PRACTICE SET -1

1. The unit of Stefan's constant σ is:

   a. $W\,m^{-2}\,K^{-1}$ b. $W\,m^{2}\,K^{-4}$ c. $W\,m^{-2}\,K^{-4}$ d. $W\,m^{-2}\,K^{4}$

2. The velocity of a particle depends upon as $v = a + bt + ct^2$; if the velocity is in m/sec, the unit of a will be:

   a. m/sec b. m/sec^2 c. m^2/sec b. m/sec^3

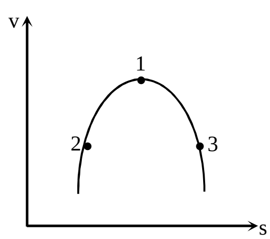
3. The lines $\vec{r} = 2\hat{k} + \lambda(3\hat{i} + 2\hat{j} + \hat{k})$ and $\vec{r} = 3\hat{i} + 2\hat{j} + 3\hat{k} + \mu(6\hat{i} + 4\hat{j} + 2\hat{k})$ are:

   a. non-intersecting
   b. non-coplanar
   c. intersects exactly at one point
   d. intersect at more than one point

4. Let $\vec{a}, \vec{b}, \vec{c}$ be vectors of length 3, 4, 5 respectively. Let $\vec{a}$ be perpendicular to $\vec{b} + \vec{c}$, $\vec{b}$ to $\vec{c} + \vec{a}$ & $\vec{c}$ to $\vec{a} + \vec{b}$. Then, $|\vec{a} + \vec{b} + \vec{c}|$ is:

   a. $2\sqrt{5}$ b. $2\sqrt{2}$ c. $10\sqrt{5}$ d. $5\sqrt{2}$

5. The velocity-displacement curve for an object moving along a straight line is shown in the figure. At which of the points marked, the object is speeding up?



   a. 1 b. 2 c. 1 and 3 d. 1, 2 and 3

6. Two cars A and B are traveling in the same direction with velocities V_A and V_B $(V_A > V_B)$. When the car A is at a distances s behind the car B, the driver to the car A applies the brakes producing a uniform retardation a; there will be no collision when:

   a. $s < \frac{(V_A - V_B)^2}{2a}$ b. $s = \frac{(V_A - V_B)^2}{2a}$

   c. $s \geq \frac{(V_A - V_B)^2}{2a}$ d. $s \leq \frac{(V_A - V_B)^2}{2a}$

7. A coin is dropped in a lift. It takes time t_1 to reach the floor when lift is stationary. It takes time t_2 when lift is moving up with constant acceleration. Then

   a. $t_1 > t_2$ b. $t_2 > t_1$ c. $t_1 = t_2$ d. $t_1 >> t_2$

8. If a person with a spring balance and a body hanging from it goes up and up in an aeroplane, then the reading of the weight of the body as indicated by the spring balance will:

   a. go on increasing
   b. go on decreasing
   c. first increase and then decrease
   d. remain the same

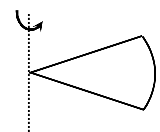
9. A body of mass m kg is lifted by a man to a height of 1 metre in 30 sec. Another man lifts the same mass to the same height in 60 sec. The work done by them are in the ratio

   a. 1 : 2 b. 1 : 1 c. 2 : 1 d. 4 : 1

10. A cord is used to lower vertically a block of mass M by a distance d with constant downward acceleration $\frac{g}{4}$. Work done by the cord on the block is:

    a. $Mg\frac{d}{4}$ b. $3Mg\frac{d}{4}$ c. $-3Mg\frac{d}{4}$ d. Mgd

11. One-quarter section is cut from a uniform circular disc of radius R. This section has a mass M. It is made to rotate about a line perpendicular to its plane and passing through the centre of the original disc.

