MGIMS-Wardha Medical Entrance Exam Physics Solved Paper-2011

1. A circular coil has 500 turn of wire and its radius is 5 cm. The self-inductance of the coil is
(a) 25×10^{-3} mH (b) 25 mH
(c) 50×10^{-3} H (d) 50×10^{-3} mH

2. An astronomical telescope has a large aperture to
(a) reduce spherical aberration
(b) have high resolution
(c) increase span of observation
(d) have low dispersion

3. Which of the following is more close to a black body?
(a) Black board paint (b) Green leaves
(c) Black holes (d) Red roses

4. A child swinging on a swing in sitting position, stands up, then the time period of swing will
(a) increase
(b) decrease
(c) remain same
(d) increase if the child is long and decrease if the child is short

5. The radius of nucleus of silver (atomic number =47) is 3.4×10^{-14} m. The electric potential on the surface of nucleus is ($e=1.6\times10^{-19}$ C)
(a) 1.99×10^{6}V (b) 2.9×10^{6} V
(c) 4.99×10^{6} V (d) 0.99×10^{6} V

6. The unit of inductance is
(a) $\frac{\text{volt}}{\text{ampere}}$ (b) $\frac{\text{joule}}{\text{ampere}}$
(c) $\frac{\text{volt-second}}{\text{ampere}}$ (d) $\frac{\text{volt-ampere}}{\text{second}}$

7. If a body travels half the distance with velocity v_1 and the next half with velocity v_2 its average velocity will be given by
(a) $v = \ v_1v_2$ (b) $v = \frac{v_1 + v_2}{2}$
(c) $v = \frac{v_1}{v_2}$ (d) $\frac{2}{v} = \frac{1}{v_1} + \frac{1}{v_2}$

8. The ratio of the numerical value of the average velocity and average speed of body is always
(a) unity (b) unity or less
(c) unity or more (d) less than unity

9. Mark the correct option.
If a ball is projected with velocity v_o at an angle of elevation 30°, then
(a) gravitational potential energy will be minimum at the highest point of the trajectory
(b) kinetic energy will be zero at the highest point of the trajectory
(c) vertical component of momentum will be conserved
(d) horizontal component of momentum will be conserved

10. A spring scale is adjusted to read zero. Particles of mass 1 g fall on the pan of the scale and collide elastically and they rebound upward with the same speed. If the height of fall of panicles is 2 m and their rate of collision is 100 particles per second, then the scale reading in grams will be ($g=9.8 m/s^2$)
(a) 1000 g (b) 1100g
(c) 1200 g (d) 1252 g

11. A smooth sphere of mass m moving with velocity u directly collides elastically with another sphere of mass M at rest. After collision their final velocities are V and *v* respectively. The value of *v* is

(a) $2u\frac{M}{m}$ (b) $2u\frac{m}{M}$
(c) $\frac{2u}{1+\frac{m}{M}}$ (d) $\frac{2u}{1+\frac{M}{m}}$

12. A block of mass 2 kg is kept on the floor. The coefficient of static friction is 0.4. If a force F of 2.5 N is applied on the block as shown in the figure, the frictional force between the block and the floor will be

(a) 2.5 N (b) 5N
(c) 7.84 N (d) 10N

13. A mass of 10 g moving horizontally with a velocity of 100 cm/s strikes a pendulum bob of mass 10 g. The two masses stick together. The maximum height reached by the system now is (.g = 10 m/s^2)

(a) zero (b) 5 cm
(c) 2.5cm (d) 1.25cm

14. The moments of inertia of two freely rotating bodies *A* and *B* are I_A and I_B respectively $I_A > I_B$ and their angular momenta are equal. If K_A and K_B are their kinetic energies then

(a) $K_A = K_B$ (b) $K_A > K_B$
(c) $K_A < K_B$ (d) $K_A = 2K_B$

15. A wheel of car is revolving at the rate of 1200 cycle/min. On pressing the accelerator after 10s, it does 4500 cycle/min then radial acceleration of the wheel is

