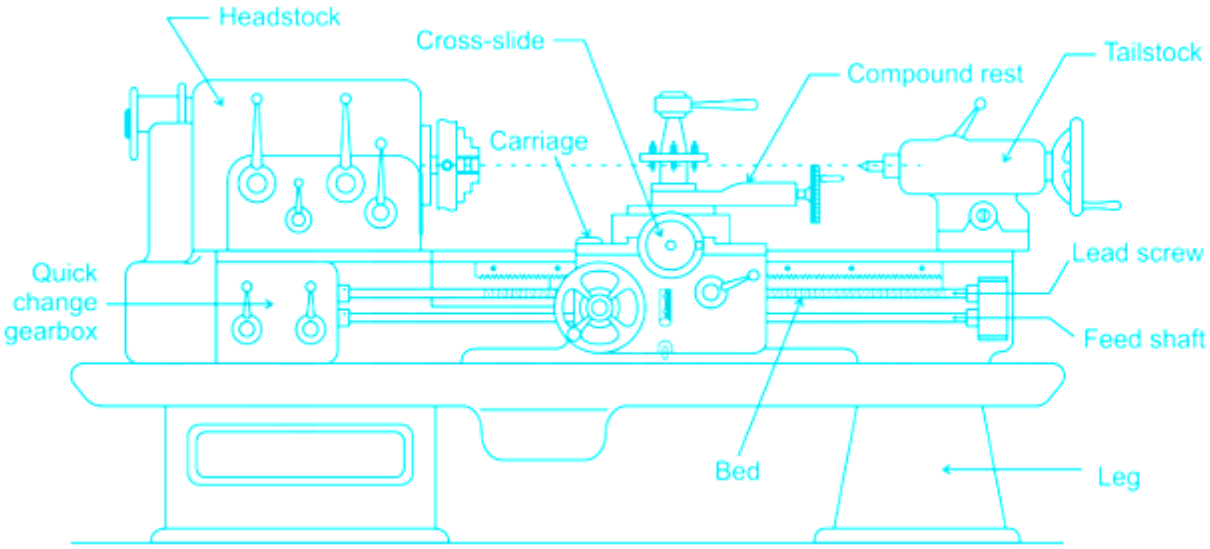
Explanation:

Concept:

A lathe is a machine tool that holds the job in between the center and base and rotates the job on its own axis.

Main parts of Lathe:

Bed	• It is the base or foundation of the lathe • It is a heavy, rugged and single piece casting made to support the working parts of the lathe • It is made from grey or nodular cast iron or it is fabricated by welding steel plates together
Carriage	• It is used to support the cutting tool and to move it along the bed so that it can cut the metal • It essentially consists of three parts: the saddle, the apron, and the cross-slide
Headstock	• It is clamped on the left-hand side of the bed • Its function is to support the main spindle or mandrel
Tailstock	• It is situated at the right-hand end of the bed and is mounted on the inner guideways • It is used to support the loose ends of the lengthy jobs for carrying out lathe operation • It is used to hold cutting tools like drill chuck, drills, reamers etc.



The carriage has the following five major parts:

Saddle: It is an H–shaped casting fitted over the bed. It moves along the guideways.

Cross–Slide: It carries the compound slide and tool post. It can be moved by power or by hand.

Compound rest: It is marked in degrees. **It is used to support the tool post and the cutting tool.It is used during taper turning to set the tool for angular cuts** .

Tool Post: The tool is clamped on the tool post.

Apron: It is attached to the saddle and hangs in front of the bed. It has gears, levers, and clutches for moving the carriage with the lead screw for thread cutting.

---

64. Answer: b

Explanation:

Explanation :

Post Weld Heat Treatment

- Post weld heat treatment at **580-650°C** was originally conceived as a means of relieving **residual stress** and was indeed known as stress relieving.
- High levels of stress also increase the risk of **hydrogen cracking** .
- The other beneficial effect of post-weld heat treatment is that it **tempers** and softens hard transformation products in the **Heat Affected Zone** , and eliminates strain-age embrittlement.
- It is required for thicker sections of carbon and carbon-manganese steel in structures and **pressure vessels** .

---

65. Answer: c

Explanation:

Explanation:

- Toughness: The ability of the material to withstand stress (resist fracture due to high impact loads) without fracture is known as toughness. It is defined as the ability to absorb energy in the plastic state.

⭐ Important Points

- Elasticity: It is the property of a material to regain its original shape after deformation when the external forces are removed.
- Plasticity: It is the property of a material that r etains the deformation produced under load permanently. Thus, it is a property of a material that allows it to deform without fracture .
- Ductility: The property of the material that allows it to be drawn into wires or elongated before failure is known as ductility.
- Brittleness: The property of a material that produces fracture without any appreciable deformation is known as brittleness. It is the opposite of toughness.
- Stiffness: Stiffness of a material is the resistance offered to deformation, below the elastic limit. A material with a high value of Young's modulus E is stiffer than the material with the lower value of Young's modulus. Small values of E indicate flexible materials and a large value of E reflects stiffness and rigidity.

Mistake Point

The basic difference between plasticity and toughness is that plasticity allows to deform up to fracture point and toughness withstand or resist to deform up to fracture point. Both are the properties of a material.

For example, A material which is having very high toughness will not deform much because toughness will resist the deformation. Hence we can say that it is having less plasticity as it is not allowed to deform more.

---

66. **Answer: a**

Explanation:

Explanation :

In a real fluid, the following forces are present

Gravity force (F g) due to gravity

Pressure force (F p) due to the pressure of the fluid

Viscous force (F ν) due to viscosity

Tension force (F s) due to surface tension

Turbulent force (F t) due to turbulence.

and (F c)due to compressibility.

∴ Fnet = F g + F p + F ν + F s + F t + F c

- If Fnet = F g + F p + F ν + F t this is known as Reynold's equations of motion .
- If Fnet = F g + F p + F ν this is known as the Navier-Stokes equation of motion .

- If Fnet = F g + F p this is known as Euler's equation of motion .

∵ the **fluid is in rest i.e. the velocity gradient is zero, therefore no shear stress/force** will be acting and no external force is acting on it, the **only force present is due to gravity (F_g) and pressure of the fluid (F_p) i.e. normal force only.**

---

67. **Answer: a**

Explanation:

Concept:

Psychrometry is the study of the properties of mixtures of air and water vapor.

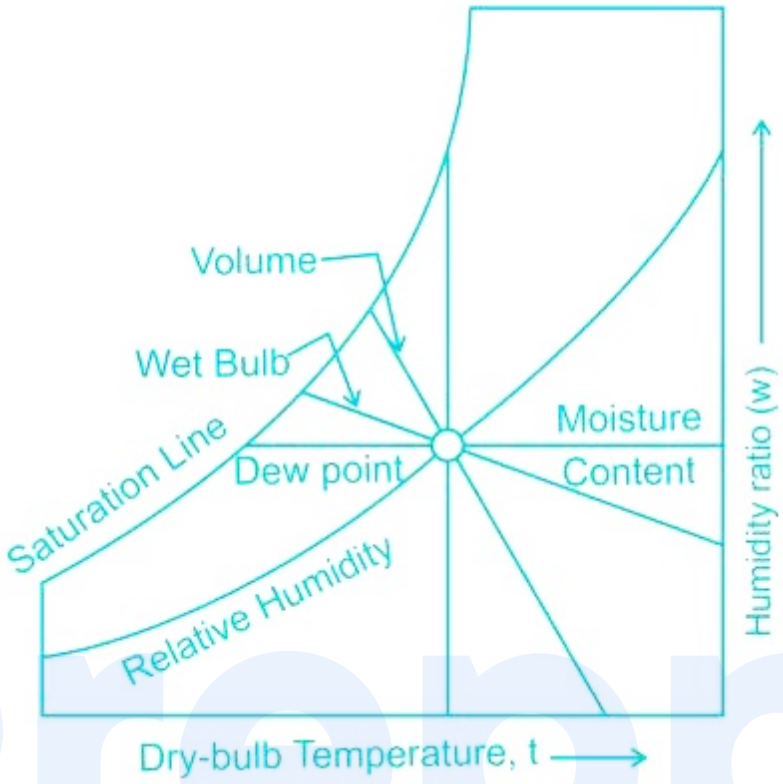
Every psychometric chart includes

- **Vertical lines** that represent the **dry bulb temperatures,**
- The diagonal line represents the wet-bulb temperature
- Curved lines represent relative humidity.

Dry Bulb Temperature: Actual temperature of gas or mixture of gases

Wet Bulb temperature: Temperature obtained by an accurate thermometer having a wick moistened with distilled water

Dew point temperature: Temperature at which the liquid droplets just appear when the moist air is cooled continuously.



⭐ Important Points

- Relative humidity along the saturation line is 100%.
- From the Psychrometric Chart, we can conclude that at constant specific humidity, DPT remains constant and is independent of DBT.

---

68. Answer: a

Explanation:

Concept:

- A spherical mirror, whose reflecting surface is curved inwards, that is, faces towards the center of the sphere, is called a concave mirror.
- A spherical mirror whose reflecting surface is curved outwards is called a convex mirror.

- Magnification produced by a spherical mirror gives the relative extent to which the image of an object is magnified with respect to the object size.
- It is expressed as the ratio of the height of the image to the height of the object. It is usually represented by the letter m. If h is the height of the object and h′ is the height of the image, then the magnification m produced by a spherical mirror is given by,

$$m = \frac{Height\ of\ the\ image\ (h')}{Height\ of\ the\ object\ (h)}$$

$$m = \frac{h'}{h}$$

- The magnification (m) is also related to the object distance (u) and image distance (v). It can be expressed as Magnification (m) = $\frac{h'}{h} = \frac{v}{v}$

⭐ Important Points

- You may note that the height of the object is taken to be positive as the object is usually placed above the principal axis. The height of the image should be taken as positive for virtual images.
- However, it is to be taken as negative for real images .
- A negative sign in the value of the magnification indicates that the image is real.
- A positive sign in the value of the magnification indicates that the image is virtual .

---

69. Answer: c

Explanation:

The correct answer is**Three triads**.

- **Doberiener found only 3 triads in elements, so his concept was discarded.**
- He states that **groups of three elements (triads) could be formed** in which **all the elements with similar physical and chemical properties.**
  - 1st triad was made up of the alkali metals lithium, sodium, and potassium.
  - 2nd triad was made up of calcium, barium, and strontium.

- 3rd triad was made up of halogens chlorine, bromine, and iodine.
- 4th triad was formed by the elements sulfur, selenium, and tellurium.
- 5th or last triad was made up of Iron, cobalt, and nickel.

- **Dobereiner's Triads exist in the columns of Newlands' Octaves.**

⭐ Important Points

- **In Newlands' Octaves Lithium (Li), Sodium (Na), and Potassium (K) exists as same these elements are in Doereiner's Triads.**

---

70. Answer: c

Explanation:

Explanation :

- **Grinding** involves an **Abrasive action** and while removing material abrasive also wears out and when the **rubbing force** reaches the threshold, the worn-out abrasives are pulled out of the wheel.
- Thereby giving chance to a fresh layer of abrasives for removing material. This is known as the **self -sharpening** behavior of the **grinding wheel** .
- The ratio of the **volume of material** removed to the **volume of wheel** wear is known as grinding ratio.

$$Grinding\ ratio = \frac{V_m}{V_w} = \frac{l \times b \times d}{\frac{\pi}{4} \times w \times \left(D_i^2 - D_f^2\right)},\ where\ w = width\ of\ wheel$$

- The grinding ratio varies from 1.0 - 5.0 in very rough grinding .

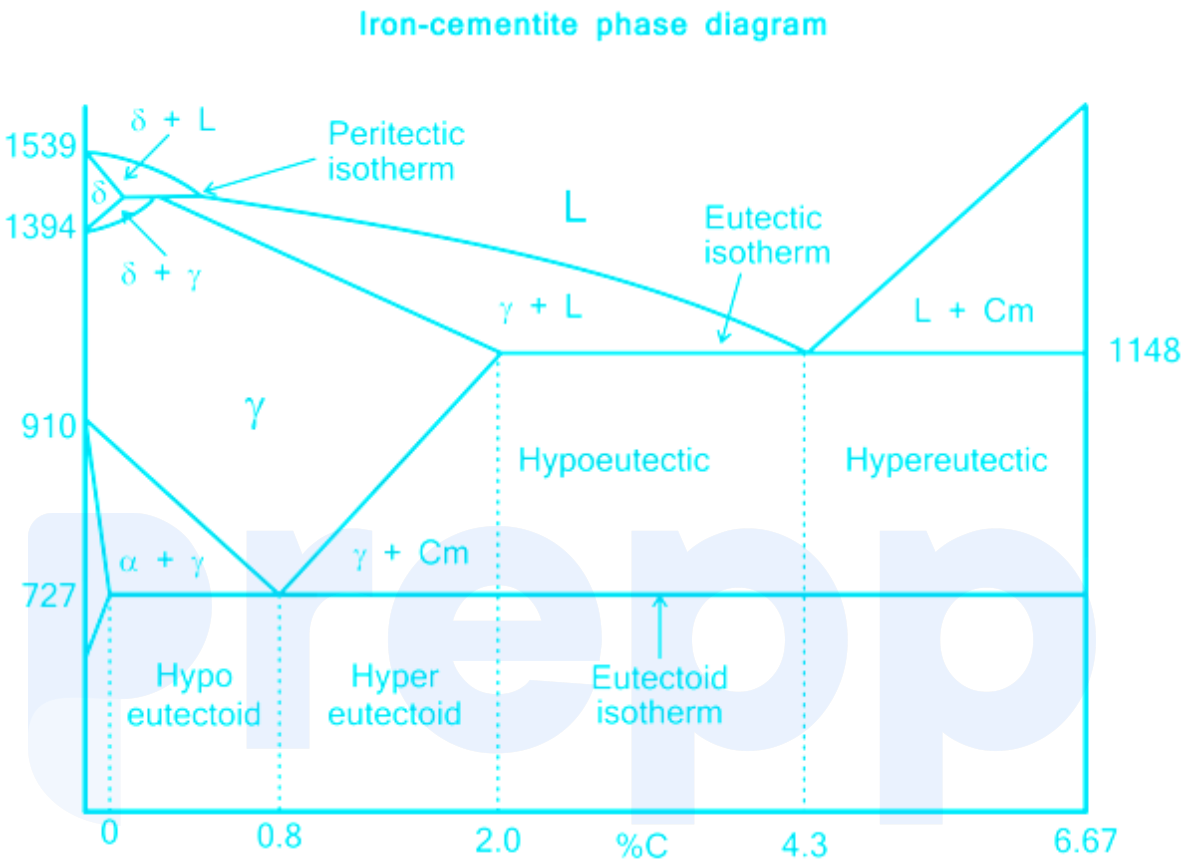
---

71. Answer: c

Explanation:

Concept:

Steel is an alloy of iron and carbon. Composition up to 2.1%C is steel and beyond this, it is considered as cast iron.



Eutectoid/Pearlite steel:

A 0.84% carbon steel or eutectoid steel is known as PEARLITE steel. This is much stronger than ferrite or cementite.

- Hypo-eutectoid Steel
  - Plain carbon steels in which carbon percentage is less than 0.8% are called hypo-eutectoid steel.
- Hypereutectoid Steel
  - Plain carbon steels in which carbon percentage is more than 0.8% are called hyper-eutectoid steel.

---

72. Answer: b

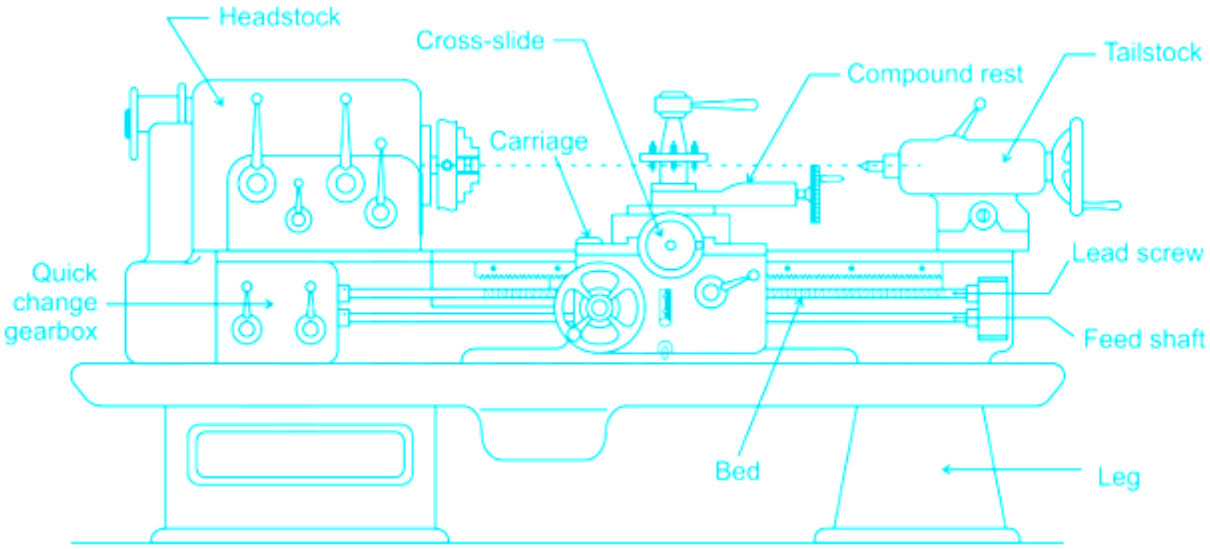
Explanation:

Concept:

A lathe is a machine tool that holds the job in between the center and base and rotates the job on its own axis.

