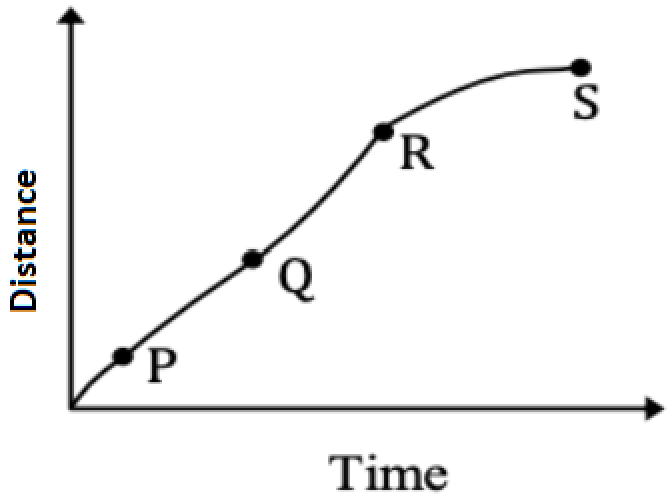
MOCK KCET Physics QP SET-3

Question 1: A particle shows the distance-time curve as shown in the figure. The maximum instantaneous velocity of the particle is around the point.



1. a. P
2. b. S
3. c. R
4. d. Q

Solution:

1. **Answer: (c)**

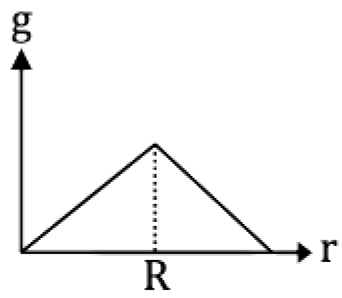
   V_{m} ax = dx/dt = maximum slope

   From the figure, at point R the slope is maximum, hence at this point velocity is maximum.

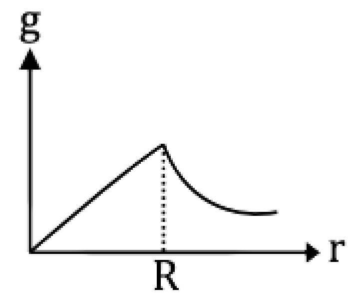
   ∴ The maximum instantaneous velocity of the particle is around the point ‘R’.

Question 2: Which of the following graphs correctly represents the variation of ‘g’ on the Earth?

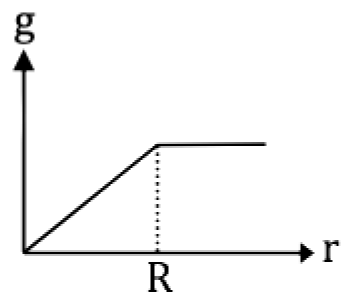
a.



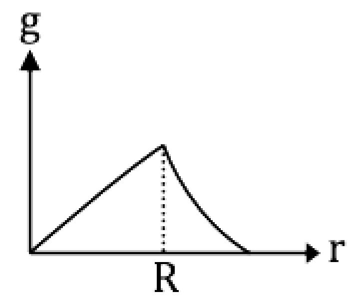
b.



c.

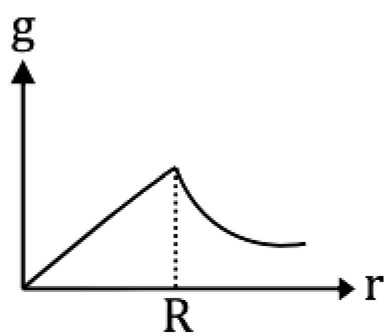


d.



Solution:

1. **Answer: (b)**



For an isothermal process,

B = [1 / P] c

The graph will be a rectangular hyperbola.

Question 3: A cup of tea cools from 65.5°C to 62.5°C in 1 minute in a room at 22.5°C. How long will it take to cool from 46.5°C to 40.5°C in the same room?

1. a. 4 minutes
2. b. 2 minutes
3. c. 1 minute
4. d. 3 minutes

Solution:

1. **Answer: (a)**

   T_1 = 65.5°C, T_2 = 62.5°C

   Room temperature (T_0) = 22.5°C

   I[st] Case:-

   Using Newton's law cooling,

   $[T_1 - T_2] / t = –k [\{[T_1 – T_2] / t\} - T_0]$

   [65.5 – 62.5] / 1 = –k [{[65.5 – 62.5] / 1} - 22.5]

   3 = – k [64 – 22.5]

   3 = – k [41.5] ------- (1)

   II[nd] Case:-

   T_1 = 46.5°C, T_2 = 40.5°C

   [46.5 – 40.5] / t = –k [{[46.5 + 40.5] / 2} - 22.5]

   (6 / t) = – k [43.5 – 22.5]

   (6 / t) = – k [21] ---- (2)

   Equation (1) dividing by Equation (2),

   3 / [6 / t] = – k [41.5] / – k [21]

   (t / 2) = 41.5 / 21

   After solving, t = 4 min.

Question 4: The dimensions of the ratio of magnetic flux (φ) and permeability (μ) are

1. a. $[M^0L^1T^0A^1]$
2. b. $[M^0L^{-3}T^0A^1]$
3. c. $[M^0L^1T^1A^{-1}]$
4. d. $[M^0L^2T^0A^1]$

Solution:

1. **Answer: (a)**

   Magnetic flux (φ) = BA

   Permeability (μ) = B / H

   $\varphi = B.A \times \mu_0 (1 / d) A \Rightarrow 0 / \mu = IA / d$

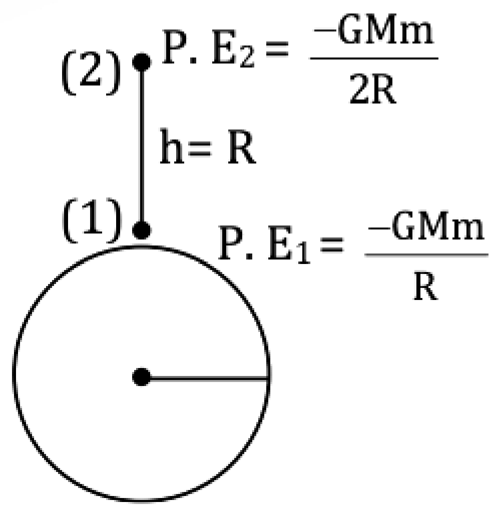
   $\Rightarrow IL \Rightarrow [M^0L^1T^0A^1]$

Question 5: A mass 'm' on the surface of the Earth is shifted to a target equal to the radius of the Earth. If 'R' is the radius and 'M' is the mass of the Earth, then work done in this process is