(a) 30rad/s^2 (b) 1880 degree/s^2
(c) 40 rad/s^2 (d) 1980 degree/s^2

16. The diameter of each plate of an air capacitor is 4 cm. To make the capacity of this plate capacitor equal to that of 20 cm diameter sphere, the distance between the plates will be

(a) 4×10^{-3} m (b) 1×10^{-3}m
(c) 1cm (d) 1×10^{-3}cm

17. The electric potential *V* is given as a function of distance x (m) by *V* =(5.x^2 + 10x-9) volt. Value of electric field at x = 1 m is

(a) 20V/m (b) 6V/m
(c) HV/m (d) -23V/m

18. In Young's experiment, the wavelength of red light is 7800Å and that of blue light is 5200Å. The value of n for which (n +1) the blue band coincides with nth red band is

(a) 1 (b) 2
(c) 3 (d) 4

19. If the height of a satellite from the earth is negligible in comparison to the radius of the earth *R,* the orbital velocity of the satellite is

(a) gR (b) $\frac{gR}{2}$
(c) $\frac{g}{R}$ (d) gR

20. A satellite is revolving round me earth in an elliptical orbit. Its speed

(a) will be same at all points of the orbit
(b) will be maximum when it is at maximum distance from earth
(c) will be maximum when its distance from the earth will be minimum
(d) goes on increasing or decreasing continuous in dependines upon the mass of the satellite

21. A particle of mass 10 g is executing simple harmonic motion with an amplitude of 0.5 m and periodic time of ($\pi/5$) second. The maximum value of the force acting on the particle is

(a) 25 N (b) 5N
(c) 2.5 N (d) 0.5 N

22. The period of vibration of a mass m suspended from a spring is 2 s. If along with it another mass of 2 kg is also suspended, the period of oscillation increases by Is. The mass *m* will be

(a) 2 kg (b) 1 kg
(c) 1.6kg (d) 2.6kg

23. A wire of length *L* and cross-sectional area A is made of a material of Young's modulus *Y.* It is stretched by an amount *x.* The work done is

(a) $\frac{YxA}{2L}$ (b) $\frac{Yx^2A}{L}$

(c) $\frac{Yx^2A}{2L}$ (d) $\frac{2Yx^2A}{L}$

24. Compressibility of water is 5x 10^{-10} m /N. The change in volume of 100 mL water subjected to 15 x 10^6 Pa pressure will

(a) no change

(b) increase by 0.98 mL

(c) decrease by 0.75 mL

(d) increase by 1.50 mL

25. A water film is made between two 10 cm long straight wires and at a distance of 0.5 cm. If distance between the wires is increased by 1 mm, then work done will be $(T = 7.2\times10^{-2}\ N/m)$

(a) $7.22\times10^{-5} J$ (b) $1.44\times10^{-5} J$

(c) $2.88\times10^{-5} J$ (d) $5.76\times10^{-5} J$

26. The force of cohesion is

(a) maximum in solids

(b) maximum in liquids

(c) maximum in gases

(d) same in solid, liquid and gas

27. The temperature at which root mean square velocity of molecules of helium is equal to root mean square velocity of hydrogen at NTP is

(a) 273°C (b) 273 K

(c) S46°C (d) 844 K

28. The average kinetic energy of a hydrogen gas molecule at NTP will be

(Boltzmann's constant $k = 1.38\times10^{-23} J/K$

(a) $0.186\times10^{-20} J$ (b) $0.372\times10^{-20} J$

(c) $0.56\times10^{-20} J$ (d) $5.6\times10^{-20} J$

29. The height of a water fall is 84 m. Assuming that the entire kinetic energy of falling water is converted into heat, the rise in temperature of the water will be

(a) 0.196°C (b) 1.960°C

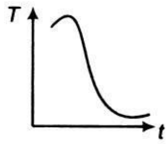
(c) 0.96°C (d) 0.0196°C

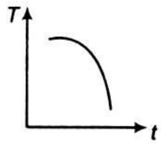
30. For adiabatic process $\left(\gamma \frac{C_p}{C_v}\right)$

(a) $p^{\gamma}V =$ constant (b) $Tp^{\gamma}V =$ constant

(c) $pV^{\gamma} =$ constant (d) $pV =$ constant

31. A cup of tea having the temperature 80°C is kept in a room, which is at 20°C. Which of the given curves best represents the variation of temperature T of the cup with time r?