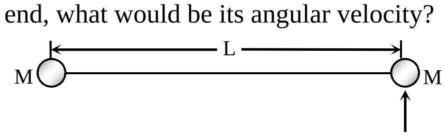


    Its moment of inertia about the axis of rotation is:

    a. $\frac{1}{2}MR^2$ b. $\frac{1}{4}MR^2$

    c. $\frac{1}{8}MR^2$ d. $\sqrt{2}MR^2$

12. Consider a body, shown in figure, consisting of two identical balls, each of mass M connected by a light rigid rod. If an impulse $J = Mv$ is imparted to the body at one of its end, what would be its angular velocity?



    a. v/L b. $2v/L$ c. $v/3L$ d. $v/4L$

13. The amplitude of a particle executing S.H.M. with frequency of 60 Hz is 0.01 m. The maximum value of the acceleration of the particle is:

    a. $144\pi^2 m/sec^2$ b. $144 m/sec^2$

    c. $\frac{144}{\pi^2} m/sec^2$ d. $288\pi^2 m/sec^2$

14. The total energy of a particle, executing simple harmonic motion is:

    a. $\propto x$ b. $\propto x^2$

    c. Independent of x d. $\propto x^{1/2}$

15. An earth satellite is moved from one stable circular orbit to a further stable circular orbit, which one of the following quantities increase?

a. Gravitational force **b.** Gravitational P.E.
c. Linear orbital speed **d.** Centripetal acceleration

16. If the value of g at the surface of the earth is 9.8 m/sec^2, then the value of g at a place 480 km above the surface of the earth will be: (Radius of the earth is 6,400 km)

a. $8.4\ \text{m/sec}^2$ **b.** $9.8\ \text{m/sec}^2$
c. $7.2\ \text{m/sec}^2$ **d.** $4.2\ \text{m/sec}^2$

17. The value of g at a place decreases by 2%. The barometric height of mercury:

a. increase by 2%
b. decreases by 2%
c. remain unchanged
d. sometimes increases and sometimes decreases

18. Two bodies with volumes V and $2V$ are in equilibrium on a balance. The larger body is then immersed in oil of density $\rho = 0.9\times10^3\ \text{kg/m}^3$. What must be the density of the liquid in which a smaller body is simultaneously immersed so as not to disturb the equilibrium of the balance?

a. $0.9\times10^3\ \text{kg/m}^3$ **b.** $1.8\times10^3\ \text{kg/m}^3$
c. $0.45\times10^3\ \text{kg/m}^3$ **d.** $1.35\times10^3\ \text{kg/m}^3$

19. If x longitudinal strain is produced in a wire of Young's modulus y, then the energy stored in the material of the wire per unit volume is:

a. yx^2 **b.** $2yx^2$ **c.** $\frac{1}{2}y^2x$ **d.** $\frac{1}{2}yx^2$

20. If Young's modulus for a material is zero, then the state of material should be:

a. Solid **b.** Solid but powder
c. Gas **d.** None of the above

21. A cylindrical tube, open at both ends, has a fundamental frequency f in air. The tube is dipped vertically in water so that half of its lengths is in water. The fundamental frequency of the air column is now:

a. $f/2$ **b.** $3f/4$ **c.** f **d.** $2f$

22. An object of specific gravity ρ is hung from a thin steel wire. The fundamental frequency for transverse standing waves in the wire is 300 Hz. The object is immersed in water, so that one half of its volume is submerged. The new fundamental frequency (in Hz) is:

a. $300\left(\frac{2\rho-1}{2\rho}\right)^{1/2}$ **b.** $300\left(\frac{2\rho}{2\rho-1}\right)^{1/2}$
c. $300\left(\frac{2\rho}{2\rho-1}\right)$ **d.** $300\left(\frac{2\rho-1}{2\rho}\right)$

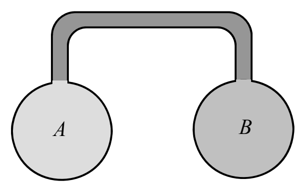
23. If a thermometer reads freezing point of water as 20°C and boiling point as 150°C, how much thermometer read when the actual temperature is 60°C?

a. 98°C **b.** 110°C **c.** 40°C **d.** 60°C

24. When a bimetallic strip is heated, it

a. does not bend at all
b. gets twisted in the form of an helix
c. bend in the form of an arc with the more expandable metal outside
d. bends in the form of an arc with the more expandable metal inside

25. Two spherical vessel of equal volume, are connected by *a n* arrow tube. The apparatus contains an ideal gas at one atmosphere and 300 K. Now if one vessel is immersed in a bath of constant temperature 600 K and the other in a bath of constant temperature 300 K. Then, the common pressure will be:



a. 1 *atm* **b.** $\frac{4}{5}$ *atm* **c.** $\frac{4}{3}$ *atm* **d.** $\frac{3}{4}$ *atm*

