PRACTICE SET -3

1. Which of the following is not a unit of energy?

a. W-s b. kg-m/sec

c. N-m d. Joule

2. Let $\vec{r} = \vec{a} + \lambda\vec{l}$ and $\vec{r} = \vec{b} + \mu\vec{m}$ be two lines in space where $\vec{a} = 5\hat{i} + \hat{j} + 2\hat{k}$, $\vec{b} = -\hat{i} + 7\hat{j} + 8\hat{k}$, $\vec{l} = -4\hat{i} + \hat{j} - \hat{k}$ and $\vec{m} = 2\hat{i} - 5\hat{j} - 7\hat{k}$ then, the p.v. of a point which lies on both of these lines, is:

a. $\hat{i} + 2\hat{j} + \hat{k}$

b. $2\hat{i} + \hat{j} + \hat{k}$

c. $\hat{i} + \hat{j} + 2\hat{k}$

d. non existent as the lines are skew

3. If $\vec{a} + \vec{b} + \vec{c} = 0$, $|\vec{a}| = 3$, $|\vec{b}| = 5$, $|\vec{c}| = 7$, then the angle between $\vec{a}$ & $\vec{b}$ is:

a. $\frac{\pi}{6}$ b. $\frac{2\pi}{3}$ c. $\frac{5\pi}{3}$ d. $\frac{\pi}{3}$

4. For three particles A, B and C moving along x-axis $x-t$ graphs are as shown in the figure. Mark out the correct relationship between their average velocities between the points P and Q:

a. $\upsilon_{av,A} > \upsilon_{av,B} = \upsilon_{av,C}$ b. $\upsilon_{av,A} = \upsilon_{av,B} = \upsilon_{av,C}$

c. $\upsilon_{av,A} > \upsilon_{av,B} > \upsilon_{av,C}$ d. $\upsilon_{av,A} < \upsilon_{av,B} < \upsilon_{av,C}$

5. The relation between time t and distance x is, $t = \alpha x^2 + \beta x$, where α and β are constants. The retardation is:

a. $2\alpha\upsilon^3$ b. $2\beta\upsilon^3$

c. $2\alpha\beta\upsilon^3$ d. $2\beta^3\upsilon^3$

6. An object with a mass 10 kg moves at a constant velocity of 10 m/sec. A constant force then acts for 4 second on the object and gives it a speed of 2 m/sec in opposite direction. The acceleration produced in it, is

a. $3 m/sec^2$ b. $-3 m/sec^2$

c. $0.3 m/sec^2$ d. $-0.3 m/sec^2$

7. In an elevator moving vertically up with an acceleration g, the force exerted on the floor by a passenger of mass M is:

a. Mg b. $\frac{1}{2}$Mg c. Zero d. 2 Mg

8. A force $\vec{F} = (5\hat{i} + 3\hat{j})$ newton is applied over a particle which displaces it from its origin to the point $\vec{r} = (2\hat{i} - 1\hat{j})$ metres. The work done on the particle is:

a. –7 joules b. +13 joules

c. +7 joules d. +11 joules

9. A body of mass 2 kg is thrown up vertically with K.E. of 490 joules. If the acceleration due to gravity is 9.8 m/s^2, then the height at which the K.E. of the body becomes half its original value is given by:

a. 50 m b. 12.5 m

c. 25 m d. 10 m

10. A cylinder rolls up an inclined plane, reaches some height and then rolls down (without slipping throughout these motions). The directions of the frictional force acting on the cylinder are:

a. up the incline while ascending and down the incline while descending

b. up the incline while ascending as well as descending

c. down the incline while ascending and up the incline while descending

d. down the incline while ascending as well as descending

11. A child is standing with folded hands at the centre of a platform rotating about its central axis. The kinetic energy of the system is K. The child now stretches his arms so that the moment of inertia of the system doubles. The kinetic energy of the system now is:

a. 2K b. K / 2

c. K / 4 d. 4K

12. A particle in S.H.M. is described by the displacement function, $x(t) = a\cos(\omega t + \theta)$. If the initial $(t = 0)$ position of the particle is 1 cm and its initial velocity is $\pi\ cm/s$. The angular frequency of the particle is $\pi\ rad/s$, then its amplitude is:

a. 1 cm b. $\sqrt{2}\ cm$ c. 2 cm d. 2.5 cm

13. What is the maximum acceleration of the particle doing the SHM $y = 2\sin\left[\frac{\pi t}{2} + \phi\right]$ where, 2 is in cm?