(a) 

(b) 

(c) (d)

32. An ice box made of Styrofoam (thermal conductivity $=0.01 Jm^{=1} K)$ is used to keep liquids cool. It has a total wall area including lid of0.8 m^2 and wall thickness of 2.0 cm. A bottle of water is placed in the box and filled with ice. If the outside temperature is 30°C, the rate of flow of, heat into the box is (in Js^{-1})

(a) 16 (b) 14

(c) 12 (d) 10

33. The length of two open organ pipes are l and $(l+\Delta l)$ respectively. Neglecting end corrections the beats frequency between them will be approximatelly

(a) $\frac{v}{2l}$ (b) $\frac{v}{4l}$

(c) $\frac{v\Delta l}{2l^2}$ (d) $\frac{v\Delta l}{l}$

34. 5 g of ice of 0°C is dropped in a beaker containing 20 g of water at 40 °C. The final temperature will be

(a) 32°C (b) 16°C

(c) 8°C (d) 24°C

35. If a body loses half of its velocity on penetrating 3 cm in a wooden block then how much will it penetrate more before coming to rest?

(a) 1 cm (b) 2 cm

(c) 3 cm (d) 4 cm

36. The minimum velocity (in ms^{-1}) with which a car driver must traverse a flat curve of radius 150 m and coefficient of friction to avoid skidding is

(a) 60 (b) 30
(c) 15 (d) 25

37. The energy band gap is maximum in

(a) metals (b) superconductors
(c) insulators (d) semiconductors

38. The phenomenon of polarization of light indicates that

(a) light is a longitudinal waves
(b) light is transverse wave
(c) light if not a wave
(d) light travels with the velocity of 3×10^8 m/s

39. The manifestation of band structure in solids is due to

(a) Heisenberg's uncertainly principle
(b) Pauli's exclusion principle
(c) Bohr's correspondence principle
(d) Boltzmann's law

40. If there were no gravity, which of the following will not be there for a fluid?

(a) Viscosity
(b) Surface tension
(c) Pressure
(d) Archimedes' upward thrust

41. Which one of the following is ferromagnetic?

(a) Gold (b) Wood
(c) Manganese (d) Nickle

42. Two lenses have powers equal to +2 D and -4 D respectively, the power of combination will be

(a) -2D (b) +2D
(c) -40 (d) +4D

43. Shown below is a distribution of charges, the flux of electric field due to these charges through the surface is

(a) $\frac{3q}{\varepsilon_o}$ (b) zero
(c) $\frac{2q}{\varepsilon_o}$ (d) $\frac{q}{\varepsilon_o}$

44. A steel ball is dropped from a height ft and it makes a perfectly elastic collision with a horizontal plane. Following its initial release, it will make periodic motion with frequency

(a) $2\pi\sqrt{\frac{g}{h}}$ (b) $2\pi\sqrt{\frac{h}{g}}$
(c) $\frac{1}{2}\sqrt{\frac{g}{2h}}$ (d) $\frac{1}{2}\sqrt{\frac{2g}{g}}$

45. Three charged particles are initially in position-1. They are free to move and they come to position-2, after some time. Let U_1 and U_2 be the electrostatic potential energies in position-1 and 2 then

(a) $U_1 = U_2$ (b) $U_2 \geq U_1$
(c) $U_2 > U_1$ (d) $U_1 > U_2$

46. In Young's double slit experiment are slit is covered with red filter and another slit is covered by green filter, then interference pattern will be

(a) red (b) green
(c) yellow (d) invisible

47. For the stationary wave $y = u \sin \frac{\pi x}{15} \cos 96\pi t$

The distance between a node and the next antinode is

(a) 7.5cm (b) 15cm
(c) 22.5 cm (d) 30 cm

48. In *L-R* circuit the current increases to three-fourth of its maximum value in 4s, then the time constant of the circuit is

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

49. 1 Wb/m^2 is equal to

(a) 10^4 G (b) 10^2 G
(c) 10^{-2} G (d) 10^{-4} G

50. If the earth is treated as a sphere of radius *R* and mass M, its angular momentum about the axis of rotation with time period *T* is

