Engineering Services (P) Examination, 2024

DO NOT OPEN THIS TEST BOOKLET UNTIL YOU ARE TOLD TO DO SO

T.B.C. : PNGE–D–MCH **Test Booklet Series**

A

Serial No. 1011769

TEST BOOKLET

Paper—II

(MECHANICAL ENGINEERING)

Time Allowed : Three Hours **Maximum Marks : 300**

INSTRUCTIONS

1. IMMEDIATELY AFTER THE COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS TEST BOOKLET *DOES NOT* HAVE ANY UNPRINTED OR TORN OR MISSING PAGES OR ITEMS, ETC. IF SO, GET IT REPLACED BY A COMPLETE TEST BOOKLET.
2. **Please note that it is the candidate's responsibility to encode and fill in the Roll Number and Test Booklet Series A, B, C or D carefully and without any omission or discrepancy at the appropriate places in the OMR Answer Sheet. Any omission/discrepancy will render the Answer Sheet liable for rejection.**
3. You have to enter your Roll Number on the Test Booklet in the Box provided alongside. *DO NOT* write *anything else* on the Test Booklet.
4. This Test Booklet contains **150** items (questions). Each item comprises four responses (answers). You will select the response which you want to mark on the Answer Sheet. In case you feel that there is more than one correct response, mark the response which you consider the best. In any case, choose *ONLY ONE* response for each item.
5. You have to mark your responses *ONLY* on the separate Answer Sheet provided. See directions in the Answer Sheet.
6. ***All*** items carry equal marks.
7. Before you proceed to mark in the Answer Sheet the response to various items in the Test Booklet, you have to fill in some particulars in the Answer Sheet as per instructions sent to you with your Admission Certificate.
8. After you have completed filling in all your responses on the Answer Sheet and the examination has concluded, you should hand over to the Invigilator *only the Answer Sheet*. You are permitted to take away with you the Test Booklet.
9. Sheets for rough work are appended in the Test Booklet at the end.
10. **Penalty for wrong answers :**
    THERE WILL BE PENALTY FOR WRONG ANSWERS MARKED BY A CANDIDATE.
    (i) There are four alternatives for the answer to every question. For each question for which a wrong answer has been given by the candidate, **one-third** of the marks assigned to that question will be deducted as penalty.
    (ii) If a candidate gives more than one answer, it will be treated as a **wrong answer** even if one of the given answers happens to be correct and there will be same penalty as above to that question.
    (iii) If a question is left blank, i.e., no answer is given by the candidate, there will be **no penalty** for that question.

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1. Consider the following statements :

   1. Viscosity of liquid increases with increase in temperature.
   2. Viscosity of gas decreases with increase in temperature.
   3. In liquids, cohesive forces predominate the molecular momentum transfer.
   4. In gases, cohesive forces are small and the molecular momentum transfer predominates.

   Which of the above statements are correct?

   (a) 1 and 2 only

   (b) 2 and 3 only

   (c) 3 and 4 only

   (d) 1, 2, 3 and 4

2. A fluid in which shear stress is more than the yield value and shear stress is proportional to the rate of shear strain is known as

   (a) non-ideal plastic fluid

   (b) Newtonian fluid

   (c) non-Newtonian fluid

   (d) ideal plastic fluid

3. Two horizontal plates are placed 1·25 cm apart, the space between them being filled with an oil of viscosity 15 poises. What is the shear stress in the oil if the upper plate is moved with a velocity of 2·5 m/s?

   (a) 280 N/m^2

   (b) 260 N/m^2

   (c) 300 N/m^2

   (d) 250 N/m^2

4. What is the capillary rise in a glass tube of 2·0 mm diameter when immersed vertically in mercury? (Take surface tension of mercury as 0·52 N/m. The specific gravity of mercury is 13·6 and the angle of contact is 130°)

   (a) – 0·25 cm

   (b) – 0·65 cm

   (c) – 0·8 cm

   (d) – 0·5 cm

5. Consider the following statements :

1. One end of piezometer is connected to the point where pressure is to be measured and the other end is open to the atmosphere.

2. Inverted U-tube differential manometer is used to measure high pressure.

3. U-tube differential manometer contains heavy liquid.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

6. A circular opening, 3 m diameter, in a vertical side of a tank is closed by a disc of 3 m diameter which can rotate about a horizontal diameter. What is the force on the disc if the head of water above the horizontal diameter is 5 m?

(a) 277·4 kN *(b)* 324·4 kN

(c) 311·2 kN *(d)* 346·7 kN

7. Consider the following statements regarding dynamics of fluid flow :

1. Pitot tube is a device used to measure rate of flow of fluid through a pipe.

2. Orifice meter is a device used for measuring velocity of flow at any point in a pipe.

3. Venturi meter consists of converging part, throat and diverging part.

Which of the above statements is/are correct?

(a) 1 and 3

(b) 2 only

(c) 3 only

(d) 1 and 2

8. What is the pressure gradient per metre width for the laminar flow of oil with a maximum velocity of 2 m/s between two horizontal parallel fixed plates which are 100 mm apart? (Take dynamic viscosity = 2·5 N-s/m^2)

(a) -4000 N/m^2 per m

(b) -3700 N/m^2 per m

(c) -3500 N/m^2 per m

(d) -3200 N/m^2 per m

9. Consider the following statements regarding dynamics of fluid flow :

1. Kinetic energy correction factor is defined as the ratio of kinetic energy of the flow per second based on actual velocity to kinetic energy of the flow per second based on average velocity.

2. Kinetic energy correction factor is defined as the ratio of kinetic energy of the flow per second based on average velocity to kinetic energy of the flow per second based on maximum velocity.

3. Momentum correction factor is defined as the ratio of momentum of the flow per second based on actual velocity to momentum of the flow per second based on average velocity.

4. Momentum correction factor is defined as the ratio of momentum of the flow per second based on average velocity to momentum of the flow per second based on maximum velocity.

Which of the above statements are correct?

