Prepp

Your Personal Exams Guide

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RRB ALP 2019 (CBT 2) (Physics and Maths) Previous Year Papers (22 Jan 2019) Shift 1

Total Time: 1 Hour **Total Marks:** 75

Instructions

Sl No.	Section Name	No. of Question	Maximum Marks	Negative Marks	Positive Marks
1	Part B	75	75	0.33	1

1.) A total of 60 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.

Part B

1. What is the missing term in the Arithmetic progression? **(+1, -0.33)**

   243, 255, ..., 279, 291

   a. 265

   b. 264

   c. 267

   d. 261

---

2. A boy throws two balls in air in such a manner that when the first ball is at it's maximum height he throws the second ball. If the balls are thrown with the time difference of one second, the maximum height attained by each ball is ($g = 10\ m / s^2$) **(+1, -0.33)**

   a. 2.5 m

   b. 5 m

   c. 10 m

   d. 3.5 m

---

3. Two resistors 1 ohm and 2 ohm are connected in series. The effective resistance is **(+1, -0.33)**

   a. 2 / 3 ohm

   b. 3 ohm

   c. 1 ohm

d. 2 ohm

---

4. A 1.8 m tall boy is standing at some distance from a 12 m tall building. The angle of elevation from his eyes to the top of the building increases from 45° to 60° as he walks towards the building. Find the distance (in meters) he walked towards the building. **(+1, -0.33)**

a. $\frac{51\left(\sqrt{3}+1\right)}{5\sqrt{3}}$

b. $\frac{51\left(\sqrt{3}-1\right)}{5\sqrt{3}}$

c. $\frac{12\left(\sqrt{3}-1\right)}{\sqrt{3}}$

d. $\frac{12\left(\sqrt{3+1}\right)}{\sqrt{3}}$

---

5. Solve for x in $12x^2 + 45x = 0$ **(+1, -0.33)**

a. $x = 0, x = \frac{-15}{4}$

b. $x = 0, \frac{15}{4}$

c. x = 0, x = -12

d. x = 0, x = - 45

---

6. Which of the following forces is conservative? **(+1, -0.33)**

a. Frictional force

b. Air resistance

c. Electrostatic force

d. Viscous force

---

7. Reduce to linear form $\frac{5x+1}{2x} = \frac{5}{4}$ (+1, -0.33)

a. 5x - 2 = 0

b. 5x + 2 = 0

c. 5x - 4 = 0

d. 5x + 1 = 0

---

8. The ability of eye to focus on both near and far objects is called (+1, -0.33)

a. Power of accommodation

b. Myopia

c. Hypermetropia

d. Presbyopia

---

9. A current through a horizontal power line flows in east to west direction. The direction of magnetic field at a point directly below it is (+1, -0.33)

a. south to north

b. north to south

c. west to east

d. east to west

---

10. A famer wants to fence his rectangular field of length 200 m and area 3000 m^2. If the cost of fencing per metre is 5 rupees, what is the total cost of fencing in rupees? **(+1, -0.33)**

a. 500

b. 1000

c. 2150

d. 2500

---

11. Triangles PQR and ABC are similar triangles. **(+1, -0.33)**

Triangle ABC have the following sides

AB = 12 cm

AC = 15 cm

CB = 21 cm

Triangle PQR have the following sides:

PQ = 4 cm

RQ = 7 cm

What is the length of side PR?

a. 3 cm

b. 12 cm

c. 5 cm

d. 15 cm

---

12. An electric bulb is connected to a 200 V generator. The current is 0.5 A. The power of the bulb is **(+1, -0.33)**

a. 10 W

b. 1000 W

c. 1 W

d. 100 W

---

13. If 'c' is the velocity of light in free space, the time taken by light to travel a distance x in medium of refractive index μ is given by **(+1, -0.33)**

a. μxc

b. $\frac{\mu x}{c}$

c. $\frac{\mu c}{x}$

d. $\frac{x}{\mu c}$

---

14. The heat generated while transferring 96000 coulomb of charge in one hour through a potential difference of 50 V is **(+1, -0.33)**

a. 4.8×10^{4} J

b. 1.33×10^{3} J

c. 4.8×10^{6} J

d. 1.33×10^{4} J

---

15. A(1, 2), B(a, -26), C(13, -14) and D(6, 14) s are the vertices of a parallelogram, taken in order, find the value of a. **(+1, -0.33)**

a. 14

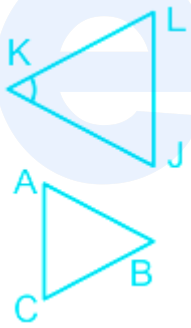
b. 8

c. 22

d. 6

---

16. What is the angle at B in the triangle ABC, if the angle made at K is 60°? The triangles shown in the figure are similar. **(+1, -0.33)**



a. 20°

b. 75°

c. 60°

d. 40°

---

17. Let $y = \frac{1}{10}x$ and x + 50y = 120. What is the value of x and y? **(+1, -0.33)**

a. x = 2 and y = 20

b. x = 20 and y = 2

c. x = 10 and y = 2

d. x = 60 and y = 6

---

18. The Table given below represent the ages of students in a private music school. What is the average age of the students? **(+1, -0.33)**

Age Band	Students
0 - 10	4
10 - 20	5
20 - 30	15
30 - 40	4

a. Approximately 22 years

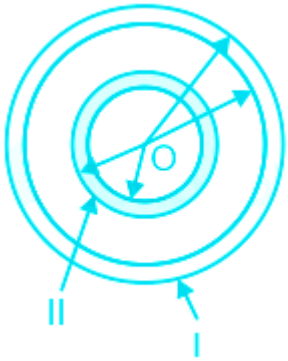
b. Approximately 15 years

c. Approximately 20 years

d. Approximately 26 years

---

19. The inner and outer radius of rings I of dartboard are 15 cm and 17 cm respectively and those of ring II are 12 cm and 13 cm respectively. What is the total area of these two ring? **(+1, -0.33)**



a. $89\pi \text{ cm}^2$

b. $25\pi \text{ cm}^2$

c. $34\pi \text{ cm}^2$

d. $106.85\pi \text{ cm}^2$

---

20. Two circles have radius in the ratio 4 : 3, write a polynomial to express the combined total surface are of the two circles. **(+1, -0.33)**

a. $12\pi x^2$

b. πx^2

c. $25\ \pi x^2$

d. $7\ \pi x^2$

---

21. An object of mass 3 kg is at rest. Now a 6 N force is applied on the object for 3 seconds. Find the velocity of the object acquired by it in m / s. **(+1, -0.33)**

a. 12

b. 6

c. 9

d. 8

---

22. Simplify the given expression: **(+1, -0.33)**

$32 \div 16 + 8(96 \div 12) - 8$

a. 68

b. 58

c. 54

d. 64

---

23. A car has two wipers which do not overlap. Each wiper has blade of length 18 cm sweeping through an angel of 126° Find the total area cleaned at each seep of the blades. Take $\pi = 22 / 7$ **(+1, -0.33)**

a. 196.5 cm^2

b. 712.8 cm^2

c. 356.8 cm^2

d. 188.2 cm^2

---

24. Three blocks of masses m_1, m_2, and m_3 are connected by massless strings as shown in the figure on a frictionless table. **(+1, -0.33)**

They are pulled with a force F = 40 N. If m_1= 10 kg, m_2= 6 kg and m_3= 4 kg, then tension T_2will be

a. 20 N

b. 40 N

c. 10 N

d. 32 N

---

25. Light year is the unit of a quantity whose unit can also be **(+1, -0.33)**

a. second

b. kilogram

c. square metre

d. Angstrom

---

26. ABCD is a diameter of a circle of radius 12 cm. The lengths AB, BC and CD are equal. Semi-circles are drawn on AB and BD as diameters as shown in the given figure. Find area of the shaded region. **(+1, -0.33)**

a. 48 πcm^2

b. 84 πcm^2

c. 24 πcm^2

d. $96\ \pi cm^2$

---

27. Magnetic field lines being more crowded towards the pole of a magnet indicates that the magnetic field due to the magnet in that region is **(+1, -0.33)**

a. the weakest

b. the outcome of a property of a ferromagnetic substance

c. aligned with the magnetic field of earth

d. the strongest

---

28. If $x = a + bt + ct^2$ **(+1, -0.33)**

x is meters and t in seconds, then the unit of a is:

a. ms^{-1}

b. m^2s

c. m^3s^{-2}

d. m

---

29. A symmetrical biconvex lens of focal length 'f' is cut into four identical pieces along and perpendicular to its principal axis The focal length of each of four pieces is **(+1, -0.33)**

a. 4f

b. f / 4

c. 2f

d. f / 2

---

30. The dispersive power of the material of a prism is 0.0221. If the deviation produced by it for yellow colour is 38°, then the angular dispersion between red and violet colours is **(+1, -0.33)**

a. 0.84°

b. 0.65°

c. 0.48°

d. 1.26°

---

31. A body falling from rest has a velocity 'v' after it falls through a distance 'h'. The distance it has to fall down further, for its velocity to become double, is _ _ _ _ _ _ _ _ _ times 'h'. **(+1, -0.33)**

a. 0.5

b. 1.5

c. 2

d. 3

---

32. What is the value of (2 - 3i) + (3 + 5i) **(+1, -0.33)**

a. 5 - 2i

b. 6 - 2i

c. 6 - 15i

d. 5 + 2i

---

33. A man walks 6 km towards north and turns left and walks 2 kms towards West. If he has started from point Z and reached point A, then what is the shortest distance between point Z and A. **(+1, -0.33)**

a. 2√5 km

b. $\sqrt{10}$ km

c. 2 $\sqrt{10}$ km

d. $\sqrt{15}$ km

---

34. Two tuning forks have frequencies 200 Hz and x. When they are sounded together 4 beats / sec are heard. The value of x is **(+1, -0.33)**

a. 196 Hz or 204 Hz

b. 200 Hz only

c. 205 Hz or 201 Hz

d. 200 Hz or 198 Hz

---

35. What would be the area of the triangle with A(8, 8), B(22, 8) and C(16, -10) as vertices? **(+1, -0.33)**

a. 129 sq. units

b. 128 sq. units

c. 126 sq. units

d. 118 sq. units

---

36. The length and the cross-sectional area of a conductor in the shape of a cylinder are 'l' and 'A' respectively. The resistivity of the material of the conductor is 'ρ'. Its resistance depends upon **(+1, -0.33)**

p) l only

q) l and A

r) ρ, l and A

s) ρ and l, but not A

Pick up the right option from those given above.

a. p)

b. r)

c. s)

d. q)