a. $\frac{\pi}{2} cm/s^2$ b. $\frac{\pi^2}{2} cm/s^2$ c. $\frac{\pi}{4} cm/s^2$ d. $\frac{\pi}{4} cm/s^2$

14. If radius of earth is R then the height 'h' at which value of 'g' becomes one-fourth is:

a. $\frac{R}{4}$ b. $\frac{3R}{4}$ c. R d. $\frac{R}{8}$

15. The mass of the moon is $\frac{1}{81}$ of the earth but the gravitational pull is $\frac{1}{6}$ of the earth. It is due to the fact that:

a. The radius of the moon is $\frac{81}{6}$ of the earth

b. The radius of the earth is $\frac{9}{\sqrt{6}}$ of the moon

c. Moon is the satellite of the earth

d. None of the above

16. *A* suction pump at ground level can draw water from a well whose depth of level is:

a. more than 40 cm **b.** less than 34 cm

c. less than 10.2 cm **d.** about 10^5 m

17. How much lead of specific gravity 11 should be added to a piece of cork of specific gravity 0.2 weighing 10 g so that it may just float on water?

a. 4.4 g **b.** 44 g **c.** 440 g **d.** 2.2 g

18. If the temperature increases, the modulus of elasticity:

a. Decreases **b.** Increases

c. Remains constant **d.** Becomes zero

19. The coefficient of linear expansion of brass and steel are α_1 and α_2. If we take a brass rod of length l_1 and steel rod of length l_2 at 0°*C*, their difference in length $(l_2 - l_1)$ will remain the same at a temperature if:

a. $\alpha_1 l_2 = \alpha_2 l_1$ **b.** $\alpha_1 l_2^2 = \alpha_2 l_1^2$

c. $\alpha_1^2 l_1 = \alpha_2^2 l_2$ **d.** $\alpha_1 l_1 = \alpha_2 l_2$

20. An organ pipe P_1 closed at one end vibrating in its first harmonic and another pipe P_2 open at both ends vibrating in its third harmonic are in resonance with a given tuning fork. The ratio of the length of P_1 and P_2 is:

a. 8 / 3 **b.** 3 / 8 **c.** 1 / 6 **d.** 1 / 3

21. Two vibrating strings of the same material but of lengths *L* and 2*L* have radii 2*r* and *r* respectively. They are stretched under the same tension. Both the string vibrates in their fundamental modes. The one of length *L* with frequency v_1 and the other with frequency v_2. The ration v_1 / v_2 is given by.

a. 2 **b.** 4 **c.** 8 **d.** 1

22. Thermoelectric thermometer is based on

a. Photoelectric effect **b.** Seebeck effect

c. Compton effect **d.** Joule effect

23. If a cylinder of diameter 1.0 *cm* at 30°*C* is to be solid into a hole of diameter 0.9997 *cm* in a steel plate at the same temperature, then minimum required rise in the temperature of the plate is:

(Coefficient of linear expansion of steel $= 12 \times 10^{-6} / °C$)

a. 25°*C* **b.** 35°*C* **c.** 45°*C* **d.** 55°*C*

24. Suppose ideal gas equation follows $VP^3 =$ constant. Initial temperature and volume of the gas are *T* and *V* respectively. If gas expand to 27*V* then its temperature will be come:

a. *T* **b.** 9*T* **c.** 27*T* **d.** *T* / 9

25. The volume of a gas at pressure $21 \times 10^4\ N/m^2$ and temperature 27°*C* is 83 litres. If *R* = 8.3 *J*/mol/*K*, then the quantity of gas in *gm*-mole will be:

a. 15 **b.** 42 **c.** 7 **d.** 14

26. An ideal monatomic gas is taken round the cycle *ABCDA* as shown in the *p*-*V* diagram (see figure). The work done during the cycle is:

a. pV **b.** $2pV$ **c.** $\frac{1}{2}pV$ **d.** zero

27. Water of volume 2 L in a container is heated with a coil of 1 kW at 27°C. The lid of the container is open and energy dissipates at rate of 160 J/s. In how much time temperature will rise from 27°C to 77°C?