(a) $\frac{\pi MR^2}{T}$ (b) $\frac{MR^2 T}{2\pi}$
(c) $\frac{2\pi MR^2}{T}$ (d) $\frac{4\pi MR^2}{5T}$

51. Which one of the following is used as a moderator in nuclear reaction?

(a) Uranium (b) Heavy water
(c) Cadmium (d) Plutonium

52. The sensitiveness of a moving coil galvanometer can be increased by decreasing the

(a) number of turns in the coils
(b) are of the coil
(c) magnetic field
(d) couple per unit twist of the suspension

53. An electric heater of resistance 6H works for 10 min on a 60 V line. The energy liberated in this period of time is

(a) 7.2 x 10^3 J (b) 3.6 x 10^s J
(c) 43.2 x 10^4 J (d) 28.8 x 10^4 J

54. The material of wire of potentiometer is made of

(a) copper (b) steel
(c) manganin (d) aluminium

55. The rest mass of the photon is

(a) zero
(b) infinite
(c) between zero and infinite
(d) equal to that of electron

56. The k_α line from molybdenum (atomic number =42) has a wavelength of 0.7078 Å. The wavelength of k_α line of zinc (atomic number = 30) will be

(a) 1Å (b) 1.3872 A
(c) 0.3541 A (d) 0.5 A

57. Decay constant of radioactive element is 1.5×10^9 Average age of element is

(a) 1.5×10^9 (b) 4.62×10^8
(c) 6.67×10^8 (d) 10.35×10^8

58. A potential difference *V* is applied the ends of a copper wire of length l and diameter *d.* On doubling only d, drift velocity

(a) becomes two times
(b) becomes half
(c) does not change
(d) becomes one-fourth

59. A steady current of 5 A is maintained for 45 min. During this time it deposits 4.572 g of zinc at the cathode of a voltmeter. ECE of zinc is

(a) $3.387\times10^{-4}\ g/C$ (b) $3.397\times10^{-4}\ g/C$
(c) $3.384\times10^{-3}\ g/C$ (d) $3.394\times10^{-3}\ g/C$

60. The earth's magnetic induction at a certain point is 7×10^{-5} Wb/m^2. This is to be annuled by the magnetic induction at the centre of a circular conducting loop of radius 5 cm. The required current in the loop is

(a) 0.56 A (b) 5.6 A
(c) 0.28 A (d) 2.8 A

Answer – Key

1. b	**2.** b	**3.** a	**4.** b	**5.** a	**6.** c	**7.** d	**8.** b	**9.** d	**10.** d
11. d	**12.** a	**13.** c	**14.** c	**15.** d	**16.** b	**17.** a	**18.** b	**19.** d	**20.** c
21. d	**22.** c	**23.** c	**24.** c	**25.** b	**26.** a	**27.** a	**28.** c	**29.** a	**30.** c
31. c	**32.** c	**33.** c	**34.** b	**35.** a	**36.** b	**37.** c	**38.** b	**39.** b	**40.** d
41. d	**42.** a	**43.** b	**44.** c	**45.** d	**46.** d	**47.** a	**48.** c	**49.** a	**50.** d
51. b	**52.** d	**53.** b	**54.** c	**55.** a	**56.** b	**57.** c	**58.** c	**59.** b	**60.** b

Hints and Solutions

1. Self inductance of circular coil is

$$L = \frac{\mu_0 n^2 \pi r}{2}$$
$$= \frac{4\pi \times 10^{-7}}{2} \times (500)^2 \times \pi \times (5 \times 10^{-2})$$
$$= 25 \times 10^{-3}\ \text{H}$$
$$= 25\ \text{mH}$$

4. As the girl stands up, the effective length of pendulum decreases due to the reason that the centre of gravity rises up so, according to

$$T = 2\pi\sqrt{\frac{l}{g}}$$

T will decrease.