---

37. A trading website states 40% of its customers prefer to buy that particular stock, what is the probability that a customer will not prefer to buy stock? **(+1, -0.33)**

a. 0.1

b. 0.6

c. 0.8

d. 0.4

---

38. What would be the value of $(0.\overline{5353}.....)$ **(+1, -0.33)**

a. 53\90

b. 48\99

c. 25\45

d. 53\99

---

39. If a spherical mirror is immersed in a liquid, its focal length will **(+1, -0.33)**

a. decrease

b. depend on the nature of liquid

c. increase

d. remain unchanged

---

40. If two hemispheres of curved surface area 8π cm ^{2}each are joined together to form a sphere. What is the volume of the sphere so formed in cm ^{3}? **(+1, -0.33)**

a. 4π

b. 16π

c. 32π / 3

d. 8π

---

41. In a arithmetic progression the 1 st term is 7 and the third term is 28, what is the second term? **(+1, -0.33)**

a. 17.5

b. 10

c. 8

d. 18

---

42. What is the quadratic equation whose roots are 5 and 2 **(+1, -0.33)**

a. $x^2 + 14 + 10 = 0$

b. $x^2 - 14x + 10 = 0$

c. $x^2 - 7x + 10 = 0$

d. $x^2 + 7x + 10 = 0$

---

43. Pick the rational number from the given options **(+1, -0.33)**

a. e

b. π

c. $\sqrt{3}$

d. $\sqrt{64}$

---

44. The relation between acceleration due to gravity (g) and universal gravitational constant (G) is given by, **(+1, -0.33)**

a. $G = \frac{gM}{R^2}$

b. $R = \frac{GM}{g}$

c. $g = \frac{GM}{R^2}$

d. M = gGR ^{2}

---

45. An automobile that is towing a trailer is accelerating on a level road. The force that the automobile exerts on the trailer is **(+1, -0.33)**

a. equal to the force the trailer exerts on the automobile

b. greater than the force the trailer exerts on the automobile

c. equal to the force the trailer exerts on the road

d. equal to the force the road exerts on the trailer

---

46. A spring when compressed by 4 cm has 2 J energy stored in it. The force required to extend it by 8 cm will be **(+1, -0.33)**

a. 2 N

b. 20 N

c. 2000 N

d. 200 N

---

47. Find the zero of the function f(x) = (x - 17) (x - 7) **(+1, -0.33)**

a. 0. -7

b. 2, 7

c. 17, 7

d. -17, -7

---

48. The quantity of motion of a body is best represented by **(+1, -0.33)**

a. its velocity

b. its speed

c. its mass

d. its linear momentum

---

49. A pump is required to lift 600 kg of water per minute from a well 25 m deep and to eject it with a speed of 50 m / s. If g = 10 m / s^2, the power required to perform the above task is **(+1, -0.33)**

a. 20 kW

b. 15 kW

c. 10 kW

d. 22.5 kW

---

50. The dimensional formula of speed **(+1, -0.33)**

a. $[ML^0T^{-1}]$

b. $[MLT^{-1}]$

c. $[M^0LT^{-1}]$

d. $[MLT^{-2}]$

51. What is the area in sq. cm. of the triangle with a base of 8 cm and sides of length 6 cm each? **(+1, -0.33)**

a. $16\sqrt{5}$

b. 16

c. $8\sqrt{5}$

d. $4\sqrt{5}$

---

52. What is the missing term in this A.P? **(+1, -0.33)**

2, 25, _ _ _ _ _, 71

a. 43

b. 38

c. 36

d. 48

---

53. Find the quadratic equation with real coefficients which has (-5 -i) as a root. **(+1, -0.33)**

a. $x^2 - 26x - 10 = 0$

b. $x^2 + 10x + 26 = 0$

c. $x^2 - 26x + 10 = 0$

d. $x^2 - 10x = 26 = 0$

---

54. Divide $\frac{(-10x+50)}{x-5}$, when x ≠ 5 **(+1, -0.33)**

a. (x -5)

b. 10

c. (-10x)

d. 10(x - 5)

---

55. What would be the point which divides the line segment connecting the points P(10, 18), Q(5, 8) in the ratio 2 : 3 internally? **(+1, -0.33)**

a. (9, 15)

b. (7, 12)

c. (8, 14)

d. (8, 12)

---

56. Atom bomb is based on the principle of **(+1, -0.33)**

a. nuclear fission

b. nuclear fusion

c. atomic energy imbalance

d. atomic mass conservation

---

57. A tree breaks due to storm and the broken part bends, so that the top of the tree touches the ground making an angle of 30° with the ground. The **(+1, -0.33)**

distance between the foot of the tree to the point where the top touches the ground is 18 m. Find the height of the tree (in metres)

a. $24\sqrt{3}$

b. 9

c. $9\sqrt{3}$

d. $18\sqrt{3}$

---

58. A long sighted person has a least distance of distinct vision of 50 cm. He wants to reduce to 25 cm. He should use a **(+1, -0.33)**

a. concave lens of focal length 25 cm

b. convex lens of focal length 50 cm

c. concave lens of focal length 50 cm

d. convex lens of focal length 25 cm

---

59. If an echo is heard after 0.6 s when a boy fires a cracker 99 m away from a tall building then the speed of sound is **(+1, -0.33)**

a. 165 m / s

b. 330 m / s

c. 340 m / s

d. 350 m / s

---

60. Dams are constructed to collect water flowing in high altitude rivers. The **(+1, -0.33)**

stored water has a lot of

a. Both KE and PE

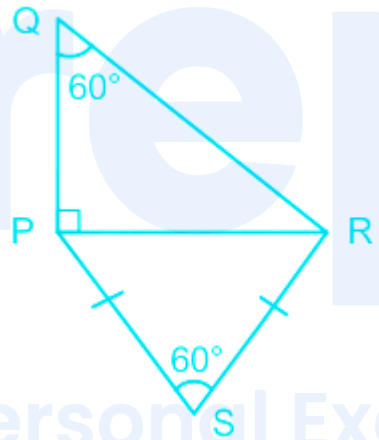
b. Kinetic energy (KE)

c. potential energy (PE)

d. Neither KE nor PE

---

61. In the given figure, if RS = 3√3 cm and RPS is an equilateral triangle, then find the value of QR **(+1, -0.33)**



a. 6√3 cm

b. 6 cm

c. 12√3 cm

d. 24 cm

---

62. What is the real part of the number 15 + 2i **(+1, -0.33)**

a. 3

b. 2

c. 15

d. 4

---

63. The length of a board is 12 cm and its breadth is 3 cm. The board needs to be taped around its sides covering all four sides. How long the tape should be? **(+1, -0.33)**

a. 30 cm

b. 12 cm

c. 15 cm

d. 3 cm

---

64. In a car showroom different models of car are on display. There are two models of 800 cc car and four models of 1500 cc car. What is the probability that a customer will choose am 800 cc car? **(+1, -0.33)**

a. 0.22

b. 0.67

c. 0.33

d. 0.5

---

65. In a right angled triangle, with angle at A being 90°, the side AB is of length 3 cm and BC is 12 cm. What is the length of side AC? **(+1, -0.33)**

a. 3√15 cm

b. 3√3 cm

c. 3√17 cm

d. 3 cm

---

66. A body is projected horizontally with a velocity u from a point which is at a height h above the ground level. The range (R) is (Take acceleration due to gravity = g units) **(+1, -0.33)**

a. $R = h\sqrt{\frac{2u}{g}}$

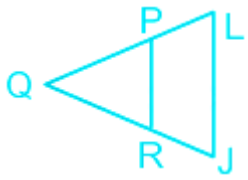
b. $R = u\sqrt{\frac{2g}{h}}$

c. $R = g\sqrt{\frac{2h}{u}}$

d. $R = u\sqrt{\frac{2h}{g}}$

---

67. For a pair of similar triangles, the angle made at Q is same in both the triangles PQR and LQJ. **(+1, -0.33)**



If the length of side QJ is 10 cm and QR is 5 cm, what is the ratio of their total areas?

a. 5

b. 2

c. 10

d. 4

---

68. A bird in air is at a height 'y' from the surface of water. A fish is at a depth 'x' below the surface of water. The apparent distance of fish from the bird is (The refractive index of water is μ) **(+1, -0.33)**

a. $x + \frac{y}{\mu}$

b. μx + y

c. $\frac{x}{\mu} - y$

d. $\frac{x}{\mu} + y$

---

69. Complete the statement with correct option. **(+1, -0.33)**

In dispersion without deviation, _ _ _ _ _ _ _ _ _ _

a. the emergent rays of all the colours are parallel to the incident ray.

b. all the rays are parallel, but not parallel to the incident ray.

c. yellow coloured ray is parallel to the incident ray

d. only red coloured ray is parallel to the incident ray

---

70. If three particles, each of mass M are placed at the three corners of an equilateral triangle of side a, the force exerted by this system on another particle of mass M placed at the midpoint of a side is **(+1, -0.33)**

a. $4GM^2/5a^2$

b. $4GM^2/3a^2$

c. $2GM^2/3a^2$

d. $2GM^2/5a^2$

---

71. What would be the value of sin(75°) **(+1, -0.33)**

a. $\frac{\sqrt{2-\sqrt{3}}}{2}$

b. $\frac{2+\sqrt{3}}{2}$

c. $\frac{2-\sqrt{3}}{2}$

d. $\frac{\sqrt{2+\sqrt{3}}}{2}$

---

72. Two spheres of masses m and M are situated in air and the gravitational force between them is F. The space between the masses is not filled with a liquid of specific gravity 3. The gravitational force will now be **(+1, -0.33)**

a. F / 3

b. F / 9

c. 3F

d. F

---

73. What would be the value of cos(105°) **(+1, -0.33)**

a. $\frac{(1-\sqrt{3})}{(2\sqrt{2})}$

b. $\frac{(1-\sqrt{3})}{(\sqrt{2})}$

c. $\frac{(1+\sqrt{3})}{(2\sqrt{2})}$

d. $\frac{(1-\sqrt{3})}{(2)}$

---

74. What would be the result of the following expression? **(+1, -0.33)**

$\frac{\sec^2 x+\tan^2 x}{\sin^2 x+1} = ?$

a. 0

b. $\frac{1}{\sin^2 x}$

c. -cos ^{2}x

d. $\frac{1}{\cos^2 x}$

---

75. Which of the following mirrors is used by doctors to focus a parallel beam of light on the patient's organs like teeth for the examination? **(+1, -0.33)**

a. Convex mirror

b. Plano-convex mirror

c. Plane mirror

d. Concave mirror

Answers

1. **Answer: c**

Explanation:

GIVEN:

$a = 243$

CONCEPT:

FORMULAE USED:

d = common difference = $a_n - a_{(n-1)}$

$a_n = a + (n - 1)\, d$

CALCULATION:

$d = 255 - 243 = 12$

$a_3 = 243 + [(3 - 1) \times 12]$

$\therefore a_3 = 267$

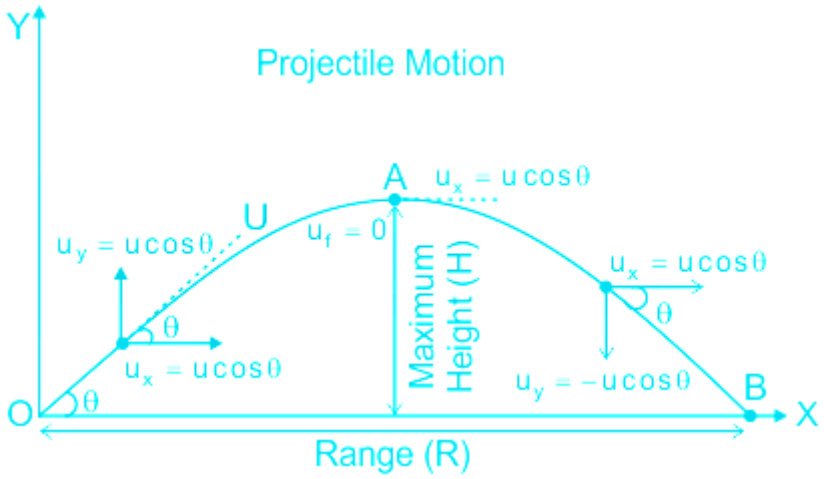
---

2. **Answer: b**

Explanation:

CONCEPT :

- Projectile motion:



- Projectile motion is the motion of an object projectedinto the air , under only the acceleration of gravity . The object is called a projectile , and its path is called its trajectory .
    - Initial Velocity: The initial velocity can be given as x components and y components.

u x = u cosθ

u y = u sinθ

Where u stands for initial velocity magnitude and θ refers to projectile angle.