Main parts of Lathe:

Bed	• It is the base or foundation of the lathe • It is a heavy, rugged and single piece casting made to support the working parts of the lathe • It is made from grey or nodular cast iron or it is fabricated by welding steel plates together
Carriage	• It is used to support the cutting tool and to move it along the bed so that it can cut the metal • It essentially consists of three parts: the saddle, the apron, and the cross-slide
Headstock	• It is clamped on the left-hand side of the bed • Its function is to support the main spindle or mandrel
Tailstock	• It is situated at the right-hand end of the bed and is mounted on the inner guideways • It is used to support the loose ends of the lengthy jobs for carrying out lathe operation • It is used to hold cutting tools like drill chuck, drills, reamers etc.



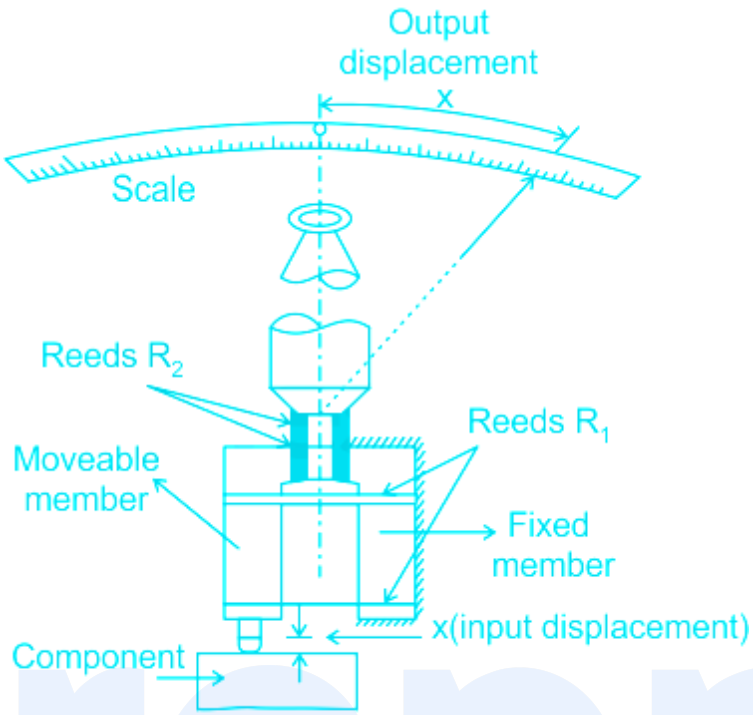
- The bed is the base or foundation of the lathe. It is massive (heavy) and rigid casting made in one piece to resist deflection and vibrations.
- It holds or supports all other parts, that is, head stock, tail stock and carriage etc.
- The beds are mostly made of close – grained grey cast iron.
- Cast iron has very high damping capacity. Cast iron can withstand more compressive load and resist vibration.

---

73. **Answer: a**

Explanation:

Explanation:



Reed Comparator

- This is generally used to measure the **small displacement of spindles** .
- It is having a **sensitive gauging** head with a high-quality dial indicator mounted on the sturdy column as shown in the above figure.
- This consists of fixed block A & movable block B which are coupled together with the help of slip gauges at the middle portion.

⭐ Important Points

- **Sigma comparator** → used to measure the roughness of the surface
- **The optical comparator** → used for a wide range of dimensional inspection applications
- **The electric comparator** → used to compare the dimensions of a given working component with the actual working standard.

---

74. **Answer: d**

Explanation:

Concept:

Case hardening is a method used to harden the outer surface of low-carbon steel while leaving the center or core soft and ductile. Case hardening involves heating the metal to its critical temperature in some carbonaceous material. The following methods are commonly used:

1. Pack method
2. Cyaniding
3. Nitriding
4. Induction Hardening
5. Flame hardening

Cyaniding:

- In this process of surface hardening, both **carbon and nitrogen** are added to the surface layer of steel (ferrous material, usually low carbon grade).
- The process is based on the decomposition of cyanide compounds that easily release the cyan group (CN). Cyaniding involves heating the steel in a liquid or solid medium.
- The steel is heated in a molten cyanide salt bath maintained at 950°C, followed by water or oil quenching.
- Salt bath compositions may vary according to the temperature of the salt, the thickness of the case to be obtained, type of steel to be heat-treated, and period of operation.
- Case thickness from 0.075 – 1.5 mm can be obtained in the process.

⭐ Important Points

Heat treatment is an operation involving heating and cooling of a metal or alloy so as to obtain certain desirable properties. A few important heat treatment processes are:

1. Annealing
2. Normalizing
3. Hardening
4. Tempering

75. **Answer: a**

Explanation:

Concept:

Impact Printers

- The impact printers basically use a sharp needle. The needle is pressed against a ribbon that has ink on it and a mark is created on the paper thus giving a printed form of the data.
- Dot-matrix printers, drum printers, **line printers** , daisy-wheel printers and other early age printers were known as impact printers

Non-impact printers

- Non-impact printers print the characters without using ribbons, These printers print a complete page at a time so they are also called as page printers. E.g. Ink-Jet printer, Laser printer
- Non-impact printers require less maintenance than early age printers.

76. **Answer: b**

Explanation:

Concept:

- According to AWS standards, the prefix "E" designates an arc welding electrode. The first two digits of a 4-digit number and the first three digits of 5-digit number indicate minimum tensile strength.
- For example, **E6010 is a 60,000 psi tensile strength** electrode while E10018 designates a 100,000 psi tensile strength electrode.

E	60	1	10
Electrode	Tensile strength	Position	Type of coating and current

The next to last digit indicates position.

- The "1" designates an all-position electrode, "2" is for flat and horizontal positions only; while "4" indicates an electrode that can be used for flat, horizontal, vertical down and overhead.
- The last 2 digits taken together indicate the type of coating and the correct polarity or current to use. See chart below

Digit	Type of Coating	Welding Current
0	High cellulose sodium	DC+
1	High cellulose potassium	AC, DC+ or DC-
2	High titania sodium	AC, DC-
3	High titania potassium	AC, DC+
4	Iron powder, titania	AC, DC+ or DC-
5	Low hydrogen sodium	DC+
6	Low hydrogen potassium	AC, DC+
7	High iron oxide, iron powder	AC, DC+ or DC-
8	Low hydrogen potassium, iron powder	AC, DC+ or DC-

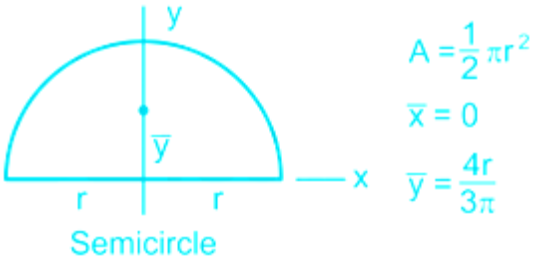
77. **Answer: a**

Explanation:

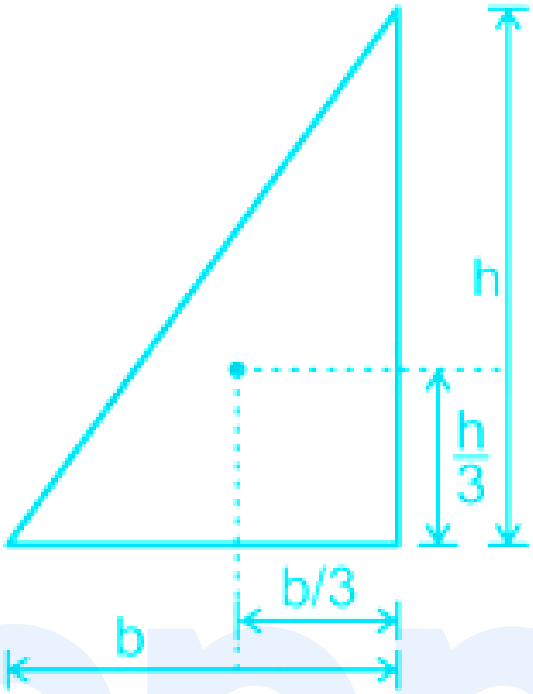
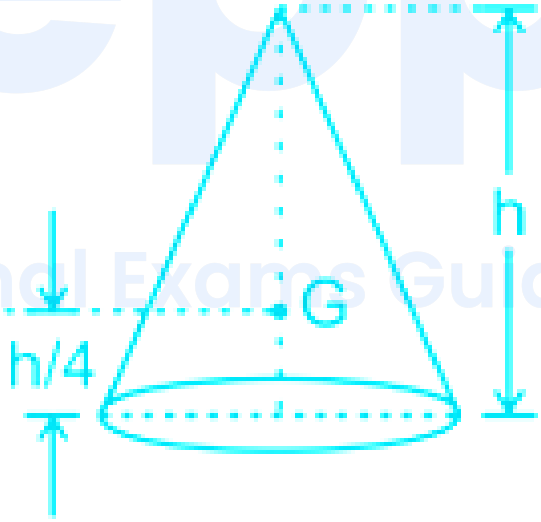
Explanation:

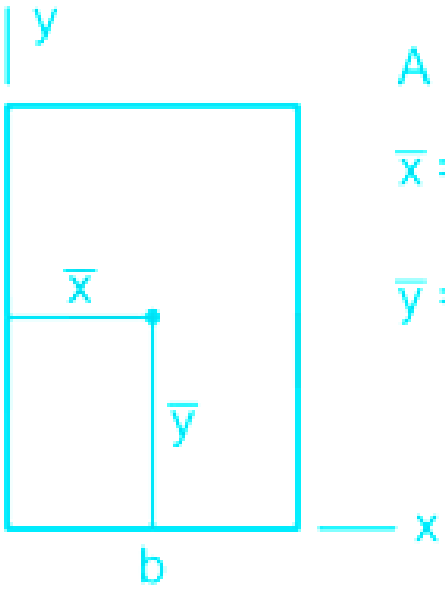
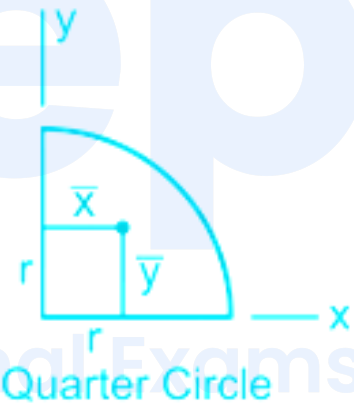
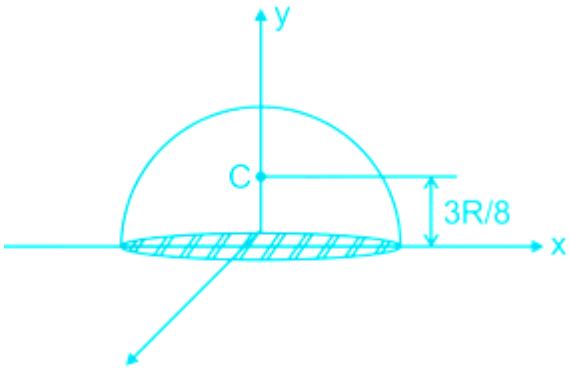
The center of gravity of a semi-circle lies at a distance of $4r/3\pi$ measured along the vertical radius.

1) Semi-circle of radius 'r'



Centre of gravity of various plane areas

Triangle	
Cone	
Rectangle	

	 $A = bd$ $\bar{x} = \frac{1}{2}b$ $\bar{y} = \frac{1}{2}b$
Quarter Circle	 $A = \frac{1}{4}\pi r^2$ $\bar{x} = \frac{4r}{3\pi}$ $\bar{y} = \frac{4r}{3\pi}$
Solid hemisphere	

78. **Answer: b**

Explanation:

Explanation:

Rotation is the process or act of **turning**.

Let us see some **examples**

- Fan moving in the house
- Rotation of worm driver over worm gear
- Group of people holding hands in a circle and walking in the same direction

⭐ Important Points

Translation motion	Movement of the drawer of a table
Linear motion (also called a rectilinear motion)	Movement of a car on a straight road
Revolution	The motion of the earth around the sun

---

79. **Answer: d**

Explanation:

Concept:

- Hydraulic turbines are directly coupled to the electric generators, which are required to run at a constant speed irrespective of variations in the load.
- In reaction turbines, this is performed with the **governing of a quantity of water flow using a governor.**

- Governing of reaction turbines is usually done by altering the position of the guide vanes and thus controlling the flow rate by changing the gate openings to the runner.
- In Pelton turbines, this is usually achieved by a spear valve in the nozzle.
- Movement of the spear and the axis of the nozzle changes the annular area between the spear and the housing.
- Spear valve is used with the deflectors to avoid the water hammer problem in the penstock due to sudden changes in the flow rate.
- These plates temporarily defect the jet so that the entire flow does not reach the bucket; the spear valve may then be moved slowly to its new position to reduce the rate of flow in the pipe-line gradually.

⭐ Important Points

Bleeding:

- Bleeding is the process of draining steam from the turbine, at certain points during its expansion, and using this steam for heating the feed-water supplied to the boiler.
- The Ideal Rankine cycle, modified to take into account the effect of bleeding is known as the Regenerative cycle .

Reheating

- Reheating of Rankine cycle: In a simple Rankine cycle, after the isentropic expansion in the turbine, steam is directly fed into condenser for the condensation process.
- But in a reheat system, two turbines (high-pressure turbine and low-pressure turbine) are employed for improving efficiency. Steam, after expansion from the high-pressure turbine, is sent again to the boiler and heated until it reaches a superheated condition.
- It is then left to expand in the low-pressure turbine to attain condenser pressure.
- T he reheat cycle has been developed to take advantage of the increased efficiency with higher pressures, and yet avoid excessive moisture (improve in quality) in the low-pressure stages of the turbine.

- $\eta_{Rankine} = 1 - \frac{T_2}{T_m}$ (T m is mean temperature) So with reheat the mean temperature of heat addition increases and so efficiency and work output. Note: Due to reheating, thermal efficiency marginally increases. The improvement in thermal efficiency due to reheating is dependent upon the reheat pressure with respect to the original pressure of steam.

---

80. Answer: b

Explanation:

Explanation:

- The principal component of **corundum** and **emery** is natural aluminum oxide (alumina).
- **Corundum** is composed of about **85% aluminum oxide** and **15% iron oxide** .
- Emery contains 60% aluminum oxide and 40% iron oxide.

⭐ Important Points

Steel	• It is an **alloy** of **iron and carbon** , with **carbon** content up to a **maximum of 1.5%.** • Most of the steel produced nowadays is **plain carbon steel** or **simply carbon steel** .
Silicon	• It increases the **strength** and **hardness** of steel without lowering its **ductility** . • **Silicon steels** containing from 1 to 2% silicon and 0.1 to 0.4% carbon have good magnetic permeability and high **electrical resistance** .

---

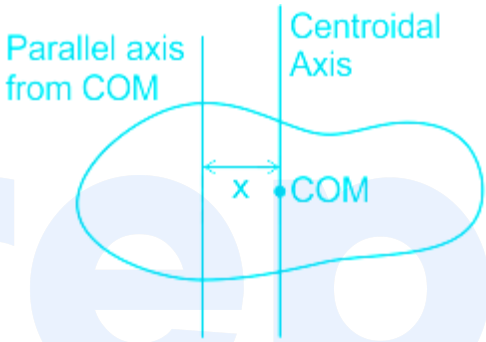
81. Answer: d

Explanation:

Concept:

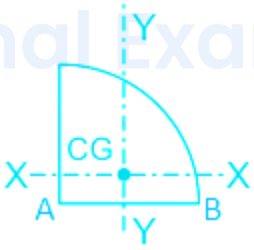
Parallel Axis Theorem:

The moment of inertia of a body about an axisparallel to the body passing through its center is equal to the sumofmomentofinertia of the body about the axis passing through the center and product of the area of the bodytimes the square of the distance between the two axes



I = I com + Ax 2

Calculation:



The Moment of Inertia of a quarter circle about its base is given as:

$$I_{AB} = \frac{\pi d^4}{4 \times 64} = \frac{\pi d^4}{256} \Rightarrow \frac{\pi r^4}{4 \times 4}$$

⭐ Additional Information

The Moment of Inertia of a quarter circle about the centroidal axis is given by:

$$\mathrm{I_{xx}} = \mathrm{I_{AB}} - \mathrm{A} \times (\bar{\mathrm{x}})^2$$

$A = \frac{\pi r^2}{4}$

We know that centroid of the quarter circle is at:

$h = \bar{x} = \bar{y} = \frac{4r}{3\pi}$

I xx = I AB- A × h 2

$I_{xx} = \frac{\pi r^4}{4\times 4} - \left(\frac{\pi r^2}{4}\right) \times \left(\frac{4r}{3\pi}\right)^2$

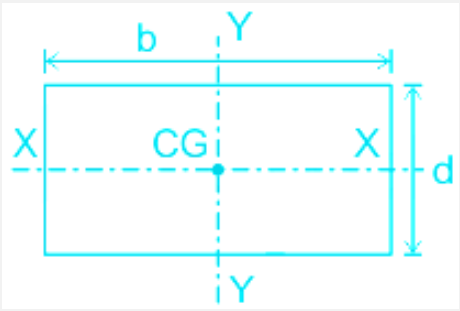
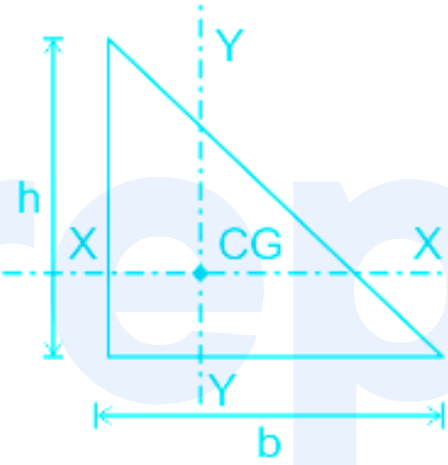
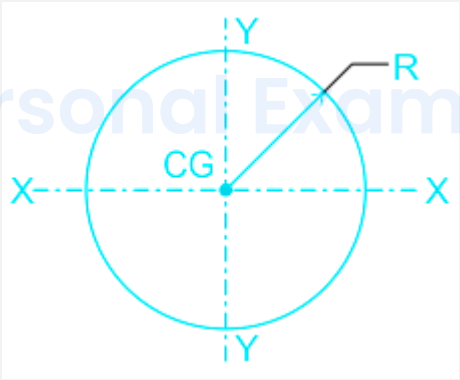
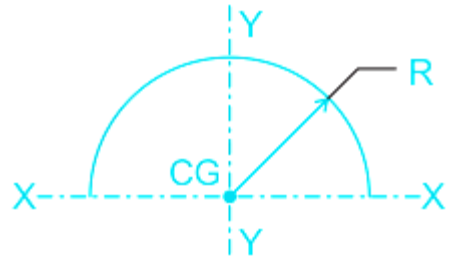
$I_{xx} = \frac{\pi r^4}{16} - \frac{4r^4}{9\pi}$

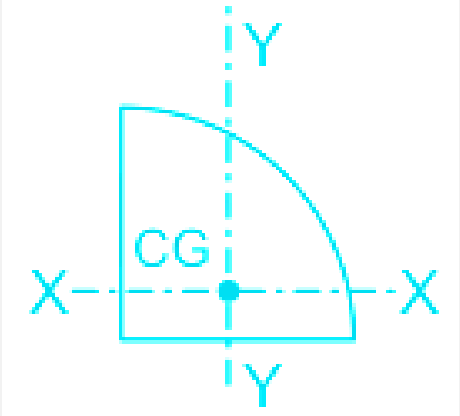
$I_{xx} = \frac{\left(9\pi^2 - 64\right)r^4}{144\pi}$

∴ I xx = 0.05488r 4

⭐ Important Points

The following table shows the Second moment of inertia of different shapes

Shape	Figure	Moment of Inertia
Rectangle		$I_{xx} = \frac{bd^3}{12}$ $I_{yy} = \frac{db^3}{12}$
Triangle		$I_{xx} = \frac{bh^3}{36}$ $I_{yy} = \frac{hb^3}{36}$
Circle		$I_{xx} = \frac{\pi}{64}d^4$ $I_{yy} = \frac{\pi}{64}d^4$
Semicircle		$I_{xx} = 0.11R^4$ $I_{yy} = \frac{\pi}{8}R^4$
Quarter circle		$I_{xx} = 0.055R^4$

		$I_{yy} = 0.055R^4$

82. **Answer: a**

Explanation:

Explanation:-

Shortage or Stockout cost

- Shortage simply means the absence of inventory and the loss associated with not serving the customer is known as Shortage or stockout cost. It includes potential profit delay loss, fast transportation cost

⭐ Important Points

Carrying cost	It is the cost associated with storing keeping inventory items in the production system.
Procurement cost	It is the cost of purchasing inventory for sale.
Unit cost	A unit cost is a total expenditure incurred by a company to produce, store, and sell one unit of a particular product.