5. Charge on nucleus

$$q = Ze = 47 \times 1.6 \times 10^{-19}$$
$$= 7.52 \times 10^{-18}\ \text{C}$$

Potential at the surface of the nucleus

$$V = \frac{1}{4\pi\varepsilon_0}\frac{q}{r}$$
$$= \frac{9 \times 10^9 \times 7.52 \times 10^{-18}}{3.4 \times 10^{-14}}$$
$$= 1.99 \times 10^6\ \text{V}$$

6. Induced emf, $e = L\dfrac{di}{dt}$

$$\Rightarrow \qquad L = \frac{e}{di/dt}$$

Unit of inductance $L = \dfrac{\text{volt}}{\text{amp/s}}$

$$= \frac{\text{volt-sec}}{\text{amp}}$$

7. Average velocity

$$= \frac{\text{total distance travelled}}{\text{total time taken}}$$

Let the total distance $= d$.

$$\therefore \qquad v = \frac{d}{\dfrac{d}{2v_1} + \dfrac{d}{2v_2}}$$
$$v = \frac{d}{\dfrac{d}{2}\left(\dfrac{1}{v_1} + \dfrac{1}{v_2}\right)}$$

or $$v = \frac{2v_1 v_2}{v_1 + v_2}$$

or $$\frac{v_1 + v_2}{v_1 v_2} = \frac{2}{v}$$

or $$\frac{1}{v_1} + \frac{1}{v_2} = \frac{2}{v}$$

8. The average speed of a particle in a given interval of time is defined as the ratio of distance travelled to the time taken while average velocity is defined as the ratio of displacement to time taken. Thus, if the distance travelled is Δs and displacement of a particle is $\Delta \mathbf{r}$ in a given time interval Δt then

$$v_{av} = \text{average speed} = \frac{\Delta s}{\Delta t}$$

and $$\mathbf{v}_{av} = \text{average velocity} = \frac{\Delta \mathbf{r}}{\Delta t}$$

So, the required ratio is always unity or less than one.

9. Horizontal and vertical components of velocity in projectile motion are

$$u_x = u\cos\theta$$
$$u_y = u\sin\theta$$

So, horizontal and vertical components of momentum are

$$p_x = mu\cos\theta$$
$$p_y = mu\sin\theta$$

At the highest point of its path, the vertical component of momentum becomes zero but horizontal component remains same. So, horizontal component of momentum will be conserved.

10. The velocity attained by particle on falling from height 2 m.

$$v = \sqrt{2gh} = \sqrt{2 \times g \times 2} = 2\sqrt{g}$$

Rate of change of momentum of 100 particles

$$= 2\,mv \times 100 = 200\,mv$$

From Newton's law, rate of change of momentum is equal to force.

$$\text{Force} = 200\,mv$$
$$= 200 \times 1 \times 10^{-3} \times 2\sqrt{g}$$
$$= 1252\text{g (reading)}.$$

11. Velocity of sphere $v = \left[\dfrac{M-m}{M+m}\right]u' + \dfrac{2mu}{m+M}$

Before collision, sphere of mass M remain at rest.

Therefore $u' = 0$

$$\therefore \quad v = \frac{2mu}{m+M} = \frac{2u}{1+\dfrac{M}{m}}$$

12. Limiting frictional force $F_s = \mu_s R$

$$= \mu_s mg = 0.4 \times 2 \times 9.8 = 7.84\text{ N}$$

Applied force 2.5 N < 7.84 N

So, block cannot move and force of friction will be equal to applied force.

Force of friction = 2.5 N.

13. $m_1 = 10\text{ g}, v = 100\text{ cm/s}$

$$m_1 + m_2 = 20\text{ g}, h = ?$$
$$g = 10\text{ m/s}^2 = 1000\text{ cm/s}^2$$

From law of conservation of energy

$$\frac{1}{2}mv^2 = (m_1 + m_2)gh$$

$$\Rightarrow \quad h = \frac{m_1 v_1^2}{2(m_1+m_2)g}$$

$$\therefore \quad h = \frac{10 \times 100 \times 100}{2 \times 20 \times 1000}$$