- Time of Flight: The time of flight of projectile motion is the time from when the object is projected to the time it reaches the surface .

$\Rightarrow \mathrm{T} = \frac{2\ \mathrm{v}\ \sin\theta}{\mathrm{g}}$

Where T is the total time taken by the projectile, g is the acceleration due to gravity.

- Maximum height : It is the maximum height from the point of projection, a projectile can reach
- The mathematical expression of the maximum height is -

$\Rightarrow H = \frac{v^2 \sin^2\theta}{2g}$

EXPLANATION:

Given - Time to reach maximum height is 1 sec and the time taken by the ball to reaches the surface (T) = 2 sec

- The time of flight of projectile motion is

$\Rightarrow \mathrm{T} = \frac{2\ \mathrm{v}\ \sin\theta}{\mathrm{g}} = \frac{2v}{g}$ [$\because$ sin 90° = 1]

$\Rightarrow 2 = \frac{2v}{g}$

$\Rightarrow$ v = g = 10 m/s

- The mathematical expression of the maximum height is -

$\Rightarrow H = \frac{v^2 \sin^2\theta}{2g} = \frac{v^2}{g}$

$\Rightarrow H = \frac{10\times10}{2\times10} = 5\,m$

- Time is taken to reach maximum height: it is half of the totaltime of flight.

$\Rightarrow \mathrm{T}_{1/2} = \frac{\mathrm{v}\ \sin\theta}{\mathrm{g}}$

Where T 1/2 =time taken by the projectile to reach maximum height, g = acceleration due to gravity and v = velocity

Where T is the total time taken by the projectile, g is the acceleration due to gravity.

- Range: The range of the motion is fixed by the condition y = 0.

$\Rightarrow R = \frac{v^2 sin2\theta}{g}$

Where R is the total distance covered by the projectile.

3. **Answer: b**

Explanation:

CONCEPT:

Resistance:

- The measurement of the opposition of the flow of electric current through a conductor is called resistance of that conductor. It is denoted by R.

1. Resistances in series:

- When two or more resistances are connected one after another such that the same current flows through them are called as resistances in series .
- The net resistance/equivalent resistance (R) of resistances in series is given by:
- Equivalent resistance, R = R 1 + R 2

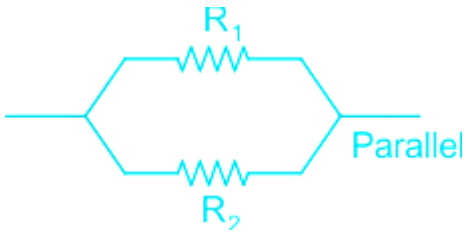
CALCULATION:

- Here 1 Ω and 2 Ω are in series combination, therefore the resultant resistance is

⇒ R ser = 1 Ω + 2 Ω = 3 Ω

NOTE :

2. Resistances in parallel:



- When the terminals of two or more resistances are connected at the same two points and the potential difference across them is equal is called resistances in parallel.

- The net resistance/equivalent resistance(R) of resistances in parallel is given by:
- $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$

---

4. Answer: b

Explanation:

GIVEN:

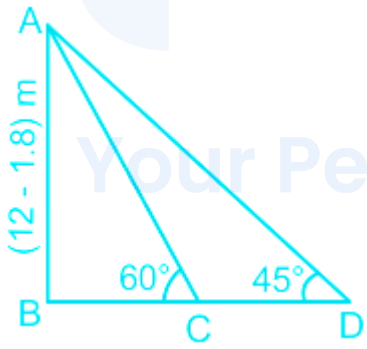
BA = 12 - 1.8 = 51/5

FORMULAE USED:

CD = BD - BC

Tan θ = Perpendicular/Base

CALCULATION:



Tan 60° = 10.2/BC

⇒ BC = 51/5√3

Tan 45° = 10.2/ BD

⇒ BD = 51/5

CD = 51/5 - 51/5√3

∴ CD = 51(√3 - 1)/5√3

5. **Answer: a**

Explanation:

Concept used:

Factorise and equate the factors to 0

Calculation:

$12x^2 + 45x = 0$

$\Rightarrow x(12x + 45) = 0$

So, $x = 0$

And $12x + 45 = 0$

$\Rightarrow x = -45/12 = -15/4$

$\Rightarrow x = 0, -15/4$

∴ The roots of equation will be 0 and -15/4

---

6. **Answer: c**

Explanation:

CONCEPT:

There are mainly two types of force :

Sl. No.	Conservative force	Non-conservative force
1	When the work done by the force is independent of the path taken and only depends on the initial and final position. Then this force is called a conservative force.	When the work done by the force depends on the path taken then the force is called a non-conservative force.
2	The work done by a conservative force on a closed path is zero.	The work done by a non-conservative force on a closed path is non-zero.
3	Examples : Gravitational force, electrostatic force, magnetic force, elastic spring force, air resistance, etc.	Examples:Frictional force , Viscous force , Airdrag, etc .

EXPLANATION:

- From the above table, it is clear that the **electrostatic force** , gravitational force, and spring force are examples of a **conservative force** . Therefore option 3 is correct.

---

7. **Answer: b**

Explanation:

CONCEPT:

To make a linear equation in x cross multiply the equation.

CALCULATION:

$2(5x + 1) = x \times (5)$

$10x + 2 = 5x$

$\therefore 5x + 2 = 0$ is the reduced linear equation

8. **Answer: a**

Explanation:

CONCEPT :

- Power of Accommodation of eye is the ability of the eye to **observe distinctly the objects situated at widely different distances from the eye** , on account of change in focal length of the eye lens by the action of ciliary muscles holding the lens.
- The maximum power of accommodation of the eye for a person having normal vision (d = 25 cm) is

$$P = \frac{100}{f} = \frac{100}{d} = \frac{100}{25} = 4\,dioptre$$

EXPLANATION :

- From the above, it is clear that, the **ability of the eye to focus on both near and far objects** is called the **power of accommodation** . therefore option 2 is correct.

Defects of Vision	Details	Corrections
Myopia (short-sightedness)	The human eye can see a nearby object clearly but cannot see far away object clearly.	concave lens
Hypermetropia or Farsightedness	The human eye can see distant objects clearly but cannot see nearby objects clearly.	Convex Lens
Presbyopia	In this defect, both near and far objects are not clearly visible. It is an old age disease and it is due to the loosing power of accommodation.	Bifocal lenses
Astigmatism	In this defect, the eye cannot see horizontal and vertical lines clearly, simultaneously. It is due to the imperfect spherical nature of the eye lens.	Cylindrical lens

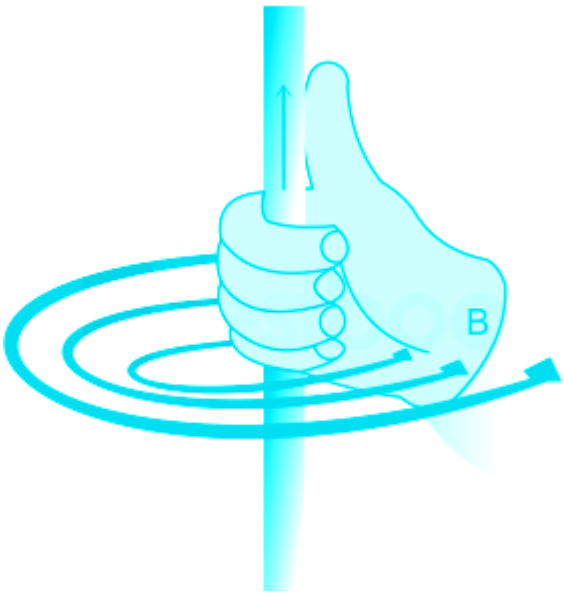
9. **Answer: b**

Explanation:

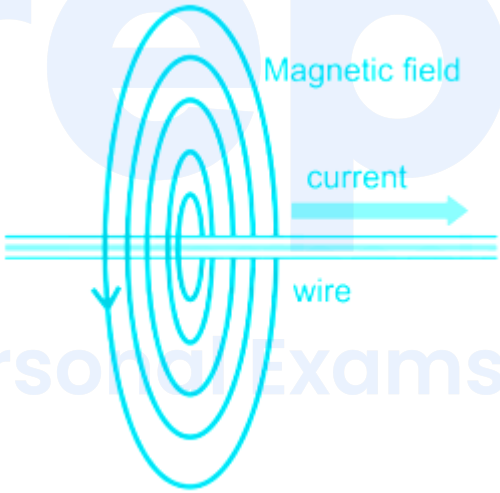
CONCEPT :

Right-hand thumb rule:

- According to this rule, if we imagine the linear wire conductor to be held in the grip of the right hand so that the thumb points in the direction of the current , then the curvature of the fingers around the conductor will represent the direction of the magnetic field lines .



EXPLANATION :



- If the current through a horizontal power line flows in the **east to west direction** , then the **direction of the magnetic field** at a point directly below it will be from **north to south** . Therefore option 2 is correct.

---

10. **Answer: c**

Explanation:

GIVEN:

Length = 200 m

Area = 3000 m^2

Cost of fencing per metre = Rs. 5

FORMULAE USED:

Area = length × breadth

Perimeter = 2(length + breadth)

Cost of fencing = Perimeter × cost of fencing per metre

CALCULATION:

Breadth = 3000 / 200 = 15 m

Perimeter = 2(200 + 15) = 430 m

Cost of fencing = 430 × 5

∴ Cost of fencing = 2150

---

11. Answer: c

Explanation:

GIVEN:

AB = 12 cm

AC = 15 cm

PQ = 4 cm

CONCEPT:

Using the relationship between the sides of similar triangles.

FORMULAE USED:

For similar triangles

PQ / AB = PR / AC

CALCULATION:

PR = 4 × 15 / 12

∴ PR = 5 cm

---

12. Answer: d

Explanation:

CONCEPT :

- Electric Power : The rate at which electrical energy is dissipated into other forms of energy is called electrical power i.e.,

$P = \frac{W}{t} = VI = I^2R = \frac{V^2}{R}$

Where V = Potential difference, R = Resistance and I = current.