[Specific heat of water is 4.2 kJ/kg]

a. 8 min 20 s **b.** 6 min 2 s

c. 7 min **d.** 14 min

28. Wires *A* and *B* have identical lengths and have circular cross-sections. The radius of *A* is twice the radius of *B* *i.e.* $r_A = 2r_B$. For a given temperature difference between the two ends, both wires conduct heat at the same rate. The relation between the thermal conductivities is given by:

a. $K_A = 4K_B$ **b.** $K_A = 2K_B$

c. $K_A = K_B / 2$ **d.** $K_A = K_B / 4$

29. Which of the following statement is correct?

a. A good absorber is a bad emitter

b. Everybody absorbs and emits radiations at every temperature

c. The energy of radiations emitted from a black body is same for all wavelengths

d. The law showing the relation of temperatures with the wavelength of maximum emission from an ideal black body is Plank's law

30. A total charge Q is broken in two parts Q_1 and Q_2 and they are placed at a distance R from each other. The maximum force of repulsion between them will occur, when:

a. $Q_2 = \frac{Q}{R}, Q_1 = Q - \frac{Q}{R}$ **b.** $Q_2 = \frac{Q}{4}, Q_1 = Q - \frac{2Q}{3}$

c. $Q_2 = \frac{Q}{4}, Q_1 = \frac{3Q}{4}$ **d.** $Q_1 = \frac{Q}{2}, Q_2 = \frac{Q}{2}$

31. Two point charges $+3\mu C$ and $+8\mu C$ repel each other with a force of $40N$. If a charge of $-5\mu C$ is added to each of them, then the force between them will become:

a. $-10\,N$ **b.** $+10\,N$ **c.** $+20\,N$ **d.** $-20\,N$

32. A condenser of capacity $50\,\mu F$ is charged to 10 volts. Its energy is equal to:

a. 2.5×10^{-3} joule **b.** 2.5×10^{-4} joule

c. 5×10^{-2} joule **d.** 1.2×10^{-8} joule

33. Force of attraction between the plates of a parallel plate capacitor is:

a. $\frac{q^2}{2\varepsilon_0 AK}$ **b.** $\frac{q^2}{\varepsilon_0 AK}$ **c.** $\frac{q}{2\varepsilon_0 A}$ **d.** $\frac{q^2}{2\varepsilon_0 A^2 K}$

34. The resistivity of iron is $1\times10^{-7}\,ohm-m$. The resistance of a iron wire of particular length and thickness is 1 ohm. If the length and the diameter of wire both are doubled, then, the resistivity in $ohm-m$ will be:

a. 1×10^{-7} **b.** 2×10^{-7} **c.** 4×10^{-7} **d.** 8×10^{-7}

35. A metallic block has no potential difference applied across it, then the mean velocity of free electrons is: (T = absolute temperature of the block)

a. Proportional to T

b. Proportional to $\sqrt{T}$

c. Zero

d. Finite but independent of temperature

36. Two small bar magnets are placed in a line with like poles facing each other at a certain distance d apart. If the length of each magnet is negligible as compared to d, the force between them will be inversely proportional to:

a. d **b.** d^2 **c.** $\frac{1}{d^2}$ **d.** d^4

37. Earth's magnetic field always has a horizontal component except at or horizontal component of earth's magnetic field remains zero at:

a. Equator **b.** Magnetic poles

c. A latitude of 60^o **d.** An altitude of 60^o

38. A charge 'q' coulomb moves in a circle at n revolutions per second and the radius of the circle is r metre. Then magnetic field at the centre of the circle is:

a. $\frac{2\pi q}{nr}\times10^{-7}$ N/amp/metre **b.** $\frac{2\pi q}{r}\times10^{-7}$ N/amp/metre

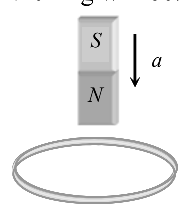
c. $\frac{2\pi nq}{r}\times10^{-7}$ N/amp/metre **d.** $\frac{2\pi q}{r}$ N/amp/metre