26. If pressure of CO_2 (real gas) in a container is given by $P = \frac{RT}{2V-b} - \frac{a}{4b^2}$ then mass of the gas in container is:

a. 11 *gm* **b.** 22 *gm* **c.** 33 *gm* **d.** 44 *gm*

27. Two metallic spheres S_1 and S_2 are made of the same material and have got identical surface finish. The mass of S_1 is thrice that of S_2. Both the spheres are heated to the same high temperature and placed in the same room having lower temperature but are thermally insulated from each other. The ratio of the initial rate of cooling of S_1 to that of S_2 is:

a. $\frac{1}{3}$ **b.** $\frac{1}{\sqrt{3}}$ **c.** $\frac{\sqrt{3}}{1}$ **d.** $\left(\frac{1}{3}\right)^{1/3}$

28. Starting with the same initial conditions, an ideal gas expands from volume V_1 to V_2 in three different ways, the work done by the gas is W_1 if the process is purely isothermal, W_2 if purely isobaric and W_3 if purely adiabatic, then

a. $W_2 > W_1 > W_3$ **b.** $W_2 > W_3 > W_1$

c. $W_1 > W_2 > W_3$ **d.** $W_1 > W_3 > W_2$

29. Two rods of same length and material transfer a given amount of heat in 12 seconds, when they are joined end to end. But when they are joined lengthwise, then they will transfer same heat in same conditions in

a. 24 s **b.** 3 s **c.** 1.5 s **d.** 48 s

30. Hot water cools from $60°C$ to $50°C$ in the first 10 minutes and to $42°C$ in the next 10 minutes. The temperature of the surrounding is:

a. $5°C$ **b.** $10°C$ **c.** $15°C$ **d.** $20°C$

31. There are two charges +1 microcoulombs and +5 microcoulombs. The ratio of the forces acting on them will be:

a. 1 : 5 **b.** 1 : 1 **c.** 5 : 1 **d.** 1 : 25

32. ABC is a right angled triangle in which $AB = 3\text{cm}$ and $BC = 4\text{cm}$. And $\angle\ ABC = \pi/2$. The three charges $+15, +12$ and $-20 e.s.u.$ are placed respectively on A, B and C. The force acting on B is:

a. 125 dynes **b.** 35 dynes **c.** 25 dynes **d.** zero

33. The capacity of a parallel plate capacitor increases with the:

a. Decrease of its area **b.** Increase of its distance

c. Increase of its area **d.** None of the above

34. When a slab of dielectric material is introduced between the parallel plates of a capacitor which remains connected to a battery, then charge on plates relative to earlier charge:

a. Is less

b. Is same

c. Is more

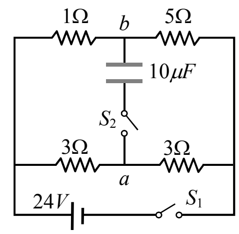
d. May be less or more depending on the nature of the material introduced

35. When the length and area of cross-section both are doubled, then its resistance

a. Will become half **b.** Will be doubled

c. Will remain the same **d.** Will become four times

36. In the circuit shown in figure, switch S_1 is initially closed and S_2 is open. Find $V_a - V_b$?



a. 4 V **b.** 8 V **c.** 12 V **d.** 16 V

37. A moving coil galvanometer is converted into an ammeter reading up to 0.03A by connecting a shunt of resistance $4r$ across it and into an ammeter reading up to 0.06A when a shunt of resistance r is connected across it. What is the maximum current which can be sent through this galvanometer if no shunt is used?

a. $0.01A$ **b.** $0.02A$ **c.** $0.03A$ **d.** $0.04A$

38. A long magnetic needle of length $2L$, magnetic moment M and pole strength m units is broken into two pieces at the middle. The magnetic moment and pole strength of each piece will be:

a. $\frac{M}{2}, \frac{m}{2}$ **b.** $M, \frac{m}{2}$ **c.** $\frac{M}{2}, m$ **d.** M, m

39. The earth's magnetic field at a certain place has a horizontal component 0.3 Gauss and the total strength 0.5 Gauss. The angle of dip is:

a. $\tan^{-1}\frac{3}{4}$ **b.** $\sin^{-1}\frac{3}{4}$ **c.** $\tan^{-1}\frac{4}{3}$ **d.** $\sin^{-1}\frac{3}{5}$