CALCULATION :

Given - Potential difference (V) = 200 V and current (I) = 0.5 A

- Electric power can be written as,

⇒ P = VI

⇒ P = 200 × 0.5 = 100 W

---

13. Answer: b

Explanation:

CONCEPT:

Refractive index:

- The ratio of the speed of light in a vacuum to speed of light in a medium is called the refractive index of that medium.
- It is also called an absolute refractive index .

$$\text{Refractive index } (\mu) = \frac{Speed\ of\ light\ in\ vaccum(C)}{Speed\ of\ light\ in\ a\ medium(v)}$$

EXPLANATION :

Given - Velocity of light in free space = c, distance = x, and refractive index = μ

As we know,

$$\Rightarrow Time = \frac{distnace}{speed(v)}$$

$$\Rightarrow Time(t) = \frac{distnace(x)}{\frac{Speed\ of\ light\ in\ vaccum(c)}{refractive\ index(\mu)}}$$

$$\Rightarrow t = \frac{x}{\frac{c}{\mu}} = \frac{x\mu}{c}$$

---

14. Answer: c

Explanation:

CONCEPT:

- Whenever a current is flowing in the resistance then heat is produced in it .
- The phenomenon of producing heat by the electric current is called as the heating effect of electric current .
- The amount of heat produced (H) in joules = I 2 R t = VIt

Where I = current, R = resistance, t = the time taken, and V = electric potential

EXPLANATION:

Given - I = Q/t = 96000/3600 = 80/3 A, V = 50 V and t = 1 hour = 3600 sec

- The amount of heat produced (H) in joules is

⇒ H = VIt

⇒ $H = 50 \times \frac{80}{3} \times 3600$

⇒ H = 4.8 × 10 6 J

---

15. **Answer: b**

Explanation:

GIVEN:

The vertices of the parallelogram = A(1, 2), B(a, -26), C(13, -14) and D(6, 14)

CONCEPT:

Using the distance formulae we will equate the parallel sides of the parallelogram.

FORMULAE USED:

D = $\sqrt{((x_2 - x_1)^2 + (y_2 - y_1)^2)}$

CALCULATION:

AB = DC

⇒ $\{(a - 1)^2 + (-26 - 2)^2\} = \{(6 - 13)^2 + (14 - (-14))^2\}$

⇒ $(a - 1)^2 + 784 = 49 + 784$

⇒ $(a - 1)^2 = 49$

⇒ a - 1 = 7

∴ a = 8

---

16. **Answer: c**

Explanation:

∠ B = ∠ K = 60° as the triangles are similar

---

17. **Answer: b**

Explanation:

CALCULATION:

x + 50y = 120

⇒ x + 50(x / 10) = 120

⇒ x + 5x = 120

⇒ x = 120 / 6 = 20

Now,

y = 20 / 10 = 2

∴ x = 20 and y = 2

---

18. **Answer: a**

Explanation:

CALCULATION:

Sum of age of Students in age band 0-10 = 0

Sum of age of Students in age band 10-20 = 50

Sum of age of Students in age band 20-30 = 300

Sum of age of Students in age band 30-40 = 120

Average age = (0 + 50 + 300 + 120) / (4 + 5 + 15 + 4)

∴ Average age = 22.6 ≈ 22 years

---

19. **Answer: a**

Explanation:

FORMULAE USED:

Area of the Ring = $\pi(R^2 - r^2)$

CALCULATION:

Area of the Ring I = $\pi(17^2 - 15^2) = 64p$

Area of the Ring II = $\pi(13^2 - 12^2) = 25p$

∴ The total area of the two rings = $89\pi r^2$

Note: Diameter was given in place of radius in official paper but options were according to the radius hence we modified the question according to the option and replaced diameter with radius.

---

20. **Answer: c**

Explanation:

GIVEN:

Ratio of radius of circles = 4 : 3

CONCEPT:

Let the radius of one circle be 4x

Then radius of other circle = 3x

FORMULAE USED:

Area of the circle = πr^2

CALCULATION:

Combined total surface are of the two circles = $\pi(3x)^2 + \pi(4x)^2 = 9\pi x^2 + 16\pi x^2$

$\therefore$ Combined total surface are of the two circles = $25\pi x^2$

---

21. Answer: b

Explanation:

CONCEPT :

Newton's Second Law:

- The rate of change of linear momentum of a body is directly proportional to the external force applied on the body and this change takes place always in the direction of the applied force .
- If a body of mass m moves with velocity $\vec{v}$ then its linear momentum can be given by $\vec{p} = m\vec{v}$ and if force $\vec{F}$ is applied on a body, then
  $\therefore \vec{F} = m\vec{a}$
  Where F = Force, m = mass and a = acceleration

CALCULATION :

Given – Mass of a object (m) = 3 kg, initial velocity (u) = 0 m/s, t = 3 sec and force (F) = 6 N

According to Newton's second law of motion,

$\Rightarrow F = m\left(\frac{v-u}{t}\right)$

$\Rightarrow 6 = 3(\frac{v-0}{3})$

⇒ v = 6 m/s

---

22. Answer: b

Explanation:

CONCEPT:

Follow BODMAS rule to solve this question, as per the order is given below:

Step-1: Parts of an equation enclosed in 'Brackets' must be solved first and in the bracket,

Step-2: Any mathematical 'Of' or 'Exponent' must be solved next,

Step-3: Next, the parts of the equation that contain 'Division' and 'Multiplication' are calculated,

Step-4: Last but not least, the parts of the equation that contain 'Addition' and 'Subtraction' should be calculated.

CALCULATION:

32 / 16 + 8(96 / 12) - 8

⇒ 2 + 8(8) - 8

∴ = 58

---

23. **Answer: b**

Explanation:

GIVEN:

Subtended angle = 126°

Length of blade = 18 cm

Number of blades = 2

CONCEPT:

Total area cleaned at each seep = 2 × Area of the sector

FORMULAE USED:

Area of the sector = (Subtended angle / 360°) × πr^2

CALCULATION:

Total area cleaned at each seep = 2 × (126° / 360°) × $\pi(18)^2$ = 2 × (7 / 20) × (22 / 7) × (324)

∴ Total area cleaned at each seep = 712.8 cm^2

---

24. **Answer: d**

Explanation:

CONCEPT :

Newton's Second Law:

- The rate of change of linear momentum of a body is directly proportional to the external force applied on the body and this change takes place always in the direction of the applied force .

- If a body of mass m moves with velocity $\vec{v}$ then its linear momentum can be given by $\vec{p} = m\vec{v}$ and if force $\vec{F}$ is applied on a body, then
  $\therefore \vec{F} = m\vec{a}$
  Where F = Force, m = mass and a = acceleration

CALCULATION :

Given – F = 40 N, m 1 = 10 kg, m 2 = 6 kg and m 3 = 4 kg

- Three blocks are connected with each other, therefore the **total mass of the system** is

⇒ M = 10 + 6 + 4 = 20 kg

- The **total acceleration of the system** is

$\Rightarrow a = \frac{F}{M} = \frac{40}{20} = 2\,m/s^2$

- From the above figure, we can see that string T_2 pulls blocks of masses m_1 and m_2, therefore tension T 2 will be

⇒ $T_2 = (m_1 + m_2)a$

⇒ T 2 = (10 + 6) × 2 = 32 N

---

25. Answer: d

Explanation:

Explanation:

Light year:

- The distance travelled by light in one year is called one light-year. It is the unit of astronomical distance.
- **1 light-year = 9.461 trillion kilometres** which is a very large distance.
- The unit of length which is equal to 10^{-10} meters is called **1**Angstrom. Itis denoted by Å .

⭐ **Additional Information**

SI Prefix		
Prefix	Symbol	Multiplier
exa	E	10^{18}
peta	P	10^{15}
tera	T	10^{12}
giga	G	10^{9}
mega	M	10^{6}
kilo	k	10^{3}
hecto	h	10^{2}
deca	da	10^{1}
deci	d	10^{-1}
centi	c	10^{-2}

mili	m	10^{-3}
micro	μ	10^{-6}
nano	n	10^{-9}
angstrom	Å	10^{-10}
pico	p	10^{-12}
femto	f	10^{-15}
atto	a	10^{-18}

26. **Answer: a**

Explanation:

GIVEN:

AD = 24 cm

AB = BC = CD = AD / 3 = 24 / 3 = 8 cm

CONCEPT:

FORMULAE USED:

Area of the shaded region = Area of the semi-circle with diameter AD + Area of the semi-circle with diameter AB - Area of the semi-circle with diameter BD

Area of the semi-circle = ½ πr^2

CALCULATION:

Area of the semi-circle with diameter AD = ½ $\pi(12)^2 = 72\pi$

Area of the semi-circle with diameter AB = ½ $\pi(4)^2 = 8\pi$

Area of the semi-circle with diameter BD = ½ $\pi(8)^2 = 32\pi$

Area of the shaded region = $72\pi + 8\pi - 32\pi$

∴ Area of the shaded region = 48π

---

27. **Answer: d**

Explanation:

CONCEPT:

Magnetic field strength:

- The space or region around the current-carrying wire/ moving electric charge or around the magnetic material in which force of magnetism can be experienced by other magnetic material is called a magnetic field by that material.
- The value of this magnetic field is called magnetic field strength of that magnetic material.

Properties of Magnetic Field Lines:

1. A magnetic field line is directed from **north-pole to south-pole outside the magnet** .
2. A magnetic field line is a **closed and continuous curve** . (Magnetic field lines inside the magnet where these are directed from south pole to north pole).

3. The magnetic field lines are **crowded near the pole** where the **magnetic field is strong** and are **far apart near the middle of the magnet** and **far from the magnet** where the **magnetic field is weak** .
4. The magnetic field lines **never intersect each other** because if they do so, there would be two directions of the magnetic field at that point which is absurd.
5. In case the field lines are parallel and equidistant, these represent a uniform magnetic field. The Earth's magnetic field is uniform in a limited space.

EXPLANATION :

- From the above, it is clear that the **magnetic field due to the magnet** in the **crowded region is the strongest** .

---

28. Answer: d

Explanation:

CONCEPT :

Principle of homogeneity of dimensions:

- According to this principle , a physical equation will be dimensionally correct if the dimensions of all the terms occurring on both sidesof the equation are the same .
- This principle is based on the fact that only the physical quantities of the same kind can be added , subtracted, or compared .
- Thus, velocity can be added to velocitybut not to force .

EXPLANATION

Given - $x = a + bt + ct^2$

- From the principle of dimensional homogeneity, the left-hand side of the equation dimensionally equal to the right-hand side of the equation.
- The dimension formula of distance $(x) = [L]$

∴ [L] = [a]

- Therefore the **unit of 'a'** is **m**.

For the second term,

⇒ [L] = [b] [T]

$\Rightarrow [b] = \frac{[L]}{[T]} = [LT^{-1}]$

- Therefore the unit of 'b' is ms -1.

For the third term,

⇒ [L] = [c] [T 2]

$\Rightarrow [c] = \frac{[L]}{[T^2]} = [LT^{-2}]$

- Therefore the unit of 'c' is ms -2.

---

29. Answer: c

Explanation:

CONCEPT:

- Lens : The transparent curved surface which is used to refract the light and make an image of any object placed in front of it is called a lens .
  - Convex lens : A lens having two spherical surfaces, bulging outwards is called a double convex lens (or simply convex lens).
    - It is thicker in the middle as compared to the edges.
  - Convex lenses converge light rays and hence, convex lenses are also called converging lenses .

EXPLANATION :

- The lens maker's formula is given by:

$\Rightarrow \frac{1}{f} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

Where, f is the focal length (half the radius of curvature), n is the refractive index of the material used, R 1 is the radius of curvature of sphere 1 and R 2 is the radius of curvature of sphere 2

- For **equiconvex** lens

$\Rightarrow \frac{1}{f} = (n-1)\left(\frac{1}{R} + \frac{1}{R}\right) = (n-1)\frac{2}{R}$ -------- (1)

- If a **biconvex lens** is cut perpendicular to its principal axis, then it will become the **plano-convex lens** and then the focal length of the plano-convex lens is

$\Rightarrow \frac{1}{f'} = (n-1)\frac{1}{R}$ ------ (2)

From 1 and 2, we get

⇒ f' = 2f

- The **focal length of each of the four pieces is 2f** . Therefore option 3 is correct.