39. An arc of a circle of radius R subtends an angle $\frac{\pi}{2}$ at the centre. It carries a current i. The magnetic field at the centre will be:

a. $\frac{\mu_0 i}{2R}$ **b.** $\frac{\mu_0 i}{8R}$

c. $\frac{\mu_0 i}{4R}$ **d.** $\frac{2\mu_0 i}{5R}$

40. A metallic ring is attached with the wall of a room. When the north pole of a magnet is brought near to it, the induced current in the ring will be:



a. First clockwise then anticlockwise

b. In clockwise direction

c. In anticlockwise direction

d. First anticlockwise then clockwise

41. A coil of area $100cm^2$ has 500 turns. Magnetic field of $0.1\,weber/metre^2$ is perpendicular to the coil. The field is reduced to zero in 0.1 second. The induced e.m.f. in the coil is:

a. 1 V **b.** 5 V **c.** 50 V **d.** Zero

42. The resistance of a coil for DC is in ohms. In AC, the resistance:

a. Will remain same **b.** Will increase

c. Will decrease **d.** Will be zero

43. The peak value of an alternating e.m.f. E is given by $E = E_0 \cos \omega t$ is 10 volts and its frequency is 50 Hz. At time, $t = \frac{1}{600}$ sec , the instantaneous e.m.f. is:

a. 10 V **b.** $5\sqrt{3}V$ **c.** 5 V **d.** 1 V

44. In an astronomical telescope in normal adjustment, a straight black line of length L is drawn on the objective lens. The eyepiece forms a real image of this line. The length of this image is l. The magnification of the telescope is:

a. $\frac{L}{l}$ **b.** $\frac{L}{l}+1$ **c.** $\frac{L}{l}-1$ **d.** $\frac{L+l}{L-l}$

45. The diameter of the eyeball of a normal eye is about 2.5 cm. The power of the eye lens varies from

a. 2 D to 10 D **b.** 40 D to 32 D

c. 9 D to 8 D **d.** 44 D to 40 D

46. Mayer's formula for the relation between two principal specific heats Cpand Cy of a gas is given by

a. $C_V - C_P = R$ b. $\frac{C_P}{C_V} = R$

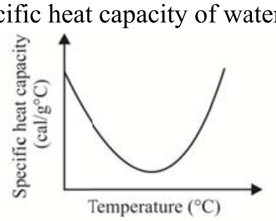
c. $C_p - C_V = R$ d. $\frac{C_V}{C_P} = R$

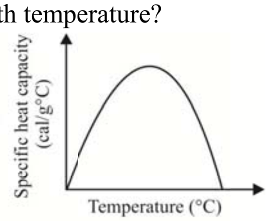
47. For a gas of molecular weight M specific heat capacity at constant pressure is $\left(\gamma = \frac{C_P}{C_V}\right)$

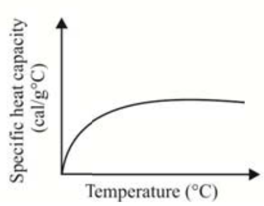
a. $\frac{R}{\gamma-1}$ b. $\frac{\gamma R}{\gamma-1}$

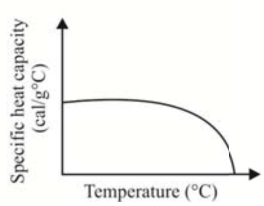
c. $\frac{\gamma R}{M(\gamma-1)}$ d. $\frac{\gamma RM}{(\gamma-1)}$

48. Which one of the following graphs represents variation of specific heat capacity of water with temperature?

a.


b.


c.


d.


49. An ideal gas having molar specific heat capacity at constant volume is $\frac{3}{2}$R, the molar specific heat capacities at constant pressure is

a. $\frac{1}{2}$R **b.** $\frac{5}{2}R$

c. $\frac{7}{2}$R **d.** $\frac{9}{2}$R

50. For nitrogen $C_P - C_V$ = x and for argon, $C_P - C_V$ = y. The relation between x and y is given by

a. x = y b. x = 7y

c. y = 7x d. x = $\frac{1}{2}$ y

Answers and Solutions

1. **(b)** *Kg-m/sec* is the unit of linear momentum

2. **(a)** $\lambda = \mu = 1$

3. **(d)** $\vec{a} + \vec{b} = -\vec{c}$ Square $|\vec{a}|^2 + |\vec{b}|^2 + 2\vec{a}.\vec{b} = |\vec{c}|^2$

$$\therefore \quad \cos\theta = \frac{|\vec{c}|^2 - |\vec{a}|^2 - |\vec{b}|^2}{2|\vec{a}||\vec{b}|}$$

4. **(b)** We have $\upsilon_{av} = \frac{\text{displacement}}{\text{time interval}}$ = slope of chord on $x-t$ graph.

Here, slope of chord between P and Q for all three particles is same, so average velocity of all the three particles would be same.