83. **Answer: b**

Explanation:

Concept:

Four-stroke engines: In this type of engine, one power stroke is obtained in two revolutions of the crankshaft.

Two-stroke engines: In this engine, one power stroke is obtained in each revolution of the crankshaft.

Four Stroke Engine	Two-stroke Engine
Four operations (suction, compression, power, and exhaust) take place in the four strokes of the piston	The four operations take place in two strokes of the piston
In gives one power stroke in the four strokes, i.e. in two revolutions of the crankshaft. As such three strokes are idle strokes	The power stroke takes place in every two strokes i.e. one power stroke for one revolution of the crankshaft
Due to more idle strokes and non-uniform load on the crankshaft, a heavier flywheel is required	The engine has a more uniform load as every time the piston comes down it is the power stroke. As such a lighter flywheel is used
The engine has more parts such as valves and its operating mechanism. Therefore, the engine is heavier	The engine has no valves and valve operating mechanism; Therefore, it is lighter in weight.
The engine is costlier as it has more parts	The engine is less expensive as it has a lesser number of parts
The engine efficiency is more as the charge gets completely burnt out. Consequently, fuel efficiency is more	The efficiency is less. A portion of the charge escapes through the exhaust port, and because of this, the fuel efficiency is less.

84. **Answer: a**

Explanation:

Concept:

- **Mass:** It is a unit to measure the amount of matter present of the body.
- And it is expressed as m and its S.I unit is the kilogram (kg)
- And the mass of the body is always constant but the weight of the body can differ from place to place since the weight of an object is directly proportional to the rate of acceleration due to gravity
- Thus, the weight is the product of its mass and its acceleration due to gravitational force
- i.e., weight, W = mg
- Here 'm' is mass of an object, 'W' is the weight of an object and 'g' is the gravitational acceleration
- **The weight of an object depends on the value of 'g', i.e. acceleration due to gravity.**
- Acceleration due to gravity of the earth is 6 times the acceleration due to the gravity of the moon i.e. $g_e = (1/6)g_m$
- Therefore the weight of an object on the moon is equal to 1/6th of its weight on the Earth.
- At the surface of the earth, Weight = mg
- At the surface of Moon, Weight = mg / 6
- Acceleration due to Moon's gravity = (Acceleration due to Earth's gravity)/6
- W m = (1/6) × W e

---

85. **Answer: b**

Explanation:

Concept:

- Biodiversity conservation can be done in two modes

1. In-Situ
2. Ex-Situ.

- In-Situ Conservation
  - The conservation method to protect the entire ecosystem in which the species are protected in their natural habitat.
  - Examples of In-Situ Conservation: National parks, Sanctuaries Biosphere reserves, Reserved forests, Protected forests.
  - **Project Lion, Project Rhino, Project Elephant comes under In-situ conservation.**
- Ex-Situ Conservation
  - The mode of conservation which includes protective maintenance of threatened species outside the areas where they naturally occur is called as Ex-Situ Conservation.
  - Conservation through Botanical gardens, Zoological Parks and Breeding Centre is Ex-Situ mode of conservation because in this mode endangered species are protected outside its natural habitat.
  - Examples of Ex-Situ Conservation : Zoological parks and botanical gardens, in vitro fertilisation, tissue culture propagation and cryopreservation of gametes

---

86. **Answer: b**

Explanation:

The correct answer is**Japan**.

⭐ **Important Points**

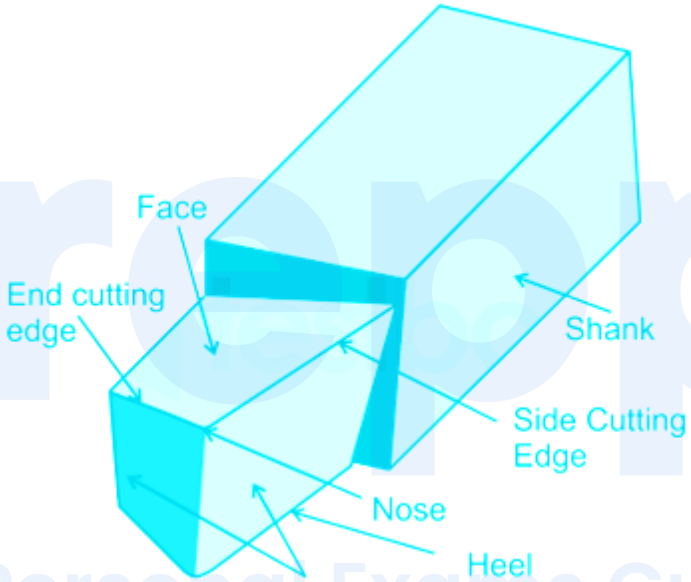
- **Derived from the words ki ("wear") and mono ("thing"), the kimono is a traditional Japanese garment.**
- It looks like a **"T" shape** with **4 single pieces of fabric called tans and tied with an obi, or belt.**
- **Men kimono is called 'Yukata'.**
- There are many other dress in japan called **Hakama, Furisode, Happi** etc.

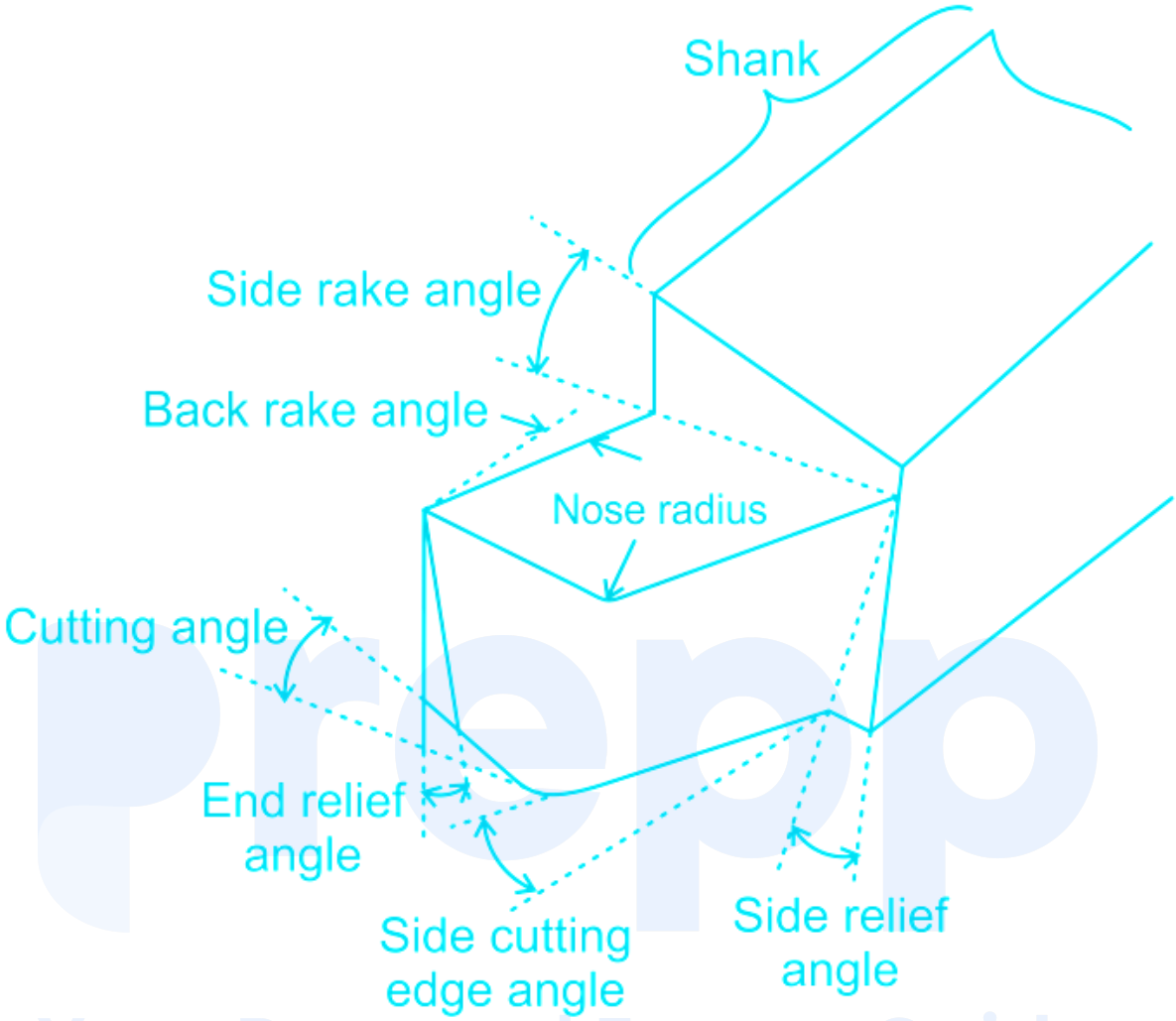
87. **Answer: b**

Explanation:

Explanation:

Single point cutting tool





Nose	It is the intersection of side cutting edge and end cutting edge
Heel	**It is the intersection of the flank and base of the tool**
Shank	It is the main body of a tool
Base	It is the bottom part of the shank. It takes the tangential force of cutting

Face: Face is the surface of the tool on which chip impinges when separated from work-piece

Side Cutting Edge Angle:

- The angle between side cutting edge and side of the tool shank is called side cutting edge angle.
- It is also called lead angle or principle cutting angle.

End Cutting Edge Angle:

- The angle between the end cutting edge and a line perpendicular to the shank of the tool is called end cutting edge angle.

Side Relief Angle:

- The angle between the portion of the side flank immediately below the side cutting edge and the line perpendicular to the base of the tool measured at right angles to the side flank is known as side relief angle.
- It is the angle that prevents interference, as the tool enters the work material.

End Relief Angle:

- End relief angle is the angle between the portion of the end flank immediately below the end cutting edge and the line perpendicular to the base of the tool, measured at right angles to end flank.
- It is the angle that allows the tool to cut without rubbing on the work-piece.

Back Rake Angle:

- The angle between the face of the tool and a line parallel with the base of the tool, measured in a perpendicular plane through the side cutting edge is called

back rake angle.

- It is the angle that measures the slope of the face of the tool from the nose toward the rear.
- If the slope is downward toward the nose, it is a negative back rake angle. And if the slope is downward from the nose, it is a positive back rake angle. If there is not any slope, the back rake angle is zero.

Side Rake Angle:

- The angle between the face of the tool and a line parallel with the base of the tool, measured in a plane perpendicular to the base and side cutting edge is called the side rake angle.
- It is the angle that measures the slope of the tool face from cutting edge. If the slope is towards the cutting edge, it is a negative side rake angle.
- If the slope is away from the cutting edge, it is a positive side rake angle.

---

88. Answer: d

Explanation:

Concept:

Resistance welding

- This process makes use of the electrical resistance for generating heat that is required for melting the work-piece.
- Generally used to and join thin plate structures .
- Also considered as a green process since it does not generate gases and flames as in metal arc welding and gas welding.
- The heat generated in Resistance welding is given by $H = I^2Rt$
- H = Heat generated, I = Current, R = Resistance of joint, t = Time of flow of current.
- Resistance depends upon:
  - work-piece to be joined
  - electrode used

- gap resistance
- Types of Resistance Welding:
  - Spot welding
  - Seam welding
  - Projection welding
  - Flash butt welding
  - Stud welding
  - Percussion welding

---

89. Answer: c

Explanation:

Explanation:-

MRP II

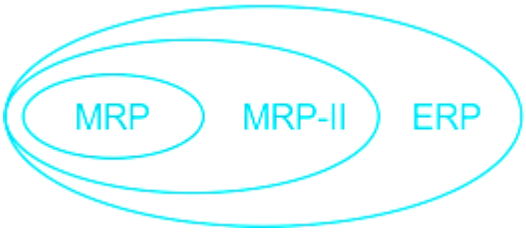
- **Manufacturing Resources Planning (MRP II)** is defined as a method for the effective planning of all resources of a manufacturing company.
- MRP II Serves as an extension of MRP

⭐ Additional Information

Materials Requirement Planning, It is a planning technic that converts the master production schedule of end products into a detailed schedule for raw materials and parts used in those end products.

Maximum retail price is the highest price labeled on the product which can be charged by the seller of that product.

ERP - Enterprise Resource Planning



90. **Answer: b**

Explanation:

Concept:

Energy is a phenomenon which is transferred from one object to another in the form of heat, as a result, it performs work. When the energy is transferred from one object to another, it changes its form and this phenomenon is called conservation of energy. The following types of energy are discussed below:

Renewable sources of energy is that energy that can be derived or grown again after consumption. Plantscan be derived with the help of seeds. The main characteristics of renewable sources of energy are:

- It is necessary for protecting the environment.
- It does not produce pollution.
- It can be exploited for a long period
- It is produced continuously in nature and is inexhaustible

While the non-renewable source of energy is produced by fossil fuels and can not be recycled. Also, it takes millions of years to produce but eliminates quickly. Coal, petrol, diesel, uranium are examples of it. It is also called a **Conventional source of energy.**

91. **Answer: d**

Explanation:

Explanation:

- Igor Stimac is appointed the head coach of the men's senior national football team by the All India Football Federation (AIFF) in 2019.
- Igor Stimac was a former professional footballer in Croatia .

- Sunil Chhetri is the captain of the Indian football team.
- The current FIFA ranking of the Indian football team is 108 .

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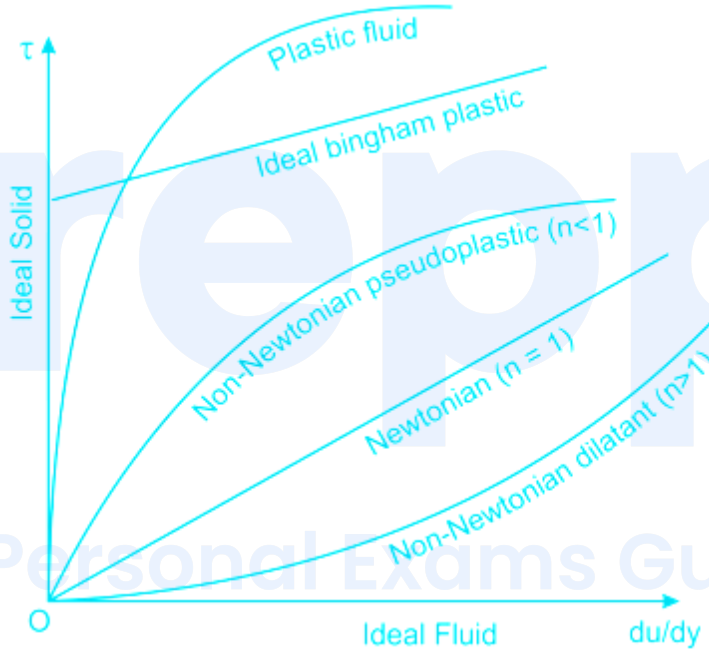
92. Answer: d

Explanation:

Explanation:-



Types of fluid

1. Newtonian
2. Non-Newtonian
    1. Time independent
        1. Dilatant
        2. Bingham
        3. Pseudo plastic
    2. Time-dependent
        1. Thixotropic
        2. Rheopectic

- Newtonian Fluids: Air, water, mercury, glycerine, kerosene, and other engineering fluids under normal circumstances.
- Pseudoplatsic: Fine particle suspension, gelatine, blood, milk, **paper pulp** , polymeric solutions such as rubbers, paints.
- Dilatant fluids: Ultrafine irregular particle suspension, sugar in water, an aqueous suspension of rice starch, quicksand, butter printing ink.
- Ideal plastics or Bingham fluids : Sewage sludge, drilling muds.
- Viscoelastic fluids: Liquids solid combination in pipe flow, bitumen, tar, asphalt, polymerized fluids with drag reduction features.
- Thixotropic: Printer's ink, crude oil, lipstick, certain paints, and enamels.
- Rheopectic fluids: Very rare liquid-solid suspensions, gypsum suspension in water and bentonite solutions.