---

30. Answer: a

Explanation:

CONCEPT :

Dispersive power (ω):

- It is the ability of the prism materials to cause dispersion .
- It is defined as the ratio of the angular dispersion to the mean deviation .

$\omega = \frac{Angular\ dispersion}{Mean\ devaition}$

$\omega = \frac{\delta_v - \delta_r}{\delta_y} = \frac{\mu_v - \mu_r}{u_y - 1}$

CALCULATION :

Given - Dispersive power (ω) = 0.0221 and deviation (δ_Y) = 38°

$\Rightarrow \omega = \frac{\delta_v - \delta_r}{\delta_y}$

⇒ δ V - δ R = ω × δ Y

⇒ δ V - δ R = 0.0221 × 38° = 0.84°

---

31. Answer: d

Explanation:

CONCEPT:

- Equation of Kinematics : These are the various relations between u, v, a, t and s for the particle moving with uniform acceleration where the notations are used as:
- Equations of motion can be written as

V = U + at

$s = ut + \frac{1}{2}at^2$

V 2 =U 2+ 2as

Where, U = Initial velocity, V = Final velocity, g= Acceleration, t = time, and h= height/Distance covered

Where u = Initial velocity of the particle at time t = 0 sec

v = Final velocity at time t sec

a = Acceleration of the particle

s = Distance travelled in time t sec

CALCULATION :

Given - Initial velocity (u) = 0 m/s, final velocity (v) = v and initial distance (s) = h_1

- Equations of motion can be written as

$\Rightarrow V^2 = U^2 + 2gh_1$

$\Rightarrow V^2 = 2gh_1$

$\Rightarrow h_1 = v^2/2g$

- When velocity become double, then the new height will be

$\Rightarrow h_2 = 4v^2/2g = 4h_1$

- The distance it has to fall down further, for its velocity to become double is

$\Rightarrow h = h_2 - h_1$

$\Rightarrow h = 4h_1 - h_1 = 3h_1$

---

32. Answer: d

Explanation:

CALCULATION:

$(2 - 3i) + (3 + 5i) = 2 - 3i + 3 + 5i = 5 + 2i$

---

33. Answer: c

Explanation:

CONCEPT:

Distance :

- The measurement of how much any object moved is called distance .

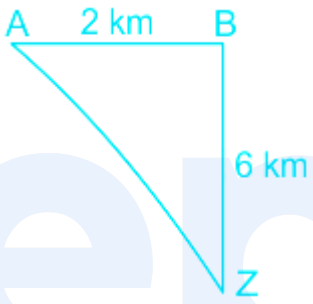
- It is a scalar quantity .

Displacement :

- The minimum distance between two points is called displacement of the object.
- It is a vector quantity .

CALCULATION:

Given - ZB = 6 km and BA = 2 km



- The shortest distance between point Z and A is

$\Rightarrow XY = \sqrt{ZB^2 + AB^2}$

$\Rightarrow XY = \sqrt{6^2 + 2^2} = \sqrt{40} = 2\sqrt{10}km$

⭐ Important Points

- The magnitude of displacement is equal to the minimum possible distance between two positions . So distance ≥ Displacement .
- For a moving particle, distancecan never be negative or zero while displacement can be (Zero displacement means that body after motion has come back to initial position). i.e., Distance > 0 but Displacement > = or < 0 .
- For motion between two pointsdisplacement is single-valued while distance depends on the actual path and so can have many values.
- For a moving particle, distance can never decrease with time while displacement can .
- A decrease in displacement with time means the body is moving towards the initial position .

34. **Answer: a**

Explanation:

CONCEP T:

- When **two sound waves of slightly different frequencies**, travelling in a medium along the **same direction**, **superimpose on each other**, the **intensity of the resultant sound** at a particular **position rises and falls regularly with time**.
- This phenomenon of **regular variation in the intensity of sound with time** at a particular position is called **beats**.
- **Beat frequency**: The **number of beats produced per second** is called a **beat frequency**.
- Beat frequency = number of beats/sec
- If n_1 and n_2 are the frequency of two sources, then the difference in frequencies of two sources

$\Rightarrow m = (n_1 - n_2)$ or $(n_2 - n_1)$

Where m = beat frequency

CALCULATION:

Given – m = 4, n 1 = 200 Hz and n 2 = x

- The beat frequency can be calculated as

$\Rightarrow m = (n\,1 \pm n\,2)$

$\Rightarrow x = 200 - 4 = 196$ HZ

$\Rightarrow m = (n\,2 - n\,1)$

$\Rightarrow x = 200 + 4 = 204$ HZ

35. **Answer: c**

Explanation:

GIVEN:

Vertices of triangle = A(8, 8), B(22, 8) and C(16, -10)

FORMULAE USED:

$D = \sqrt{((x_2 - x_1)^2 + (y_2 - y_1)^2)}$

HERON's Formulae

$S = (a + b + c) / 2$

Area of triangle $= \sqrt{s(s - a)(s - b)(s - c)}$

CALCULATION:

$a = AB = 14$

$b = AC = \sqrt{(8^2 + 18^2)} = 19.7$

$c = BC = \sqrt{(36 + 18^2)} = 19$

$S = 26.4$

Applying HERON's Formulae

Area of Triangle ABC $= \sqrt{26.4\ (26.4 - 14)(26.4 - 19)(26.4 - 19.7)}$

∴ Area of Triangle ABC ≈ 126

---

36. Answer: b

Explanation:

CONCEPT:

- Resistance (R): The resistance offered to the flow of current is known as the resistance .
- SI unit of resistance is the ohm (Ω).
- Mathematically resistance can be written as

$R = \frac{\rho l}{A}$

Where R = resistance, l = length, A = area of cross-section and ρ = resistivity

EXPLANATION:

- From the above, it is clear that the **resistance of the wire** is **directly proportional to its length** .
- The **resistance of the wire** is **inversely proportional** to the **area of cross-section** .
- The resistance of the wire depends on the **nature of the material** . Therefore option 2 is correct.

---

37. **Answer: b**

Explanation:

GIVEN:

Customers prefer to buy that particular stock

FORMULAE USED:

Customer will not prefer to buy stock = 1 - percentage preferred by customers to buy that particular stock

CALCULATION:

Customer will not prefer to buy stock = 1 - 0.4

∴ Customer will not prefer to buy stock = 0.6

---

38. **Answer: d**

Explanation:

Given:

$(0.5\bar{3}53.....)$

Calculation:

Let X = $(0.5\bar{3}53.....)$

X = 0.5353 -------(1)

Multiply equation (1) by 100 we get,

100X = 53.5353 -------(2)

Subtract equation (1) from equation (2) we get,

99X = 53

X = 53/99

∴ The value of $(0.5\bar{3})$ is 53/99.

---

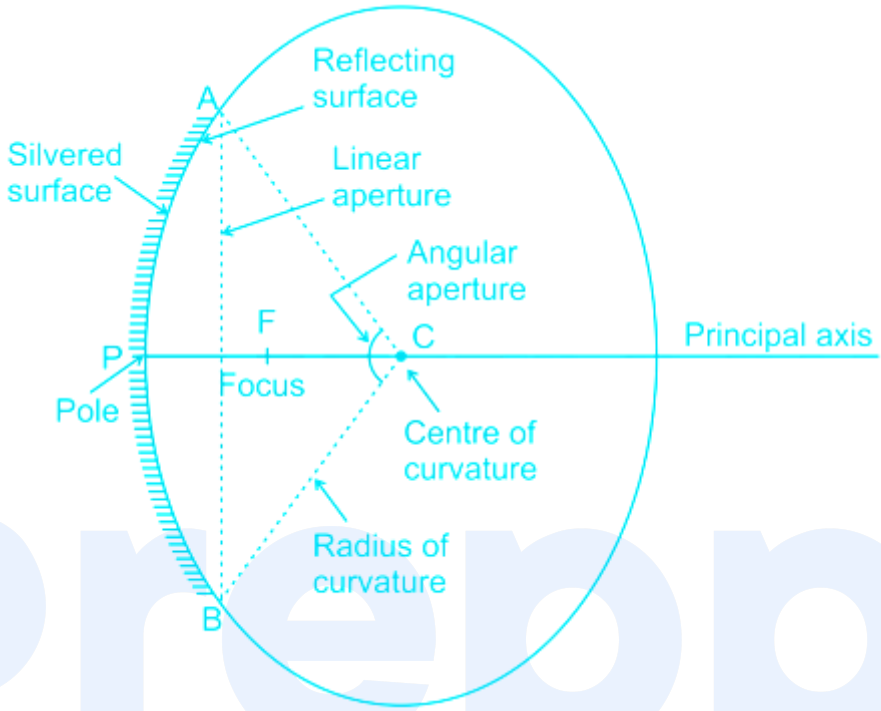
39. **Answer: d**

Explanation:

CONCEPT:

- A spherical mirror is a mirror whose reflecting surface is a part of a hollow sphere of glass .
- One side of the mirror is well polished and reflecting, and another side of the mirror is opaque (often painted red) .
- Spherical mirrors are of two types - Convex mirror, and Concave mirror.

- The image formed by the spherical mirrors depends on the position of the object.



EXPLANATION :

- In case of spherical mirrors, there will be **no change in the focal length of the mirrors** when immersed in water.
- It is so because the **focal length of mirrors does not depend on the external medium** in which it is held.

---

40. Answer: c

Explanation:

FORMULAE USED:

Curved surface area = $2\pi r^2$

Volume of Sphere = $4\pi r^3/3$

CALCULATION:

$2\pi r^2 = 8\pi$

$r = 2$

Volume of Sphere $= 4\pi(2)^3 / 3$

$\therefore$ Volume of Sphere $= 32\pi / 3$

---

41. Answer: a

Explanation:

GIVEN:

First term = 7

Third term = 28

CONCEPT:

When three quantities are in AP, the middle one is called as the arithmetic mean of the other two.

FORMULAE USED:

If a, b and c are three terms in AP

Then $b = (a + c)/2$

CALCULATION:

Second term $= (7 + 28)/2 = 35/2$

$\therefore$ Second term = 17.5

⭐ Alternate Method

a = 7,

a + 2d = 28

⇒ 2d = 28 - 7 = 21

⇒ d = 10.5

2nd term = a + d = 7 + 10.5 = 17.5

---

42. Answer: c

Explanation:

GIVEN:

Roots = 5 and 2

FORMULAE USED:

Quadratic equation = x^2 - (sum of roots)x + (product of the roots)

CALCULATION:

Sum of roots = 5 + 2 = 7

Product of the roots = 5 × 2 = 10

∴ Quadratic equation will be $x^2 - 7x + 10 = 0$

---

43. Answer: d

Explanation:

CONCEPT:

We need to remember that a ***rational number*** is a number that can be expressed as the quotient or fraction p/q of two integers, a numerator p and a non-zero denominator q.

CALCULATION:

Looking at the options only √64 = 8

Thus it can be written as 8/1

∴ Rational Number = √64

⭐ **Additional Information**

The number **e**, also known as Euler's number, is a mathematical constant approximately equal to 2.71828

---

44. Answer: c

Explanation:

CONCEPT :

Acceleration Due to Gravity :

- The force of attractionexerted by the earth on a body is called gravitational pull or gravity .
- We know that when a force acts on a body , it produces acceleration . Therefore, a body under the effect of gravitational pull must accelerate .
- The acceleration produced in the motion of a body under the effect of gravity is called acceleration due to gravity , it is denoted by g.