40. The magnetic field $d\vec{B}$ due to a small current element $d\vec{l}$ at a distance $\vec{r}$ and element carrying current i is,

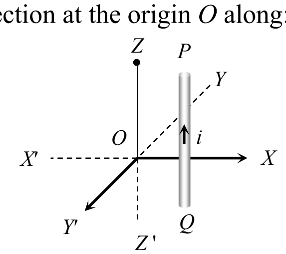
or

Vector form of Biot-Savart's law is:

a. $d\vec{B} = \frac{\mu_0}{4\pi} i\left(\frac{d\vec{l} \times \vec{r}}{r}\right)$ **b.** $d\vec{B} = \frac{\mu_0}{4\pi} i^2\left(\frac{d\vec{l} \times \vec{r}}{r}\right)$

c. $d\vec{B} = \frac{\mu_0}{4\pi} i^2\left(\frac{d\vec{l} \times \vec{r}}{r^2}\right)$ **d.** $d\vec{B} = \frac{\mu_0}{4\pi} i\left(\frac{d\vec{l} \times \vec{r}}{r^2}\right)$

41. A vertical wire kept in Z-X plane carries a current from Q to P (see figure). The magnetic field due to current will have the direction at the origin O along:



a. OX **b.** OX' **c.** OY **d.** OY'

42. A coil having 500 square loops each of side 10 cm is placed normal to a magnetic flux which increases at the rate of 1.0 tesla/second. The induced e.m.f. in volts is:
a. 0.1 b. 0.5 c. 1 d. 5

43. A coil of Cu wire (radius -r, self inductance -L) is bent in two concentric turns each having radius $\frac{r}{2}$. The self inductance now:
a. 2L b. L c. 4 L d. L / 2

44. Choke coil is used to control
a. AC b. DC
c. Both AC and DC d. Neither AC nor DC

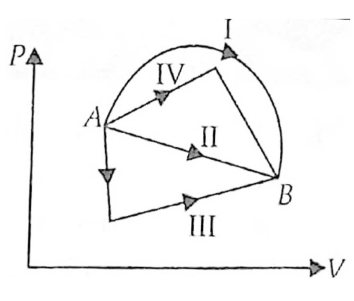
45. In a series circuit $R = 300\ \Omega,\ L = 0.9\ H,\ C = 2.0\ \mu F$ and $\omega = 1000 \text{rad/sec}$. The impedance of the circuit is :
a. 1300 Ω b. 900 Ω c. 500 Ω d. 400 Ω

46. The Zeroth law of thermodynamics leads to the concept of
a. internal energy b. heat content
c. pressure d. temperature

47. "Two systems in thermal equilibrium with a third system separately are in thermal equilibrium with each other."
The above statement is
a. First law of thermodynamics
b. Second law of thermodynamics
c. Third law of thermodynamics
d. Zeroth law of thermodynamics

48. Internal energy of an ideal gas depends upon
a. temperature only
b. volume only
c. both volume and temperature
d. neither volume nor temperature

49. An ideal gas undergoing a change of state from A to B through four different paths I, II, III and IV as shown in the P-V diagram that lead to the same change of state, then the change in internal energy is



a. same in I and II but not in III and IV
b. same in III and IV but not in I and II
c. same in I, II and III but not in IV
d. same in all the four cases

50. Which of the following is not a path function?
a. ΔQ c. ΔW
c. Δw d. ΔQ – ΔW

Answers and Solutions

1. (c) Stefan's law is $E = \sigma(T^4) \Rightarrow \sigma = \frac{E}{T^4}$

where, $E = \frac{\text{Energy}}{\text{Area} \times \text{Time}} = \frac{\text{Watt}}{m^2}$

$\sigma = \frac{\text{Watt - } m^{-2}}{K^4} = Watt - m^{-2}K^{-4}$

2. (a) Quantities of similar dimensions can be added or subtracted so unit of a will be same as that of velocity.