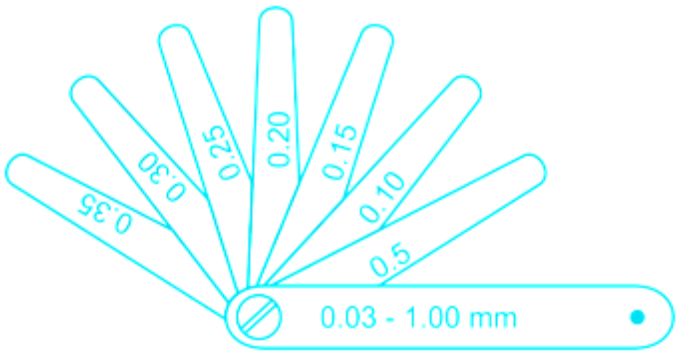
---

93. Answer: b

Explanation:

Concept:

- A feeler gauge is a tool used to measure gap widths .
- Feeler gauges are mostly used in engineering to measure the clearance between two parts like **spark plug gaps, bearing clearance, the gap between the mating parts, etc.**
- They consist of a number of small lengths of steel of different thicknesses with measurements marked on each piece.



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94. **Answer: a**

Explanation:

Explanation:-

The degree of concentration shows the content ratio of Diamond/CBN abrasive grains (abrasive grain ratio) in the abrasive layer.

- 4.4 cc/cm ^{3}= Degree of concentration of 100" is defined, generally used in the range of 20 to 200.
- In the case of electrodeposition, which has only one abrasive grain layer, there is no degree of concentration standard.

⭐ Important Points

Concentration	Content of Abrasive Grains (ct/cm^3)
200	8.8
150	6.6
125	5.5
100	4.4
75	3.3
50	2.2
25	1.1

95. **Answer: b**

Explanation:

Explanation:

The code 'V' represents the bond.

Designation of Grinding Wheel:

Prefix / Suffix: These are the secret codes used by the manufacturers to represent the wheel by its size and shapes respectively.

Type of Abrasives / Grain type:

- It indicates materials used for the manufacturing of abrasive particles.
- Out of the abrasives B 4C is giving the poor performance during machining and diamond is very costly, therefore Al 2O 3 or SiC is the most commonly bused abrasives in the grinding wheel.
- Al 2O 3 soft and tougher than the SiC whereas SiC will be hard and brittle than Al 2O 3
- The type of abrasive is selected based on the mechanical properties of workpiece material I.e. for machining of soft and ductile workpieces, Al 2O 3, and machining of hard and brittle workpiece SiC will be used .
- A- Al 2O 3, B – B 4C, C – SiC, D - Diamond

Grain size or Grit size:

- It indicates the size of abrasive particles.
- i.e. Side if abrasives = 1/ Grain Size Number(GSN)
- when the GSN > 600, the size of the abrasive particles becomes very very small and it cannot act as a cutting tool, therefore MRR is less.
- When GSN < 600, the actual size of the abrasive is increasing, the chip size is increasing and MRR is increasing.
- As the GSN is reducing or the size of the abrasive is increasing, the MRR is increasing first and then reducing.
- The grain size is selected based on the surface finish required on the workpiece i.e. for a rough grinding, course or medium grain size is selected and for finished grinding fine or very fine grain size will be selected.
- 10-24= Coarse, 30-60 = Medium, 80 -180 = Fine, 220 – 600 = Very fine

Grades of Grinding Wheel:

- It indicates the hardness of the grinding wheel.

- The grade of the grinding wheel is selected based on the mechanical properties of the workpiece material.
- Soft wheels are used for grinding of hard workpiece because the rubbing forces induced by the blunt abrasive particle i.e. the self-sharpening is taking place and no dressing is required.
- Hard wheels are used for grinding of the soft workpiece, the abrasive particle will be effectively utilized so that at the end of effective utilization the dressing will be carried for resharpening of grinding wheel.
- A –H = Soft, I – P = Medium, Q – Z = Hard

Structure:

- The structure is indicating the average gap between the two consecutive abrasive particles .
- As the average gap is large , the number of abrasive particle presents per unit area will be small hence it is called the open structure.
- The structure of a grinding wheel can be varied by varying the % of abrasive particles and bonding material in the manufacturing of a grinding wheel. i.e. when higher % of abrasives and lower % of bonding material is used in manufacturing it produces the dense structure and vice-versa.
- 0 – 7 = Dense, 8 – 16 = Open

Bonds:

- Bond indicates the bonding material used for the manufacturing of the grinding wheel.
- Out of the different bonding materials, vitrified is the most commonly used bonding material because it gives higher bonding strength , high temperature withstanding capability, and high thermal conductivity .
- For the manufacturing of flexible grinding wheels also called buffing wheels, shellac or rubber can be used as the bonding material.
- V – Vitrified, B – Bakelite, S – Silicate, E – Shellac, R - Rubber

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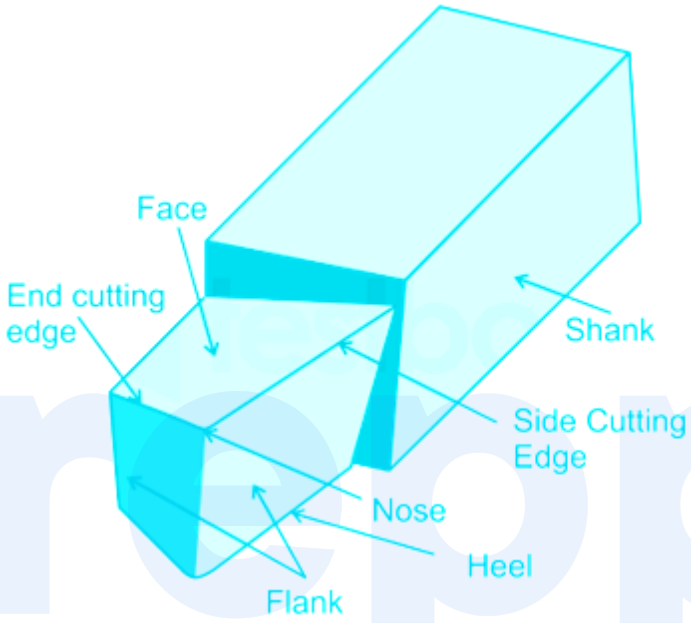
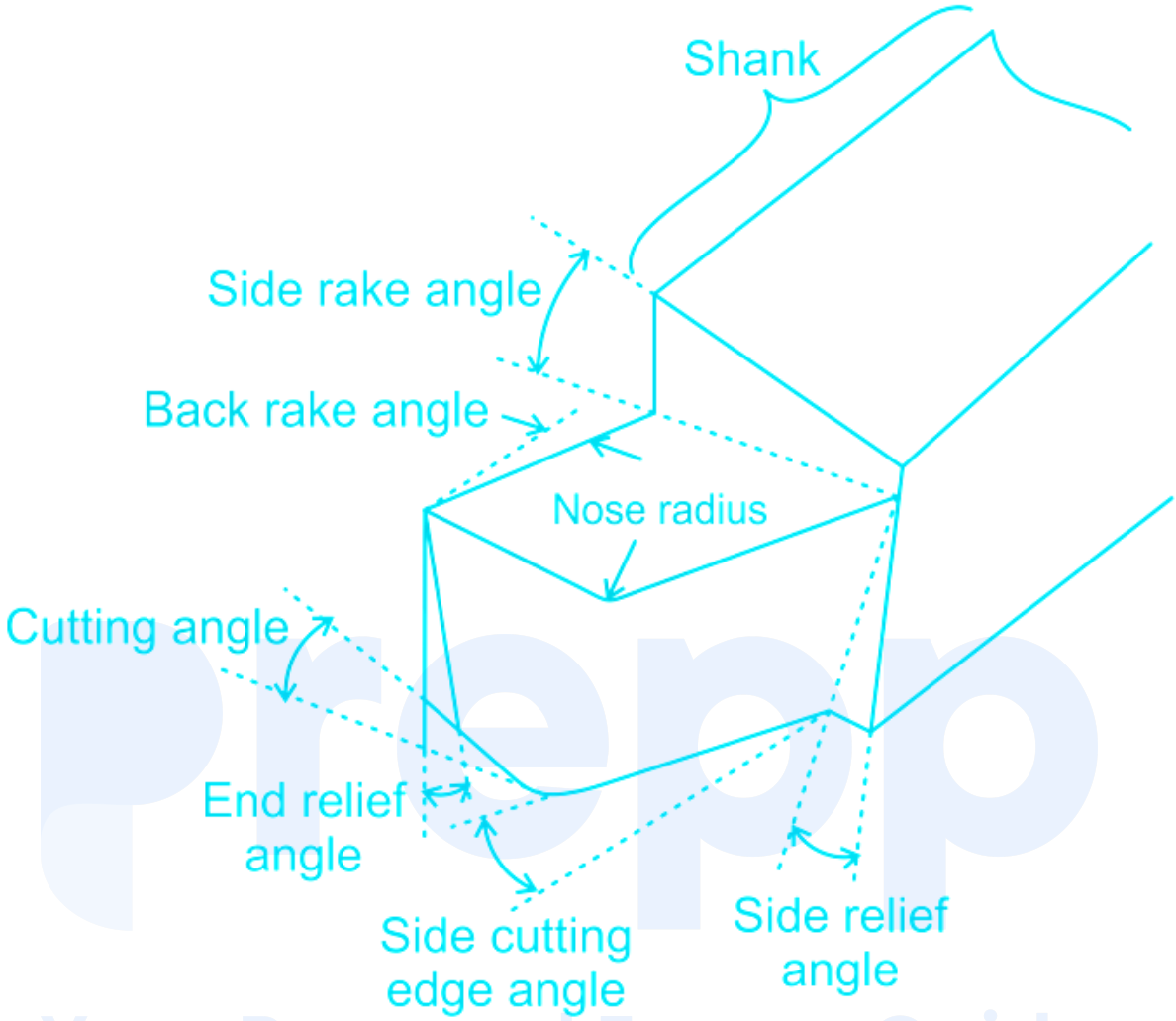
96. Answer: c

Explanation:

Explanation:

Single point cutting tool





Face: Face is the surface of the tool on which the chip impinges when separated from work-piece

Side Cutting Edge Angle:

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- The end relief angle is the angle between the portion of the end flank immediately below the end cutting edge and the line perpendicular to the base of the tool, measured at right angles to the end flank.
- It is the angle that allows the tool to cut without rubbing on the work-piece.

Back Rake Angle:

- **The angle between the face of the tool and a line parallel with the base of the tool, measured in a perpendicular plane through the side cutting edge is called back rake angle.**
- It is the angle that measures the slope of the face of the tool from the nose toward the rear.
- If the slope is downward toward the nose, it is a negative back rake angle. And if the slope is down from the nose, it is a positive back rake angle. If there is not any slope, the back rake angle is zero.

Side Rake Angle:

- The angle between the face of the tool and a line parallel with the base of the tool, measured in a plane perpendicular to the base and side cutting edge is called the side rake angle.
- It is the angle that measures the slope of the tool face from the cutting edge. If the slope is towards the cutting edge, it is a negative side rake angle.
- If the slope is away from the cutting edge, it is a positive side rake angle.

⭐ Important Points

- **Normal Plane** —it is a plane perpendicular to the principal cutting edge of the tool.
- **Orthogonal Plane** —it is a plane perpendicular to the reference plane and also perpendicular to the cutting plane.

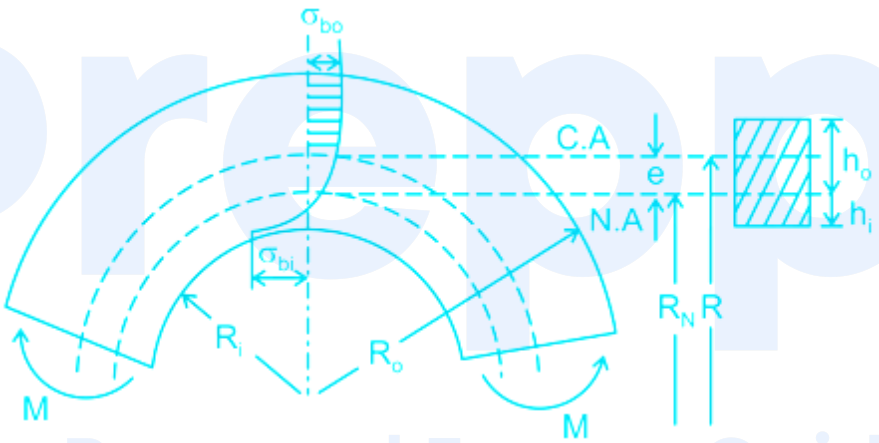
- **Machine Longitudinal Plane** —it is a plane perpendicular to the reference plane and along the direction of longitudinal feed.
- **Machine Transverse Plane —it is a plane perpendicular to the reference plane and along the direction of transverse feed.**

---

97. Answer: c

Explanation:

Concept:



The **bending stress** in a **straight beam** is linear whereas that in a **curved beam** is hyperbolically varying over the cross-section.

The bending stress at any point distant y from the **neutral axis** is

$\sigma_b = \frac{M}{A.e \times (r_n - y)}$

where A is the cross-section area.

Eccentricity (e) = $(R - R_N)$

- **If the section is symmetrical , the maximum bending stress always occurs at radius r ¡of the inside fiber.**
- If the section is **unsymmetrical** , the stress may be maximum either at $R_¡$.

- The neutral axis where the bending stress is zero is located between the **centroidal axis** at radius R and the neutral axis at radius R_N.
- The distance h_o is to be reckoned positive for distances towards the **center of curvature** and negative for distances away from the center of curvature.

---

98. Answer: b

Explanation:

Concept:

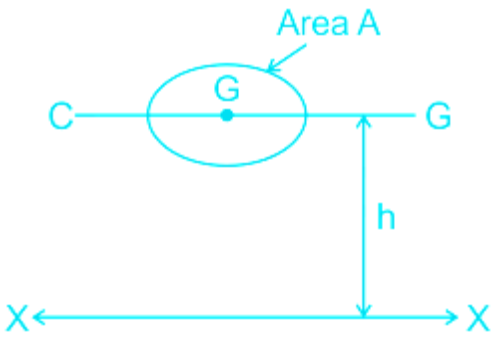
Moment of inertia of an area or Second moment of area (MI):

- MI of a body about any axis is defined as the summation of the second moment of all elementary areas about the axis.
- $I = \Sigma(A \times d^2)$

Unit: m^4 or mm^4 or cm^4

Parallel axis theorem:

The moment of inertia of a plane section about an axis parallel to the centroidal axis is equal to the moment of inertia of the section about the centroidal axis plus the product of the area of the section and the square of the distance between the two axis



I_{CG} = MI of the area about its centroidal axis

I XX = MI of the area about any axis X-X which is parallel to the centroidal axis C.G.

A = Area of the section, h = Distance between the two axes.

Then by parallel axis theorem

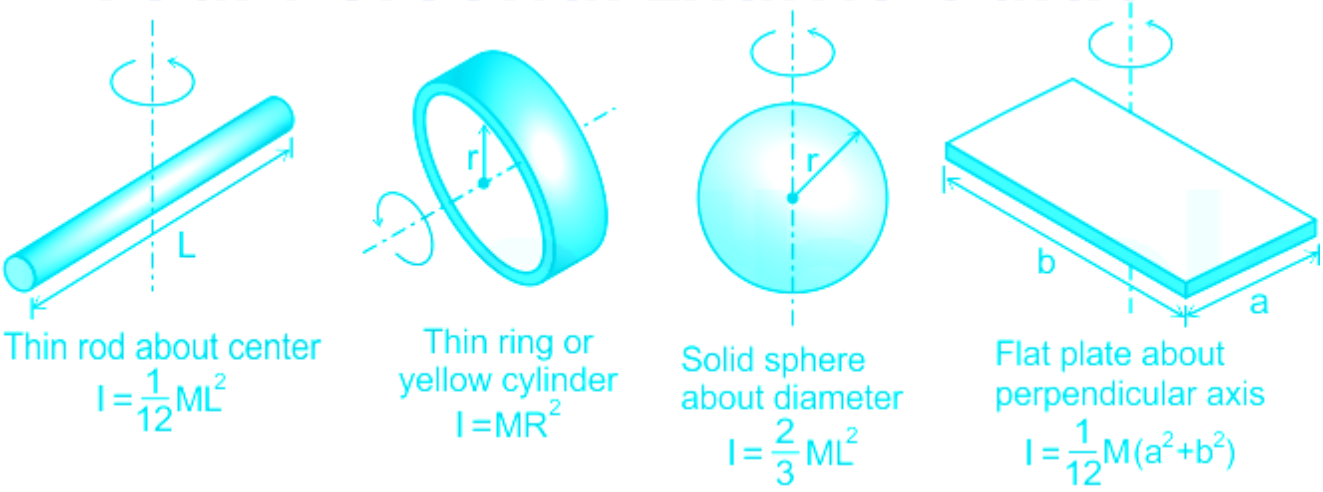
I XX = I CG + Ah 2

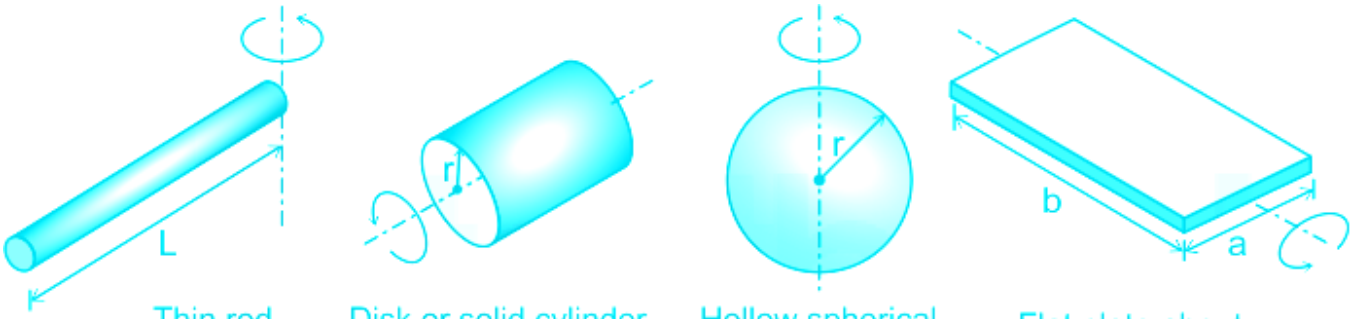
This theorem is used to find MI of any plane figure about any axis located at some distance away from the centroidal axis.