EXPLANATION :

- The acceleration due to gravity on the surface of the earth is given by,

$\Rightarrow g = \frac{GM}{R^2}$

Where G = universal gravitational constant, M = mass of the earth and R = radius of the earth

---

45. **Answer: a**

Explanation:

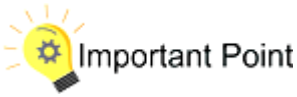
CONCEPT :

Newton's Third Law:

- To every action , there is always an equal (in magnitude) and opposite (in direction) reaction .
- When a bo dy exerts a force on any other body , the second body also exerts an equal and opposite force on the first .
- Forces in nature always occur in pairs . A single isolated force is not possible .

EXPLANATION :

- Here an **automobile is towing a trailer** , so the force that the automobile exerts on the trailer is **equal and opposite than the force** that the trailer exerts on the automobile. Therefore option 1 is correct.



- Newton's third law of motion is applicable irrespective of the nature of the forces . The forces of action and reactions may be mechanical , gravitational , electric, or of any other nature .
- Action and reaction always act on different bodies . If they acted on the same body, the resultant force would be zero and there could never be accelerated motion .
- The forces of action and reaction cannot cancel each other . This is because action and reaction , though equal and opposite, always act on different bodies and so cannot balance each other .
- No action can occur in the absence of a reaction .

46. **Answer: d**

Explanation:

CONCEPT :

Elastic Potential Energy (U) :

- When a spring is stretched or compressed from its normal position (x = 0) by a small distance x, then a restoring forceis produced in the spring to bring it to the normal position.
- According to Hooke's law, this restoring force is proportional to the displacement x and its direction is always opposite to the displacement .

F = -kx

- Mathematically elastic potential energy can b written as,

$U = \frac{1}{2}kx^2$

Where K = spring constant

EXPLANATION :

Given – U = 2 J and x = 4 cm = 4 × 10 -2 m

- Elastic potential energy is,

$\Rightarrow U = \frac{1}{2}kx^2$

$\Rightarrow k = \frac{2U}{x^2} = \frac{2\times2}{(4\times10^{-2})^2}$

⇒ k = 10^4/4 N/m

- The force required to extend it by 8 cm will be

⇒ F = -kx

$\Rightarrow F = \frac{10^4}{4} \times 8 \times 10^{-2} = 200\,N$

---

47. Answer: c

Explanation:

GIVEN:

f(x) = (x - 17) (x - 7)

CONCEPT:

To find the zero of a function we equate the function with zero.

FORMULAE USED:

f(x) = 0

CALCULATION:

⇒ (x - 17) (x - 7) = 0

So,

⇒ (x - 17) = 0

⇒ x = 17

And,

⇒ (x - 7) = 0

⇒ x = 7

∴ x = 17, 7

---

48. Answer: d

Explanation:

CONCEPT :

Linear Momentum:

- The linear momentum of a body is the quantity of motion contained in the body .
- It is measured in terms of the force required to stop the body in unit time .
- It is also measured as the product of the mass of the body and its velocity i.e.,

Momentum (p) = mass (m) × velocity (v)

EXPLANATION :

- Momentum is the total quantity of motion contained in the same body . Therefore option 4 is correct.

---

49. **Answer: b**

Explanation:

CONCEPT:

- Power : The rate of work done is called power.
  - It is denoted by P.
  - Mathematically it is written as

$Power\ (P) = \frac{d\,W}{dt}$

- Kinetic energy (KE): The energy possessed by a body by virtue of its motion is called kinetic energy .

$KE = \frac{1}{2}mv^2$

Where m = mass of the body and v = velocity of the body

- Potential energy (PE): The energy possessed by a body by virtue of its position or configuration is called potential energy.

$PE = mgh$

Where, m = mass of the body, g = acceleration due to gravity and h = height of the body

CALCULATION :

Given - m = 600 kg, h = 25 m and v = 50 m/s

- The **total energy** of the body is the **sum of kinetic and potential energy.**

⇒ T = KE + PE

$\Rightarrow T = mgh + \frac{1}{2}mv^2$

$\Rightarrow T = 600 \times 10 \times 25 + \frac{1}{2} \times 600 \times (50)^2$

⇒ T = 150000 + 750000 = 900000 J

- The power required to perform the above task is

$\Rightarrow P = \frac{900000}{60} = 15000\,W$

⇒ P = 15 kW

---

50. Answer: c

Explanation:

CONCEPT :

- Measurement of any physical quantity involves comparison with a certain basic, arbitrarily chosen, internationally accepted reference standard called unit, and a Dimension is a mathematical tool used for studying the nature of physical quantities .

- The basic concept of dimensions is that we can add or subtract only those quantities which have the same dimensions .
- And the dimensional formula is defined as the expression of the physical quantity in terms of mass , length , and time .

EXPLANATION :

- **Speed** is defined as the **rate of change of distance** i.e.,

$\Rightarrow Speed(v) = \frac{Distance(d)}{time(t)}$

As we know, the dimension formula of distance (d) = [L]

The dimension formula of time (t) = [t]

∴ The dimension formula of speed is

$\Rightarrow v = \frac{[L]}{[T]} = [M^0 LT^{-1}]$

Quantity	Unit	Dimension
Pressure	Pascal	[ML -1 T-2]
Stress	Pascal	[ML -1 T-2]
Velocity	m/s	[LT -1]
Speed	m/s	[LT -1]
Force	Newton	[MLT -2]
Impulse	Newton-second	[MLT -1]
Work	Joule	[ML 2T -2]
Energy	Joule	[ML 2T -2]
Capacitance (C)	Coulomb/volt or Farad	[M -1 L-2 T4 A2]
Resistivity or Specific resistance (ρ)	Ohm-meter	[ML 3T -3 A-2]
Electric current (I)	Ampere	[A]
Electric charge (q)	Coulomb	[AT]
Inductance (H)	henry	[ML 2T -2 A-2]

51. **Answer: c**

Explanation:

GIVEN:

Base = 8 cm

Side = 6 cm

CONCEPT:

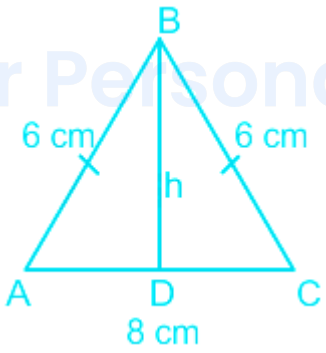
FORMULAE USED:

Using Pythagoras theorem

$BD^2 = BC^2 - DC^2$

Area of triangle = ½ (Base × Height)

CALCULATION:



As ΔABC is isosceles then AD = DC = AC/2 = 8/2

DC = 4 cm

$BD^2 = 6^2 - 4^2$

BD = √(36 - 16) = √20

Base = AC = 8 cm, Height = BD = √20 cm

Area of triangle = 1/2 × AC × BD = 1/2 × 8 × √20 = 4√20

⇒ 4(√2 × 2 × 5) = 8√5

∴ Area of triangle = 8√5

---

52. Answer: d

Explanation:

FORMULAE USED:

d = common difference = a_n - a(n - 1)

a_n = a + (n - 1) d

CALCULATION:

d = 25 - 2 = 23

a3 = 2 + (3 - 1) 23 = 48

∴ Missing term = 48

---

53. Answer: b

Explanation:

FORMULAE USED:

Quadratic equation = x^2 - (sum of roots)x + (product of the roots)

CALCULATION:

Let another root of the equation be (-5 + i)

Sum of roots = -5 + i + -5 - i = -10

Product of the roots = (-5 + i) × (-5 - i) = 25 - i^2 = 25 - (-1) = 26

Quadratic equation will be x^2 - (-10)x + 26 = 0

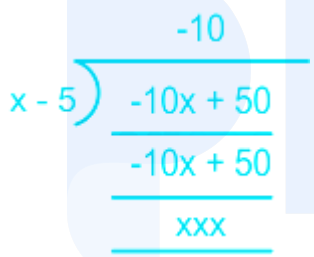
∴ Quadratic equation will be x^2 + 10x + 26 = 0

---

54. Answer: b

Explanation:

CALCULATION:



∴ On dividing we get -10

---

55. Answer: c

Explanation:

FORMULAE USED:

The coordinates of point when (x_1, y_1) and (x_2, y_2) are divided in m : n internally

Point = (mx_2 + nx_1) / (m + n), (my_2 + ny_1) / (m + n))

CALCULATION:

x - Coordinate = (10 + 30) / (2 + 3) = 40 / 5 = 8

y - Coordinate = (16 + 54) / (2 + 3) = 70 / 5 = 14

$\therefore$ Point = $(8, 14)$

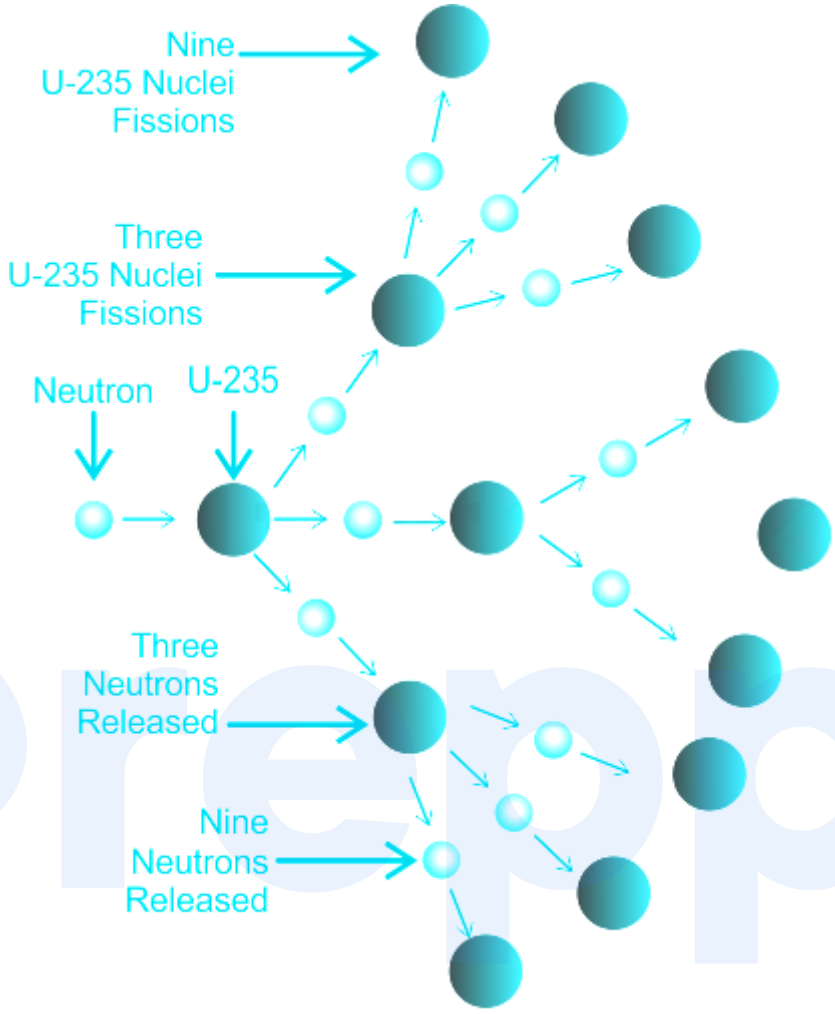
---

56. Answer: a

Explanation:

CONCEPT:

- The nucleus of a heavy atom (such as uranium, plutonium or thorium), when bombarded with low-energy neutrons , can be split apart into lighter nuclei. This process is called nuclear fission .
- Fission occurs when a neutron slams into a larger atom , forcing it to excite and split into two smaller atoms —also known as fission products .
- A chain reaction refers to a process in which neutrons released in fission reaction produces an additional fission reaction in at least one further nucleus. This nucleus, in turn, produces neutrons, and the process repeats.