3. (d) The lines are parallel. If they are coincident , the equation

$3\lambda = 6\mu + 3$ . . .(i)

$2\lambda = 4\mu + 2$ . . .(ii)

$2 + \lambda = 3 + 2\mu \Rightarrow \lambda = 2\mu + 1$ . . .(iii)

(i) , (ii) and (iii) are identical. Hence infinite solution

4. (d) $\left.\begin{array}{l} \vec{a}\cdot(\vec{b}+\vec{c}) = 0 \\ \vec{b}\cdot(\vec{c}+\vec{a}) = 0 \\ \vec{c}\cdot(\vec{a}+\vec{b}) = 0 \end{array}\right\} \Rightarrow \vec{a}\cdot\vec{b} + \vec{b}\cdot\vec{c} + \vec{c}\cdot\vec{a} = 0$

$\because\ \vec{a}\cdot\vec{b} = \vec{b}\cdot\vec{c} = \vec{c}\cdot\vec{a} = 0$ now square $|\vec{a}+\vec{b}+\vec{c}|$ to get the result

5. (a) From $a = \upsilon\frac{dv}{ds}$, we can find the sing of acceleration at various points. v is +ve for all three points 1, 2 and 3.
$\frac{dv}{ds}$ is +ve for point 1, zero for point 2 and –ve for point 3.
So only for point 1, veloc ity and acceleration have same sign. So object is speeding up at point 1 only.

6. (c) For no collision, the speed of car A may be reduced to V_B before the cars meet, i.e., final relative velocity of car A with respect to car B is zero, i.e., $V_r = 0$ here, u_r = initial relative velocity $= V_A - V_B$ Relative acceleration $= a_r = -a - 0 = -a$.
Then using the equation, $\upsilon^2 = u^2 + 2as$

$0 = (V_A - V_B)^2 = 2as'$ or $s' = \frac{(V_A - V_B)^2}{2a}$

For no collisions $s' \le s$, i.e., $\frac{(V_A - V_B)^2}{2a} \le s$

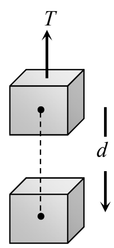
7. (a) For stationary lift $t_1 = \sqrt{\frac{2h}{g}}$ and when the lift is moving up with constant acceleration $t_2 = \sqrt{\frac{2h}{g+a}}$

$\therefore\ t_1 > t_2$

8. **(c)** Initially due to upward acceleration apparent weight of the body increases but then it decreases due to decrease in gravity.

9. **(b)** Work done does not depend on time.

10. **(c)** When the block moves vertically downward with acceleration $\frac{g}{4}$ then tension in the cord



$T = M\left(g - \frac{g}{4}\right) = \frac{3}{4}Mg$

Work done by the cord = $\vec{F}.\vec{s} = Fs\cos\theta$

$= Td\cos(180°) = -\left(\frac{3Mg}{4}\right)\times d = -3Mg\frac{d}{4}$

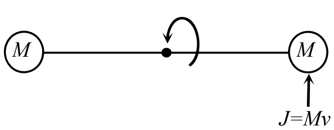
11. **(a)** Mass of the whole disc = 4*M*

Moment of inertia of the disc about the given axis $= \frac{1}{2}(4M)R^2 = 2MR^2$

$\therefore$ Moment of inertia of quarter section of the disc $= \frac{1}{4}(2MR^2) = \frac{1}{2}\text{MR}^2$

Note: These type of questions are often asked in objective student generally error in taking mass of the whole disc. They take it M instead of 4M.

12. **(a)** Let ω be the angular velocity of the rod. Applying, angular impulse = change in angular momentum about centre of mass of the system $J.\frac{L}{2} = I_c\ \omega$



$$\therefore \quad (Mv)\left(\frac{L}{2}\right) = (2)\left(\frac{ML^2}{4}\right)\omega$$

$$\therefore \quad \omega = \frac{v}{L}$$

13. **(d)** $-a\omega^2$ when it is at one extreme point.

14. **(c)** Total energy $= \frac{1}{2}m\omega^2a^2 =$ constant

15. **(b)** $U = \frac{-GMm}{r}$. If *r* increases then *U* also increases.

16. **(a)** The value of *g* on the surface of the earth $g \propto \frac{1}{R^2}$

At height *h* from the surface of the earth $g' \propto \frac{1}{(R+h)^2}$

$$\therefore \quad g' = g\frac{R^2}{(R+h)^2} = \frac{9.8\times(6400)^2}{(6400+480)^2} = 8.4\ m/s^2$$

17. **(c)** Pressure = force exerted by air column. When g decreases, the force due to air column also decreases; so barometric height remains unchanged.