(a) 1 and 4

(b) 1 and 3

(c) 2 and 4

(d) 2 and 3

10. An oil is flowing through a pipe of diameter 300 mm with velocity of 5 m/s. What is the head loss to maintain the flow for a length of 1000 m? (Take coefficient of friction = 0·005)

(a) 60·2 m

(b) 72·4 m

(c) 76·7 m

(d) 84·9 m

11. Consider the following statements :

1. The apparent viscosity of a pseudoplastic fluid decreases with decrease in the shear rate.
2. The apparent viscosity of a dilatant fluid increases with increase in the shear rate.
3. Bingham plastic fluid requires a finite yield stress before beginning to flow.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

12. The dimensional formula of bulk modulus of elasticity in *MLT* notation system is

(a) MLT^{-1} (b) $M^{-1}LT^{2}$

(c) $ML^{-1}T^{-1}$ (d) $ML^{-1}T^{-2}$

13. Consider the following statements regarding general conventions in stress analysis :

1. Tensile stress is positive and compressive stress is negative.
2. A pair of shear stresses on parallel planes forming a clockwise couple is positive and a pair with a counterclockwise couple is negative.
3. Clockwise angle is taken as negative and counterclockwise couple is positive.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

14. Consider the following statements regarding principle of superposition :

1. The principle of superposition states that if a body is acted upon by a number of loads on various segments of the body, then the net effect on the body is the sum of the effects caused by each of the loads acting independently on the respective segment of the body.
2. The superposition principle applies to all parameters like stress, strain and deflection.
3. The superposition principle is applicable to materials with non-linear stress-strain characteristic, which do not follow Hooke's law.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

15. Rails are laid such that they have no stress at 24 °C. What is the stress in the rails at 80 °C, when there is no allowance for expansion? (Assume coefficient of linear expansion = 11×10^{-6} °C^{-1} and Young's modulus of rails metal = 205 GPa)

(a) 126·28 MPa

(b) 251·84 MPa

(c) 296·72 MPa

(d) 325·35 MPa

16. When a body is acted upon by pure shear stresses on two perpendicular planes, the planes inclined at 45° are subjected to

(a) a tensile stress of magnitude equal to that of the shear stress

(b) a compressive stress of magnitude equal to that of the shear stress

(c) a torsional stress of magnitude equal to that of the shear stress

(d) a bending stress of magnitude equal to that of the shear stress

17. A piece of material is subjected to same two perpendicular tensile stresses of 100 MPa each. What is the direct stress?

(a) 90 MPa

(b) 100 MPa

(c) 96 MPa

(d) 86 MPa

18. The strain energy per unit volume required to cause the material to rupture is called

(a) modulus of toughness

(b) modulus of rigidity

(c) resilience

(d) proof resilience

19. Consider the following statements regarding buckling concept :

1. Buckling can occur when the induced stresses are compressive such as in a column.
2. Buckling analysis uses the Young's modulus of the material and the moment of inertia of the column cross-section, as well as its length.
3. The load that buckles the column is called the crushing load.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

20. Consider the following statements regarding theories of failures :

1. Maximum principal strain theory is known as St. Venant's theory.
2. Maximum shear strain energy theory is known as Mises and Hencky theory.
3. Maximum strain energy theory is known as Guest and Tresca theory.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

21. Consider the following statements regarding beams :

1. Beams with one end fixed and the other end simply supported are known as propped cantilevers.
2. Beams supported at more than two sections are known as fixed beams.
3. Beams with one end fixed and the other end free are known as cantilevers.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

22. Consider the following statements regarding effective length of a column :

1. The effective length is the distance between the points of inflection in the deformed shape of the column, which is referred to as the elastic curve.
2. At the inflection point, the moment does not change sign and the member is not expected to resist any moment.
3. At the transition point, the curvature is changed and it is called the contraflexure point.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

23. Consider the following statements regarding power transmitted through a circular shaft :

1. The stress and deformation induced in the shaft can be calculated by relating power to torque.
2. The power produced by a motor is rated in terms of shaft horsepower at a specified rotational speed.
3. Power is defined as the work done per unit time.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

24. When a body is acted upon by pure shear stresses on two perpendicular planes, the planes inclined at 135° are subjected to

(a) a tensile stress of same magnitude with no shear stress on these planes

(b) a compressive stress of same magnitude with no shear stress on these planes

(c) a torsional stress of same magnitude with no shear stress on these planes

(d) a bending stress of same magnitude with no shear stress on these planes

25. Which one of the following is the ability of a material to regain its original shape on removal of the applied load?

(a) Proof resilience

(b) Resilience

(c) Modulus of resilience

(d) Gradual resilience

26. Which one of the following properties is ***not*** an extensive property of a system?

(a) Energy

(b) Enthalpy

(c) Volume

(d) Temperature

27. Two cylindrical vessels of 2 m^3 each are inter-connected through a pipe with a valve in-between. Initially, the valve is closed and one vessel has 20 kg air while 4 kg of air is there in second vessel. Assuming the system to be at 27 °C temperature initially and perfectly insulated, what is the final pressure in vessels after the valve is opened to attain equilibrium?

(a) 516·6 kPa

(b) 51·66 kPa

(c) 561·6 kPa

(d) 56·16 kPa

28. Thermoelectric thermometer works on the principle of

(a) Wheatstone bridge

(b) entropy

(c) Seebeck effect

(d) ohmmeter

29. Isentropic expansion efficiency is expressed as

(a) Ideal work in expansion – Actual work in expansion

(b) Actual work in expansion + Ideal work in expansion

(c) $\frac{\text{Ideal work in expansion}}{\text{Actual work in expansion}}$

(d) $\frac{\text{Actual work in expansion}}{\text{Ideal work in expansion}}$

30. In the reheat cycle, the principal advantage of reheat is to increase the quality of steam at

(a) turbine exhaust

(b) turbine inlet

(c) feed pump inlet

(d) feed pump exhaust

31. Consider that the Rankine cycle efficiency is improved in the following ways :

1. By reducing heat addition in boiler
2. By increasing steam turbine expansion work
3. By reducing feed pump work

Which of the above are correct?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

32. What is the actual pressure of air in the tank if the pressure of compressed air measured by manometer is 30 cm of mercury and atmospheric pressure is 101 kPa? (Take $g = 9 \cdot 78 \text{ m/s}^2$ and density of mercury at room temperature as 13550 kg/m^3)

(a) 140·76 GPa

(b) 140·76 MPa

(c) 140·76 kPa

(d) 140·76 Pa

33. The equation for two-dimensional steady-state conduction without heat sources is

(a) $\frac{d^2T}{dr^2} + \frac{q}{k} = 0$

(b) $\frac{d^2T}{dx^2} + \frac{1}{r}\frac{dT}{dr} = 0$

(c) $\frac{d^2T}{dx^2} = 0$

(d) $\frac{\partial^2T}{\partial x^2} + \frac{\partial^2T}{\partial y^2} = 0$

34. Which one of the following expressions is correct about the relation among Grashof number (Gr), Prandtl number (Pr) and Rayleigh number (Ra)?