5. **(a)** $t = \alpha x^2 + \beta x = x(\alpha x + \beta)$

$$1 = 2\alpha \frac{dx}{dt} \cdot x + \beta \frac{dx}{dt}$$

$$\therefore \quad \upsilon = \frac{dx}{dt} = \frac{1}{\beta + 2\alpha x}$$

$$\frac{d\upsilon}{dt} = \frac{-2\alpha\upsilon}{(\beta + 2\alpha x)^2} = -2\alpha\upsilon^3$$

6. **(b)** $\vec{a} = \frac{\vec{v}_2 - \vec{v}_1}{t} = \frac{(-2)-(+10)}{4} = \frac{-12}{4} = -3\ m/s^2$

7. **(a)** $F = ma = \frac{m\Delta v}{\Delta t} = \frac{0.2 \times 20}{0.1} = 40\ N$

8. **(c)** $W = \vec{F}.\vec{s} = (5\hat{i} + 3\hat{j}).(2\hat{i} - \hat{j}) = 10 - 3 = 7\ J$

9. **(b)** Let h is that height at which the kinetic energy of the body becomes half its original value *i.e.,* half of its kinetic energy will convert into potential energy.

$\therefore \quad mgh = \frac{490}{2}$

$\Rightarrow \quad 2 \times 9.8 \times h = \frac{490}{2}$

$\Rightarrow \quad h = 12.5m.$

10. **(b)** $mg\sin\theta$ component is always down the plane whether it is rolling up or rolling down. Therefore, for no slipping, sense of angular acceleration should also be same in both the cases. Therefore, force of friction f always acts upwards.

11. **(b)** From conservation of angular momentum $(I\ \omega = \text{constant})$, angular velocity will remain half. As,

$K = \frac{1}{2} = I\ \omega^2$

The rotational kinetic energy will become half. Hence, the correct option is (b).

12. **(b)** $x = a\cos(\omega t + \theta)$ ...(i)

and $v = \frac{dx}{dt} = -a\omega\sin(\omega t + \theta)$ ...(ii)

Given at $t = 0$, $x = 1cm$ and $v = \pi$ and $\omega = \pi$

Putting these values in equation (i) and (ii) we will get $\sin\theta = \frac{-1}{a}$ and $\cos\theta = \frac{1}{a}$

$\Rightarrow \quad \sin^2\theta + \cos^2\theta = \left(-\frac{1}{a}\right)^2 + \left(\frac{1}{a}\right)^2$

$\Rightarrow \quad a = \sqrt{2}\ cm$

13. **(b)** Comparing given equation with standard equation,

$y = a\sin(\omega t + \phi)$, we get, $a = 2cm$, $\omega = \frac{\pi}{2}$

$\therefore \quad A_{\max} = \omega^2 A = \left(\frac{\pi}{2}\right)^2 \times 2 = \frac{\pi^2}{2} cm/s^2.$

14. **(c)** $g' = g\left(\frac{R}{R+h}\right)^2 = \frac{g}{4}$. By solving $h = R$

15. **(b)** Gravitational pull depends upon the acceleration due to gravity on that planet.

$M_m = \frac{1}{81}M_e, g_m = \frac{1}{6}g_e$

$$g = \frac{GM}{R^2} \Rightarrow \frac{R_e}{R_m} = \left(\frac{M_e}{M_m} \times \frac{g_m}{g_e}\right)^{1/2} = \left(81 \times \frac{1}{6}\right)^{1/2}$$

$\therefore \quad R_e = \frac{9}{\sqrt{6}} R_m$

16. **(c)** $\Delta P = hdg$ and $(\Delta P)_{\text{max}} = 1\,\text{atm} = 10^5\ \text{N/m}^3$

$\Rightarrow \quad h = \frac{\Delta P}{dg} = \frac{10^5\ \text{N/m}^3}{(10^3\text{kg/m}^3)(9.8)} \approx 10.2\ \text{m}$

17. **(b)** $m_1 g + m_2 g = (V_1 + V_2)\sigma_w g$

$\Rightarrow \quad m_1 + 10 = \left(\frac{m_1}{11} + \frac{10}{0.2}\right) \times 1$

$\Rightarrow \quad m_1 = 44\ \text{g}$

18. **(a)** Because due to increase in temperature intermolecular forces decreases.