1. a. mgR / 2
2. b. mgR
3. c. 2 mgR
4. d. mgR / 4

Solution:

1. **Answer: (a)**



P.E. of the earth surface ($P.E_1$) = − GMm / R

P.E. of h height on the surface of earth

$P.E,_2$ = − GNM / [R + R] ⇒ – GMm / 2R

∴ W = U_f – V_i ⇒ $P.E._2$ – $P.E._1$ ⇒ {– GMm / 2R} – {− GMm / R}

After solving,

W = –MgR / 2

Question 6: First overtone frequency of a closed pipe of length 'l_1' is equal to the 2^{nd} harmonic frequency of an open pipe of length 'l_2'. The ratio l_1 / l_2 =

1. a. 3 / 4
2. b. 4 / 3
3. c. 3 / 2
4. d. 2 / 3

Solution:

1. **Answer: (a)**

   First overtone frequency for closed

   Organ pipe $f = 3V / 4L_1$

   Frequency for open pipe $f = 2u / 2L_2$

   $\Rightarrow L_1 / L_2 = 3 / 4$

Question 7: The resistance R = V / I where V = (100 ± 5) V and I = (10 ± 0.2) A. The percentage error in R is

1. a. 5.2%
2. b. 4.8%
3. c. 7%
4. d. 3%

Solution:

1. **Answer: (c)**

   R = V / I

   V = (100 ± 5) V and I = (10 ± 0.2) A

   R = 100 / 10 = 10

   $\Delta R / R = \pm [(\Delta V / V) + (\Delta I / I)]$

   $[\Delta R / R] * 100 = \pm [(\Delta V / V) * 100 + (\Delta I / I) * 100]$

   $= \pm [(5 / 100) * 100 + (0.2 / 10) * 100]$

   R = ± 7 %

Question 8: A block rests on a rough inclined plane making an angle of 30° with the horizontal. The coefficient of static friction between the block and the plane is 0.8. If the frictional force on the block is 10 N, the mass of the block is (g = 10 ms^{-2})

1. a. 1 kg
2. b. 2 kg
3. c. 3 kg
4. d. 4 kg

Solution:

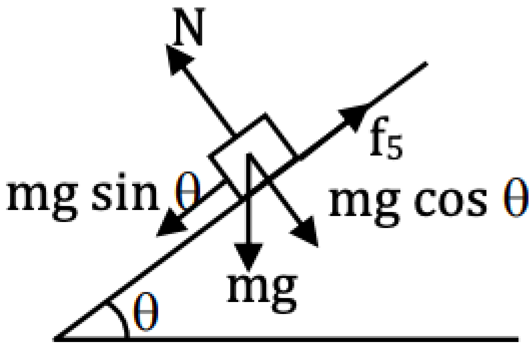
1. **Answer: (b)**

   $N = mg \cos\theta$

   $Mg \sin \theta = f_s$

$M \times 10 \times \sin 30 = 10$

$\therefore m = 2$ kg



Question 9: Two particles of masses m_1 and m_2 have equal kinetic energies. The ratio of their moments is

1. a. $m_1 : m_2$
2. b. $m_2 : m_1$
3. c. $\sqrt{m_1} : \sqrt{m_2}$
4. d. $m_1^2 : m_2^2$

Solution:

1. **Answer: (c)**

   Kinetic energy, $k = P^2 / 2M$

   $\therefore P^2 = 2\ mK$

   $P = \sqrt{2\ mK}$

   $P_1 / P_2 = \sqrt{[2m_1K / 2m_2K]}$

   $= \sqrt{m_1 / m_2}$

   $\therefore P_1 : P_2 = \sqrt{m_1} : \sqrt{m_2}$

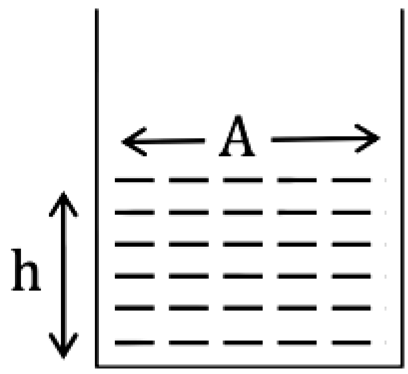
Question 10: The pressure at the bottom of a liquid tank is not proportional to the

1. a. Acceleration due to gravity
2. b. The density of the liquid
3. c. Height of the liquid
4. d. Area of the liquid surface

Solution:

1. **Answer: (d)**

The pressure depends on acceleration, the height of the liquid and the density of the liquid. Pressure does not depend on the area of the liquid surface.



Force (F) = (h . A) ρ.g

F = hAρg

Pressure (P) = F / A

P = hρg

Question 11: A Carnot engine takes 300 calories of heat from a source at 500 K and rejects 150 calories of heat to the sink. The temperature of the sink is

1. a. 125 K
2. b. 250 K
3. c. 750 K
4. d. 1000 K

Solution:

1. **Answer: (b)**

   Given:- T_1 = 500 k

   Q_1 = 300 calories

   Q_3 = 150 calories

   T_2 = ?

   $Q_2 / Q_1 = T_2 / T_1$

   $T_2 = [Q_2 \times T_1] / Q_1$

   $T_2 = [150 \times 500] / 300$

   T_2 = 250 K

Question 12: Pressure of an ideal gas is increased by keeping the temperature constant. The kinetic energy of molecules

1. a. Decreases
2. b. Increases
3. c. Remains the same
4. d. Increases or decreases depending on the nature of gas

Solution:

1. **Answer: (c)**

   PV = nRT

   Hence P ∝ V

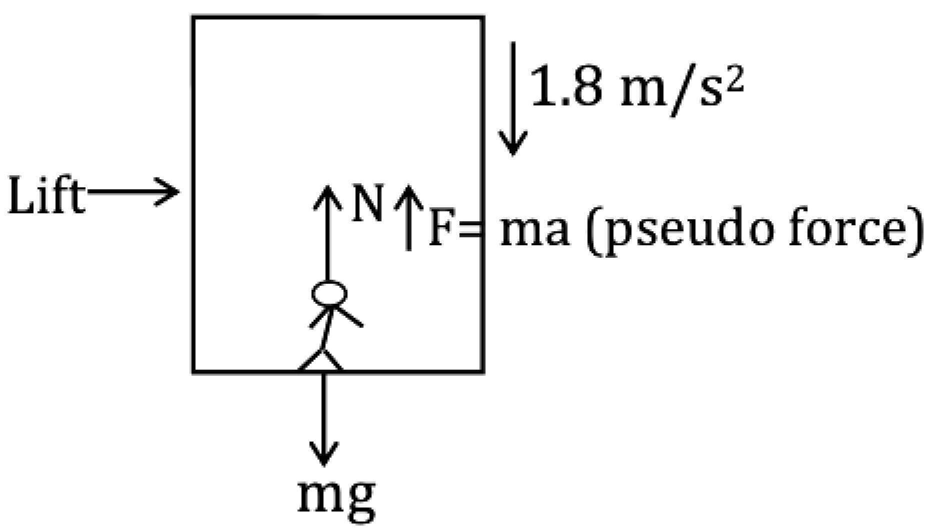
   Temperature is constant and there is no change in Kinetic energy of molecules.