(a) Ra = Gr Pr

(b) Gr = Ra Pr

(c) Ra = Gr – Pr

(d) Gr = Ra – Pr

35. An order-of-magnitude analysis of the free convection boundary layer equations will indicate a general criterion for determining whether free convection effects dominate. The criterion is that when

(a) $\text{Gr}/\text{Re}^2 < 10$, then free convection is of primary importance

(b) $\text{Gr}/\text{Re}^2 = 10$, then free convection is of primary importance

(c) $\text{Gr}/\text{Re}^2 > 10$, then free convection is of primary importance

(d) $\text{Gr}/\text{Re}^2 > 10$, then forced convection is of primary importance

36. If the monochromatic emissivity of a body is independent of wavelength, it is called

(a) transparent body

(b) reflective body

(c) black body

(d) gray body

37. Which one of the following equations is called Kirchhoff's identity?

(a) $\varepsilon = \frac{E}{E_b}$

(b) $\varepsilon = \frac{E_b}{E}$

(c) $\varepsilon = \infty$

(d) $\varepsilon = 1$

38. The interface angles of rhombohedral crystal systems are

(a) $\alpha = \beta = \gamma \neq 90°$

(b) $\alpha = \beta = \gamma = 90°$

(c) $\alpha = \beta = 90° \neq \gamma$

(d) $\alpha = \beta = 90°; \gamma = 120°$

39. Consider the following statements for the characteristics of ionic compounds :

1. Ionic compounds are generally crystalline in nature and rigid.
2. They are generally non-conductors of electricity.
3. They are insoluble in organic solvents, but highly soluble in water.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

40. Consider the following statements for the characteristics of covalent compounds :

1. They can exist in all states of matter.
2. They are generally electric insulators.
3. They are insoluble in water, but soluble in non-polar solvents such as benzene and alcohol, etc.

Which of the above statements are correct?

(a) 1 and 3 only

(b) 2 and 3 only

(c) 1 and 2 only

(d) 1, 2 and 3

41. Consider the following statements :

1. X-rays are not deflected by electric or magnetic fields.
2. They produce fluorescence in many substances.
3. They are highly penetrating and destructive on living tissues on excessive exposure.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

42. Consider the following statements :

The application of X-rays in scientific research is

1. to investigate the structure of crystalline solids
2. to study complex organic compounds by analyzing their structures
3. to find the atomic numbers and energy levels to identify the elements

Which of the above statements are correct?

(a) 1 and 3 only

(b) 2 and 3 only

(c) 1 and 2 only

(d) 1, 2 and 3

43. Consider the following statements :

The influence of molybdenum element in steels

1. imparts higher temperature strength
2. enhances resistance to creep
3. minimizes temperature brittleness

Which of the above statements is/are correct?

(a) 1 only

(b) 2 and 3 only

(c) 1 and 2 only

(d) 1, 2 and 3

44. The alloying elements of tungsten-based tool steels are

(a) Cr, V, Co and W

(b) Cr and V only

(c) Cr, Ni and Mo

(d) Cr, W, V and Mo

45. Consider the following disadvantages of LAUE methods :

1. Various reflections may make the appearance of the photograph complicated.
2. Due to the wide range of wavelengths, there is overlapping of diffraction images.
3. There is a variation of incident X-ray beam due to the large range of wavelengths.

Which of the above disadvantages is/are correct?

(a) 1 and 3 only

(b) 1 and 2 only

(c) 3 only

(d) 1, 2 and 3

46. Optical pyrometer works based on the principle of

(a) conduction only

(b) convection only

(c) radiation

(d) conduction and convection

47. Consider the following common defects in steel due to heat treatment :

1. Warping
2. Oxidation
3. Quenching cracks

Which of the above defects are correct?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

48. Consider the following conditions to be fulfilled before a powder metallurgy product can be made :

1. It must be possible to form a continuously bonded matrix.
2. The metal in the powder form must be able to respond to solid phase welding.
3. The powders in which the basic materials are available must be sufficiently close packing under pressure.

Which of the above conditions are correct?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

49. Consider the following statements regarding mechanical properties of metals :

1. The phenomenon leading to fracture under repeated stresses having a maximum value less than the ultimate strength of material is called creep.
2. A time-temperature parameter used to predict stress rupture due to creep is called Larson-Miller parameter.
3. Time-dependent deformation of a material when subjected to a constant load or stress is called fatigue.

Which of the above statements is/are correct?

(a) 1 and 2 only

(b) 2 only

(c) 3 only

(d) 1, 2 and 3

50. Consider the following statements regarding mechanical properties of metals :

1. The process of atoms moving over each other during the permanent deformation of a metal is called slip.
2. An empirical equation that relates the strength of a metal to its grain size is known as Hall-Petch relationship.
3. The ability of some metals to deform plastically by 1000–2000 percent at high temperatures and low loading rates is called super-plasticity.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

51. The Rolls-Royce CV12 turbocharged four-stroke direct injection diesel engine has a displacement of 26·1 litres. The engine has a maximum output of 900 kW at 2300 r.p.m. What is the brake mean effective pressure?

(a) 18 bar

(b) 15 bar

(c) 10·15 bar

(d) 21 bar

52. A high-performance four-stroke SI engine has a compression ratio 10 : 1. The ideal air standard Otto cycle efficiency is 0·602. The indicated efficiency is 55 percent of the corresponding ideal air standard Otto cycle efficiency. The engine mechanical efficiency is 85 percent, and the volumetric efficiency is 90 percent. The calorific value of the fuel is 44 MJ/kg. What is the engine arbitrary overall efficiency?