- During this reaction, a tremendous amount of energy is released.

EXPLANATION:

- **Fission reaction** can further be classified into **controlled** and **uncontrolled fission reaction** .
- In controlled fission the chain reaction is controlled and only a controlled amount of reaction is allowed, nuclear reactors in nuclear power plants are one of the examples of the controlled fission reaction.
- And for uncontrolled fission chain reaction it is allowed to happen unless fission material is over, **atomic bomb** is one of the examples of an **uncontrolled fission reaction** .

57. **Answer: d**

Explanation:

GIVEN:

BC = 18 m

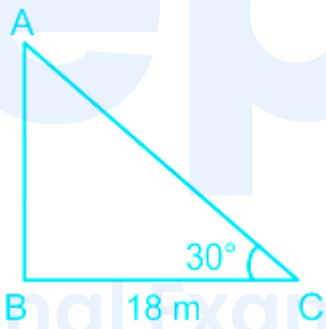
CONCEPT:

FORMULAE USED:

Tanθ = Perpendicular/Base

Cosθ = Base/Hypotenuse

CALCULATION:



Height of the tree = AB + AC

Tan 30° = AB/18

⇒ (1/√3) = AB/18

⇒ AB = (18/√3)

Cos 30° = BC/AC = 18/AC

⇒ √3/2 = 18/AC

⇒ AC = 36/√3

Hence, AB + AC = 18/√3 + 36/√3 = 54 / √3

⇒ 54/√3 × √3 /√3 (rationalizing to remove root from denominator)

⇒ 54√3 / 3 = 18√3

∴ Height of the tree = 18√3.

Mistake Point : Here, total height of tree is (AB + AC).

The above Question is previous year Question taken directly from NCERT class 10th. Correct answer will be 18√3

---

58. Answer: b

Explanation:

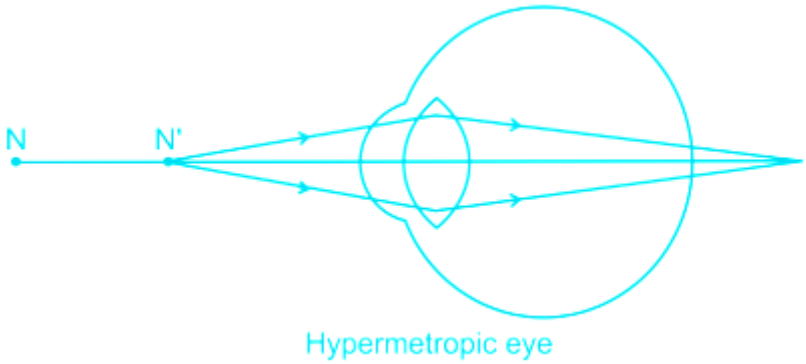
CONCEPT :

Hypermetropia (long-sightedness):

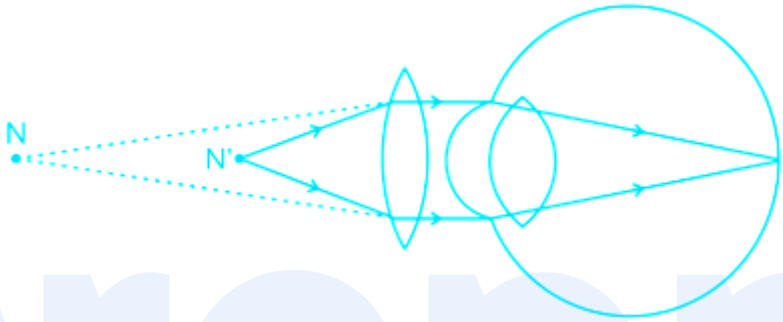
- It is a defect of the eye due to which a person can see f artherobjects clearly but nearer objects are not clearly visible .

EXPLANATION:

- The image is formed behind the retina and the near point moves away .



Hypermetropic eye



Correction for Hypermetropic eye

- In this defect focal length or radii of curvature of the lensincreases or the power of the lensdecreases or the distance between the eye lens and retina decreases .
- This defect can be removed by using a convex lens.

CALCULATION :

Given - least distance of distinct vision (v) = 50 cm

The object distance for long-sighted person = ∞

- According to the lens formula

$\Rightarrow \frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$\Rightarrow \frac{1}{f} = \frac{1}{50} - \frac{1}{\infty} = \frac{1}{50}$

⇒ f = 50 cm

- He should use **convex lens of focal length 50 cm** .

59. **Answer: b**

Explanation:

CONCEPT :

- Echo : If we shout or clap near a suitable reflecting object such as a tall building or a mountain, we will hear the same sound again a little later. This sound that we hear is called an echo.
  - Echoes are heard due to the phenomenon of Reflection of sound waves .
  - To hear the echo clearly, the reflecting object must be more than 17.2 m from the sound source for the echo to be heard by a person standing at the source.

CALCULATION :

Given - time (t) = 0.6 sec and distance (d) = 99 m,

For hearing, echo sound must go to the obstacle and reach back the ear of the listene r on reflection, thus the **distance is doubled i.e. d' = 198 m.**

- The speed of sound is

$\Rightarrow Speed(v') = \frac{distance(d')}{time(t)}$

$\Rightarrow v' = \frac{198}{0.6} = 330\, m/s$

Therefore the speed of sound is 330 m/s .

---

60. **Answer: c**

Explanation:

CONCEPT :

Hydroelectric Power Plant:

- The electricity produced from the kinetic energy of flowing water is called hydroelectricity and a plant that generates electricity on a large scale from flowing water is called a hydroelectric power plant .
- The requirements for a hydroelectric power plant are a strong , fast flow of water and a significant drop down in which the water can fall .

EXPLANATION :

- A storage dam (a high rise structure) is constructed to collect water in a large artificial lake (like Gobind Sagar Lake which collects water for Bhakra Dam).
- In this process, the kinetic energy of water is transformed into its potential energy . The stored water has a lot of potential energy .
- Water from the top of the dam is allowed to fall through pipelines over the blades of a turbine at the bottom of the dam .
- In this process, the potential energy of water changes into its kinetic energy which is transferred to the turbine. Therefore option 2 is correct.
- Moving the turbine rotates the armature of a generator to produce electricity, i.e., the turbine changes the kinetic energy of water into electricity .
- After having run the turbines, water collects in a **control dam** .
- Water in the **control dam** can either be made to fall again through a height to produce electricity in the same way as discussed earlier or can be sent to canals for irrigation.

---

61. **Answer: b**

Explanation:

GIVEN:

RS = 3√3 cm

PR = RS = 3√3 cm

CONCEPT:

FORMULAE USED:

Sin θ = PR / QR

Sin 60° = √3 / 2

CALCULATION:

√3 / 2 = 3√3 / QR

QR = 3√3 / √3 / 2

∴ QR = 6 cm

---

62. Answer: c

Explanation:

GIVEN:

CONCEPT:

The part containing 'i' is the imaginary part and the rest is the real part.

FORMULAE USED:

CALCULATION:

Imaginary part = 2i

∴ Real part = 15

---

63. Answer: a

Explanation:

GIVEN:

Length of a board = 12 cm

Breadth of a board = 3 cm

CONCEPT:

Length of the tape = Perimeter of Rectangle

FORMULAE USED:

Perimeter = 2(Length + Breadth)

CALCULATION:

Length of the tape = 2(12 + 3) = 2 × 15

∴ Length of the tape = 30 cm

---

64. **Answer: c**

Explanation:

GIVEN:

Number of models of 800 cc car = 2

Number of models of 1500 cc car = 4

CONCEPT:

FORMULAE USED:

Probability that a customer will choose am 800 cc = Number of models of 800 cc car / Total number of cars

CALCULATION:

Probability that a customer will choose am 800 cc = 2 / 6

∴ Probability that a customer will choose am 800 cc = 1 / 3 = 0.33

---

65. **Answer: a**

Explanation:

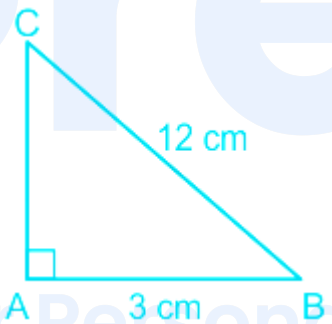
CONCEPT:

To solve this question we will use Pythagoras theorem

FORMULAE USED:

$AC^2 = BC^2 - AB^2$

CALCULATION:



$AC^2 = 12^2 - 3^2$

$AC^2 = 144 - 9$

$AC = \sqrt{135}$

$AC = 3\sqrt{15}$ cm

---

66. **Answer: d**

Explanation:

CONCEPT :

Horizontal Projectile:

- When a body is projected horizontally from a certain height 'y' vertically above the ground with initial velocity u.
- If friction is considered to be absent, then there is no other horizontal force that can affect the horizontal motion .
- The horizontal velocity, therefore,remains constant and so the object covers equal distance in the horizontal direction in equal intervals of time .
- The trajectory of horizontal projectile: The horizontal displacement x is governed by the equation

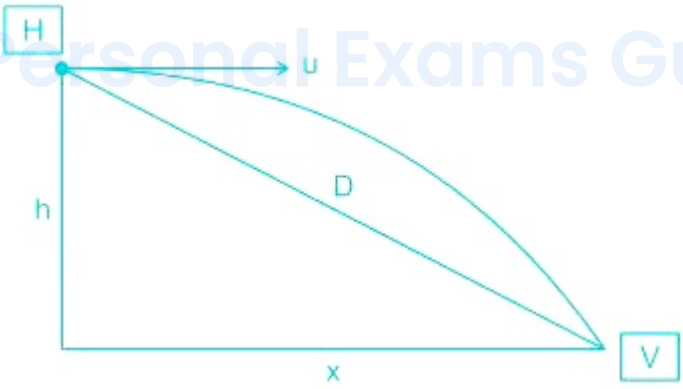
$x = ut \Rightarrow t = \frac{x}{u}$

- The vertical displacement y is governed by

$y = \frac{1}{2}gt^2$

EXPLANATION :

Given - speed = u and altitude = h



- Here, h = height above the ground level. and v = velocity

$\Rightarrow h = 0 + \frac{1}{2}gt^2 \Rightarrow t = \sqrt{\frac{2h}{g}}$

- The horizontal distance covered by the food packet in time t,

$\Rightarrow R = ut = u\sqrt{\frac{2h}{g}}$

∴ The range (R) is

$\Rightarrow R = u\sqrt{\frac{2h}{g}}$

---

67. Answer: d

Explanation:

FORMULAE USED:

Area of ΔPQR / Area of ΔLQJ = (QR / QJ) ^{2}

CALCULATION:

Area of ΔPQR / Area of ΔLQJ = (5 / 10) ^{2}

∴ Area of ΔLQJ / Area of ΔPQR = 4

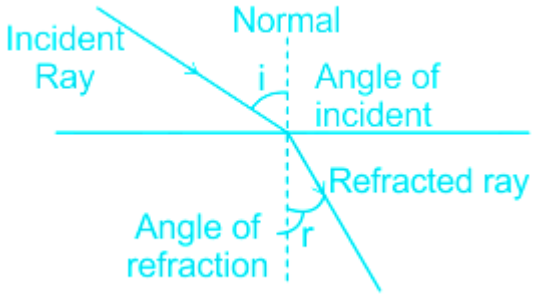
---

68. Answer: d

Explanation:

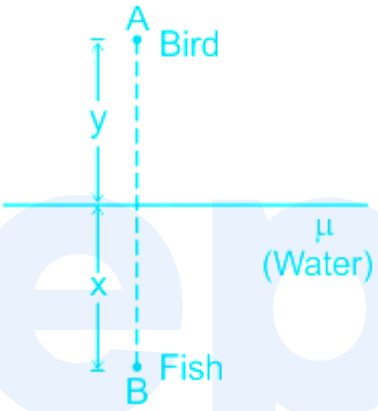
CONCEPT :

- Refraction of Light: The bending of the ray of light passing from one medium to the other medium is called refraction .