Question 13: A man weighing 60 kg is in a lift moving down with an acceleration of 1.8 ms^{-2}. The force exerted by the floor on him is

1. a. 588 N
2. b. 480 N
3. c. Zero
4. d. 696 N

Solution:

1. **Answer: (b)**



   Lift –

   Now –

   N + F = mg

[Where F is a Pseudo force]

N = mg – F

= mg – ma

= m (g – a)

= 60 (9.8 – 1.8)

= 60 × 8 N

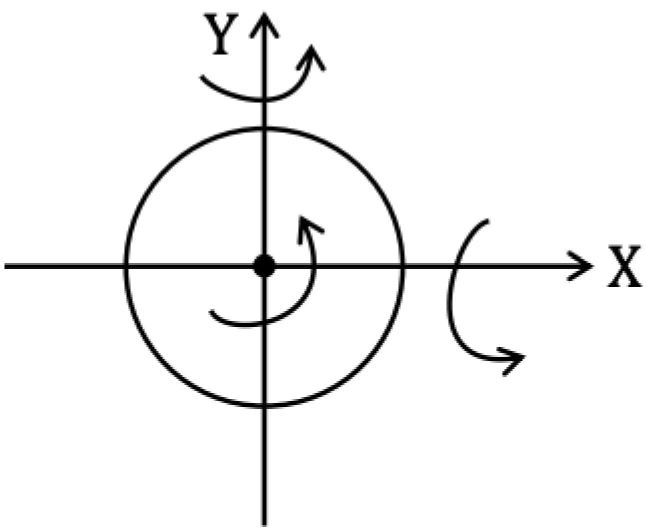
= 480 N

Question 14: Moment of inertia of a body about two perpendicular axes X and Y in the plane of the lamina are 20 kg m^2 respectively. Its moment of inertia about an axis perpendicular to the plane of the lamina and passing through the point of intersection of X and Y axes is

1. a. 5 kg m^2
2. b. 45 kg m^2
3. c. 12.5 kg m^2
4. d. 500 kg m^2

Solution:

1. **Answer: (b)**



Using perpendicular axis theorem:-

$I_z = I_x + I_y$ … (1)

Given:-

$I_x = 20$ kg m^2

$I_y = 25$ kg m^2

Substitute values in equation (1),

$I_2 = 20 + 25$

$I_2 = 45$ kg m^2

Question 15: Two wires A and B are stretched by the same load. If the area of cross-section of wire 'A' is double that of 'B', then the stress on 'B' is

1. a. Equal to that on A
2. b. Twice that on A
3. c. Half that on A
4. d. Four times that on A

Solution:

1. **Answer: (b)**

   Stress = F / A

   Stress A / Stress B = $(F / A_A) / (F / A_B) = A_B / A_A$

   Given:-

   Area of a cross-section of wire 'A' is double that of 'B'

   ∴ $A_A = 2A_B$

   Stress A / Stress B = $A_B / 2A_B = 1 / 2$

   ∴ Stress B = twice on stress 'A'

Question 16: The magnitude of point charge due to which the electric field 30 cm away has the magnitude 2 NC^{-1} will be

1. a. 2×10^{-11}C
2. b. 3×10^{-11} C
3. c. 5×10^{-11}C
4. d. 9×10^{-11}C

Solution:

1. **Answer: (a)**

   The magnitude of the electric field is 2 N / C.

   Distance r = 30 cm ⇒ 30×10^{-2} m

   Apply formula of E.F.

$E = Kq / r^2$

$2 = [9 \times 10^9 \times q] / [30 \times 10^{-2}]^2$

$q = [2 \times (30 \times 10^{-2})^2] / [9 \times 10^9]$

$q = (2 \times (900 \times 10^{-4})) / (9 \times 10^9)$

After solving

$Q = 2 \times 10^{-11}$ C

Question 17: A mass of 1 kg carrying a charge of 2 C is accelerated through a potential of 1 V. The velocity acquired by it is

1. a. √2 ms^{-1}
2. b. 2 ms^{-1}
3. c. 1 / √2 ms^{-1}
4. d. 1 / 2 ms^{-1}

Solution:

1. **Answer: (b)**

   Given:-
   m = 1 kg

   q = 2C

   Potential (V) = 1 V

   Electrostatic Potential Energy = K.E.

   $q \times V = ½ MV^2$

   $2 \times 1 = ½ \times 1 \times V^2$

   V = 2 m / s

Question 18: The force of repulsion between two identical positive charges when kept, with a separation ‘r’ in the air is ‘F’. Half the gap between the two charges is filled by a dielectric slab of dielectric constant = 4. Then, the new force of repulsion between those two charges becomes

1. a. F / 3
2. b. F / 2
3. c. F / 4
4. d. 4F / 9

Solution:

1. **Answer: (d)**

Case 1:

Force (f) = kq_1q_2 / r^2 ----- (1)

F = $[1 / (4\pi\varepsilon_0)] [q_1q_2 / r^2]$

Case 2:

New distance after a dielectric slab is inserted between 2 changes,

$d_{new} = [(r / 2) + (r / 2) * \sqrt{4}]$

⇒ (r / 2) + r ⇒ 3r / 2

Thus,

New force $[F^1] = [1 / (4\pi\varepsilon_0)] [q_1q_2 / (3r / 2)^2]$ ---- (2)

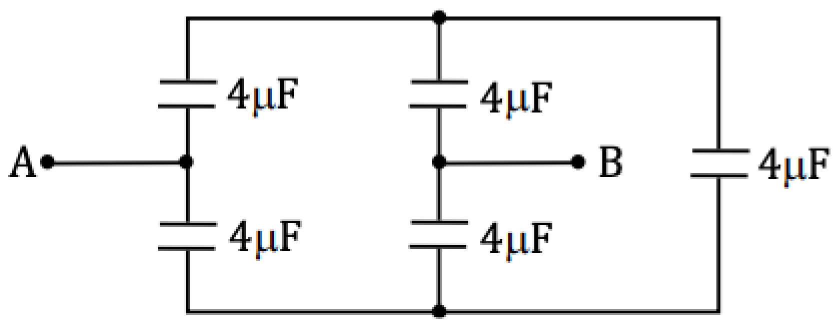
Equation (ii) dividing by equation (i)