Mass Moment of Inertia (I):

- It is a measure of an object's resistance to change in the rotation direction. Moment of Inertia has the same relationship to angular acceleration as mass has to linear acceleration.
- Moment of Inertia of a body depends on the distribution of mass in the body with respect to the axis of rotation.
- For a point mass, the Moment of Inertia is the mass times the square of the perpendicular distance to the rotation reference axis and can be expressed as
- I = m × r 2 where I = moment of inertia, m = mass, r = distance between axis and rotation mass

Mass moment of inertia for different shapes are given below:





Thin rod about end $I = \frac{1}{3}ML^2$

Disk or solid cylinder about its axis $I = \frac{1}{2}MR^2$

Hollow spherical shell about diameter $I = \frac{2}{3}MR^2$

Flat plate about central axis $I = \frac{1}{12}Ma^2$

First moment of area

- It is nothing but **Section modulus** of the beam.
- The section modulus (Z) of the cross-sectional shape is significant in designing beams. It is a direct measure of the strength of the beam.
- A beam that has a larger section modulus than another will be stronger and capable of supporting greater loads.
- To calculate Z, the distance (y) to the extreme fibers from the centroid (or neutral axis) must be found as that is where the maximum stress could cause failure.

$$\begin{array}{*{20}{l}} {\frac{{\rm{M}}}{{\rm{I}}}{\rm{ = }}\frac{{\rm{\sigma }}}{{\rm{y}}}{\rm{ = }}\frac{{\rm{E}}}{{\rm{R}}}}\\ {{\rm{Z = }}\frac{{\rm{I}}}{{{\rm{Y}}_{{\rm{max}}}}}} \end{array}$$

where, I = Second moment of inertia, Y max = Distance of centroidal axis from the bottom

$$Z = \frac{I}{Y_{max}} = \frac{AY^2_{max}}{Y_{max}}$$

Z = AY max = First moment of inertia

---

99. Answer: d

Explanation:

Explanation :

Creep

- It is defined as **time-dependent permanent deformation** of materials when subjected to **constant load** or **stress** and it becomes important at a temperature beyond **recrystallization** .
- As soon as materials are loaded some **strain** will appear in a material called **instantaneous creep** .
- This creep is similar to **elastic strains** and will be recovered as soon as the load is removed.
- The higher the grain size structure greater will be the **creep rate** .
- The finer the grain size structure lower will be the **creep resistance** .

⭐ Important Points

Ductile Fracture	• Ductility refers to the **capacity of a material to undergo deformation** under **tension without rupture** . • Due to material **heterogeneity** metals will fail sometimes prematurely through the **ductile fracture** .
Brittle Fracture	• Brittleness is defined as a tendency **to fracture without appreciable deformation** and is therefore the opposite of ductility or malleability. • A brittle material will fracture with little permanent deformation/distortion; it is a **sudden failure** . • It will not **stretch** or **bend** before breaking. • **Cast Iron** is an example of brittle material.
Fatigue	• When subjected to **fluctuating or repeated loads** (or stresses), materials tend to develop a characteristic behavior that is different from that (of the materials) under steady loads. • **Fracture** takes place under repeated or **fluctuating stresses** whose maximum value is less than the tensile strength of the material (under steady loads). • **Fatigue fracture** is progressive, beginning as minute cracks that grow under the action of fluctuating stress.

---

100. **Answer: c**

Explanation:

The correct answer is**1.50 milligram per liter**.

- **The World Health Organization recommended the upper limit of fluoride in drinking water is 1.5 mg/l** , for several countries such as Canada, China, India, Australia, and the European Union.
- **Desirable fluorides in drinking water are 1 mg/l.**

⭐ Key Points

- **The oxidation state of the fluoride ion is -1.**
- WHO's Guidelines for Drinking-water Quality, set up in Geneva, 1993.
  - **pH value: 6.5 to 8.5.**
  - **Total hardness (as CaCO3): 300 mg/l.**
  - **Iron: 0.3 mg/l.**
  - **Chlorides: 250 mg/l.**
  - **Sulphate: 200 mg/l.**
  - **Cadmium: 0.01 mg/l.**

---

101. Answer: b

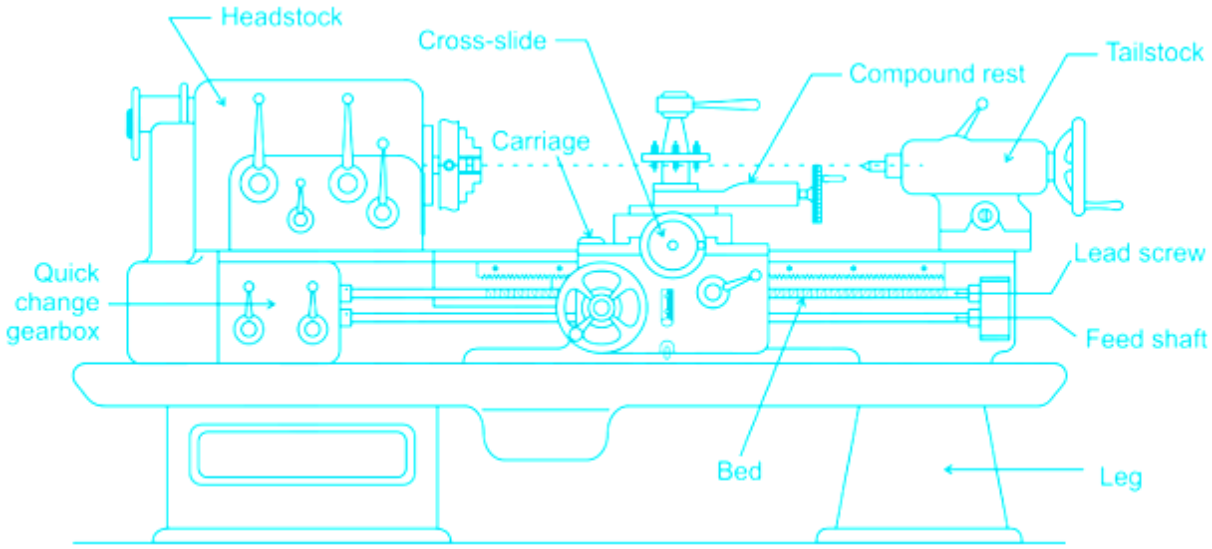
Explanation:

Explanation :

The swing and distance between centers define the **capacity of a lathe** .

Specification of Lathe

- **The length between the centers** → this expresses the maximum length of job that can be mounted between the lathe centers ie.e between head stock and tail stock.
- **The length of the bed** → gives the approximate floor area that the lathe can occupy.
- **The height of the centers** → is measured from the lathe bed.
- **The maximum diameter** → is the diameter of the work or bar that may pass through the hole of the headstock spindle.
- **The swing diameter of the bed** → indicates the maximum diameter of the work that may revolve over the bed ways.
- **The swing diameter over carriage** → indicates the maximum diameter of the work that may rotate over the saddle. This is normally less than the swing diameter over the bed.



102. **Answer: c**

Explanation:

Concept:

- Kanishka belonged to the Kushan dynasty.
- The kushan dynasty was founded by Kujūla Kadphises .
- Kanishka ruled around the 1st century CE and was the greatest king of the Kushan dynasty.
- At the time of Kanishka, kushan rule was spread over the northern part of the Indian subcontinent, Afghanistan, and possibly areas of Central Asia north of the Kashmir region.
- He is also remembered as a great patron of Buddhism.
- He studied Buddhism under the Buddhist poet Ashvaghosha.
- The Fourth Buddhist Council was also convened under his patronage in Kashmir .
- That council compiled The Great Commentary on Abhidharma.

103. **Answer: b**

Explanation:

The correct answer is**Micro operations**.

- **The operations executed on data stored in registers are called micro-operations.**
- A micro-operation is an elementary operation **performed on the information stored in one or more registers.**
- The term **register transfer** means **the availability of hardware logic circuits that can perform a stated micro-operation and transfer the result of the operation to the same or another register.**
- Example of the micro-operation: **Shift, count, clear, and load.**

⭐ Important Points

Bit operation	• **It involves working with individual bits, which are the smallest units of data in a computer.** • Example: **AND, OR, EX-OR, NOT, EX-NOT** etc.
Macro operation	• It is **more than 2 lavel operation in CPU.** • Sometime it is called **asembly operation.** • A macro instruction is a group of programming instructions that have been compressed into a simpler form and appear as a single instruction.

⭐ Key Points

- A register consists of a **group of flip-flops and gates, which is a very fast computer memory, used to store data/instruction in-execution.**
- A Register is **capable of storing one bit of information.**

---

104. **Answer: b**

Explanation:

Concept:

- Abrasive grains are held together in a grinding wheel by a bonding material.
- The bonding material does not cut during the grinding operation. Its main function is to hold the grains together with varying degrees of strength. Standard grinding wheel bonds are silicate, vitrified, resinoid, shellac, rubber, and metal.
    - Silicate bond: This bonding material is used when the heat generated by grinding must be kept to a minimum. Silicate bonding material releases the abrasive grains more readily than other types of bonding agents.
    - Vitrified bond : Vitrified bonds are used on more than 75 percent of all grinding wheels. Vitrified bond material is comprised of finely ground clay, feldspar, and fluxes with which the abrasive is thoroughly mixed.
    - Resinoid bond: Resinoid bonded grinding wheels are second in popularity to vitrified wheels. The phenolic resin in powdered or liquid form is mixed with the abrasive grains in a form and cured at about 360F.
    - Shellac bond: It's an organic bond used for grinding wheels that produce very smooth finishes on parts such as rolls, cutlery, camshafts, and crankpins. Generally, they are not used on heavy-duty grinding operations.
    - Rubber bond : Rubber-bonded wheels are extremely tough and strong. Their principal uses are as thin cut-off wheels and driving wheels in centerless grinding machines. They are used also when extremely fine finishes are required on bearing surfaces.
    - Metal bond: Metal bonds are used primarily as binding agents for diamond abrasives. They are also used in electrolytic grinding where the bond must be electrically conductive.

---

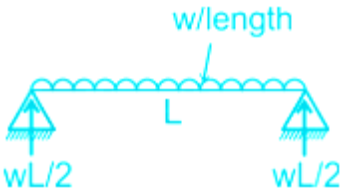
105. **Answer: a**

Explanation:

Explanatiion:

Uniformly Distributed Load

- **A uniformly distributed load (UDL)** is a load that is distributed across the whole region of a beam or slab.
- In other words, the magnitude of the load remains uniform throughout the whole element.
- Figure shows the UDL on Simply supported beam.



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106. **Answer: c**

Explanation:

The correct answer is**100011**.

- Procedure: Use a double dabble method that is for the **whole part with divide by 2 and for fractional part multiplied by 2 methods.**
  35 / 2 = 17, Remainder = **1**
  17 / 2 = 8, Remainder = **1**
  8 / 2 = 4, Remainder = **0**
  4 / 2 = 2, Remainder = **0**
  2 / 2 = 1, Remainder = **0**
  1 / 2 = 0, Remainder = **1**
  till we get quotient zero.
  Take all remainders in reverse order will be the binary equivalent, $(35)_{10} = (100011)_{2}$

---

107. **Answer: a**

Explanation:

The correct answer is an option1, i.e. 2, 8, 3.

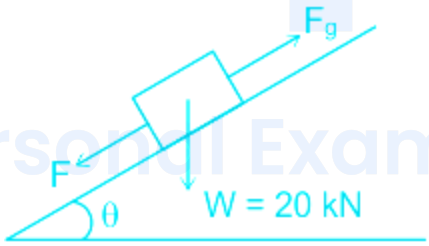
- Aluminium is a chemical element with symbol Al.
- The atomic number of aluminium is 13 .
  - Aluminium has 13 protons and 13 electrons.
- It is a silvery-white, ductile, and non-magnetic metal in the Boron group (13 th).
- Electronic distribution of 13 Al - 2(K), 8(L), 3(M)
  - w here K, L and M - shells
- Electronic configuration - 1s 2 2s 2 2p 6 3s 2 3p 1

---

108. Answer: c

Explanation:

Concept:



w = weight of the body, θ = angle of inclination of the plane with the horizontal

Calculation:

Given:

W = 20 kN, θ = 30°

Gravity force parallel to the inclined plane is

$F_g = W sin\ \theta = 20 \times \sin(30) = 20 \times \frac{1}{2} = 10\ kN$

⭐ Important Points

The effort (P) required moving the body **up** an **inclined plane** is given by

$$P = \frac{W.\sin(\alpha+\phi)}{\sin[\theta-(\alpha+\phi)]}$$

The effort (P) required moving the body **down** an **inclined plane** is given by

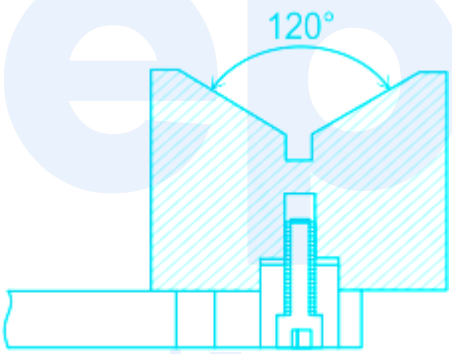
$$P = \frac{W.\sin(\alpha-\phi)}{\sin[\theta-(\alpha-\phi)]}$$

---

109. Answer: b

Explanation:

Explanation :



The major purpose of **V-blocks** is to hold **cylindrical pieces** or, more to the point, to establish precisely the centerline or axis of a cylindrical piece.

- For **special purposes** such as **checking the triangle effect** or for **taps** and other **three-fluted tools** , 60° V-blocks can be secured.
- The **included angle** of the V then is **120°** .

⭐ Important Points

- **Standard V-blocks** come as 45° blocks, i.e., the V-slides slope 45 degrees from horizontal or vertical, the **included angle** of the V being, of **90°** .
- Because they are made with **sides and ends parallel** and/or square to each other, they may be used lying flat or turned over on their sides, or up-ended vertically.

110. **Answer: a**

Explanation:

Explanation :

Coulomb Law of Friction

- Coulomb's law of **sliding friction** can represent the most fundamental and simplest model of friction **between dry contacting surfaces** .
- When sliding takes place, the coulomb law states that the **tangential friction force** is **proportional** to the magnitude of the **normal contact force** .
- It is **independent** of relative **tangential velocity** .

⭐ Important Points

- When **contacting bodies slide** or tend to slide relative to each other **tangential forces** are generated.
- These forces are usually referred to as friction forces.
- **Three basic principles** have been established namely:
  - The friction force acts in a **direction opposite** to that of the **relative motion** between the two contacting bodies.
  - The friction force is **proportional** to the **normal load** on the contact.
  - The friction force is **independent** of a **normal area** of contact.

---

111. **Answer: b**

Explanation:

The correct answer is**P.S. Reddy**.

⭐ Important Points

- The largest commodity bourse Multi-Commodity Exchange of India Ltd (MCX) launched India's first commodity options in **Gold**.
- MCX was launched by Union Finance Minister Arun Jaitley.
- MCX was established in 2003 and is based in Mumbai.
- MCX was seventh among the global commodity exchanges in terms of the number of futures contracts trade in 2016.

⭐ Key Points

- **Chittaranjan Rege is Head of the Base Metals, Multi Commodity Exchange of India.**
  - Multi Commodity Exchange of India Limited is an independent and de-mutualized exchange. The Exchange is recognized by the Government of India for facilitating online trading, clearing, and settlement operations for commodity futures markets across the country.
- **Pareshnath Paul is Chief Information Officer at Multi Commodity Exchange of India Ltd.**
- **Deepak Mehta is former head of Multi Commodity Exchange of India.**

---

112. **Answer: b**

Explanation:

Concept :

The cutting tool life equation is given as,

$$VT^n = Constant$$

V = cutting speed m/min, T = tool life in min

Calculation:

Given:

T_1= 80 min, V_1= 30 m/min

T_2= 8 min, V_2= 60 m/min

$V_1T_1^n = V_2T_2^n$ = Constant

$V_1T_1^n = V_2T_2^n$

$30 \times (80)^n = 60 \times (8)^n$

$\frac{30}{60} = \left(\frac{8}{80}\right)^n \Rightarrow 0.5 = \left(\frac{1}{10}\right)^n$

$\ln(0.5) = n \times \ln\left(\frac{1}{10}\right) \Rightarrow n = 0.3$

$\therefore VT^{0.3} = C$

---

113. Answer: b

Explanation:

Explanation :

Depth of Fusion

- These defects **inherent** in penetration welding are **fusion irregularities** at the weld root and cavities extending deep into the weld metal.
- **Irregular fusion** in-depth decreases at a higher **welding speed**.
- Reduce non-uniform fusion and porosity is to **deflect the laser beam** from its vertical line by 15 to 17° in the **direction of welding**.

