

SECTION-A (OBJECTIVE) [30 M]

i) Answer all questions, each question carries one mark [30x1=30M].

ii) Do not write the description and Answers must be in the order.

iii) Marks are not awarded if the answers are OVER WRITTEN.

1. Choose the correct option

- (A) Angular velocity is a scalar quantity
- (B) Angular velocity is a vector quantity
- (C) Angular velocity vector lies along the axis of rotation
- (D) Both 'B' and 'C'

2. A force acts on a particle whose position vector is $\mathbf{i} - \mathbf{j} + \mathbf{k}$. The torque of the force $7\mathbf{i} + 3\mathbf{j} - 5\mathbf{k}$ about the origin is

- (A) $\mathbf{i} + 10\mathbf{j} + 10\mathbf{k}$
- (B) $2\mathbf{i} + 12\mathbf{j} + 10\mathbf{k}$
- (C) $\mathbf{i} - 12\mathbf{j} - 10\mathbf{k}$
- (D) $-2\mathbf{i} - 12\mathbf{j} + 10\mathbf{k}$

3. When 100J of work is done on a fly wheel, its angular velocity is increased from 60rpm to 180rpm. The moment of inertia of the wheel is....

- (A) 0.63 kg m^2
- (B) 0.63 g cm^2
- (C) 6.3 kg m^2
- (D) 6.3 g cm^2

4. An ice skater is in a fast spin with her arms held tightly to her body. When she extends her arms, which of the following statements is not true

- (A) She increases her moment of inertia
- (B) She decreases her angular speed
- (C) Her total angular momentum remains constant
- (D) Her moment of inertia remains constant

5. A function $f(t) = A \cos \omega t + B \sin \omega t$ is periodic, if its amplitude is

- (A) $A+B$
- (B) A
- (C) $\sqrt{A+B}$
- (D) $\sqrt{A^2+B^2}$

6. A metal ring of mass 5 kg is attached to a spring of spring constant 500 N/m. It slides without friction over a horizontal rod. The ring is displaced from its equilibrium position by 10.0 cm and released. The period of oscillation is

- (A) 0.63 Sec
- (B) 6.3 Sec
- (C) 0.063 Sec
- (D) 63Sec

7. The phase difference between displacement and acceleration of a simple harmonic oscillator is

- (A) $\pi/4$
- (B) $\pi/6$
- (C) $\pi/2$
- (D) π

8. A simple pendulum is attached to the roof of a lift. The time period of oscillation, when lift is stationary is 'T'. Then time period of oscillation when the lift falls freely is
 (A) Zero (B) infinite (C) $1/T$ (D) none
9. Two bodies of mass 100 kg and 1000 kg are lying one meter apart. Where an object of mass 'm' has to be placed from 100 kg body such that the net gravitation force acting on it will be zero?
 (A) 16cm (B) 24cm (C) 32cm (D) 48cm
10. A Satellite orbits on the earth at height equal to the radius of earth. Its orbital speed is
 (A) 5.592km/s (B) 4.592km/s (C) 6.592km/s (D) None
11. Choose the correct statements of the following
 1. The Geo stationary satellite (GSS) will orbit the earth at a distance of 35,800 km from its surface.
 2. The GSS will orbit the earth at a distance of 42200 km from its centre.
 3. The period of revolution of a GSS is 24hrs.
 4. The time period of revolution of a polar satellite is 100 min.
 (A) Only 1, 2, 3 are correct (B) Only 2, 3, 4 are correct
 (C) Only 3 is correct (D) All are correct.
12. The relation between escape velocity(v_e) from the surface of the earth and the orbital velocity(v_o) is
 (A) $\sqrt{2} v_e = v_o$ (B) $v_e = \sqrt{2} v_o$ (C) $v_e = 2 v_o$ (D) $4 v_e = 3 v_o$
13. Which of the following is most elastic
 (A) Rubber (B) Glass (C) Steel (D) Copper
14. The Young's modulus of wire of length 'L' and radius 'r' is 'Y'. The length is reduced to $L/2$ and radius $r/2$, then its Young's modulus will be
 (A) $Y/2$ (B) $2Y$ (C) Y (D) $4Y$
15. If an iron wire is stretched by 1%, what is the strain on the wire
 (A) 0.1 (B) 1 (C) 0.01 (D) none
16. Determine the pressure required to reduce the given volume of water by 2%. Bulk modulus of water is $2.2 \times 10^9 \text{ N/m}^2$
 (A) $4.4 \times 10^5 \text{ N/m}^2$ (B) $4.4 \times 10^7 \text{ N/m}^2$ (C) $44 \times 10^5 \text{ N/m}^2$ (D) $44 \times 10^7 \text{ N/m}^2$
17. Pressure is a quantity.
 (A) Vector (B) Scalar (C) Dimensionless (D) None
18. If density of atmospheric gases is 1.3 kg/m^3 and is constant throughout, up to what height the atmosphere is extended? [Take $g = 10 \text{ m/s}^2$]
 (A) 12 km (B) 14 km (C) 8 km (D) 6 km