$F^1 / F = \{[1 / (4\pi\varepsilon_0)] [q_1q_2 / (9r^2 / 4)]\} / \{[1 / (4\pi\varepsilon_0)] [q_1q_2 / r^2]\}$

After solving,

F' = 4F / 9

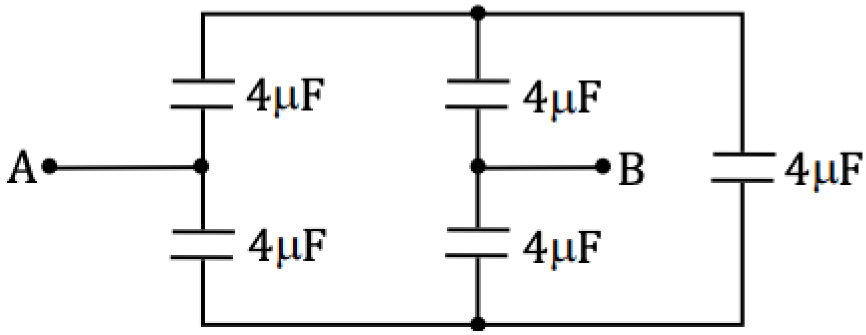
Question 19: For the arrangement of capacitors as shown in the circuit, the effective capacitance between point A and B is (capacitance of each capacitor is 4μF)



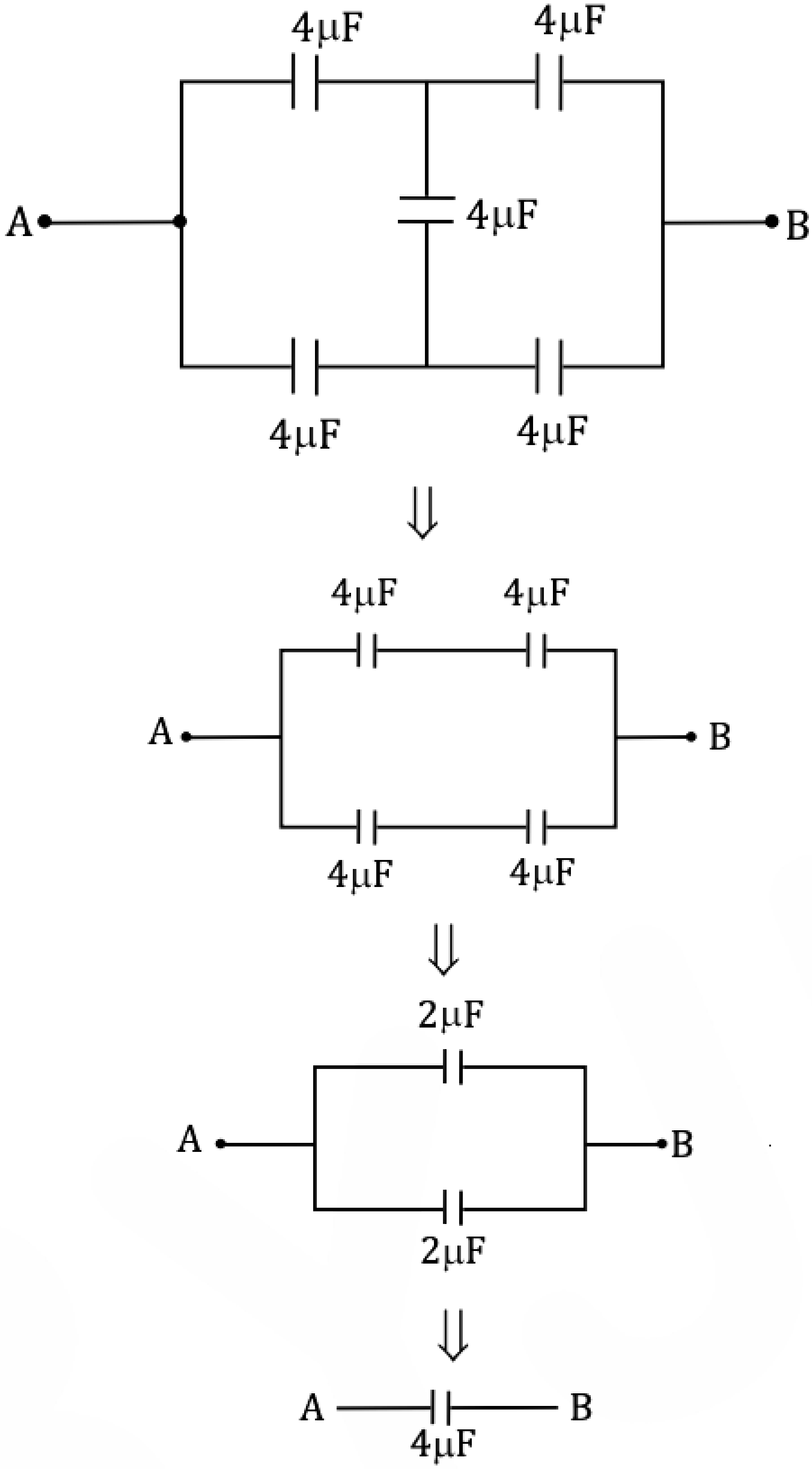
1. a. 4 μF
2. b. 2 μF
3. c. 1 μF
4. d. 8 μF

Solution:

1. **Answer: (a)**



From the balanced Wheatstone bridge,



Question 20: The work done to move a charge on an equipotential surface is

1. a. Infinity
2. b. Less than 1
3. c. Greater than 1
4. d. Zero

Solution:

1. **Answer: (d)**

   An equipotential surface is one in which all the points are at the same electric potential, so the work done to move a charge on an equipotential surface is zero. According to the formula,

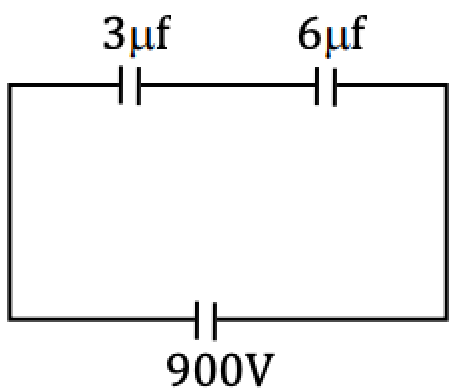
   dw = q.dv

Question 21: Two capacitors of 3 μF and 6 μF are connected in series and a potential difference of 900 V is applied across the combination. They are then disconnected and reconnected in parallel. The potential difference across the combination is