- The refraction of light takes place on going from one medium to another because the speed of light is different in the two media .
- The greater the differencein the speeds of light in the two media, the greater will be the amount of refraction .
- A medium in which the speed of light is more is known as optically rarer medium and a medium in which the speed of light is less is known as an optically denser medium .

EXPLANATION :



Given - Real depth of the fish = x, real depth of the bird = y and refractive index of water (μ_w) = μ

- The apparent depth is the **distance of the virtual image from the surface of reference** and the real depth is the **distance of the real image from the surface of reference** .

$\Rightarrow Refrective\ index = \frac{Real\ depth}{Apparent\ depth}$

- The **apparent distance of fish from the bird** is

$\Rightarrow Apparent\ depth = \frac{y}{\mu} + \frac{x}{\mu_w}$

$\Rightarrow Apparent\ depth = y + \frac{x}{\mu}$ [∵ Refractive index of water (μ) = 1]

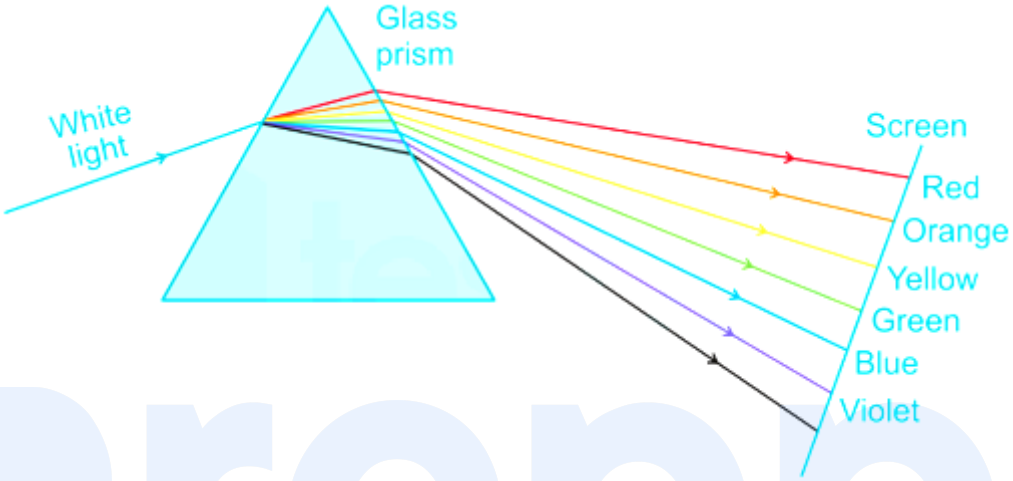
---

69. **Answer: c**

Explanation:

CONCEPT :

Dispersion of light:



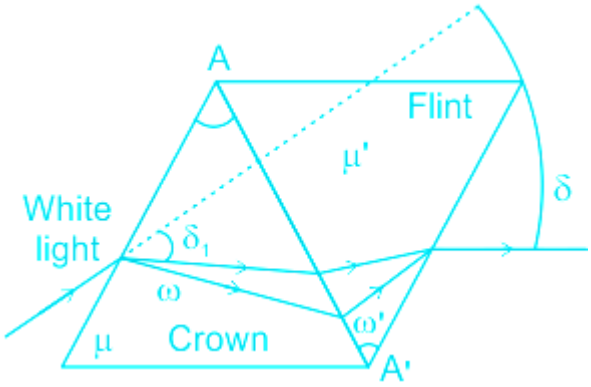
- Dispersion of light is the phenomenon of splitting of a beam of white light into its constituent colours on passing through a prism.
- The band of seven colours so obtained is called the (visible) spectrum .
- The dispersion of white light occurs because the colours of white light travel at different speeds through the glass prism .

EXPLANATION :

- From above it is clear that in dispersion, a white light **splits** into its constituent colours on passing through a prism.
- Deviation without Dispersion (Achromatic Prism): It is possible to combine two prisms of different materials in such a way that each cancels the dispersion due to the other . Thus, the net dispersion is zero but a deviation is produced . The required condition is

$(\mu_v - \mu_r) A = (\mu'_v - \mu'_r) A'$

Where for the first prism: μ_v = refractive index of the medium in violet light, μ_r = refractive index of the medium in red light A = angle of the prism; For the second prism: μ'_v = refractive index of the medium in violet light, μ'_r = refractive index of the medium in red light, A′ = angle of prism.)



- Being the **yellow light in the middle of the visible spectrum** , it emerges out **parallel to the incident ray** .

---

70. Answer: b

Explanation:

CONCEPT :

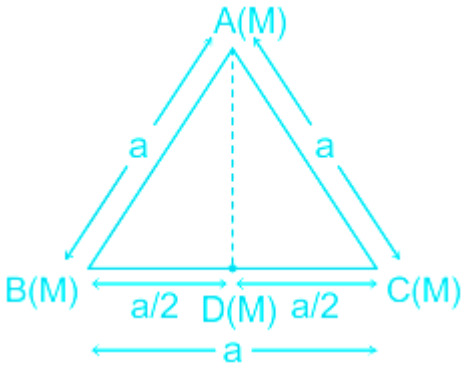
Newton's law of Gravitation:

- Newton's law of gravitation states that everybody in this universe attracts every other body with a force , which is directly proportional to the product of their masses and inversely proportional to the square of the distance between their centers .
- The direction of the force is along the line joining the particles .
- The magnitude of the gravitational force F is

$F = G\frac{M_1 M_2}{R^2}$

Where G = universal gravitational constant, M 1 = mass of 1 st body, M 2 = mass of 2 nd body and R = distance between the two bodies.

EXPLANATION :



- The **gravitational force at D due to C** is

$\Rightarrow F_{DC} = G\frac{MM}{(\frac{a}{2})^2} = G\frac{4M^2}{a^2}$ ------- (1)

- The gravitational force at D due to B is

$\Rightarrow F_{DB} = G\frac{MM}{(\frac{a}{2})^2} = G\frac{4M^2}{a^2}$ ------- (2)

- Since F_{BD} and F_{DC} are **equal in magnitude but they are opposite in direction**, therefore they will cancel out each other.

Here,

$\Rightarrow AD^2 = \sqrt{AC^2 - CD^2}$

$\Rightarrow AD^2 = \sqrt{a^2 - \frac{a^2}{4}} = \sqrt{\frac{3a^2}{4}}$

- The gravitational force at D due to A is

$\Rightarrow F_{DC} = G\frac{MM}{AD^2} = G\frac{4M^2}{3a^2}$

---

71. Answer: d

Explanation:

FORMULAE USED:

sin(A + B) = sinA cosB + cosA sinB

CALCULATION:

$\sin(45° + 30°) = \sin 45° \cos 30° + \cos 45° \sin 30°$

$\sin(45° + 30°) = [(\sqrt{3} / 2) \times (1 / \sqrt{2})] + [(1 / 2) \times (1 / \sqrt{2})]$

$\therefore \sin(45° + 30°) = \sqrt{(2 + \sqrt{3})} / 2$

---

72. Answer: d

Explanation:

CONCEPT :

Newton's law of Gravitation:

- Newton's law of gravitation states that everybody in this universe attracts every other body with a force , which is directly proportional to the product of their masses and inversely proportional to the square of the distance between their centers .
- The direction of the force is along the line joining the particles .
- The magnitude of the gravitational force F is

$F = G\frac{M_1 M_2}{R^2}$

Where G = universal gravitational constant, M 1 = mass of 1 st body, M 2 = mass of 2 nd body, and R = distance between the two bodies.

EXPLANATION :

- From above it is clear that the gravitational force **depends** on the **mass of the bodies** and the **distance between them** .
- It is independent of the nature and size of the bodies as well as the nature of the medium between the bodies . Therefore it will remain the same i.e. **F**.

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73. **Answer: a**

Explanation:

FORMULAE USED

cos(A+B)=cosAcosB-sinAsinB

CALCULATION:

cos(105°) = cos(45° + 60°)

cos(105°) = cos 45°.cos60° - sin 45°.sin 60°

cos(105°) = (1/√2)(1/2) - (1/√2)(√3/2)

∴ cos 105° = $\frac{(1-\sqrt{3})}{(2\sqrt{2})}$

---

74. **Answer: d**

Explanation:

FORMULAE USED:

sec $^2\theta$ = (1 / cos $^2\theta$)

tan $^2\theta$ = (sin $^2\theta$ / cos $^2\theta$)

CALCULATION:

$\frac{\sec^2 x+\tan^2 x}{\sin^2 x+1} = \frac{\frac{1}{COS^2\theta}+\frac{sin^2\theta}{COS^2\theta}}{sin^2\theta+1}$

Taking cos $^2\theta$ common in the numerator, we get

⇒ (1 / cos $^2\theta$)(1 + sin $^2\theta$) / (1 + sin $^2\theta$)

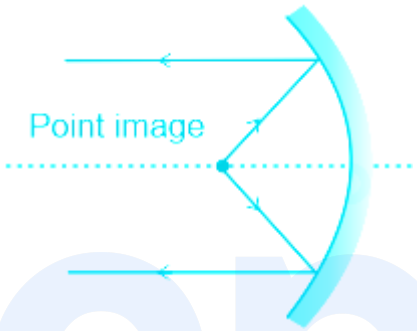
∴ (1 / cos $^2\theta$)

75. **Answer: d**

Explanation:

CONCEPT:

Concave mirror:



- If the inner surface of the spherical mirror is the reflecting surface, then it is called a concave mirror . It is also called a focusing mirror/converging mirror.
- - The size of the image produced by these mirrors can be larger or smaller than the object , depending upon the distance of the object from the mirror.
  - The concave mirror can form both real as well as virtual images of any object .

EXPLANATION :

- Concave mirrors are used by dentists to see large images of the teeth of patients .
- Since concave mirrors can form enlarged images , unlike convex mirrors, hence are used by the dentists .
- Other uses of concave mirrors are:

1. In torches, search-lights, headlights of vehicles to get a powerful beam of light.
2. Shaving mirror to see a large image of the face.
3. Large concave mirrors are used to concentrate sunlight to produce heat in solar furnaces.