(a) 26·1% *(b)* 28·1%

(c) 29·5% *(d)* 30·5%

53. The performance test of an air-conditioning unit rated as 140·7 kW (40 TR) seems to be indicating poor cooling. The test on heat rejection to atmosphere in its condenser shows the following :

Cooling water flow rate : 4 L/s
Water temperatures : In 30 °C; Out 40 °C
Power input to motor : 48 kW (95% efficiency)

What is the actual refrigeration capacity of the unit? (The specific heat capacity of water is 4·1868 kJ/kg-K)

(a) 101·5 kW *(b)* 167·4 kW

(c) 121·9 kW *(d)* 189·3 kW

54. If the partial pressure of water vapour for the mixture of dry air and water vapour is 12·79 mm Hg and its total pressure is 736 mm Hg, then what is the specific humidity?

(a) 0·068 kg w.v./kg d.a.

(b) 0·011 kg w.v./kg d.a.

(c) 0·023 kg w.v./kg d.a.

(d) 0·044 kg w.v./kg d.a.

55. If $1\,m^3$ of a gas is compressed adiabatically (the ratio of specific heats = 1·4) from 1 bar to 5 bar in a reciprocating compressor, what is the work of compression?

(a) 192543 N-m

(b) 245361 N-m

(c) 158643 N-m

(d) 204050 N-m

56. An R134a thermostatic expansion valve, not equipped with an external equalizer, has a superheat setting of 7 °C, while supplying the refrigerant to the evaporator at 0 °C. The power fluid is same as refrigerant. What is the difference in pressure in opposite sides of the diaphragm required to open the valve? (Consider evaporator pressure at 0 °C and 7 °C as 2·928 bar and 3·748 bar respectively)

(a) 2·928 bar

(b) 3·748 bar

(c) 0·82 bar

(d) 6·676 bar

57. A machine working on a Carnot cycle operates between 305 K and 260 K. What is the COP when it is operated as a refrigerating machine?

(a) 5·78

(b) 4·35

(c) 1·17

(d) 6·78

58. A cold storage plant is required to store fish. The fish is supplied at a temperature of 30 °C. The fish is stored in cold storage which is maintained at –8 °C. If the plant requires 75 kW to drive it, what is the capacity of the plant? (Assume actual COP of the plant as 0·3 of the Carnot COP)

(a) 40·8 TR

(b) 35·9 TR

(c) 44·8 TR

(d) 54·6 TR

59. On a particular day, the atmospheric air records a partial pressure of water vapour 9·62 mm Hg and the saturation pressure of vapour is 31·8 mm Hg. The barometric pressure is observed to be 756 mm Hg. What are the relative humidity and the specific humidity respectively?

(a) 30·25%, 0·008

(b) 30·25%, 0·014

(c) 35·87%, 0·014

(d) 35·87%, 0·008

60. A small water-cooled condenser uses mains water at 13 °C and heats this to 24 °C before it goes to waste. The evaporator duty is 4·2 kW and the motor output is 1·7 kW. What is the water mass flow?

(a) 0·09 kg/s

(b) 0·19 kg/s

(c) 0·21 kg/s

(d) 0·13 kg/s

61. Air circulates at the rate of 68 kg/s and is to be heated from 16 °C to 34 °C. What is the water mass flow for an air heater coil having hot water entering at 85 °C and leaving at 74 °C? (Take specific heat of air at constant pressure as 1·02 kJ/kg-K and specific heat of water as 4·187 kJ/kg-K)

(a) 19 kg/s

(b) 17 kg/s

(c) 27 kg/s

(d) 14 kg/s

62. A six-cylinder four-stroke diesel engine develops 125 kW at 3000 r.p.m. Its brake-specific consumption is 200 gm/kWh. What is the quantity of fuel to be injected per cycle per cylinder? (The specific gravity of the fuel is 0·85)

(a) 0·0726 cc/cycle

(b) 0·0379 cc/cycle

(c) 0·0981 cc/cycle

(d) 0·0545 cc/cycle

63. In a crank and slotted lever quick return motion mechanism, the distance between the fixed centres is 240 mm and the length of the driving crank is 120 mm. What is the time ratio of cutting stroke to return stroke?

(a) 1

(b) 0·5

(c) 2

(d) 3

64. *ABCD* is a four-bar chain in which link *AD* is the driver, link *BC* is the driven, and *DC* is fixed. The driver rotates uniformly at a speed of 120 r.p.m. and the constant driving torque is 50 N-m. At a particular phase of the mechanism, the angular velocity of the driven link is 2 rad/s. What is the ideal mechanical advantage?

(a) 5·26

(b) 6·28

(c) 8·98

(d) 10

65. The distance between two parallel shafts is 18 mm and they are connected by an Oldham's coupling. The driving shaft revolves at 160 r.p.m. What is the maximum speed of sliding of the tongue of the intermediate piece along its groove?

(a) 0·415 m/s

(b) 0·586 m/s

(c) 0·302 m/s

(d) 0·845 m/s

66. In a thrust bearing, the external and the internal diameters of the contacting surfaces are 320 mm and 200 mm respectively. The total axial load is 80 kN. The shaft rotates at 400 r.p.m. Taking the coefficient of friction as 0·06, what is the power lost in overcoming the friction?

(a) 26·602 kW

(b) 21 kW

(c) 44·23 kW

(d) 46 kW

67. The number of teeth of a spur gear is 30 and it rotates at 200 r.p.m. What is the pitch line velocity if it has a module of 2 mm?

(a) 376·9 mm/s

(b) 628·3 mm/s

(c) 850·7 mm/s

(d) 246·1 mm/s

68. Two spur gears have a velocity ratio of 1/3. If the driven gear has 72 teeth, then what is the number of teeth of the driver gear?

(a) 72

(b) 36

(c) 24

(d) 12

69. The following data relate to two meshing gears :

Velocity ratio = 1/3

Module = 4 mm

Centre distance = 200 mm

How many number of teeth are there on the gear wheels?