1. a. Zero
2. b. 100 V
3. c. 200 V
4. d. 400 V

Solution:

1. **Answer: (c)**



C_1 = 3μF, C_2 = 6μF, When there capacitor disconnected

The series combination charge on & reconnected in parallel the

Both capacitors is same charge & P.D. is same

$\therefore \; C_1V_1 = C_2V_2 \Rightarrow Q \quad ...(1)$

$$\frac{V_1}{V_2} = \frac{C_2}{C_1} = \frac{6}{3} \Rightarrow 2 \quad ..(2)$$

$V_1 + V_2 = 900$ V ... (3)

From Eq^n (2) & (3)

$V_2 = 300$ V, $V_1 = 600$ V

Charge on each capacitor

$$Q = CV \Rightarrow 300 \times 6$$

$$\Rightarrow 600 \times 3$$

$$= 1800 \; \mu C$$

$$\therefore \quad \frac{Q_1}{C_1} = \frac{Q_2}{C_2} = V$$

$$\frac{Q_1}{Q_2} = \frac{C_1}{C_2} = \frac{1}{2}$$

$Q_1 + Q_2 = Q$

Hence Eq^n (5

$Q_1 = 600 \; \mu C$

P.D.

$$V_1 = \frac{600}{3} = 2$$

$$V_2 = \frac{1200}{6} = 2$$

Question 22: Ohm's Law is applicable to

1. a. Diode
2. b. Transistor
3. c. Electrolyte
4. d. Conductor

Solution:

1. **Answer: (d)**

   Ohm's law is applicable only to conductors.

Question 23: If the last band on the carbon resistor is absent, then the tolerance is

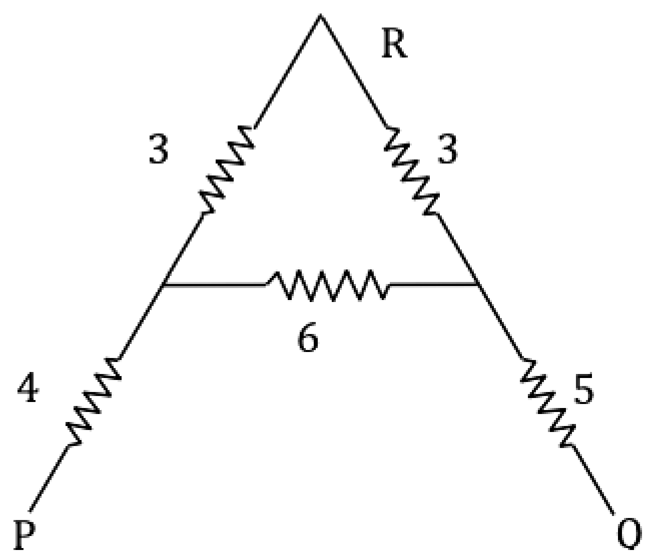
1. a. 5 %
2. b. 20 %
3. c. 10 %
4. d. 15 %

Solution:

1. **Answer: (b)**

   If the last bond on the carbon resistor is absent, there is no tolerance band, it is 20%.

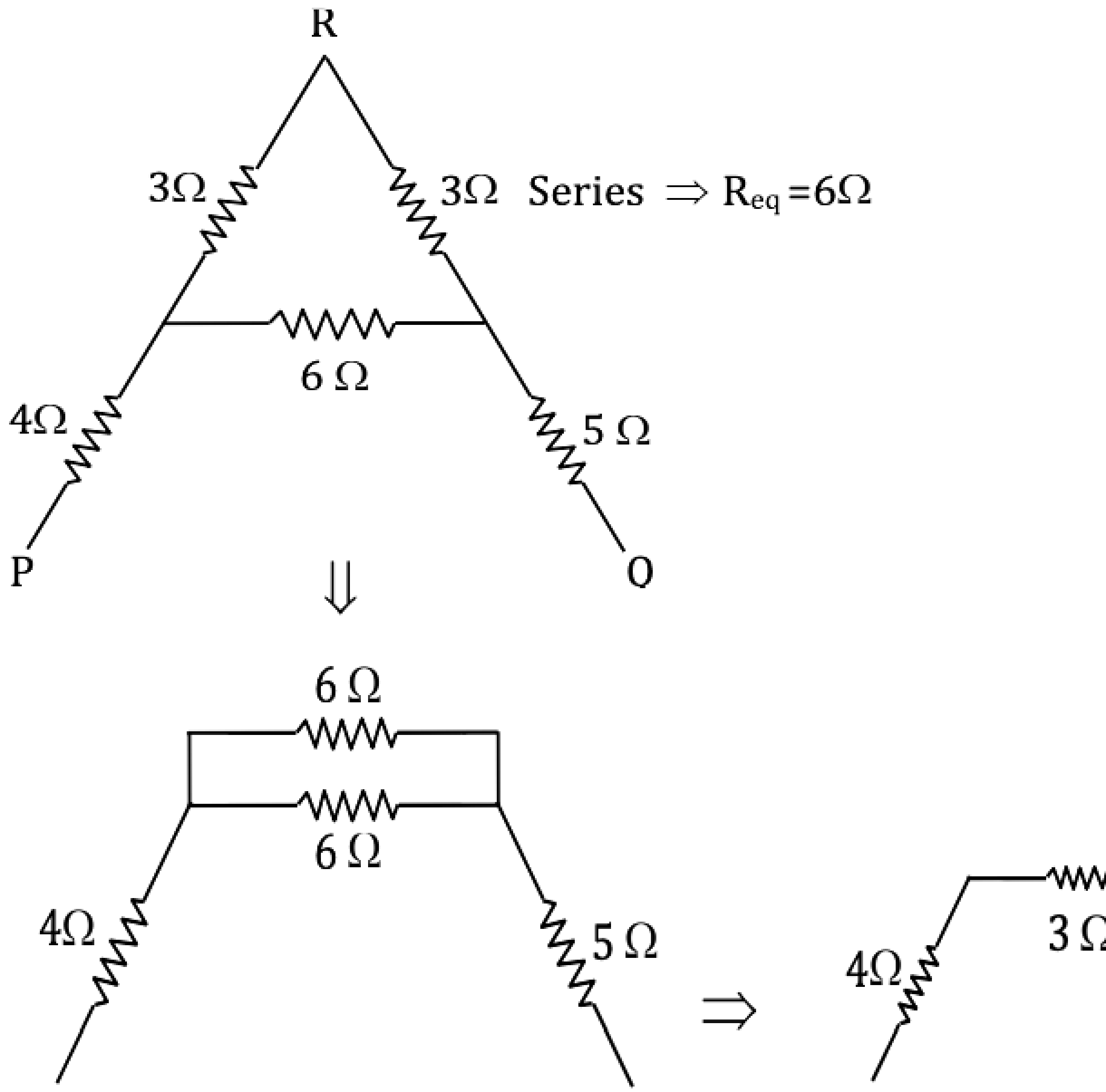
Question 24: The effective resistance between P and Q for the following network is