18. **(b)** For equilibrium the force of buoyancy on both sides should be same.

i.e., $\rho_l = 1.8\times10^3\ \text{kg/m}^3$

19. **(d)** Energy stored per unit volume $= \frac{1}{2}\times\text{Stress}\times\text{Strain}$

$= \frac{1}{2}\times\text{Young's modulus}\times(\text{Strain})^2 = \frac{1}{2}\times Y\times x^2$

20. **(b)** *Y* is defined for solid only and for powders, $Y = 0$.

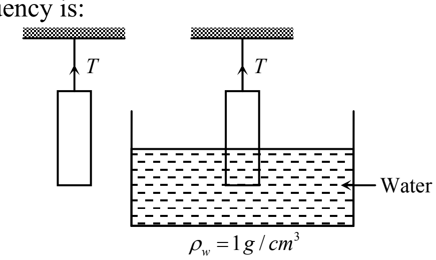
21. **(c)** Initially the tube was open at both ends and then it is closed.

$f_0 = \frac{v}{2l_0}$ and $f_C = \frac{v}{4l_C}$

Since, tube is half dipped in water, $l_C = \frac{l_0}{2}$

$$\therefore \quad f_C = \frac{v}{4\left(\frac{l_0}{2}\right)} = \frac{v}{2l_0} = f_0 = f$$

22. **(a)** The diagrammatic representation of the given problem is shown in figure. The expression of fundamental frequency is:



$$v = \frac{1}{2l}\sqrt{\frac{T}{\mu}}$$

In air $T = mg = (V\rho)g$

$$\therefore \quad v = \frac{1}{2l}\sqrt{\frac{A\rho g}{\mu}} \qquad \ldots(i)$$

When the object is half immersed in water

$T' = mg - \text{upthrust} = V\rho g - \left(\frac{V}{2}\right)\rho_w g = \left(\frac{V}{2}\right)g(2\rho - \rho_w)$

The new fundamental frequency is:

$$v' = \frac{1}{2l} \times \sqrt{\frac{T'}{\mu}} = \frac{1}{2l}\sqrt{\frac{(Vg/2)(2\rho - \rho)}{\mu}} \qquad \ldots (ii)$$

$$\therefore \quad \frac{v'}{v} = \left(\sqrt{\frac{(2\rho - \rho_w)}{2\rho}}\right)$$

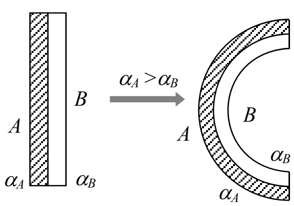
or $$v' = v\left(\sqrt{\frac{(2\rho - \rho_w)}{2\rho}}\right)^{1/2}$$

$$\Rightarrow \quad 300\left(\frac{2\rho - 1}{2\rho}\right)^{1/2} Hz$$

23. **(a)** Temperature on any scale can be converted into other scale by $\dfrac{x - LFP}{UFP - LFP}$

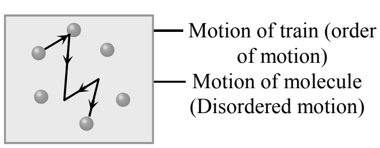
= Constant for all scales $\dfrac{x - 20}{150 - 20} = \dfrac{60}{100} \Rightarrow x = 98°C$

24. **(c)**



A bimetallic strip on being heated bends in the form of an arc with more expandable metal (1) outside (as shown…) correct.

25. **(c)** Temperature of the gas is concerned only with its disordered motion. It is no way concerned with its ordered motion.