(a) 90

(b) 60

(c) 45

(d) 75

70. An epicyclic gear train consists of an arm and two gears *A* and *B* having 30 teeth and 40 teeth respectively. The arm rotates about the centre of gear *A* at a speed of 80 r.p.m. counterclockwise. What is the speed of gear *B* if gear *A* is fixed?

(a) 140 r.p.m.

(b) 180 r.p.m.

(c) 120 r.p.m.

(d) 200 r.p.m.

71. A flywheel with a mass of 3 kN has a radius of gyration of 1·6 m. What is the energy stored in the flywheel when its speed increases from 315 r.p.m. to 340 r.p.m.?

(a) 757·5 kJ

(b) 896·2 kJ

(c) 412·1 kJ

(d) 684·9 kJ

72. A flywheel fitted to a steam engine has a mass of 800 kg. Its radius of gyration is 360 mm. The starting torque of the engine is 580 N-m and may be assumed constant. What is the kinetic energy of the flywheel after 12 seconds?

(a) 233·27 kJ

(b) 263·27 kJ

(c) 333·27 kJ

(d) 363·27 kJ

73. An aeroplane makes a complete half circle of 50 metres radius, towards left, when flying at 200 km/h. The rotary engine and propeller of the plane have a mass of 400 kg and radius of gyration of 0·3 m. The engine rotates at 2400 r.p.m. clockwise when viewed from the rear. What is the gyroscopic couple on the aircraft?

(a) 10 kN-m

(b) 15 kN-m

(c) 18 kN-m

(d) 12 kN-m

74. What is the vertical height of a Watt governor when it rotates at 60 r.p.m.?

(a) 0·157 m

(b) 0·192 m

(c) 0·205 m

(d) 0·248 m

75. The degree of freedom (DOF) for globular or spherical pair is

(a) 1

(b) 2

(c) −1

(d) 3

76. A turbine develops 9000 kW when running at a speed of 150 r.p.m. and under a head of 30 m. What is the specific speed of the turbine?

(a) 202 r.p.m.

(b) 152 r.p.m.

(c) 189 r.p.m.

(d) 217 r.p.m.

77. Consider the following statements regarding unit quantities :

1. Unit specific speed is defined as the speed of a turbine working under unit head.
2. Unit discharge is defined as the discharge passing through a turbine, which is working under a unit head.
3. Unit power is defined as the power developed by a turbine working under unit speed.

Which of the above statements is/are correct?

(a) 1 and 3

(b) 2 and 3

(c) 2 only

(d) 3 only

78. Consider the following statements regarding characteristic curves of hydraulic turbines :

1. Main characteristic curves are obtained by maintaining a constant speed and a constant gate opening on a turbine.
2. Operating characteristic curves are obtained by maintaining a constant head on a turbine.
3. Constant efficiency curves are known as Muschel curves.

Which of the above statements is/are correct?

(a) 1 and 2

(b) 2 and 3

(c) 2 only

(d) 3 only

79. Consider the following statements regarding centrifugal pumps :

1. The rotating part of a centrifugal pump is called runner.
2. Volute casing is spiral type in which area of flow increases gradually.
3. In vortex casing, a vortex chamber is introducing between the casing and impeller.
4. Foot valve is fitted at the lower end of suction pipe.

Which of the above statements are correct?

(a) 1, 2 and 3 only

(b) 2, 3 and 4 only

(c) 1, 3 and 4 only

(d) 1, 2, 3 and 4

80. Consider the following statements :

1. The horizontal distance between the centreline of the pump and the water surface in the tank to which water is delivered is known as delivery head.

2. The sum of suction head and delivery head is known as static head.

3. The manometric head is defined as the head against which a centrifugal pump has to work.

Which of the above statements is/are correct?

(a) 1 and 3

(b) 2 and 3

(c) 1 only

(d) 2 only

81. Consider the following statements regarding efficiencies of a centrifugal pump :

1. The ratio of the manometric head to the head imparted by the impeller to the water is known as manometric efficiency.

2. The ratio of the power available at the impeller to the power at the shaft of the centrifugal pump is known as overall efficiency.

3. The ratio of the power output of the pump to the power input to the pump is known as mechanical efficiency.

Which of the above statements is/are correct?

(a) 1 and 3

(b) 2 and 3

(c) 1 only

(d) 3 only

82. The outlet velocity of flow and outlet velocity of whirl of an impeller of a centrifugal pump are 5 m/s and 12 m/s respectively. What is the resultant velocity at outlet?

(a) 17 m/s

(b) 7 m/s

(c) 11 m/s

(d) 13 m/s

83. Consider the following statements regarding steam nozzles :

1. Nozzle efficiency is defined as the ratio of the actual enthalpy drop to the isentropic enthalpy drop between the same pressures.
2. Velocity coefficient is defined as the ratio of the actual exit velocity to the exit velocity when the flow is isentropic between the same pressures.
3. Velocity coefficient is the square root of nozzle efficiency.

Which of the above statements are correct?

(a) 1 and 3 only

(b) 2 and 3 only

(c) 1 and 2 only

(d) 1, 2 and 3

84. Consider the following statements regarding steam turbines :

1. Blade efficiency is the ratio of the work done on the blade per second to the energy entering the blade per second.
2. Internal efficiency is the ratio of the heat converted into useful work to the total adiabatic heat drop.
3. Net efficiency is the ratio of brake thermal efficiency to diagram thermal efficiency.

Which of the above statements are correct?

(a) 1 and 3 only

(b) 2 and 3 only

(c) 1 and 2 only

(d) 1, 2 and 3

85. Consider the following statements :

1. Bleeding is the process of draining steam from the turbine at certain point during its expansion.
2. There is a usual practice in bleeding installation to allow the bled steam to mix with the preheated air, after that the mixture of steam and air proceeds to the boiler.
3. The objective of governing is to keep the turbine speed fairly constant irrespective of load.

Which of the above statements are correct?