1. a. (1 / 12) Ω
2. b. 21Ω
3. c. 12Ω
4. d. (1 / 21)Ω

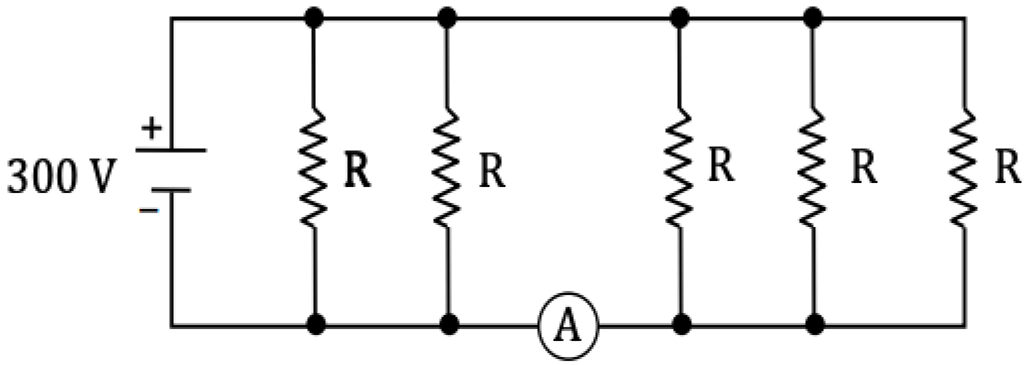
Solution:

1. **Answer: (c)**



$R_{eq.}$ = 4 + 3 + 5 = 12Ω

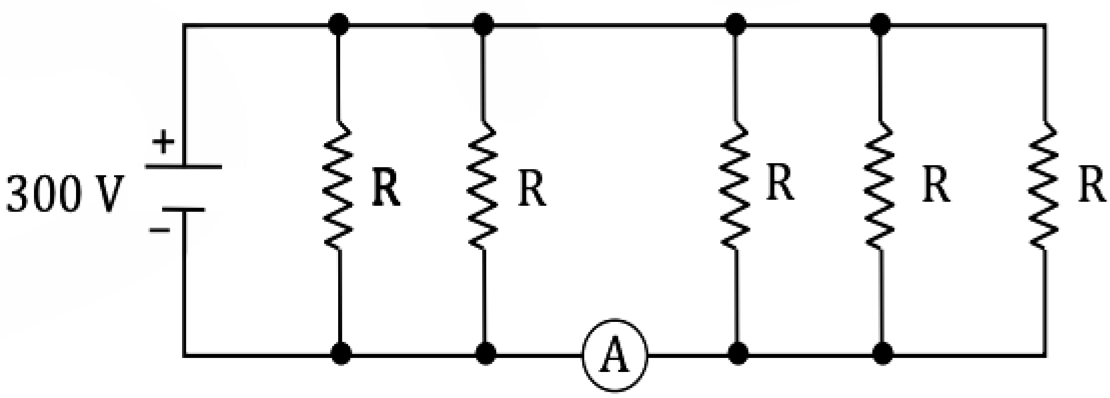
Question 25: Five identical resistors each of resistance R = 1500 are connected to a 300 V battery as shown in the circuit. The reading of the ideal ammeter A is



1. a. (1 / 5) A
2. b. (3 / 5) A
3. c. (2 / 5) A
4. d. (4 / 5) A

Solution:

1. **Answer: (b)**



Using formula V = IR

I = V / R

All resistances are in parallel.

∴ I = V / (R / 5) = [300 * 5] / R

Given:- R ⇒ 1500

Current through (A) = (3 / 5) A.

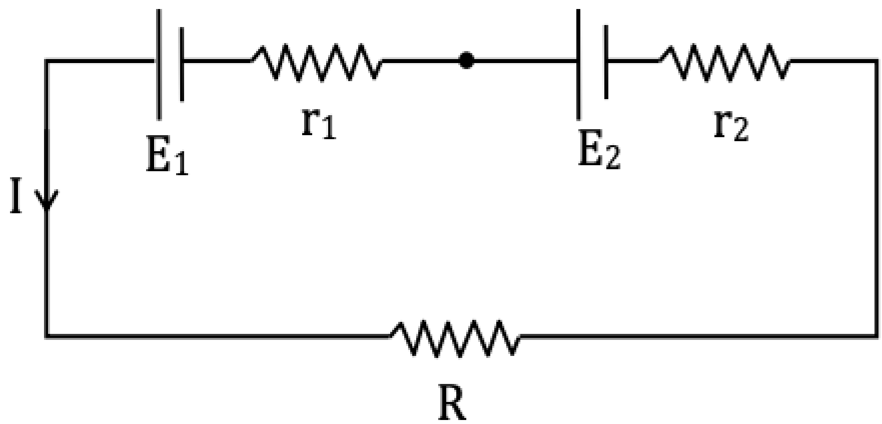
Question 26: Two cells of internal resistances r_1 and r_2 and of the same emf are connected in series, across a resistor of resistance R. If the terminal potential difference across the cells of internal resistance r_1 is zero, then the value of R is

1. a. $R = 2 (r_1 + r_2)$
2. b. $R = r_2 – r_1$

3. c. $R = r_1 - r_2$
4. d. $R = 2(r_1 - r_2)$

Solution:

1. **Answer: (c)**



According to Ohm's law V = IR

$E + E = 2I(r_1 + r_2 + R)$

$I = (2E) / (R + r_1 + r_2)$

The terminal potential difference across the cells of internal resistance $r_1 = 0$.

