Question Bank

DSC- 2A Mechanics - II (Paper II)

1 Select the most correct alternative.

(1) Who did give the helio-centric theory?

(a) Copernicus (b) Tycho-Brahe

(c) Kepler (d) Galileo

(2) The gravitational force of attraction between two bodies separated by a distance r is proportional to ....

(a) r^2 (b) $\frac{1}{r^2}$

(c) r^3 (d) $\frac{1}{r^3}$

(3) SI unit of gravitational constant is

(a) $\mathrm{Nm^2\ kg^2}$ (b) $\mathrm{Nm^2\ kg^{-2}}$

(c) Nm^2s^{-2} (d) $\mathrm{Nmkg^{-2}}$

(4) The fundamental force which holds the planets in their orbits around the sun is force of attraction.

(a) electromagnetic (b) nuclear

(c) electrostatic (d) gravitational

(5) The weight of an object of mass 10 kg on the earth is

(a) 9.8 kg (b) 9.8 N

(c) 98 kg (d) 98 N

(6) If the particle moves in a central force field, its .... is conserved.

(a) Linear momentum (b) angular momentum

(c) velocity (d) torque

(7) If the particle moves in a central force field, its .... remains constant.

(a) areal velocity (b) linear velocity

(c) angular velocity (d) linear momentum

(8) The planetary orbits around the sun are

(a) circular (b) elliptical

(c) parabolic (d) hyperbolic

(9) Kepler's third law of planetary motion is referred to as

(a) Law of elliptical orbits (b) law of equal areas

(c) harmonic law (d) law of equal periods

(10) Kepler's second law of planetary motion is referred to as

(a) Law of elliptical orbits (b) law of equal areas

(c) harmonic law (d) law of equal periods

(11) Kepler's third law of planetary motion is given as

(a) $T^2 \propto r^3$ (b) $T^3 \propto r^2$

(c) $T \propto r^2$ (d) $T^2 \propto r$

(12) Period of the satellite does not depend on ....

(a) radius of the earth (b) mass of the earth

(c) height of the satellite (d) mass of the satellite

(13) The periodic time of satellite .... as height of the projection of satellite is increased.

(a) increases (b) decreases

(c) remains constant (d) either increases or decreases

(14) The period of geostationary satellite is

(a) 6 hours (b) 12 hours

(c) 24 hours (d) 48 hours

(15) The period of GPS satellite is

(a) 6 hours (b) 12 hours

(c) 24 hours (d) 48 hours

(16) Masses m_1 and m_2 are suspended together by a massless spring of constant (k). When system is in equilibrium, m_1 is removed without disturbing the system. Now angular frequency of oscillation is

(a) $\sqrt{k/m_1}$ (b) $\sqrt{k/m_2}$

(c) $\sqrt{k/m_1+m_2}$ (d) $\sqrt{k/m_1m_2}$

(17) The displacement of a particle executing SHM is, $y = a\sin(\omega t)$. The acceleration after time, $t = T/4$ (where T is period) is ....

(a) $a\omega$

(b) $a\omega^2$

(c) $-a\omega$

(d) $-a\omega^2$

(18) The total energy of a body performing SHM is E. Then average kinetic energy of the body, over a period, is ....

(a) E

(b) $E/4$

(c) $E/2$

(d) $2E$

(19) A particle of mass 10gm is executing SHM with an amplitude of $0.5\ \text{m}$ and time period of $(\pi/5)s$. The maximum value of force acting is,

(a) $25\ \text{N}$

(b) $2.5\ \text{N}$

(c) $5\ \text{N}$

(d) $0.5\ \text{N}$

(20) A weightless spring with force constant (k), oscillates with a frequency (v) when suspended by a mass (m). If the spring is cut into two equal parts and mass $(2m)$ is suspended from one of the part, then frequency of oscillations becomes......

(a) v

(b) $v/2$

(c) $2v$

(d) $\sqrt{2}v$

(21) If a watch with a wound spring is taken on to the moon, then it .....

(a) runs slower

(b) runs faster

(c) shows no change

(d) does not work at all

(22) The oscillatory motion of a body about its mean position only under the action of restoring force developed is called .... oscillatory motion.