$$h = 2.5\text{ cm}.$$

14. Kinetic energy $K = \dfrac{L^2}{2I}$

If angular momenta are equal, then

$$K \propto \frac{1}{I}$$

i.e., $\quad IK = \text{constant}$

$$\Rightarrow \quad I_A K_A = I_B K_B$$

$$\Rightarrow \quad \frac{I_A}{I_B} = \frac{K_B}{K_A}$$

$$I_A > I_B$$

$$\therefore \quad K_B > K_A$$

15. Given, $n_1 = 1200\text{ cycle/min} = 20\text{ cycle/s}$

$$n_2 = \frac{4500}{60}\text{ cycle/s} = 75\text{ cycle/s}$$

Angular acceleration $\alpha = \dfrac{\omega_2 - \omega_1}{t}$

$$= \frac{2\pi(n_2 - n_1)}{t}$$

$$= \frac{2 \times 180(75-20)}{10}$$

$$= 1980\text{ degree/s}^2$$

16. $r_1 = \dfrac{4}{2} = 2\text{ cm} = 2 \times 10^{-2}\text{ m}$

$$r_2 = \frac{20}{2} = 10\text{ cm} = 10 \times 10^{-2}\text{ m}$$

Capacity of parallel plate capacitor

= capacitor of spherical capacitor

i.e., $\quad \dfrac{\varepsilon_0 A}{d} = 4\pi\varepsilon_0 r_2$

or $\quad \dfrac{\varepsilon_0 \pi r_1^2}{d} = 4\pi\varepsilon_0 r_2$

or $\quad d = \dfrac{r_1^2}{4r_2}$

$$\therefore \; d = \frac{(2 \times 10^{-2})^2}{4 \times 10 \times 10^{-2}} = \frac{4 \times 10^{-4}}{4 \times 10^{-1}} = 1 \times 10^{-3}\text{ m}$$

Distance between plates $= 1 \times 10^{-3}$ m.

17. Voltage $V = 5x^2 + 10x - 9$

Electric field $E = -\dfrac{dV}{dx} = -\dfrac{d}{dx}(5x^2 + 10x - 9)$

$$= -(10x + 10)$$

At $x = 1\text{ m}$

$$\therefore \quad E = 10(1) + 10 = 20\text{ V/m}$$

18. For coincidence of bonds

$$\frac{nD\lambda_1}{d} = \frac{(n+1)D\lambda_L}{d}$$

$$n\lambda_1 = (n+1)\lambda_L$$

$$7800n = 5200(n+1) \Rightarrow n = 2$$

19. Orbital velocity, $v_0 = \sqrt{\frac{gR^2}{R+h}}$

if $R >> h$

$$v_0 = \sqrt{\frac{gR^2}{R}} = \sqrt{gR}$$

20. According to Kepler's law

$$T^2 \propto r^3$$

$$\omega = \frac{2\pi}{T} \text{ or } T = \frac{2\pi}{\omega}$$

$$\frac{4\pi^2}{\omega^2} \propto T^3 \text{ or } \omega^2 \propto \frac{1}{r^3}$$

So, speed ω will be maximum when distance from the earth r is minimum.

21. Maximum force $F = m\omega^2 a$

$$= m\left(\frac{2\pi}{T}\right)^2 a = \frac{4\pi^2}{T^2} ma$$

$$= \frac{4\pi^2}{\left(\frac{\pi}{5}\right)^2} \times \frac{10}{1000} \times 0.5$$

$$= 0.5 \text{ N}$$

22. Time period $T = 2\pi\sqrt{\frac{m}{k}}$

$$\Rightarrow \quad T \propto \sqrt{m} \Rightarrow \frac{T_1}{T_2} = \sqrt{\frac{m_1}{m_2}}$$

Given, $T_1 = 2$ s and $T_2 = 2 + 1 = 3$ s

$$\therefore \quad \frac{2}{3} = \sqrt{\frac{m}{m+2}}$$

$$\frac{4}{9} = \frac{m}{m+2}$$

$$m = 1.6 \text{ kg}$$

23. Work done $W = \frac{1}{2} Fx$

where x is increase in length.