$V = E - Ir_1$

$0 = E_1 - Ir$

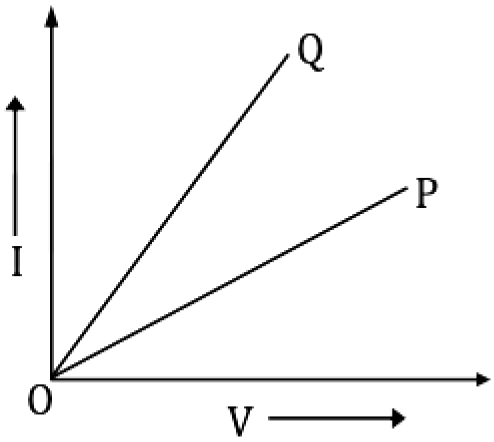
$I = E_1 / r_1$

$(2E) / (R + r_1 + r_2) = E / r_1$

$2r1 = R + r_1 + r_2$

$R = r_1 - r_2$

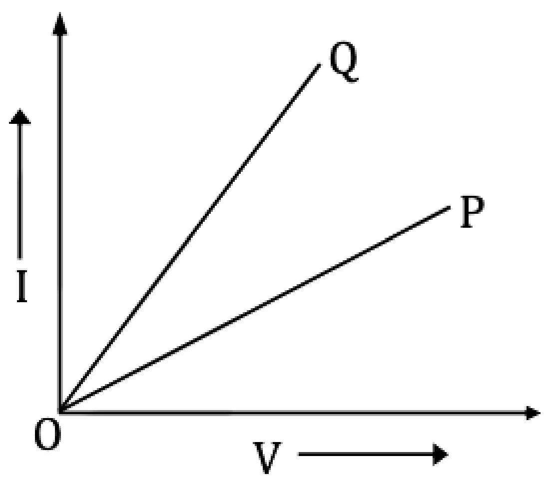
Question 27: The I – V graphs for two different electrical appliances P and Q are shown in the diagram. If R_P and R_Q be the resistances of the devices, then



1. a. $R_P = R_Q$
2. b. $R_P > R_Q$
3. c. $R_P < R_Q$
4. d. $R_P = R_Q / 2$

Solution:

1. **Answer: (b)**



The slope of this graph is the reciprocal of resistance.

Q (slope) > P (slope)

$(1 / R_Q) > (1 / R_P)$

$R_P > R_Q$

Question 28: The correct Biot-Savart law in vector form is

1. a. $d\vec{B} = \frac{\mu_0}{4\pi}\frac{I(d\vec{l} \times \vec{r})}{r^2}$
2. b. $d\vec{B} = \frac{\mu_0}{4\pi}\frac{I(d\vec{l} \times \vec{r})}{r^3}$
3. c. $d\vec{B} = \frac{\mu_0}{4\pi}\frac{I(d\vec{l})}{r^2}$

4. d. $d\vec{B} = \mu_0 4\pi I(d\vec{l})r3$

Solution:

1. **Answer: (b)**

   Biot–Savart law:-

   dB = (μ_0 / 4π) (Idl sin θ / r^2)

   Vector form:-

   Now we know,

   $\hat{r} = \vec{r}\, r \; d\vec{B} = \mu_0 4\pi Idl\sin\Theta r2 \times \hat{r} \; d\vec{B} = \mu_0 4\pi I(d\vec{l} \times \vec{r})r3$

Question 29: An electron is moving in a circle of radius r in a uniform magnetic field B. Suddenly, the field is reduced to B / 2. The radius of the circular path now becomes

1. a. r / 2
2. b. 2r
3. c. r / 4
4. d. 4r

Solution:

1. **Answer: (b)**

   Radius of circular path,

   R = mV / qB

   Thus, $r_1 B_1 = r_2 B_2$

   r . B = r^1 . [B / 2]

   r^1 = 2r

Question 30: A charge q is accelerated through a potential difference V. It is then passed normally through a uniform magnetic field, where it moves in a circle of radius r. The potential difference required to move it in a circle of radius 2r is

1. a. 2 V
2. b. 4 V
3. c. 1 V
4. d. 3 V

Solution:

1. **Answer: (b)**

Radius of circular path,

r = mV / qB

For acceleration energy,

$ev = (1 / 2) mv^2$

$v^2 = 2eV / m$

$v = \sqrt{2eV / m}$

$r \propto \sqrt{V}$

$V \propto r^2$

So,

$V_2 / V_1 = (r_2 / r_1)^2$

After solving

$V_2 = 4V_1$

Question 31: A cyclotron's oscillator frequency is 10 MHz and the operating magnetic field is 0.66 T. If the radius of its dees is 60 cm, then the kinetic energy of the proton beam produced by the accelerator is

1. a. 9 MeV
2. b. 10 MeV
3. c. 7 MeV
4. d. 11 MeV

Solution:

1. **Answer: (c)**

   Frequency, v = 10 MHz ⇒ 10^7 Hz

   Magnetic field:-

   B = 2πmv / q

   $\therefore (2 \times (22 / 7) \times 1.6 \times 10^{-27} \times 10^{7}) / (1.6 \times 10^{-19}) \Rightarrow 10.4876 / 1.6$

   After solving

   B = 0.656 T

   Now energy:-

   $E_{max} = B^2q^2R^2 / M$

   $= [(0.656)^2 \times (1.67 \times 10^{-27})^2 \times (60 \times 10^{-2})^2] / [2 \times 1.67 \times 10^{-27}]$

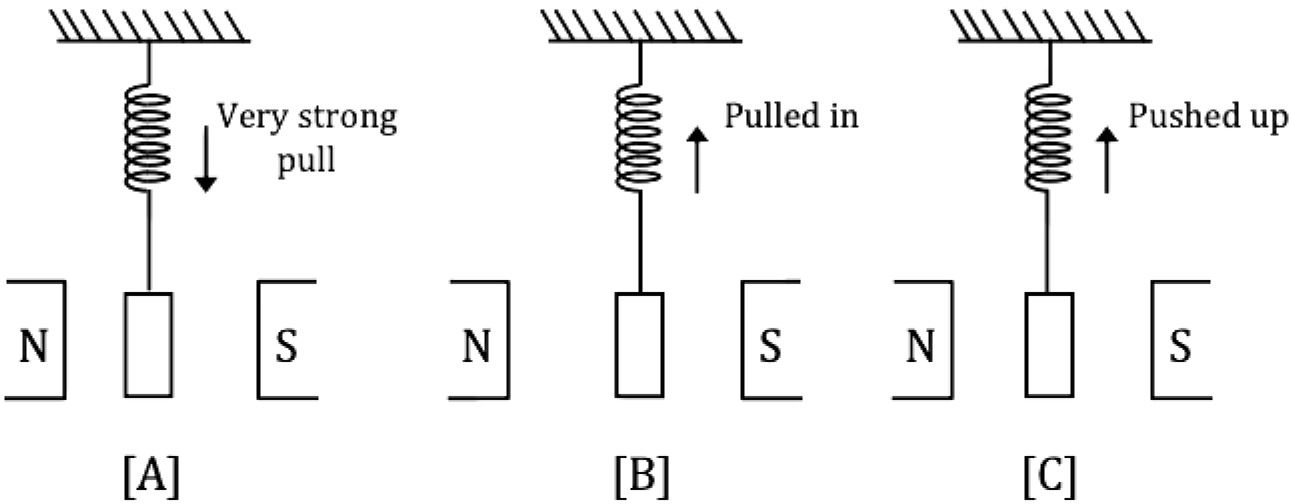
   After solving, = 7 MeV

Question 32: Needles N_1, N_2 and N_3 are made of a ferromagnetic, a paramagnetic and a diamagnetic substance respectively. A magnet, when brought close to them, will