(a) 1 and 3 only

(b) 2 and 3 only

(c) 1 and 2 only

(d) 1, 2 and 3

86. The indicated work of a single-stage reciprocating air compressor is 250 kJ/min. What is the indicated power?

(a) 250 kW

(b) 0·24 kW

(c) 15 kW

(d) 4·16 kW

87. Consider the following statements :

1. Thermal efficiency is the ratio of the network output to the heat supplied.
2. Compressor isentropic efficiency is the ratio of the work output in isentropic compression to the ideal work required.
3. Turbine isentropic efficiency is the ratio of the actual work output to the isentropic work output.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

88. Consider the following statements regarding modes of failure :

1. A ductile material is one which has a relatively large tensile strain before fracture takes place.
2. A brittle material has a relatively small tensile strain before fracture.
3. A static load is defined as a force, which is gradually applied to a mechanical component and which changes its magnitude or direction with respect to time.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

89. Consider the following statements regarding theories of elastic failure :

1. Experimental investigations suggest that maximum principal stress theory gives good predictions for brittle materials.
2. Maximum shear stress theory predicts that the yield strength in shear is equal to the yield strength in tension.
3. Maximum shear stress theory is also known as Coulomb, Tresca and Guest theory.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

90. Consider the following statements regarding distortion energy theory :

1. It is known as Huber-von Mises-Hencky theory.
2. The yield strength in shear is 0·577 times the yield strength in tension.
3. Experiments have shown that the distortion energy theory is in better agreement for predicting the failure of a brittle component than any other theory of failure.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

91. Consider the following statements regarding low-cycle and high-cycle fatigue :

1. Any fatigue failure, when the number of stress cycles is less than 1000, is called low-cycle fatigue.
2. Any fatigue failure, when the number of stress cycles is more than 1000, is called high-cycle fatigue.
3. The high-cycle fatigue involves plastic yielding at localized areas of the components.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

92. Consider the following statements regarding joints :

1. Bolted joint is the example of permanent joint.
2. Cotter joint is the example of separable joint.
3. In hand riveting, a die is placed on the protruding end of the shank and blows are applied by a hammer.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

93. Consider the following statements regarding transmission shaft :

1. Countershaft is a secondary shaft, which is driven by the main shaft and from which the power is supplied to a machine component.
2. Spindle consists of a number of shafts, which are connected in axial direction by means of couplings.
3. Jackshaft is an auxiliary shaft between two shafts that are used in transmission of power.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

94. A pair of spur gears consists of a 20 teeth pinion meshing with a 120 teeth gear. The module is 4 mm. What is the centre distance?

(a) 210 mm

(b) 280 mm

(c) 310 mm

(d) 325 mm

95. In a particular application, the expected life for 90% of the bearings is 8000 h. What is the rated bearing life when the shaft rotates at 1450 r.p.m.?

(a) 607 million revolutions

(b) 641 million revolutions

(c) 696 million revolutions

(d) 712 million revolutions

96. Consider the following statements :

1. Zero film bearing is a bearing which operates without any lubricant.
2. Thin film lubrication describes a condition of lubrication, where two surfaces of the bearing in relative motion are completely separated by a film of fluid.
3. Hydrodynamic lubrication is defined as a system of lubrication in which the load-supporting fluid film is created by the shape and relative motion of the sliding surfaces.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

97. Consider the following statements regarding lubricant :

1. Molybdenum disulphide is semi-solid lubricant.
2. It is used to protect bearing from corrosion.
3. It is used to reduce wear.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

98. A solid cast iron disc, 1130·97 kg mass, is used as a flywheel. The radius of gyration of the solid disc is 0·3535 m about its axis of rotation. It is rotating at an angular speed of 36·65 rad/s and brought to rest by means of a brake. The energy absorbed by the brake is

(a) 61 kJ

(b) 76 kJ

(c) 94 kJ

(d) 107 kJ

99. Consider the following statements regarding functions of flywheel :

1. It stores and releases energy when needed during the work cycle.
2. It increases the power capacity of the electric motor or engine.
3. It reduces the amplitude of speed fluctuations.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

100. Consider the following statements :

1. The governor controls the mean speed of the engine by varying the fuel supply to the engine.
2. The flywheel has no influence on the mean speed of the engine.
3. A flywheel may be used if the cyclic fluctuations of energy output are negligible.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

101. The yearly duration curve of a certain power plant can be considered as a straight line from 350 MW to 80 MW. Power is supplied with one generating unit of 250 MW capacity and two units of 150 MW capacity each. What is the utilization factor?

(a) 0·436

(b) 0·536

(c) 0·636

(d) 0·736

102. Which one of the following is Dulong's formula for the calculation of the calorific value of the solid or liquid fuels from their chemical composition? (Where H, O and S are hydrogen, oxygen and sulphur in percentage respectively in 100 kg of fuel)

(a) $HCV = \frac{1}{100}\left[13800 + 144000\left\{H - \frac{O}{8}\right\} + 7270S\right]$ kJ/kg

(b) $HCV = \frac{1}{100}\left[23800 + 144000\left\{H - \frac{O}{8}\right\} + 8270S\right]$ kJ/kg

(c) $HCV = \frac{1}{100}\left[33800 + 144000\left\{H - \frac{O}{8}\right\} + 9270S\right]$ kJ/kg

(d) None of the above

103. Consider the following statements regarding steam turbines :

1. In reaction turbine, the steam expands in the stationary nozzles and attains high velocity.
2. In impulse turbine, the steam enters the fast moving blades on the rotor from stationary nozzles; if the steam is superheated before allowing it to expand, the Rankine cycle efficiency may be increased.
3. In impulse turbine, the resulting high velocity steam impinges against the blades which alter the direction of steam jet thus changing the momentum of jet and causing impulsive force on the blades.
4. In steam turbine, the steam consumption does not increase with increase in years of service.

Which of the above statements are correct?

(a) 1 and 2

(b) 2 and 3

(c) 3 and 4

(d) 1 and 4

104. The overall thermal efficiency of a 40 MW turbo alternator is 30%. If the load factor of the power station is 50% and the coal burnt has a calorific value of 6800 kcal, what is the energy produced per day?