Young's modulus $Y = \frac{FL}{Ax}$

$$F = \frac{YAx}{L}$$

Work done, $W = \frac{1}{2}\frac{YAx}{L}x = \frac{YAx^2}{2L}$

24. Compressibility $K = \frac{1}{B} = \frac{\Delta V}{V\Delta p}$

$$\therefore 5 \times 10^{-10} = \frac{\Delta V}{100 \times 10^{-3} \times 15 \times 10^6}$$

$$\Rightarrow \quad \Delta V = 5 \times 10^{-10} \times 100 \times 10^{-3} \times 15 \times 10^6$$

$$= 0.75 \text{ mL}$$

Since, pressure increases, so volume will decrease.

25. Work done $W = 2\Delta AT$

$$= 2 \times \frac{10}{100} \times \frac{1}{1000} \times 7.2 \times 10^{-2}$$

$$= 1.44 \times 10^{-5} \text{ J}$$

26. Cohesion or cohesive attraction or cohesive force is the intermolecular attraction between like molecules. Cohesion explains phenomena such as surface tension. It is maximum for solids.

27. $v_{rms} = \sqrt{\frac{3RT}{M}}$

rms velocity of He and H_2 is same.

i.e., $$\frac{T_{H_2}}{M_{H_2}} = \frac{T_{He}}{M_{He}}$$

or $$\frac{273}{2} = \frac{T_{He}}{4}$$

or $$T_{He} = 546 \text{ K}$$

$$= 546 - 273$$

$$= 273°\text{C}$$

28. Average kinetic energy $= \frac{3}{2}kT$

T is absolute temperature $= 273$ K

$$\text{KE} = \frac{3}{2} \times 1.38 \times 10^{-23} \times 273$$

$$\text{KE} = 0.56 \times 10^{-20} \text{J}$$

29. If energy is converted into heat, then

$$ms\Delta\theta = \frac{1}{2}\frac{mv^2}{J} = \frac{mgh}{4.2}$$

where s is specific heat of water.

$$\therefore m \times 1 \times 10^3 \times \Delta\theta = \frac{m \times 9.8 \times 84}{4.2}$$

$$\Rightarrow \quad \Delta\theta = 0.196°C$$

Rise in temperature $= 0.196°C$

30. For adiabatic process

$$pV^{\gamma} = \text{constant}$$

From $\quad pV = RT$

$$p = \frac{RT}{V}$$

$$\therefore \quad \frac{RT}{V}V^{\gamma} = \text{constant}$$

$$TV^{\gamma-1} = \text{constant}$$

31. According to Newton's law of cooling, rate of cooling is proportional to temperature difference between system and surrounding.

So, correct graph will be (c).

32. $H = \frac{Q}{t} = \frac{KA(\theta_1 - \theta_2)}{l} = \frac{0.01 \times 0.8(30-0)}{2 \times 10^{-2}}$

$$= 12 \text{ Js}^{-1}$$

33. Frequency of open organ pipe

$$n = \frac{v}{2l}$$

For first pipe $n_1 = \frac{v}{2l}$

For second pipe $n_2 = \frac{v}{2(l + \Delta l)}$

Number of beats per sec in beats frequency

$$= |n_1 - n_2| = \left|\frac{v}{2l} - \frac{v}{2(l+\Delta l)}\right| = \frac{v\Delta l}{2l^2}$$

34. Let final temperature be θ.

Now heat taken by ice $= m_1L + mc_1\theta$

$$= 5 \times 80 + 5 \times 1(\theta - 0)$$

$$= 400 + 5\theta$$

Heat given by water at $40°C$

$$= m_2 l_2 \theta_2 = 20 \times 1 \times (40 - \theta)$$

Heat given = Heat taken

$$800 - 20\theta = 400 + 5\theta$$

$$25\theta = 400$$

$$\theta = \frac{400}{25} = 16°C$$

35. Let initial velocity of body at point A is v. AB is 3 cm

$$v^2 = u^2 - 2as$$

$$\left(\frac{v}{2}\right)^2 = v^2 - 2a \times 3$$

$$a = \frac{v^2}{8}$$

Let an penetrating 3 cm in a wooden block the body moves x distance from B to C

According to the question

$$u = \frac{v}{2} \text{ and } v = 0$$

$$\therefore \quad (0)^2 = \left(\frac{v}{2}\right)^2 - 2 \times \frac{v^2}{8} \times x$$

$$x = 1$$

36. Using the relation

$$\frac{mv^2}{r} = \mu R,\ R = mg$$

$$\frac{mv^2}{r} = \mu mg \text{ or } v^2 = \mu rg$$

$$v^2 = 0.6 \times 150 \times 10$$

$$v = 30 \text{ m/s}$$

37. Metals have minimum energy gap and insulators have maximum energy gap and semiconductor have energy gap lying between than insulators and metals.