19. If 'W' is the work done to blow an air bubble of radius 'R', what is the energy needed to increase its radius to '2R'?
- (A) 4W (B) 6W (C) 3W (D) None
20. Which liquid is used in hydraulic brakes?
- (A) Compressible (B) Viscous (C) Incompressible (D) High density
21. Coefficient of volume expansion of an ideal gas at constant pressure is
- (A) Independent of temperature (B) Directly proportional to temperature
(C) Directly proportional to square of temperature (D) Inversely proportional to temperature
22. Increase in the temperature of an aluminium rod to increase its length by 2% is _____ (Coefficient of linear expansion is $25 \times 10^{-6} \text{ } ^\circ\text{C}^{-1}$)
- (A) 800 $^\circ\text{C}$ (B) 600 $^\circ\text{C}$ (C) 400 $^\circ\text{C}$ (D) 1000 $^\circ\text{C}$
23. What is the amount of heat needed to increase the volume of gas of 5 moles by 30% in an isothermal process at 300K?
- (A) -3272 J (B) 3272 J (C) -15015 J (D) 15015 J
24. A heater boils 3 kg of water at 30 $^\circ\text{C}$ to steam at 100 $^\circ\text{C}$ in 10 minutes, what is the power (wattage) of it? [Specific heat capacity of water is 4186 J/kgK and Latent heat of steam is 2.3×10^6 J/kg].
- (A) 5 kilo Watt (B) 10 kilo Watt (C) 13 kilo Watt (D) None
25. An ideal gas is compressed isothermally to half of its volume at 273 K, then its internal energy?
- (A) Increases (B) Decreases (C) Doubled (D) remains constant
26. _____ remains constant in undamped vibrations.
27. Angle of contact for water and lotus leaf interface is _____ 90 _____.
28. Continuity equation is the consequence of _____.
29. At 4 $^\circ\text{C}$ water has maximum _____ and minimum _____.
30. First law of thermodynamics is the another form of _____.

SECTION –B (DESCRIPTIVE) [30M]

i) Answer any 'three' out of the 'six' the questions, each question carries 10 Marks.

ii) Answer all sub parts a question at the same place.

1. a) Define angular acceleration and torque and derive a relation between them. [5M]
✓ b) The angular position of a point on a rotating disc is given by $\theta = 2 + 4t^2 + 2t^3$, where ' θ ' is in radians and time ' t ' in seconds. At ' $t = 0$ Sec, what is (i) The angular position (ii) Angular velocity (iii) Angular acceleration. And also calculate angular acceleration at ' $t = 2$ Sec. [5M]
2. a) Show that motion of simple pendulum is simple harmonic and derive an equation for its time period. [5M]
b) A body describes simple harmonic motion with amplitude of 5 cm and a period of 0.2 Sec. Find the acceleration and velocity of the body when the displacement is (i) 5cm (ii) 3cm (iii) 0cm [5M]
3. a) Define Hooke's law. Describe the behaviour of a wire under gradually increasing load with the help of stress-strain graph. [5M]
✓ b) Derive an expression for the variation of acceleration due to gravity (i) above (ii) below the surface of the earth. [5M]
4. a) Deduce an expression for the speed of a flow in the wider part of the Venturi meter? [5M]
b) How high does methyl alcohol rise in a glass tube of diameter 0.6 mm. Surface tension of methyl alcohol is 0.023 Nm^{-1} and density is 0.8 gram per cc. Assume that hemisphere is formed at the meniscus? [5M]
5. a) Define coefficient of linear and volume expansions and derive the relation between them? [5M]
✓ b) A cup of tea cools from 60°C to 40°C in 7 minutes, what will be its temperature after next 7 minutes, if the surrounding's temperature is 10°C ? [5M] ✎
6. a) Derive an expression for the amount of work done in the adiabatic process? [5M]
b) Obtain an expression for the pressure of an ideal gas using hypothesis of kinetic theory of gases? [5M]