(a) 44×10^4 kWh

(b) 48×10^4 kWh

(c) 34×10^4 kWh

(d) 38×10^4 kWh

105. Consider the following statements regarding steam power plants :

1. An increase in the initial pressure of steam raises the thermal efficiency.
2. The thermal efficiency will be dropped by raising the initial temperature of the steam without changing the pressure.
3. Intermediate reheating of steam improves the thermal efficiency of the plant.
4. An increase in the initial pressure of steam improves the thermal efficiency of steam power plant and also wetness fraction of such steam decreases at the end of expansion.

Which of the above statements are correct?

(a) 1 and 2

(b) 2 and 3

(c) 3 and 4

(d) 1 and 3

106. Consider the following statements regarding cooling towers in thermal power plants :

1. In a natural draught cooling tower, the cold water is allowed to fall over louvers.
2. In an atmospheric type cooling tower, the hot water from the condenser is pumped to the troughs and nozzles situated near the bottom.
3. In forced draught cooling towers, draught fans are installed at the bottom of towers.
4. Mechanical draught cooling towers may be forced draught cooling towers or induced draught cooling towers.

Which of the above statements are correct?

(a) 1 and 2

(b) 2 and 3

(c) 3 and 4

(d) 1 and 3

107. Consider the following statements regarding steam condensers :

1. Power plant cycle improves in efficiency as the turbine exhaust pressure drops with steam condenser.
2. The use of condenser decreases the size of boiler installation.
3. The vacuum obtainable in a condenser is governed by the inlet water temperature which in turn varies with the amount of condensing water used per kg of steam and its initial temperature.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

108. Multi-cylinder turbines which have their rotors mounted on one and the same shaft and coupled to a single generator are known as

(a) single-shaft turbines

(b) multi-axial turbines

(c) topping turbines

(d) back pressure turbines

109. Consider the following features for a gas turbine plant :

1. Intercooling
2. Regeneration
3. Reheat

Which of the above features in a gas turbine cycle increase the specific output and thermal efficiency of the plant?

(a) 1, 2 and 3

(b) 1 and 2 only

(c) 2 and 3 only

(d) 1 and 3 only

110. Consider the following statements regarding combustion of fuels :

1. Carbon combines with oxygen to form carbon monoxide.
2. Hydrogen burns with oxygen to give water as the product.
3. When methane burns in the presence of oxygen, the combustion products are carbon dioxide and water vapours.

Which of the above statements are correct?

(a) 1 and 3 only

(b) 1 and 2 only

(c) 2 and 3 only

(d) 1, 2 and 3

111. Consider the following statements :

1. Air contains 23% of oxygen and 77% of nitrogen by volume.
2. The main constituents of natural gas are methane and ethane.
3. Coal gas mainly consists of hydrogen, carbon monoxide and hydrocarbons.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

112. Consider the following statements regarding properties of good coal :

1. It should have low ash content and high calorific value.
2. It should have large percentage of sulphur (more than 25%).
3. It should have high grindability index.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

113. Which one of the following interpersonal roles the manager is expected to train, counsel, mentor and encourage for high employee performance?

(a) Figurehead role

(b) Leader role

(c) Liaison role

(d) Monitor role

114. Which one of the following approaches includes application of statistics, optimization models, information models and computer simulations?

(a) Quantitative approach

(b) Qualitative approach

(c) Contingency approach

(d) Behavioural approach

115. Consider the following statements regarding purpose of the micromotion study :

1. It is to study the nature and path of movements for accomplishing the elements of an operation.
2. It is to impart training to the operators regarding motion economy principles so that unnecessary motion or movement by the operators may be avoided.
3. It is to find the most efficient way of accomplishing the elements.

Which of the above statements is/are correct?

(a) 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

116. Consider the following statements regarding computer-aided manufacturing :

1. Inventory control is concerned with managing and controlling the physical operations in the factory.
2. Manufacturing control is concerned with the demand fulfilment and also to reduce the inventory to eliminate the wastage and extra money investment.
3. Shop floor control is concerned with the problem of monitoring the progress of processing, assembling, and inspection of the products in the factory.

Which of the above statements is/are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 3 only

(d) 1, 2 and 3

117. Which of the following is/are ***not*** included in flexible manufacturing system workstation facilities?

(a) Machining centres

(b) Milling modules

(c) Inspection stations

(d) Welding workspace

118. Consider the following statements regarding pure project :

1. The project manager has full authority over the project.
2. Team members report to one boss.
3. It has longest communication chains.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

119. Consider the following statements regarding costs associated with a project :

1. Direct costs increase with time.
2. Direct costs are normal costs that can be assigned directly to a specific work package or project activity.
3. Crashing activities increase direct costs.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

120. Consider the following statements regarding redundancy :

1. Warm redundancy is also known as hot redundancy.
2. Active redundancy is also known as lightly loaded redundancy.
3. Passive redundancy is also known as standby redundancy.

Which of the above statements is/are correct?

(a) 1 only

(b) 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

121. In which one of the following casting processes, thin slabs are produced from molten metal?

(a) Gravity die casting

(b) Centrifugal casting

(c) Plaster casting

(d) Strip casting

122. Consider the following statements regarding forging :

1. In incremental forging process, a tool forges a blank into a shape in several small steps.
2. In isothermal forging process, the process heats the dies to the same temperature as that of the hot workpiece.
3. In rotary swaging process, a solid rod is subjected to radial impact forces by a set of reciprocating dies of the machine.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

123. Which one of the following instruments is commonly used for measuring the thickness and inside or outside dimensions of parts?