26. **(b)** Van der Waal's gas equation for μ mole of real gas:

$$\left(P + \frac{\mu^2 a}{V^2}\right)(V - \mu b) = \mu RT \Rightarrow \quad P = \frac{\mu RT}{V - \mu b} - \frac{\mu^2 a}{V^2}$$

On comparing the given equation with this standard equation we get $\mu = \frac{1}{2}$. Hence $\mu = \frac{m}{M} \Rightarrow$ mass of gas

$$m = \mu m = \frac{1}{2} \times 44 = 22 gm.$$

27. **(d)** The rate at which energy radiates from the object is:

$$\frac{\Delta sq}{\Delta t} = e\sigma AT^4$$

Since, $\Delta Q = mc\Delta T$, we get $\dfrac{\Delta T}{\Delta t} = \dfrac{e\sigma AT^4}{mc}$

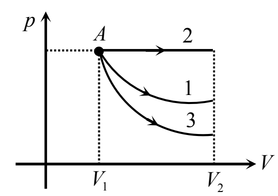
Also, since $m = \frac{4}{3}\pi r^3 \rho$ for a sphere, we get

$$A = 4\pi r^2 = 4\pi\left(\frac{3m}{4\pi\rho}\right)^{2/3}$$

Hence, $$\frac{\Delta T}{\Delta t} = \frac{e\sigma T^4}{mc}\left[4\pi\left(\frac{3m}{4\pi\rho}\right)^{2/3}\right] = K\left(\frac{1}{m}\right)^{1/3}$$

For the given two bodies $\dfrac{(\Delta T/\Delta t)_1}{(\Delta T/\Delta t)_2} = \left(\dfrac{m_2}{m_1}\right)^{1/3} = \left(\dfrac{1}{3}\right)^{1/3}$

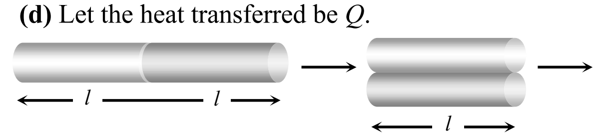
28. **(a)** The corresponding p-V graphs (also called indicate diagram) in three different processes will be as shown. Area under the graph gives the work done by the gas.



$$(\text{Area})_2 > (\text{Area})_1 > (\text{Area})_3$$

$$\therefore \quad W_2 > W_1 > W_3$$

29. **(d)** Let the heat transferred be *Q*.



When, rods are joined end to end. Heat transferred by each rod:

$$= Q = \frac{KA\Delta\theta}{l} \times 12 \qquad \ldots (i)$$

When rods are joined lengthwise, $Q = \dfrac{KA\Delta\theta}{2l} t \quad \ldots (ii)$

From equation (i) and (ii) we get $t = 48\, s$

30. **(b)** According to Newton's law of cooling

$$\frac{\theta_1 - \theta_2}{t} = K\left[\frac{\theta_1 + \theta_2}{2} - \theta_0\right]$$

In the first case, $\dfrac{(60 - 50)}{10} = K\left[\dfrac{60 + 50}{2} - \theta_0\right]$

$$1 = K(55 - \theta) \qquad \ldots (i)$$

In the second case, $\dfrac{(50 - 42)}{10} = K\left[\dfrac{50 + 42}{2} - \theta_0\right]$

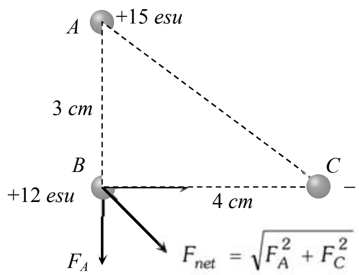
$$0.8 = K(46 - \theta_0) \qquad \ldots (ii)$$

Dividing (i) by (ii), we get $\frac{1}{0.8}=\frac{55-\theta_0}{46-\theta_0}$

or $46-\theta_0=44-0.8\theta_0 \Rightarrow \theta_0=10^oC$

31. **(b)** The same force will act on both bodies although their directions will be different.

32. **(c)**



Net force on B $F_{net}=\sqrt{F_A^2+F_C^2}$

$F_A=\frac{15\times 12}{(3)^2}=20\ dyne$,

$F_C=\frac{12\times 20}{(4)^2}=15\ dyne$

$\Rightarrow$ $F_{net}=\sqrt{F_A^2+F_C^2}=\sqrt{(20)^2+(15)^2}=25\ dyne$

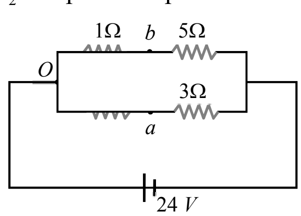
33. **(c)** Capacity of parallel plate capacitor $C=\frac{\varepsilon_0 A}{d} \Rightarrow C\propto A$

34. **(c)** When dielectric is introduced, the capacitance will increase and as the battery remains connected, so the voltage will remain constant. Hence according to $Q = CV$, the charge will increase.