⭐ Important Points

Cold lap	• **Wrinkling markings** on the surface of an **ingot** or casting from **incipient freezing** of the surface and too low a casting temperature. • A flaw that results when a workpiece fails to fill the **die cavity** during the first **forging** .
Deposition thickness	• As a minimum, one complete **circumferential bead** should be completed before stopping or interrupting the welding sequence. • In general, **welding** is started in the edge to be repaired closest to the middle of the workpiece and should proceed toward the workpiece end.
Dilution	• The smaller the **electrode** the lower the current density, which results in less dilution. • A long electrode extension for **consumable electrode** processes decreases **dilution** .

114. **Answer: d**

Explanation:

Concept:

- Abrasive grains are held together in a grinding wheel by a bonding material. The bonding material does not cut during the grinding operation. Its main function is to hold the grains together with varying degrees of strength. Standard grinding wheel bonds are silicate, vitrified, resinoid, shellac, rubber, and metal.
- Silicate bond: This bonding material is used when the heat generated by grinding must be kept to a minimum. Silicate bonding material releases the abrasive grains more readily than other types of bonding agents.

- Vitrified bond : Vitrified bonds are used on more than 75 percent of all grinding wheels. Vitrified bond material is comprised of finely ground clay, feldspar, and fluxes with which the abrasive is thoroughly mixed.
- Resinoid bond: Resinoid bonded grinding wheels are second in popularity to vitrified wheels. The phenolic resin in powdered or liquid form is mixed with the abrasive grains in a form and cured at about 360F.
- Shellac bond: It's an organic bond used for grinding wheels that produce very smooth finishes on parts such as rolls, cutlery, camshafts, and crankpins. Generally, they are not used on heavy-duty grinding operations.
- Rubber bond : Rubber-bonded wheels are extremely tough and strong. Their principal uses are as thin cut-off wheels and driving wheels in centerless grinding machines. They are used also when extremely fine finishes are required on bearing surfaces.
- Metal bond: Metal bonds are used primarily as binding agents for diamond abrasives. They are also used in electrolytic grinding where the bond must be electrically conductive.

Bond	Denoted by
Shellac	**E**
Vitrified	V
Metallic	M
Resinoid	B
Silicate	S
Rubber	R

115. **Answer: d**

Explanation:

Explanation :

Tensile Stress and Strain

- When a body is subjected to two **equal and opposite axial pulls** , as a result of which the body tends to **extend its length** , the stress and strain-induced are known as **tensile stress and tensile strain** .

Compressive Stress and Strain

- When a body is subjected to two **equal and opposite axial pushes** , as a result of which the body tends to **decrease its length** , the stress and strain-induced are known as **compressive stress and compressive strain** .

---

116. Answer: d

Explanation:

Explanation:

- Heat treatment is an operation involving heating and cooling of a metal or alloy so as to obtain certain desirable properties.
- A few important heat treatment processes are:
  - Annealing
  - Normalizing
  - Hardening
  - Tempering

Normalizing:

- Heat the steel from 30°C to 50°C above its upper critical temp, held about fifteen minutes, and then allowed to cool down in still air.
- The homogeneous structure provides a higher yield point, ultimate tensile strength and impact strength with lower ductility to steels.
- Main objective:
  - **The mechanical properties of steels are better than those produced by annealing.**
  - **Residual stresses are relieved only partly**
  - Fine grains are formed
  - Strength and hardness is more
  - **The machinability will be increased**

---

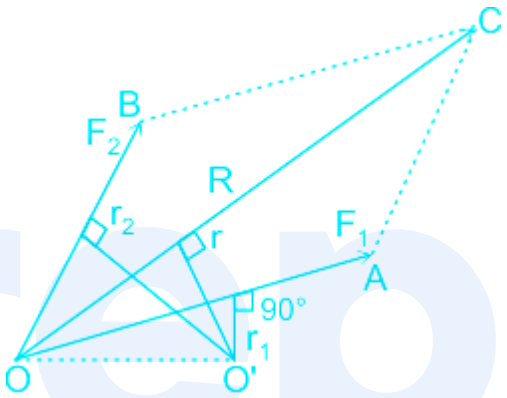
117. Answer: c

Explanation:

Concept:

Varignon's Principle of moments (or the law of moments)

It states, "If a number of coplanar forces are acting simultaneously on a particle, the algebraic sum of the moments of all the forces about any point is equal to the moment of their resultant force about the same point."

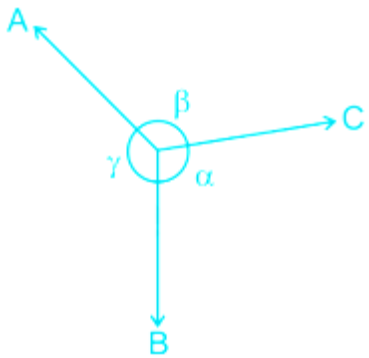


M O' = R × r = F 1 × r 1 + F 2 × r 2

⭐ Important Points

Lami's theorem

Lami's theorem states that if three forces acting at a point are in equilibrium, each force is proportional to the sine of the angle between the other two forces. Consider three forces F A, F B, F C acting on a particle or rigid body making angles α, β, and γ with each other.



Lami's Theorem

Therefore, $\frac{F_A}{sin\alpha} = \frac{F_B}{sin\beta} = \frac{F_C}{sin\gamma}$

---

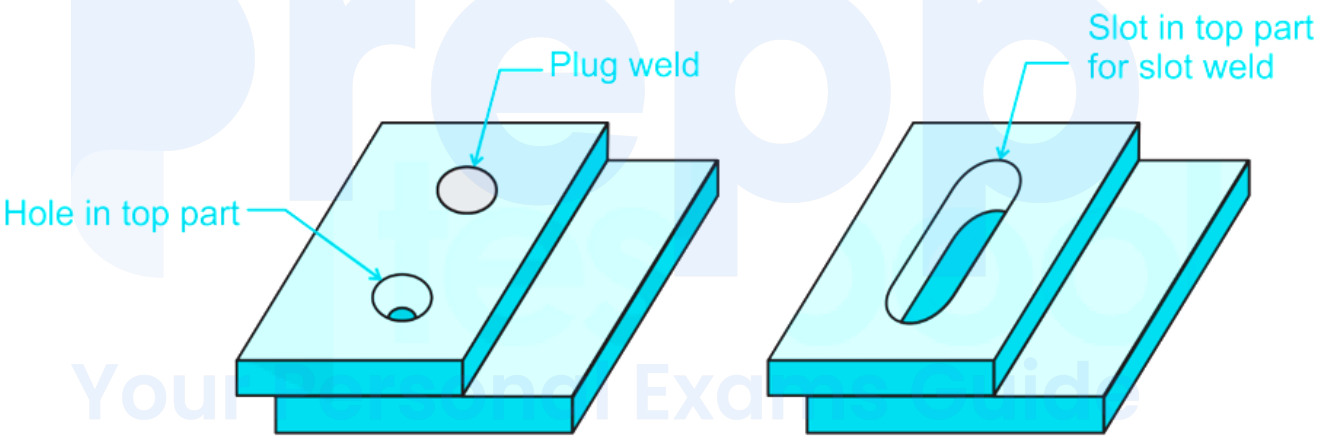
118. Answer: d

Explanation:

<u>Explanation:</u>

Slot weld

Plug Weld or slot weld: It is used for attaching flat plates using one or more holes or slots in the top part and then filling with filler metal to fuse the two parts together.



- In certain instances, the lengths available for the normal longitudinal fillet welds may not be sufficient to resist the loads.
- In such a situation, the required strength may be built up by providing slot or plug welds.
- The strength of a plug or slot weld is calculated by considering the allowable stress and its nominal area in the shearing plane.
- The length of the slot weld can be obtained from the following relationship:
- $L = \frac{Load}{Allowable\ stress}$
- Slot and plug welds are generally used along with fillet welds in lap joints.
- Sometimes, plug welds are used to **fill the holes** that are temporarily made for erection bolts for beam and column connections.

119. **Answer: b**

Explanation:

Concept:

Malleability

- Malleability is the property by virtue of which a material may be **hammered or rolled into thin sheets** without rupture. This property generally increases with the increase of temperature.
- Malleability is the ability of a metal to exhibit large deformation or plastic response when being subjected to a compressive force.
- Lead, soft steel, wrought iron, copper, and aluminium are some materials in order of diminishing malleability.

⭐ Important Points

Ductility

- Ductility is the property of the material that enables it to be drawn out or elongated to an appreciable extent before rupture occurs.
- The percentage elongation or percentage reduction in the area before the rupture of a test specimen is the measure of ductility. Normally if a percentage elongation exceeds 15% the material is ductile and if it is less than 5% the material is brittle.
- Lead, copper, aluminium, mild steel are typical ductile materials.

Sonority : It is the property of a metal which associates with producing sound.

Lustre

- The lustre of metals is because of the reflection of light due to the presence of free electrons.
- When metals are in their pure form they have shining surface and it is called metallic lustre.

- Metals have a lot of free moving electrons on their surface hence when light strikes the surface of metal they will be reflected by free electrons in a specular reflection (Light reflected in a pointed direction rather than diffused reflection).
- When these metals are in the open air they tend to react with elements like carbon, oxygen and form a thin layer of coating on the surface of metals.
- Thus metals lose their lustre.
- This lustre can be brought back by either polishing the surface of metal or treating it with suitable chemicals.

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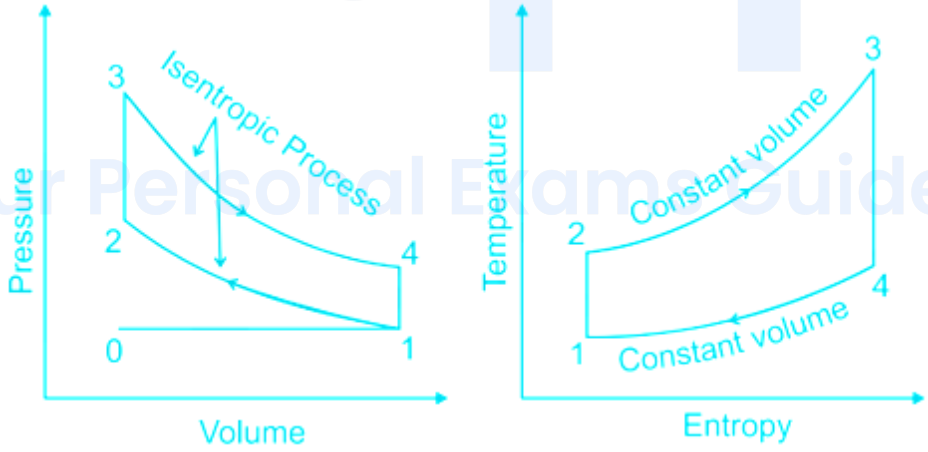
120. Answer: c

Explanation:

Explanation:

Working of 4 stroke petrol engine



Suction stroke (1 – 2)

- As seen from the T-S diagram, the temperature is minimum at the starting of suction stroke.
- During suction, the piston moves from TDC to BDC.
- The intake valve is open throughout while the exhaust valve remains closed.
- The fresh air-fuel mixture enters in the cylinder through the inlet valve.
- The piston motion during suction is known as the suction stroke.

Compression stroke (2 – 3)

- During this stroke, both valves remain closed.
- The piston moves from BDC to TDC.
- For the same mass, the pressure will increase and volume will decrease.
- At the end of the compression stroke, the mixture is ignited with the help of a spark plug located at the cylinder head.

Expansion or power stroke (3 – 4)

- After heat addition, the high pressure of burned gas forced the piston towards BDC.
- Both the valve remains closed.
- Pressure and temperature decreases during expansion.
- Inlet valve is smaller than the exhaust valve because the heat rejection process is very fast and it takes very less time.

Exhaust stroke (4 – 1)

- The piston is at BDC heat rejection takes place at constant volume.
- Inlet valve remains closed and the exhaust valve remains open.
- The major portion of expanded gas leaves the cylinder through the exhaust valve.
- The piston moves from BDC to TDC.

---

121. Answer: d

Explanation:

The correct answer is **Washington, D.C.**

⭐ **Key Points**

Explanation:

- The **headquarters of the World Bank** is in Washington D.C. United States of America (USA).
- It has a total membership of **189** countries.
- Along with the International Monetary Fund (IMF), the World Bank was established in the year **1945.**
- **IMF(International Monetary Fund)** also has its **headquarters** in **Washington D.C.**

---

122. **Answer: b**

Explanation:

Explanation:

- India's Polar Satellite Launch Vehicle (PSLV-C45) successfully launched EMISAT and 28 international customer satellites from **Satish Dhawan Space Centre (SDSC) SHAR in Sriharikota.**
- This flight marked the first mission of PSLV-QL, a new variant of PSLV with four strap-on motors.
- EMISAT is a satellite built around ISRO's Mini Satellite-2 bus weighing about 436 kg and is intended for electromagnetic spectrum measurement.
- The 28 international customer satellites, together weighing about 220 kg, are from four countries, namely, Lithuania (2), Spain (1), Switzerland (1) and USA (24).
- These foreign satellites were launched as part of commercial arrangements.
- ISRO Chairman - S. Somanath

---

123. **Answer: b**

Explanation:

Explanation:

Paging

- Paging is a memory management scheme by which a computer stores and retrieves data from secondary storage for use in the main memory.
- In this scheme, the operating system retrieves data from secondary storage in same-size blocks called pages.
- Paging is an important part of virtual memory implementations in modern operating systems, using secondary storage to let programs exceed the size of available physical memory.

Segmentation

- Segmentation is a memory - management scheme that supports the user view of memory.
- A logical address space is a collection of segments. Each segment has a name and a length.
- The addresses specify both the segment name and the offset within the segment. The user, therefore, specifies each address.

Fragmentation

- Fragmentation is done at routers which makes them complex to implement when routers take too much time to fragment packets.
- This may lead to a DOS attack on other packets.

Swapping

- The medium-term scheduler reduces the degree of multiprogramming. Some processes are removed from memory to reduce multiprogramming. Later, the process can be reintroduced into memory, and its execution can be continued where it left off. This scheme is called **swapping.**
- The long-term scheduler, or job scheduler, selects processes from a mass-storage device and loads them into memory for execution.
- The short-term scheduler, or CPU scheduler, selects from among the processes that are ready to execute and allocates the CPU to one of them.

---

124. Answer: c

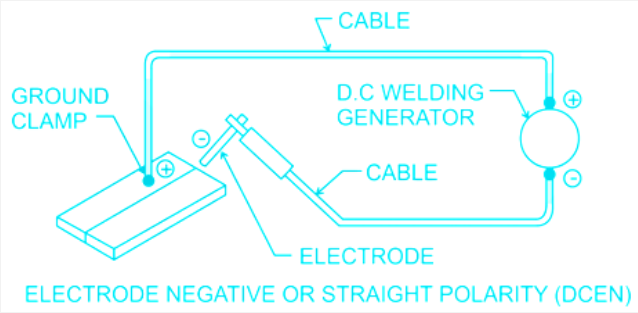
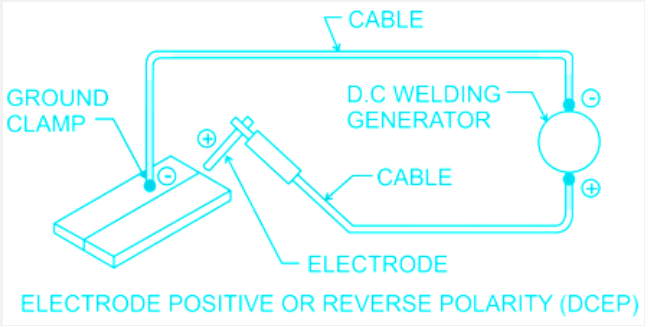
Explanation:

Explanation:

Three major things include in the welding process.

1. **Power supply**
2. **Work-piece**
3. **Electrode** .

Based on their connections polarity is defined.

Direct Current Straight Polarity (DCSP)	Direct Current Reverse Polarity (DCRP)
	
When an **electrode** is connected to the **negative** (-ve) terminal of the power supply i.e electrode behaves as a **cathode** then the connection is known as **DCSP.**	When an **electrode** is connected to the **positive** (+ve) terminal of the power supply i.e electrode behaves as an **anode** then the connection is known as **DCRP.**
It is also known as **Direct Current Electrode Negativity.**	It is also known as **Direct Current Electrode Positivity.**
More heat on the work-piece (**66%**) and less heat on the electrode (**33%**).	More heat on the electrode (**66%**) and less heat on the work-piece (**33%**).
Used for welding **high thickness** & **high melting point materials.**	Used for welding **less thickness** & **low melting point materials.**
Depth of penetration is **maximum** .	Depth of penetration is **minimum** .
Filler material weld **deposition rate is low** .	Filler material weld **deposition rate is high** .