(a) Micrometer

(b) Anvil

(c) Sine bar

(d) Surface plate

124. The technique that creates a three-dimensional image of the part by utilizing an optical system is called

(a) thermal inspection

(b) eddy current inspection

(c) holography

(d) radiography

125. The welding flame with excess oxygen is known as

(a) oxidizing flame

(b) carburizing flame

(c) reducing flame

(d) neutral flame

126. Consider the following statements regarding solar energy :

1. The sun radiates energy uniformly in all directions in the form of electromagnetic waves.
2. The output of the sun is $2 \cdot 8 \times 10^{23}$ kW.
3. The energy reaching the earth is $1 \cdot 1 \times 10^{12}$ kWh/year.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

127. Consider the following statements regarding measurement of solar radiation :

1. Pyranometer cannot measure diffuse radiation.
2. Pyrheliometer is an instrument that measures beam radiation.
3. A sunshine recorder measures the sunshine hours in a day.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

128. Consider the following statements :

1. The sum of beam and diffuse radiation is referred to as global radiation.
2. Diffuse radiation does not have a unique direction.
3. Solar radiation propagating in a straight line and received at the earth surface without change of direction is called direct radiation.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

129. Consider the following statements regarding depletion of solar radiation :

1. Nitrogen gas absorbs the X-rays and extreme ultraviolet radiations.
2. Dust particles and air molecules absorb a part of solar radiant energy irrespective of wavelength.
3. Ozone cannot absorb ultraviolet radiation.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

130. Consider the following statements :

1. Solar radiation incident on the outer atmosphere of the earth is known as extra radiation.
2. Solar radiation that reaches the earth surface after passing through the earth's atmosphere is known as terrestrial radiation.
3. The term 'solar insolation' is defined as solar radiation energy received on a given surface area in a given time.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

131. Consider the following statements regarding solar collectors :

1. Collector efficiency is defined as the ratio of the energy actually absorbed and transferred to heat-transporting fluid by the collector to the energy incident on the collector.
2. Concentration ratio is defined as the ratio of the area of the receiver to the area of aperture of the system.
3. Temperature range is the range of temperature to which the heat-transporting fluid is heated up by the collector.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

132. Consider the following statements :

1. The concentration ratio achieved from compound parabolic concentrator collector is in the range of 3–7.
2. The concentration ratio in the range of 70–80 may be achieved from cylindrical parabolic concentrator collector.
3. A concentration ratio of 10–30 may be achieved from linear Fresnel lens collector which yields temperatures between 150 °C and 300 °C.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

133. Consider the following statements regarding solar greenhouse :

1. If natural means are adopted to collect, store and distribute the energy inside, it is known as active greenhouse.
2. In cold countries, 'winter greenhouses' provide supplementary heat to maintain adequate temperature during cold months when solar insolation is low.
3. Greenhouses for arid zone are designed to conserve water resources.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

134. Consider the following statements regarding wind energy :

1. The rate of change of wind speed with height is called wind shear.
2. The layer of air from ground to gradient height is known as planetary boundary layer.
3. In the surface layer, the mean wind speed with height can be represented by Prandtl logarithmic law model.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

135. Consider the following statements regarding biomass energy :

1. Charcoal is obtained by biomization process of woody biomass to achieve higher energy enthalpy per unit mass.
2. Biodiesel is simple to use, biodegradable and non-toxic.
3. The raw vegetable oil is upgraded as biodiesel through a chemical process called trans-esterification.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

136. Consider the following statements regarding tidal energy :

1. When the sun-earth and moon-earth directions are perpendicular, the solar and lunar tides are out of phase producing net tides of maximum range.
2. Neap tides occur twice per month at times of half-moon.
3. Spring tides occur twice per lunar month at times of both full and new moon.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

137. Consider the following statements regarding phosphoric acid fuel cell :

1. The basic phosphoric acid fuel cell consists of two electrodes of porous conducting material to collect charge.
2. At the negative electrode, hydrogen gas is converted to hydrogen ions.
3. Pure hydrogen or a hydrogen-rich gas is supplied at positive electrode and oxygen or air is supplied at negative electrode.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

138. Consider the following statements regarding visual perception :

1. Vision is the most important sensory channel for humans.
2. The function of visual perception is to provide visual input to support a robot's learning process.
3. Vision plays a vital role in any machine which intends to perform autonomous motions.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

139. Trajectory is a path

(a) without time constraint

(b) with time constraint

(c) in one-dimensional space

(d) with a motion planning strategy

140. Collision-free path of the trajectory requires

(a) constrained motion of the work-space

(b) time constraint

(c) geometric model of the workspace

(d) kineto-dynamic chain

141. The purpose of defuzzification is to make a decision based on

(a) fuzzy output set

(b) fuzzy input set

(c) Boolean set

(d) motion set

142. Consider the following statements regarding issues in robotics :

1. A robot's degree of autonomy depends on its ability to perform the ordered sequence of perception, decision-making and action.
2. Kinematics is the study of motion in relation to force and torque.
3. Dynamics is the study of motion without consideration of force and torque.

Which of the above statements is/are correct?

(a) 1 only

(b) 1 and 2 only

(c) 2 and 3 only

(d) 1, 2 and 3

143. Consider the following statements regarding joints :

1. A joint is the connection between two or more links at their nodes.
2. If a joint connects only two links, the entity is also called a kinematic pair.
3. If a one degree of freedom joint imposes a translational motion, it is called a prismatic joint.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

144. HARO-1 is

(a) a prototype of robotic animal

(b) a prototype of human-like robot

(c) a prototype of robotic engine

(d) a prototype of robotic bird

145. Consider the following statements regarding sensing elements :

1. A human sensory system can be divided into five distinct sub-systems.
2. MEMS stands for 'Micro-Electro-Mechanical System'.
3. The walking procedure involves unpredictable movement done by a robot.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

146. The physical quantities related to touch are measured by

(a) simple sensors

(b) reflective sensors

(c) tactile sensors

(d) touch sensors

147. Consider the following statements regarding joint-space control :

1. The motion performed by a robot is the input motion of its mechanism.
2. The control scheme at the lowest level of a robot's motion control system is called joint-space control.
3. A robot is a machine which is skilled at executing motions.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

148. Autonomy is a characteristic which describes

(a) an automated system's degree of independence

(b) an automated system's degree of freedom

(c) an automated behaviour

(d) an automated action

149. Consider the following statements regarding monocular vision :

1. The monocular vision system takes images as input, and produces geometrical measurement as output.
2. A monocular vision system is normally composed of a single electronic camera, an image digitizer and computing hardware.
3. The electrical signals, picked up by the imaging sensor of the camera, will be converted into an analogue image.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

150. The function of parallel splitter motion is to

(a) duplicate the input motion into multiple output motions

(b) duplicate the split input motion into multiple parallel input motions

(c) duplicate the split input motion into multiple random input motions

(d) duplicate the multiple random input motions into single input motion