(a) damped

(b) free

(c) over damped

(d) forced

(23) Damped oscillatory motion occurs when the restoring force is.....

(a) greater than damping force

(b) less than damping force

(c) equal to damping force

(d) equal to external periodic force

(24) If natural frequency of vibration of a body is v and is subjected to a periodic force of frequency v'', then the body vibrates with a frequency......

(a) v

(b) v''

(c) greater than v

(d) less than v

(25) The vibratory motion of a body is heavily damped if the damping force is .... restoring force.

(a) much greater than

(b) much less than

(c) equal to

(d) less than

(26) When a beam is fixed at one end and loaded at the other, the middle filament which is neither elongated nor compressed is called .....

(a) plane of bending

(b) neutral axis

(c) neutral surface

(d) neutral filament

(27) A plane perpendicular to neutral surface is called .....

(a) plane of bending

(b) axis of bending

(c) neutral bending

(d) neutral axis

(28) The section of the neutral surface by the plane of bending is called the .....

(a) bending axis

(b) neutral axis

(c) free axis

(d) plane of axis

(29) The quantity YaK^2 is called ......

(a) geometrical moment of inertia

(b) flexural rigidity

(c) bending moment

(d) depression in bending

(30) The quantity aK^2 is called......

(a) geometrical moment of inertia

(b) flexural rigidity

(c) bending moment

(d) radius of gyration

(31) A beam fixed horizontally at one end and loaded at the other is called a ......

(a) bent beam

(b) loaded beam

(c) cantilever

(d) unloaded beam

(32) A beam supported at both the ends and loaded at the center is equivalent to ......

(a) a cantilever

(b) two cantilevers

(c) three cantilevers

(d) four cantilevers

(33) A stretched wire is said to be under torsion, if it is ....

(a) heavily loaded

(b) twisted

(c) bent into an arc of a circle

(d) shortened

(34) Torsional oscillations of a wire are due to its ....

(a) modulus of rigidity

(b) Young's modulus

(c) bulk modulus of elasticity

(d) high density

(35) The motion of a torsional pendulum is

(a) uniform linear motion
(b) accelerated linear motion
(c) angular S.H.M.
(d) linear S.H.M.

(36) In equilibrium position of bending of beam ....

(a) bending couple $>$ restoring couple
(b) bending couple $<$ restoring couple
(e) bending couple $=$ restoring couple
(d) bending couple $= 0$

(37) Geometrical moment of inertia of beam of circular cross-section of radius r is ....

(a) πr^4
(b) $\frac{\pi r^2}{4}$
(c) $\frac{\pi r^4}{4}$
(d) πr^2

(38) If C is torsional couple, then work done in twisting the wire is ......

(a) $\frac{1}{2}C\theta$
(b) $\frac{1}{2}C\theta^2$
(c) $C\theta^2$
(d) $C\theta$

(39) The modulus of rigidity of material of wire of radius a is proportional to

(a) a^2
(b) a^4
(c) $\frac{1}{a^2}$
(d) $\frac{1}{a^4}$

(40) Young's modulus Y, modulus of rigidity η and Poisson's ratio of material of wire are related by the equation ......

(a) $\sigma = \frac{Y}{2\eta}$
(b) $\sigma = \frac{Y}{2\eta} - 1$
(c) $Y = \frac{\eta}{2\sigma} - 1$
(d) $Y = \frac{\sigma}{2\eta} - 1$

(41) Which of the following is not the unit of surface tension?

(a) dyne /cm
(b) dyne cm^2
(c) erg/cm^2
(d) newton/m

(42) The angle of contact between glass and mercury is ......

(a) a right angle
(b) an acute angle
(e) an obtuse angle
(d) zero

(43) A liquid wet a solid surface if the angle of contact between them is ......

(a) a right angle
(b) an acute angle
(c) an obtuse angle
(d) π^c

(44) If T is surface tension of a liquid then the excess pressure inside the liquid drops of radius r is ......

(a) $\frac{T}{r}$ (b) $\frac{2T}{r}$

(c) $\frac{4T}{r}$ (d) $\frac{T}{2r}$

(45) If T is the surface tension of a soap solution then the excess pressure inside its bubble of radius r is ......