125. **Answer: b**

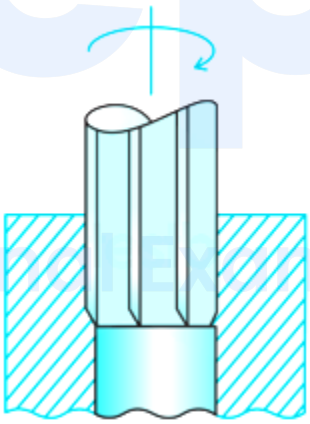
Explanation:

Concept:

Reaming

- Reaming is a sizing operation that removes a small amount of metal from a hole already drilled.
- **It is done for two purposes:**

1. To bring holes to a more exact size
2. To improve the finish of an existing hole

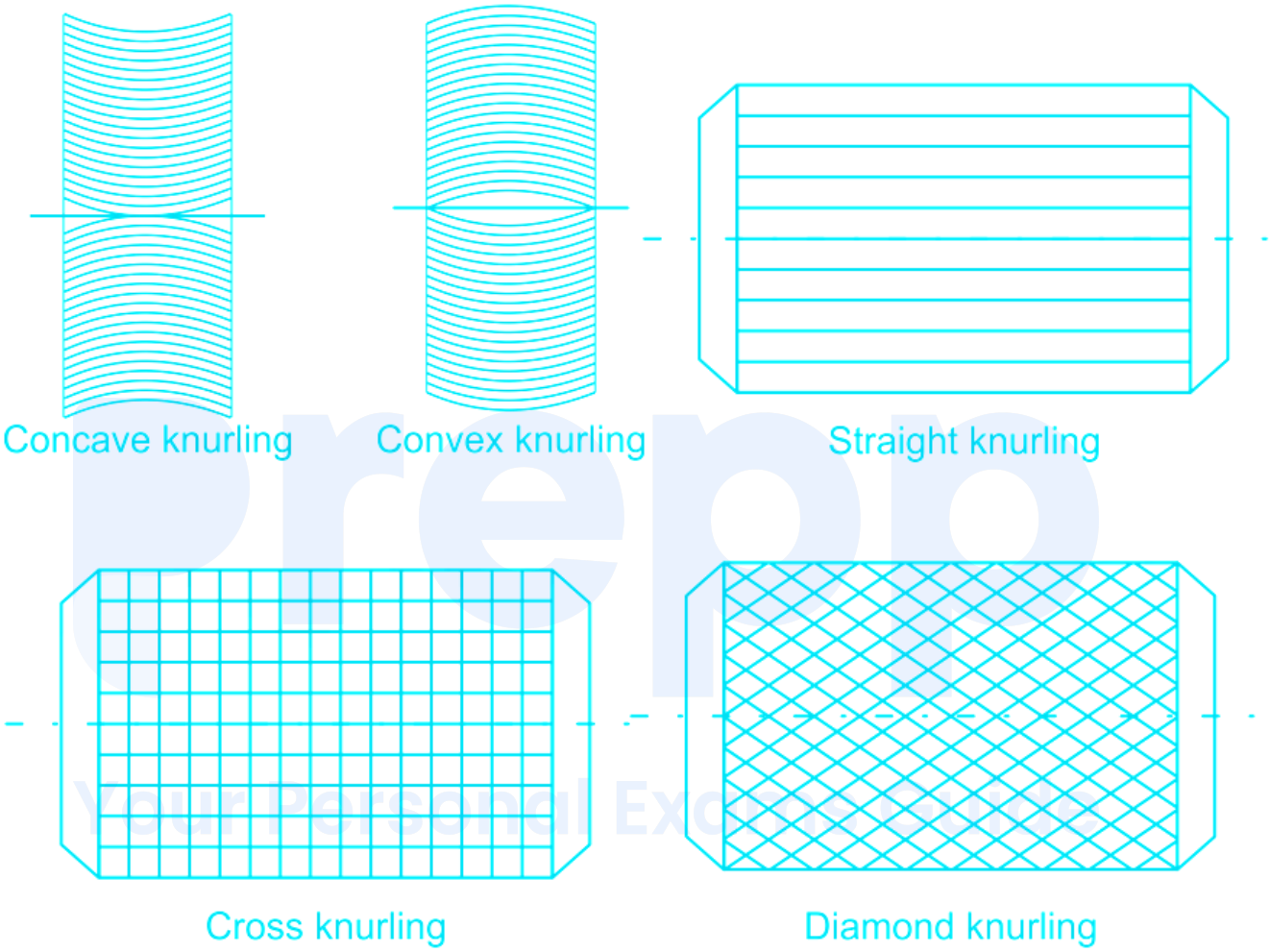


Reaming

Knurling

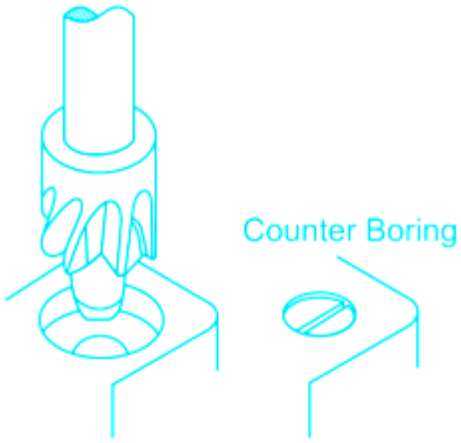
- Knurling is the operation of producing a straight-lined, diamond-shaped pattern or cross lined pattern on a cylindrical external surface by pressing a tool called knurling tool.
- Knurling is not a cutting operation but it is a forming operation.
- Knurling is done at a slow spindle speed (1/3 the turning speed). However, speed & feed given for knurling is to be divided according to the job material and the finish required.

- Purpose of knurling
  - A good grip and make for positive handling.
  - Good appearance
  - For raising the diameter to a small range for assembly to get a press-fit



Counter boring

- The operation of boring a second hole, larger in diameter than the first, is known as counterboring.
- Counter boring is an operation of enlarging a hole to an even depth in order to accommodate the socket heads or cap screws with the help of a counterbore tool.



126. **Answer: b**

Explanation:

Concept:

	Saturated Hydrocarbons	Un-saturated Hydrocarbons
Representation:	R - (m - 1) (n + 1) P	R - 1(m - 1) (n + 1) P
Chemical formula:	$C_mH_nF_pCl_q$	$C_mH_nF_pCl_q$
Relation:	n + p + q = 2m + 2	n + p + q = 2m

where m = No. of Carbon atoms, n = No. of Hydrogen atoms, p = No. of Florine atoms, q = No. of Chlorine atoms

Calculations:

Given:

R 11

By comparing with **R - (m - 1) (n + 1) P**

m – 1 = 0 ⇒ m = 1 i.e. 1 → Carbon atoms

n + 1 = 1 ⇒ n = 0 i.e. 0 → Hydrogen atoms

p = 1 i.e. 1 → Florine atom

Now

n + p + q = 2m + 2

⇒ 0 + 1 + q = 2 × 1 + 2

⇒ q = 3 i.e. 3 → Chlorine atoms

∴ $C_m H_n F_p Cl_q \Rightarrow CFCl_3$

CF_3Cl

m = 1, n = 0, p = 3 and q = 1

n + p + q = 2m + 2

0 + 3 + 1 = 2 × 1 + 2

4 = 4 satisfied

R - (m - 1) (n + 1) P ⇒ R - 13

CHFCl

m = 1, n = 1, p = 1 and q = 1

n + p + q = 2m + 2

1 + 1 + 1 = 2 × 1 + 2

3 = 4 not satisfied

Not a Saturated Hydrocarbon

Unsaturated Hydrocarbon

R - 1150

By comparing with **R - 1(m - 1) (n + 1) P**

m – 1 = 1 ⇒ m = 2 i.e. 2 → Carbon atoms

n + 1 = 5 ⇒ n = 4 i.e. 4 → Hydrogen atoms

p = 0 i.e. 0 → Florine atom

n + p + q = 2m

⇒ 4 + 0 + q = 2 × 2

⇒ q = 0 i.e. 0 → Chlorine atoms

∴ $C_mH_nF_pCl_q \Rightarrow C_2H_4$

If refrigerant is Inorganic Compound

R – (Molecular Weight + 700)

NH_3 whose molecular weight is 17 and the chemical formula is R – 717

H_20 whose molecular weight is 18 and the chemical formula is R – 718

CO_2 whose molecular weight is 44 and the chemical formula is R – 744

127. **Answer: a**

Explanation:

Explanation:

Type of Abrasives / Grain type:

- It indicates materials used for the manufacturing of abrasive particles.
- Out of the abrasives B 4C is giving the poor performance during machining and diamond is very costly, therefore Al 2O 3 or SiC is the most commonly used abrasives in the grinding wheel.
- **Al 2O 3 soft and tougher** than the SiC whereas SiC will be hard and brittle than Al 2O 3
- The type of abrasive is selected based on the mechanical properties of workpiece material I.e. for machining of soft and ductile workpieces, Al 2O 3, and machining of hard and brittle workpiece SiC will be used .
- A- Al 2O 3, B – B 4C, C – SiC, D - Diamond

Material	Hardness (HK)	Properties
Al_2O_3	2100	• Used for grinding steels, high strength alloys, etc.
SiC	2400	• Used for grinding cast iron, aluminium, brass, etc.
CBN	5000	• 2^{nd} hardest material after Diamond. • Used for grinding tool steels, hardened steels, cemented carbides tool and their alloys. • Suitable for ferrous material.
Diamond	6000	• Hardest material. • Used for grinding of glasses, ceramics, cemented carbide tools, etc. • Not suitable for ferrous material.

128. **Answer: b**

Explanation:

Explanation:

- Manohar Parrikar took charge as the Chief Minister of Goa after the 2017 elections.
- After his death, the **new CM of Goa is Pramod Sawant**
- Nitish Kumar is CM of Bihar
- Pema Khandu is CM of Arunachal Pradesh
- Bhupesh Baghel is CM of Chhattisgarh

129. **Answer: b**

Explanation:

Explanation:

Friction:

- When a solid body slides over a stationary solid body, a force is exerted at the surface of contact by the stationary body on the moving body. This force is called the ***force of friction***.

Laws of Dry Friction:

- The friction that exists between two surfaces which are not lubricated is known as **dry friction** .
- The following are the laws.
  - The limiting frictional force is independent of the shape and area of the surface in contact .
  - The force of friction acts in the **opposite direction** in which the surface is having a tendency to move.
  - The force of friction is equal to the force applied to the surface, so long the surface is at rest.
  - When the surface is on the point of motion, the force of friction is maximum and this maximum frictional force is called the **limiting friction force** .
  - The limiting frictional force bears a constant ratio to the normal reaction between two surfaces.

130. **Answer: d**

Explanation:

Explanation:

- Ecological Footprint is the quantity of nature it took to support People or an economy.
- Global Hectare is the unit of measurement of "Ecological Footprint".
- The Global Hectare is represented asgha.
- India has an Ecological Footprint of 1.12 global hectares.
- The Idea of Ecological Footprint was given by William Rees in 1992.

⭐ Important Points

- **Cubic meter** is unit of **Volume.**
- The average amount of water each person in a particular area uses on a daily basis, measured in **Gallon Per Capita.**
- **Man hour** is the unit of measure that is used in project management to measure the efforts needed to complete a task.

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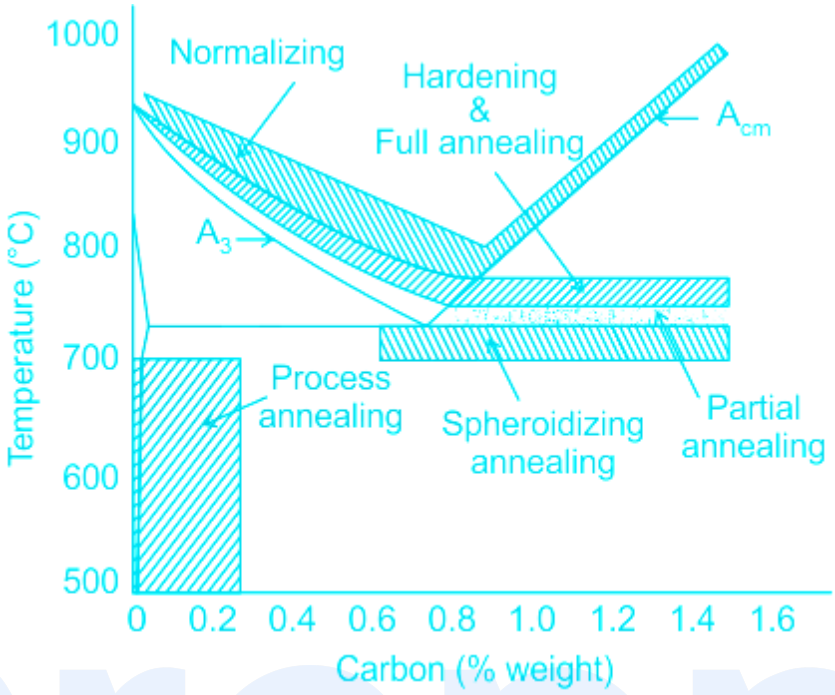
131. **Answer: c**

Explanation:

Explanation:



Diffusion Annealing	• In this process, hypo-eutectoid, eutectoid, and hyper-eutectoid steel are heated uniformly and the component is held at a temperature between 1000 °C – 1200 °C and then cooled very slowly in the furnace in order to remove the heterogeneity in the composition of heavy castings. • During this, a coarse grain structure produced. • **A homogenous structure appears** . • To increase material properties, it goes through full annealing after diffusion annealing.
Full Annealing	• Full annealing consists of heating the steel component to about 50 °C – 70 °C above the critical temperature, holding it for a sufficient length of time, and cooling the same in the furnace. • Adopted for steel casting and ingots. • The coarse structure produced during solidification break down to a much smaller size. • Machinability and ductility increases. • Hardness is reduced. • All structural imperfection gets removed.

Spherodise Annealing	• In this method heating can be done in three ways:
	  ◦ Prolonged heating just below the lower critical temperature followed by relatively slow cooling
	  ◦ Alternately heating and cooling the work-piece to just above and below the lower critical temperature.
	  ◦ Short heating at a high temperature followed by relatively slow cooling.
	• Conversion of hard lamellar or network carbides of high-carbon steels into globular or spherical shapes.
	• Improve machinability and ductility.

Process	• This process involves heating of steel to a temperature just below

Annealing	the lower critical temperature (723 °C) of steel. • Usually, cold worked steel has high hardness and low ductility making it difficult to work. • Deformed grains in cold working get reoriented. • Hardness is lowered and ductility also increases.

---

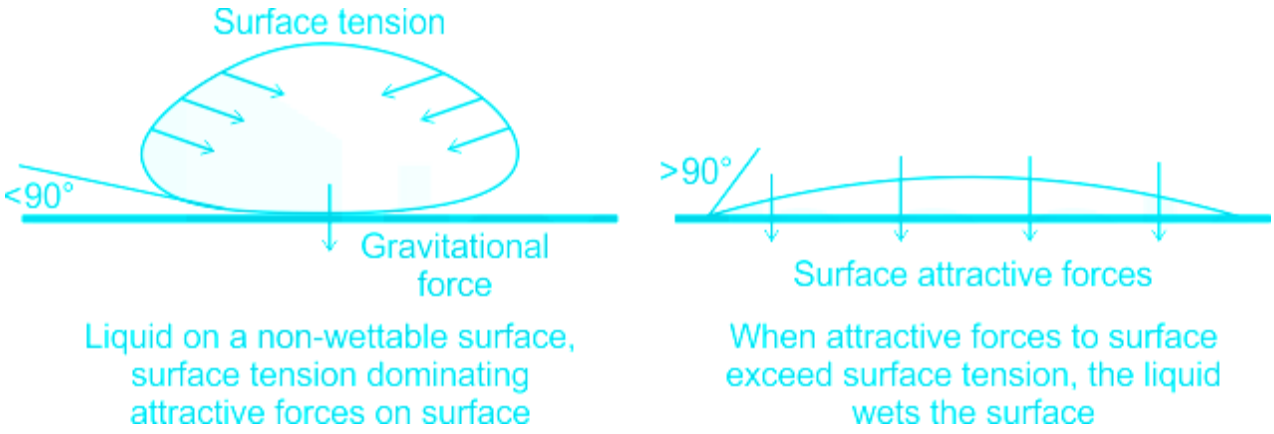
132. Answer: b

Explanation:

Explanation:

The contact angle of a liquid with a solid gives the **wettability index** .

High Wettability	Low Wettability
When contact angle ($\alpha > 90°$) it falls off and does not wet the surface.	When contact angle ($\alpha < 90°$) it remains stick and wet the surface.
For Mercury-Glass: • $\alpha = 130°$, it falls off and does not wet.	**For Air-Glass:** • $\alpha \approx 0°$, it remains stuck and wet.



Important Point

Surface Tension:

- Whenever a liquid is in contact with other liquids or gases, or solid surfaces, an interface develops that acts like a **stretched elastic membrane** , this property of the liquid surface film to **exert tension** is called **Surface Tension** .

Cohesion:

- Attractive forces between molecules of the **same type** are called **Cohesion** .

Adhesion:

- Attractive forces between molecules of **different types** are called **Adhesion** .

Capillarity:

- Rise or fall of the liquid surface in a small tube relative to the adjacent general level of liquid when the tube is held vertically in the liquid.

---

133. **Answer: d**

Explanation:

Explanation:

A constellation is a group of stars that forms an imaginary pattern on the celestial sphere.

URSA minor

- It is a constellation in the Northern Sky.
- The constellation's name means "the smaller bear," or "the lesser bear.
- It contains the **Little Dipper asterism.**
- Ursa Minor is also notable for marking the location of the north celestial pole.

---

134. Answer: d

Explanation:

Explanation:

- At higher altitudes, air compressor performance is degraded, and it can take a lot longer to complete the work than at lower altitudes.
- The performance of a compressor must also be derated at altitude due to the atmospheric variations in air pressure, temperature, and density.

---

135. Answer: a

Explanation:

Explanation:

Pressure

- The pressure is defined as the force per unit area (Pressure = Force/Area)

- SI unit of pressure is 'Pascal' and it is denoted by Pa.
- 1 Pascal equals the pressure of 1 newton per square meter and the formula is as follows: 1 Pa = 1N/m ^{2} = 1 kg/m.
- Thepascal is the SI derived unit of pressure used to quantify internal pressure, stress, Young's modulus, and ultimate tensile strength.
- It is named after the French polymath Blaise Pascal.

⭐ Important Points

- The unit of **force** is **Newton**
- A **kilogram** is a unit of **mass**
- **Kelvin** is a unit of **temperature**

---

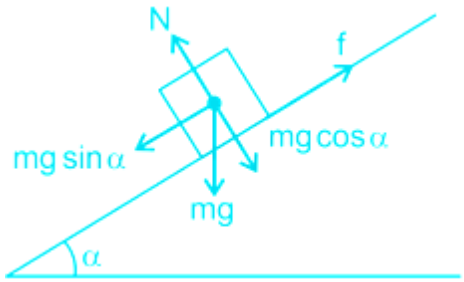
136. **Answer: b**

Explanation:

Concept:

Angle of Repose

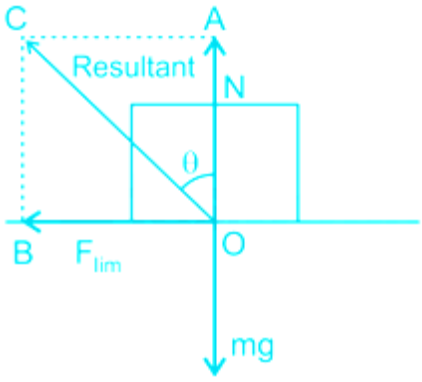
The angle of repose or angle of sliding α is defined as **the minimum angle of inclination of a plane with the horizontal such that a body placed on the plane just begins to slide down.**



Angle of Friction

The angle of friction between any two surfaces in contact is defined as the angle which the resultant of the force of limiting friction F lim and normal reaction N

makes with the direction of normal reaction N.