19. **(d)** $L_2 = l_2(1 + \alpha_2\Delta\theta)$ and $L_1 = l_1(1 + \alpha_1\Delta\theta)$

$\Rightarrow \quad (L_2 - L_1) = (l_2 - l_1) + \Delta\theta(l_2\alpha_2 - l_1\alpha_1)$

Now $(L_2 - L_1) = (l_2 - l_1)$

so, $\quad l_2\alpha_2 - l_1\alpha_1 = 0$

20. **(c)** First harmonic of closed = Third harmonic of open

$\therefore \quad \frac{v}{4l_2} = 3\left(\frac{v}{2l_2}\right) \Rightarrow \frac{l_1}{l_2} = \frac{1}{6}$

21. **(d)** Fundamental frequency is given by $v = \frac{1}{2l}\sqrt{\frac{T}{\mu}}$ (with both the ends fixed).

$\therefore$ Fundamental frequency $v \propto = \frac{1}{l\sqrt{\mu}}$ (for same tension in both strings)

Where, $\mu =$ mass per unit length of wire

$= \rho.A$ ($\rho =$density) $= \rho(\pi r^2)$

or $\quad \sqrt{\mu} \propto r$

$\therefore \quad v \propto \frac{1}{rl}$

$\therefore \quad \frac{v_1}{v_2} = \left(\frac{r_2}{r_1}\right)\left(\frac{l_2}{l_1}\right) = \left(\frac{r}{2r}\right)\left(\frac{2L}{L}\right) = 1$

22. **(b)** Thermoelectric thermometer is based on Seebeck effect.

23. **(a)** $\alpha = \frac{\Delta L}{L_0\Delta\theta} = \frac{(1 - 0.9997)}{0.9997 \times 12 \times 10^{-6}} = 25°C$

24. **(c)** For same isotherm; $T \rightarrow$ constant

$\therefore \quad P \propto \frac{1}{V} \Rightarrow P_1V_1 = P_2V_2$

25. **(c)** $PV = \mu RT \Rightarrow \mu = \frac{PV}{RT} = \frac{21\times10^4\times83\times10^{-3}}{8.3\times300} = 7$

26. **(a)** Work done in a cyclic process = area between the cyclic

$= AB\times BC = (2p-p)\times(2V-V) = pV$

Note: If cycle is clockwise (p on y-axis and V on x-axis) work done is positive and if it is anticlockwise work done is negative.

27. **(a)** Energy gained by water (in 1 s) = energy supplied – energy lost

= 1000 J – 160 J = 840 J

Total heat required to raise the temperature of water from 27°C to 77°C is $ms\Delta\theta$.

Hence, the required time

$$t = \frac{ms\Delta\theta}{\text{rate by which energy is gained by water}}$$

$$= \frac{(2)(4.2\times10^3)(50)}{840} = 500\,\text{s} = 8 \text{ min } 20 \text{ s}$$

$\therefore$ Correct answer is **(a)**.

28. **(d)** $\frac{Q}{t} = \frac{KA\Delta\theta}{l} \Rightarrow \frac{K_A}{K_B} = \frac{A_B}{A_A} = \left(\frac{r_B}{r_B}\right)^2 = \frac{1}{4} \Rightarrow K_A = \frac{K_B}{4}$

29. **(d)** A good absorber is a good emitter hence option (a) is wrong. Everybody stops absorbing and emitting radiation at 0 K hence, option (b) is wrong.

The energy of radiation emitted from a black body is not same for all wavelengths hence option (c) is wrong.

Plank's law relates the wavelength (λ) and temperature (T). According to the relation $E_\lambda d_\lambda = \frac{8\pi hc}{\lambda^5}\frac{1}{[e^{hc/kT}-1]}d_\lambda$.

Hence, option (d) is correct.

30. **(d)** $Q_1 + Q_2 = Q \qquad \ldots (i)$

and $F = k\frac{Q_1Q_2}{r^2} \qquad \ldots (ii)$

From (i) and (ii) $F = \frac{kQ_1(Q-Q_1)}{r^2}$

For F to be maximum $\frac{dF}{dQ_1} = 0$

$\Rightarrow \quad Q_1 = Q_2 = \frac{Q}{2}$

31. **(a)** In second case, charges will be $-2\mu C$ and $+3\mu C$

Since, $F \propto Q_1Q_2$ *i.e.* $\frac{F}{F'} = \frac{Q_1Q_2}{Q'_1Q'_2}$

$\therefore \quad \frac{40}{F'} = \frac{3\times8}{-2\times3} = -4$

$\Rightarrow \quad F' = 10\,N$ (Attractive)

32. **(a)** $U = \frac{1}{2}CV^2 = \frac{1}{2}\times50\times10^{-6}\times(10)^2 = 2.5\times10^{-3}\,J$

33. **(a)** Force on one plate due to another is:

$$F = qE = q\times\frac{\sigma}{2\varepsilon_0 K} = q\left(\frac{q}{2AK\varepsilon_0}\right) = \frac{q^2}{2AK\varepsilon_0}$$

(where, $\frac{\sigma}{2\varepsilon_0 K}$ is the electric field produced by one plate at the location of other).