38. The polarization is the property of electromagnetic waves such a light which describes the direction of their transverse electric field. More generally the polarisation of transverse wave describes the direction of oscillation, in the plane perpendicular to the direction, of travels. Longitudinal waves such as sound waves do not exhibit polarization because for these waves the direction of oscillation is along the direction of travel.

39. On the basis of Pauli's exclusion principle, the manifestation of band structure in solid can be explained.

40. Archimedes's upward thrust will be absent for a fluid, if there were no gravity.

41. Ferromagnetic substances are those, when placed in magnetic field, acquire a strong magnetism in the direction of field Nickle shows this property.

42. Power of combination is given by

$$P = P_1 + P_2 = 2\,\text{D} + (-4\,\text{D}) = -2\,\text{D}$$

43. Charges present outside the surface make no contribution of electric flux.

$$\therefore \quad \phi = \frac{q}{\varepsilon_0} - \frac{q}{\varepsilon_0} = 0$$

44. Time period of oscillation

$$T' = 2t = 2\sqrt{\frac{2h}{g}}$$

$$f = \frac{1}{T} = \frac{1}{2}\sqrt{\frac{g}{2h}}$$

45. The system of particles when left to themselves tend to move towards position where their potential energy is minimum. Therefore, $U_2 < U_1$ or $U_1 > U_2$.

46. Interference effect will be invisible because red and green are complementary colours.

47. Given, $y = u \sin \frac{\pi x}{15} \cos 96\pi t$

For nodes; displacement is zero

$$\sin \frac{\pi x}{15} = 0$$

$$\frac{\pi x}{15} = 0, \pi, 2\pi, \ldots$$

$$x = 0, 15, 30, \ldots$$

For antinodes, displacement is maximum

$$\sin \frac{\pi x}{15} = 1$$

$$\frac{\pi x}{15} = \frac{\pi}{2}, \frac{3\pi}{2}, \ldots$$

$$x = \frac{15}{2}, \frac{45}{2}, \ldots$$

Hence, distance between a node and next antinode $= \frac{15}{2} - 0 = \frac{15}{2} = 7.5$ cm

48. $I = I_0(1 - e^{-t/T})$

where T = time constant

$$\frac{3}{4} I_0 = I_0(1 - e^{-4/T})$$

$$1 - e^{-4/T} = \frac{3}{4}$$

$$e^{-4/T} = \frac{1}{4}$$

$$e^{4/T} = 4$$

$$\frac{4}{T} = \log_e 4$$

$$T = \frac{4}{\log_e 4} = \frac{2}{\log_e 2}$$

50. Angular momentum about the axis of rotation is

$$J = \frac{2}{5} MR^2 \times \frac{2\pi}{T} = \frac{4\pi MR^2}{5T}$$

51. Heavy water is deuterium oxide or D_2O or $2H_2O$. It is used in certain types of nuclear reactors, where it acts as a neutron moderator to slow down neutrons so that they can react with the uranium in the reactor. Because heavy water reactor can we natural uranium, it is of cancern in efforts to prevent nuclear praliferation.

52. For moving coil galvanometer

$$C\theta = niBA$$

where C = Couple per twist of the suspension

θ = deflection of galvanometer

$$\frac{\theta}{i} = \frac{nBA}{C}$$

Sensitivity of galvanometer $= \frac{nBA}{C}$

$\therefore$ To increase the sensitivity of galvanometer, value of C should be decreased.

53. Heat produced, $H = \frac{V^2}{R} t$

$$= \frac{60 \times 60}{6} \times 10 \times 60$$

$$= 3.6 \times 10^5 \text{ J}$$