⭐ Important Points

$\tan\theta = \frac{F_{lim}}{N} = \mu$

f = mg sin α

N = mg cos α

$\tan\alpha = \frac{f}{N}$

tan α = tan θ

α = θ

∴ Angle of friction = Angle of repose

---

137. **Answer: c**

Explanation:

Explanation:

- Sulfur dioxide is used in many ways.
- Sulfur dioxide is the least used refrigerant nowadays because of its many inherent disadvantages.
- SO 2 is highly toxic and it forms sulfurous acid when it comes in contact with water and sulphuric acid, provided there are water and air in the system. Both

acids are highly corrosive to metals.
- Acid rain is caused by a chemical reaction that begins when compounds like sulphur dioxide and nitrogen dioxide are released into the air.
- **The freezing point of sulphur dioxide is -76°C**

---

138. Answer: d

Explanation:

Concept:

Orifice

- A small opening of any cross-section, made on the bottom or sidewall of the tank through which a fluid can flow is called an orifice.
- The contraction of area for flow through an orifice in-tank depends on the Shape of the orifice, Size of the orifice, and on the head under which the flow takes place.

Notch

- Weir or notch is a physical structure of masonry constructed across the channel width to calculate the discharge of the channel section.

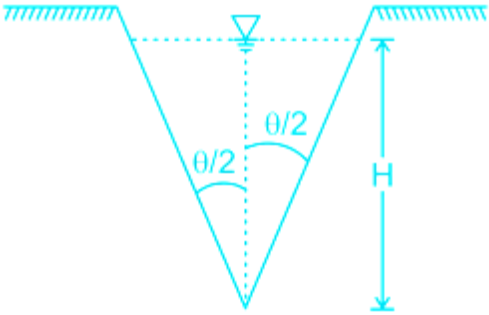
Rectangular Notch:

The discharge through a rectangular notch weir is,

$Q = \frac{2}{3} C_d L \sqrt{2g}\ H^{3/2}$

where, Q = discharge of fluid, C d = Coefficient of discharge and H = height of water above the notch

Triangular Notch:

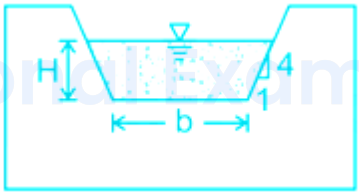


A V-notch weir is also called the triangular notch or weir. The discharge over a triangular weir or notch is given by the:

$Q = \frac{8}{15} C_d tan\frac{\theta}{2} \sqrt{2g}\ H^{5/2}$

Where, Q = discharge of fluid, C d = Coefficient of discharge, θ = Notch angle and H = height of water above the notch

Trapezoidal weir (or) Notch:



$Q = \frac{2}{3} C_{d_1} \sqrt{2g}\ LH^{\frac{3}{2}} + \frac{8}{15} C_{d_2} \sqrt{2g}.\tan\frac{\theta}{2}.H^{\frac{5}{2}}$

Where, $\left(\frac{\theta}{2}\right)$ = weir angle of inclination with the vertical.

C_{d_1} = Coefficient of discharge for the rectangular portion.

C_{d_2} = Coefficient of discharge for the triangular portion.

---

139. Answer: b

Explanation:

Explanation:

When the quantity of acids in the raining water is more than the average, then such rain is called **'Acid rain'.**

- We are aware that normally rainwater has a pH of 5.6. When the pH of the rainwater drops below 5.6 , it is called acid rain.
- Acid rain refers to the ways in which acid from the atmosphere is deposited on the earth's surface.
- Oxides of nitrogenand sulphur which are acidic in nature can be blown by the wind along with solid particles in the atmosphere and finally settle down either on the ground as dry deposition or in water, fog and snow as a wet deposition.
- Acid rain is a byproduct of a variety of human activities that emit the oxides of sulphur and nitrogen in the atmosphere.
- As mentioned earlier, burning of fossil fuels (which contain sulphur and nitrogenous matter) such as coal and oil in power stations and furnaces or petrol and diesel in motor engines produce sulphur dioxide and nitrogen oxides.
- SO 2 and NO 2 after oxidation and reaction with water vapour and sunlight are major contributors to acid rain because polluted air usually contains particulate matter that catalyses the oxidation.

$2SO_2(g) + O_2(g) + 2H_2O(l) \rightarrow 2H_2SO_4(aq)$

$4NO_2(g) + O_2(g) + 2H_2O(l) \rightarrow 4HNO_3(aq)$

The bad effects of acid rain:

- When acid rain falls and flows as groundwater to reach rivers, lakes etc, it affects plants and animal life in the aquatic ecosystem
- **Acid rain is harmful to agriculture , trees and plants as it dissolves and washes away nutrients needed for their growth**
- It causes respiratory ailments in human beings and animal
- It may also cause corrosion in many buildings bridges, monuments, fencing etc
- It causes irritation in the eyes and skin of human beings
- This rain reduces the lustre of the metals too

- Acid rain damages buildings and other structures made of stone or metal
- The Taj Mahal in India has been affected by acid rain
- Acid rain indirectly affects plants by removing nutrients from the soil during which they grow; Acid rain dissolves and washes away all the vitamins in the soil which are very much essential for plants

---

140. Answer: b

Explanation:

Explanation:

- Alexander III of Macedon, also known as Alexander the Great, was born in Pella in 356 BC.
- Alexander the Great was a king (basileus) of the ancient **Greek kingdom of Macedon.**
- Alexander is considered one of history's most successful commanders.
- He invaded India in 326 BC during the period of Dhana Nanda .
- Alexander the Great died of malaria in Babylon (now Iraq) , on June 13, 323 B.C .
- He was just 32 years old at the time of his death.

---

141. Answer: c

Explanation:

Explanation:

- **Synthetic resin, short for resin, is an artificial synthesized high molecular polymer.**
- Synthetic resin, the basic raw material of plastic, takes up 30% - 60% or more of its composition.
- Synthetic resin is an organic compound made by combining carbon atom, a hydrogen atom, and a small quantity of oxygen atom, Sulphur atom through a

certain chemical bond.

- Synthetic resin is industrially produced resin, typically viscous substances that convert into rigid polymers by the process of curing.
- In order to undergo curing, resins typically contain reactive and groups such as acrylates or epoxides.
- The most commonly used type of synthetic resin is epoxy resin.
- **Shellac is a resin secreted by the female lac bug on trees, therefore, it is a natural resin**

Types of synthetic resins are:

- Polyvinyl chloride (PVC)
- Polystyrene
- Phenolic aldehyde
- Epoxy and polyester etc.
- Saturated Polyesters
- Unsaturated Polyesters
- **Alkyds**
- Epoxies
- Acrylics
- Vinyl
- Polyacetals
- Polyurethanes
- Amino resins
- **Phenolic resins**
- Rosin modified resin
- Maleic resins
- Ketonic Resins
- Isocyanate adducts
- Polyamides
- Silicones
- Cellulose acetate Butyrate
- Nitrocellulose
- Hydroxyethyl cellulose
- Carboxy Methyl Cellulose
- Chlorinated polypropylene

142. **Answer: c**

Explanation:

Explanation:

- **Patachitra paintings** are a traditional form of art that originated in **Odisha,** West Bengal, and dates back to the 5 th century.
- It is a colorful, vibrant form of cloth-based painting that depicts temples, Hindu deities, and mythological tales.
- **Warli Painting, Rabari Embroidery, Pithora Paintings, and Rogan Painting** are a traditional form of art that originated in Gujrat.
- **Thanjavur** is famous painting from **Tamilnadu.**
- **Cherial folk Paintings** are a traditional form of art that originated in **Andhra Pradesh.**

143. **Answer: d**

Explanation:

Concept:

- Rowan plan is time based incentive plan.
- Under Rowan Plan, the standard time for the completion of a job and the rate per hour is fixed.
- If the time taken by the worker is more than the standard time, then he is paid according to the time rate, i.e. time taken multiplied by the rate per hour.
- The wages for the job is given as, $W = TR + [(S - T)/S] \times R$

144. **Answer: a**

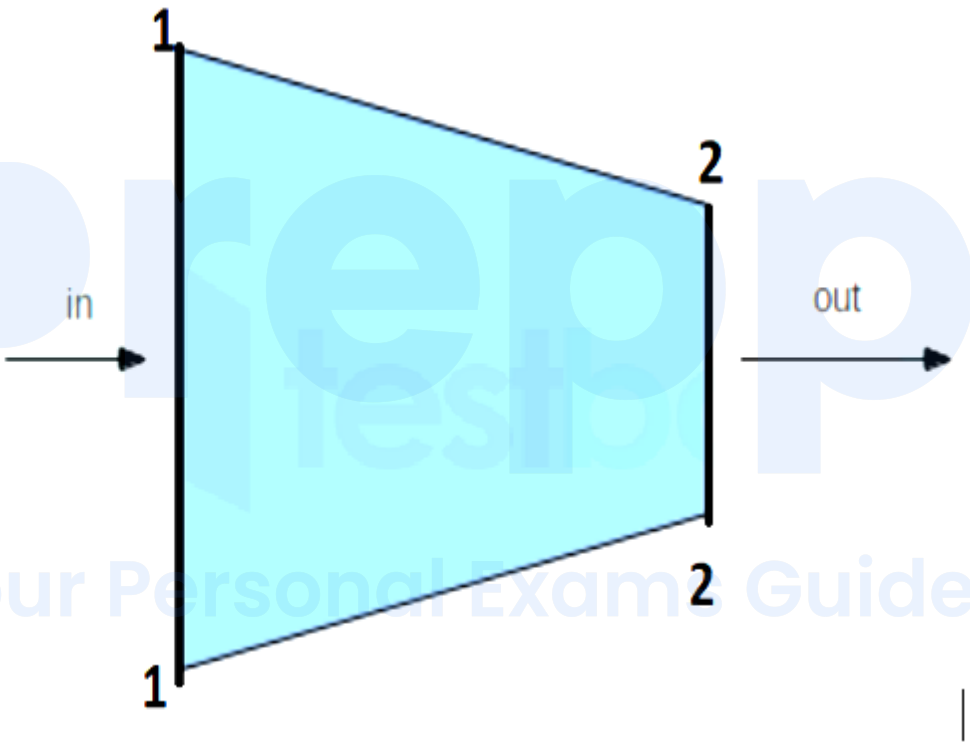
Explanation:

Explanation:

Continuity Equation

The equation is based on the principle of **conservation of mass** .

For a fluid flowing through a pipe at all cross-section, the quantity of fluid flowing per second is constant.



Consider two cross-sections of a pipe as shown.

V_1= Velocity at cross-section 1-1, V_2= Velocity at cross-section 2-2

ρ_1= Density at section at 1-1, ρ_2= Density at section at 2-2

A_1= Area of cross-section at 1-1, A_2= Area of cross-section at 2-2

∴ **rate of flow at section 1-1 = $\rho_1 A_1 V_1$ AND rate of flow at section 2-2 = $\rho_2 A_2 V_2$**

∵ mass is conserved; rate will be same in both section.

$\therefore \rho_1 A_1 V_1 = \rho_2 A_2 V_2$

This is Continuity Equation. It is valid for both compressible and incompressible fluids.

If the fluid is incompressible, then $\rho_1 = \rho_2$

$\therefore A_1 V_1 = A_2 V_2$

Continuity equation in three dimensions .

$$\frac{\partial \rho}{\partial t} + \frac{\partial}{\partial x}(\rho u) + \frac{\partial}{\partial y}(\rho v) + \frac{\partial}{\partial z}(\rho w) = 0$$

The above equation is valid for:

1. Steady and unsteady flow.
2. Uniform and non-uniform flow.
3. Compressible and incompressible flow.

For Steady flow:

$$\frac{\partial}{\partial x}(\rho u) + \frac{\partial}{\partial y}(\rho v) + \frac{\partial}{\partial z}(\rho w) = 0 \quad \left(\because \frac{\partial \rho}{\partial t} = 0\right)$$

If the fluid is Incompressible and Steady:

$$\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} + \frac{\partial w}{\partial z} = 0 \quad (\because \rho = constant)$$

---

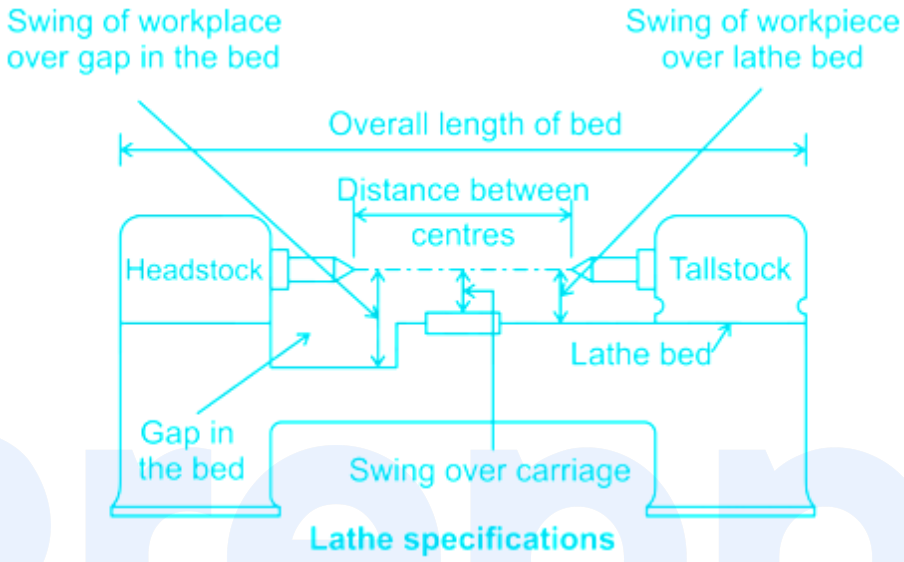
145. **Answer: c**

Explanation:

Explanation:

The largest diameter of work that can be carried between the centers of a lathe is known as **swing.**

The size of a lathe is generally specified by the following means:



Lathe specifications

- Distance between centres - Maximum length of the job that can be held between head stock and tailstock centres
- Swing over the bed – Maximum diameter that can be rotated over the bed ways
- Swing over the cross slide – Largest diameter of the work that will revolve over the lathe saddle
- **Swing or maximum diameter that can be rotated over the bed ways**
- Bed length, which may include head stock length also
- Maximum diameter of the bar that can pass through spindle or collet chuck of capstan lathe
- Maximum swing over bed
- Maximum swing over carriage
- Height of centrers over bed

⭐ Important Points

Saddle: The saddle is mounted directly on the top of the base. It carries the table and traverse crosswise to the table movement.

146. **Answer: b**

Explanation:

Concept:

- A solid can resist shear stress by a static deformation; a fluid cannot
- Any shear stress applied to a fluid, no matter how small, will result in motion of that fluid
- The fluid moves and deforms continuously as long as the shear stress is applied
- So, a fluid at rest must be in a state of zero shear stress

---

147. **Answer: b**

Explanation:

Explanation:

- Number of grams of Helium (He) = 52 gm
- Molecular mass is the sum of **total protons and neutrons.**
- The molecular mass of Helium = 2 × 2 = 4
- Now multiply the mass with a number of elements we get = 4 × 1 = 4
- One mole is equal to the total mass of the molecule.
- We know one mole is equal to 4 gm of Glucose molecule.
- Now a number of moles in 52 gm of Helium is (n) = 52/4 ⇒ n = 13 moles
- **The number of moles in 52 gm is 13 moles.**

---

148. **Answer: c**

Explanation:

Explanation:

Hardware

Computer hardware is the collection of all the parts of the computer you can physically touch.

For example - computer case, monitor, keyboard, printer, scanner, and mouse, etc.

Software

Software is a set of programs, which is designed to perform a well-defined function. A program is a sequence of instructions written to solve a particular problem.

For example - Operating System, Compilers, **Interpreter,** Assemblers, Payroll Software, Student Record Software, Inventory Management Software, Income Tax Software, Railways Reservation Software, Microsoft Office Suite Software, etc.

There are two types :

1. System Software
2. Application Software

⭐ **Important Points**

Interpreter: It translates one instruction at a time

---

149. Answer: d

Explanation:

Explanation:

- **NPL stands for National Physics Laboratory.**
- Its headquarter is in New Delhi. It was established on January 4, 1947.
- On March 17 it established an atmospheric monitoring station on the campus of the Institute of Himalayan Bioresource Technology (IHBT) at Palampur, Himachal Pradesh.
- It is situated at an altitude of 1391m for generating the base data for atmospheric trace species & properties to serve as a reference for comparison of the polluted atmosphere in India.

150. **Answer: d**

Explanation:

Explanation:

- An ecosystem is a community which comprises of both living and non-living components and their interaction with each other and the environment
- British ecologist **A.G. Tansley** used the term ecosystem for the first time in 1935
- The Ecosystem is divided into **biotic components** and **abiotic components**
- Biotic components can be divided into producer, consumer and decomposers
- Abiotic Components are the carbonic substance, non-carbonic substance and climatic factors
- Water, light, temperature, air, humidity etc. are the abiotic components of the ecosystem
- **Solar energy is the main source of energy behind the ecosystem phenomenon thus it is the driving force**
- Ecosystem is an open system because there is an exchange of energy between the ecosystem and the outer world (universe)
- With the presence of autotrophs, ecosystem has its own productive unit