34. **(a)** Resistivity of some material is its intrinsic property and is constant at particular temperature. Resistivity does not depend upon shape.

35. **(b)** In the absence of external electric field mean velocity of free electron (V_{rms}) is given by:

$$V_{rms} = \sqrt{\frac{3KT}{m}} \Rightarrow V_{rms} \propto \sqrt{T}$$

36. **(d)** $F = \frac{\mu_0}{4\pi}\left(\frac{6MM'}{d^4}\right)$ in end-on position.

37. **(b)** At magnetic poles, the angle of dip is 90°. Hence the horizontal component $B_H = B\cos\theta = 0$.

38. **(c)** The magnetic field at the centre of the circle

$$= \frac{\mu_o}{4\pi}\times\frac{2\pi i}{r} = 10^{-7}\times\frac{2\pi(nq)}{r} = \frac{2\pi nq}{r}\times10^{-7}\,N/A\text{-}m$$

39. **(b)** $B = \frac{\mu_0}{4\pi}\frac{\theta i}{r} = \frac{\mu_0}{4\pi}\times\frac{\pi}{2}\times\frac{i}{R} = \frac{\mu_0 i}{8R}$

40. **(c)** As it is seen from the magnet side induced current will be anticlockwise.

41. **(c)** When frequency is high, the galvanometer will not show deflection.

42. **(b)** The coil having inductance L besides the resistance R. Hence for ac its effective resistance $\sqrt{R^2+X_L^2}$ will be larger than its resistance R for DC.

43. **(b)** $E = E_0\cos\omega t = E_0\cos\frac{2\pi t}{T}$

$$= 10\cos\frac{2\pi\times 50\times 1}{600} = 10\cos\frac{\pi}{6} = 5\sqrt{3}\ volt.$$

44. **(a)** Here we treat the line on the objective as the object and the eyepiece as the lens.

Hence, $u = -(f_o + f_e)$ and $f = f_e$

Now, $\frac{1}{v} - \frac{1}{-(f_o+f_e)} = \frac{1}{f_e}$

Solving we get $v = \frac{(f_o+f_e)f_e}{f_o}$

Magnification $= \left|\frac{v}{u}\right| = \frac{f_e}{f_o} = \frac{\text{Image size}}{\text{Object size}} = \frac{l}{L}$

$\therefore$ Magnification of telescope in normal adjustment

$= \frac{f_o}{f_e} = \frac{L}{l}$

45. **(d)** An eye sees distant objects with full relaxation

So $\frac{1}{2.5\times10^{-2}} - \frac{1}{-\infty} = \frac{1}{f}$ or $P = \frac{1}{f} = \frac{1}{25\times10^{-2}} = 40D$

An eye sees an object at 25 cm with strain

So $\frac{1}{2.5\times10^{-2}} - \frac{1}{-25\times10^{-2}} = \frac{1}{f}$

or $P = \frac{1}{f} = 40 + 4 = 44D$

46. **(c)**

47. **(c)** According to Mayer's relation

$C_P - C_V = R$ or $1 - \frac{C_V}{C_P} = \frac{R}{C_P}$

or $1 - \frac{1}{\gamma} = \frac{R}{C_P}$ $\left(\because \gamma = \frac{C_p}{C_V}\right)$

or $\frac{\gamma-1}{\gamma} = \frac{R}{C_P}$ or $C_P = \frac{\gamma R}{\gamma - 1}$

Specific heat capacity $= \frac{\text{molar heat capacity}}{\text{molecular weight}}$

Specific heat capacity at constant pressure $= \frac{\gamma R}{M(\gamma-1)}$

48. **(a)**

49. **(b)** Here, $C_v = \frac{3}{2}$ R.

Since $C_p - C_V = R$

$\therefore C_P = C_V + R = \frac{3}{2}R + R = \frac{5}{2}R$

50. **(a)** Since for every gas, $C_P - C_V = R$

$\therefore$ x = y

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