(a) $\frac{2T}{r}$ (b) $\frac{4T}{r}$

(c) $\frac{T}{4r}$ (d) $\frac{T}{2r}$

(46) A small amount of liquid, set free in the air, takes spherical shape because of its

(a) high density (b) elasticity

(c) viscosity (d) surface tension

(47) What will be the excess pressure inside a water drop of radius 1.5 cm ? Surface tension of water is 72 dynes /cm.

(a) 72 dyne/cm (b) 36 dyne/cm

(c) 24 dyne /cm (d) 96 dyne/cm

(48) Two plates of glass wetted by few drops of water between them can be separated from each other by ....

(a) pulling them apart normal to the surface (b) sliding them parallel to their planes

(c) introducing some more water between them (d) introducing some oil between them

(49) If surface tension of a soap solution is 50 dyne/cm then what is the excess pressure inside its bubble of radius 2 cm ?

(a) 50 dyne/cm^2 (b) 100 dyne/cm^2

(c) 150 dynes /cm^2 (d) 200 dyne/cm^2

(50) Which of the following does not happen because of the surface tension?

(a) Oil rises along the wicks in oil lamps (b) The soaking of ink by blotting paper

(c) Some insects can walk along the water surface

(d) While heating, convection currents are formed in water

2. Short answer questions.

1. State the Newton's law of gravitation and define the universal constant of gravitation. Derive its dimensions.

2. What is mean by central force?

3. State Kepler's laws of planetary motion.

4. Give the applications of the satellites.

5. Explain geosynchronous orbits and geostationary satellite.

6. Explain why an astronaut in an orbiting satellite experiences a feeling of weightlessness.

7. Write a note on Global Positioning System.

8. Derive expressions for P.E. (U), K.E. (K) and total energy (E) of a particle performing SHM.

9. Obtain expressions for average P.E. $(\bar{U})$ and average K.E. $(\bar{K})$ of a particle executing SHM.

10. Obtain expression for P.E. (U) and average P.E. $(\bar{U})$ of a particle executing SHM.

11. Derive the expressions for the depressions of the centrally loaded beams supported at both the ends.

12. What is meant by (i) torsion, (ii) torsional oscillations?

13. Obtain an expression for work done in twisting a wire.

14. What is surface tension? Explain it on the basis of molecular forces.

15. What do you understand by 'angle of contact'? Derive the condition for the angle of contact to be acute or obtuse.

16. Explain wettability on the basis of angle of contact and also on the basis of cohesive and adhesive forces.

17. State and explain some applications of surface tension.

18. Derive an expression for the torsional couple per unit angular twist in case of a wire.

19. Describe the Jaeger's method to determine surface tension of a liquid.

3. Long answer questions.

1. Show that for a motion of particle in central force field, angular momentum is conserved and areal velocity remains constant.

2. Obtain an expression for period of satellite in a circular orbit round the earth.

3. Show that the square of the period of revolution of a satellite is directly proportional to the cube of the orbital radius.

4. Set up differential equation for SHM and hence obtain expression for displacement (x), velocity (v) and acceleration of the particle executing SHM.

5. Set up differential equation for SHM and then obtain solution for the same and explain the physical significance of angular frequency (ω), amplitude (a) and initial phase (α).

6. Write down differential equation for SHM and hence obtain expressions for $(x), (v)$ and acceleration and represent them graphically.

7. What are damped oscillations? Set up differential equation for a damped oscillator and obtain the solution for the same. Explain, how the amplitude and frequency of oscillator are affected.

8. What are forced oscillations? Set up differential equation for the same and obtain its solution.

9. Derive an expression for bending moment of a horizontal beam fixed at one end and loaded at the other.

10. What is a cantilever? Derive an expression for the depression of the free end of a cantilever due to a load.

11. Describe the method to determine Young's modulus of material of a bar by bending of the bar.

12. Obtain an expression for Y, η and σ for material of a wire using Searle's method.

13. Show that the excess pressure on the concave side of a curvilinear surface of a liquid is $2T\left(\frac{1}{r_1}+\frac{1}{r_2}\right)$, where r_1 and r_2 are the radii of curvature and T is the surface tension of the liquid.

14. Derive the relation between surface tension, pressure and curvature, Hence, show that the excess pressure inside a soap bubble of radius? is $\frac{4T}{r}$.