35. **(c)** $R_1 \propto \frac{l}{A} \Rightarrow R_2 \propto \frac{2l}{2A} i.e. R_2 \propto \frac{l}{A}$

$\therefore$ $R_1=R_2$

36. **(b)** Switch S_2 is open so capacitor is not in circuit.



$\therefore$ Current through 3Ω resistor $=\frac{24}{3+3}=4\ A$

$\therefore$ Let potential of point 'O' shown in fig. is V_O

$\therefore$ then using ohm's law

$\therefore$ $V_O-V_a=3\times 4=12V$ . . . (i)

$\therefore$ Now current through 5Ω resistor $=\frac{24}{5+1}=4A$

$\therefore$ So $V_0-V_b=4\times 1=4V$ . . . (ii)

$\therefore$ From equation (i) and (ii) $V_b-V_a=12-4=8V$.

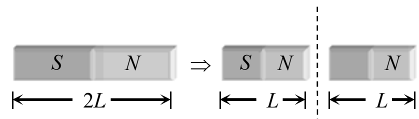
37. **(b)** $\frac{i_g}{i}=\frac{S}{G+S} \Rightarrow i_g G=(i-i_g)S$

$\therefore$ $\therefore$ $i_g G=(0.03-i_g)4r$ . . . (i)

$\therefore$ and $i_g G=(0.06-i_g)r$ . . . (ii)

$\therefore$ From (i) and (ii) $0.12-4i_g=0.06-i_g \Rightarrow i_g=0.02A$.

38. **(c)**



$\therefore$ Pole strength of each part = m

$\therefore$ Magnetic moment of each part $=M'=m'L'=mL=\frac{M}{2}$

39. **(c)**

$B^2=B_V^2+B_H^2 \Rightarrow B_V=\sqrt{B^2-B_H^2}=\sqrt{(0.5)^2-(0.3)^2}=0.4$

Now $\tan\phi=\frac{B_V}{B_H}=\frac{0.4}{0.3}=\frac{4}{3}$

$\Rightarrow$ $\phi=\tan^{-1}\left(\frac{4}{3}\right)$.

40. **(d)** $dB=\frac{\mu_0}{4\pi}\cdot\frac{idl\sin\theta}{r^2}$

$\Rightarrow$ $d\vec{B}=\frac{\mu_0}{4\pi}\cdot\frac{i(d\vec{l}\times\vec{r})}{r^3}$

41. **(d)** Use Right Hand Palm rule, or Maxwell's Corkscrew rule or any other.

42. **(d)** Induced charge doesn't depend upon the speed of magnet.

43. **(a)** $\because$ $L\propto N^2 r$;

$\frac{L_1}{L_2}=\left(\frac{N_1}{N_2}\right)^2\times\frac{r_1}{r_2}$

$\Rightarrow$ $\frac{L}{L_2}=\left(\frac{1}{2}\right)^2\times\left(\frac{r}{r/2}\right)=\frac{1}{2}$

$\Rightarrow$ $L_2=2L$

44. **(d)** Given $\omega L=\frac{1}{\omega C} \Rightarrow \omega^2=\frac{1}{LC}$

or $\omega = \frac{1}{\sqrt{10^{-3} \times 10 \times 10^{-6}}} = \frac{1}{\sqrt{10^{-8}}} = 10^4$

$\Rightarrow \quad X_L = \omega L = 10^4 \times 10^{-3} = 10\Omega$

45. **(c)** For series *R*-*L*-*C* circuit,

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

$$= \sqrt{(300)^2 + \left(1000 \times 0.9 - \frac{10^6}{1000 \times 2}\right)^2} = 500\Omega$$

46. **(d)** The Zeroth law of thermodynamics leads to the concept of temperature.

47. **(d)** The given statement is zeroth law of thermodynamics. It was formulated by R. H. Fowler in 1931

48. **(a)** The internal energy of ideal gas depends only upon temperature of gas not on other factors.

49. **(d)** From the given initial state A to final state B, change in internal energy is same all the four cases, as it is independent of the path from A to B.

50. **(d)** $\Delta U = \Delta Q - \Delta W$

The internal energy is independent of path.

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