1. a. Attract all three of them
2. b. Attract N_1 strongly, N_2 weakly and repel N_3 weakly
3. c. Attract N_1 strongly but repel N_2 and N_3 weakly
4. d. Attract N_1 and N_2 strongly but repel N_3

Solution:

1. **Answer: (b)**



a) These are strongly attracted in an external magnetic field [In ferromagnetic substance]

b) These are feebly attracted in an external magnetic field (in Paramagnetic substance).

c) These are repelled in an external magnetic field. (In diamagnetic Substance)

So,

A magnet will attract N_1 strongly, N_2 weakly and repel N_3 weakly.

Question 33: The strength of the Earth's magnetic field is

1. a. Constant everywhere
2. b. Zero everywhere
3. c. Having very high value
4. d. Varying from place to place on the Earth's surface

Solution:

1. **Answer: (d)**

   A magnetic field extends infinitely. The strength of the earth's magnetic field is not constant. It varies from one place to another place on the surface of the earth.

Question 34: A jet plane with a wing-span of 25 m is travelling horizontally towards the east with a speed of 3600 km/hour. If the Earth's magnetic field at the location is 4×10^{-4} T and the angle of dip is 30°, then, the potential difference between the ends of the wing is

1. a. 4 V
2. b. 5 V
3. c. 2 V
4. d. 2.5 V

Solution:

1. **Answer: (b)**

   Length (l) = 25 m

   Speed (V) = 3600 KM/hour

   = 3600 × (5 / 18)

   = 200 × 5

   V = 1000 m/s

   Magnetic field B = 4×10^{-4} T

   $\theta = 30°$

   Vertical component of earth (B_V)

   $B_V = B \cdot \sin\theta$

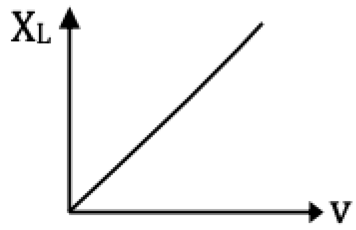
   $E = (B_V) \times l \times V \Rightarrow B \cdot \sin\theta \times l \times V$

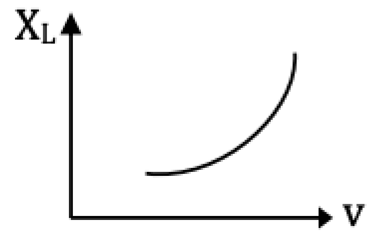
   $= 4 \times 10^{-4} \times ½ \times 25 \times 1000$

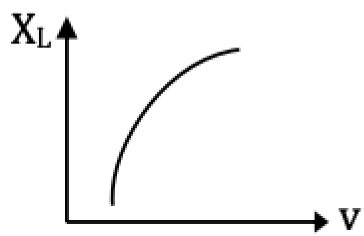
   After solving,

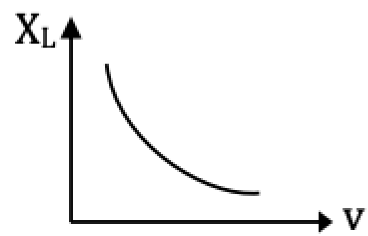
   E = 5 Volt

Question 35: Which of the following represents the variation of inductive reactance (X_L) with the frequency of voltage source (v)?

a. 

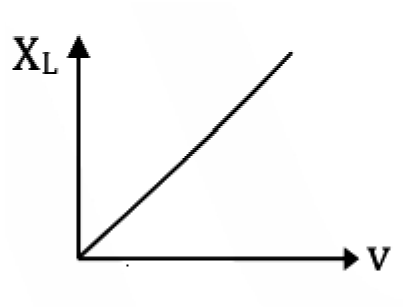
b. 

c. 

d. 

Solution:

1. **Answer: (a)**

   We know that

   Inductive reactance

   $X_L = \omega_L$

   Frequency = v

   $X_L = 2\pi vL$

   $X_L = 2\pi L \times v$

   This equation can be compared to the equation of straight line Y = m × C.

Question 36: The magnetic flux linked with a coil varies as $\Phi = 3t^2 + 4t + 9$. The magnitude of the emf induced at t = 2 seconds is

1. a. 8 V
2. b. 16 V
3. c. 32 V
4. d. 64 V

Solution:

1. **Answer: (b)**

   e = dΦ / dt

   $Φ = 3t^2 + 4t + 9$

   So,

   e = 6t + 4

   t = 2 sec.

   e = 6 × 2 + 4

   e = 16 v

Question 37: A 100 W bulb is connected to an AC source of 220 V, 50 Hz. Then the current flowing through the bulb is

1. a. [5 / 11] A
2. b. [1 / 2] A
3. c. 2 A
4. d. [3 / 4] A

Solution:

1. **Answer: (a)**

   Power (P) = 100 w

   V = 220

   We know that

   P = VI

   I = P / V ⇒ 100 / 220

   I = [5 / 11] Amp

Question 38: In the series LCR circuit, the power dissipation is through

1. a. R
2. b. L
3. c. C
4. d. Both L and C

Solution:

1. **Answer: (a)**

   The formula used power dissipated in an LCR circuit

$P = V_{rms} . I_{rms} \cos \Phi$

Question 39: In Karnataka, the normal domestic power supply AC is 220 V, 50 Hz. Here 220 V and 50 Hz refer to

1. a. Peak value of voltage and frequency
2. b. Rms value of voltage and frequency
3. c. Mean value of voltage and frequency
4. d. Peak value of voltage and angular frequency

Solution:

1. **Answer: (b)**

   $i_{rms} = V_0 / \sqrt{2}$

   rms value of voltage & frequency

Question 40: A step-up transformer operates on a 230 V line and l loads current of 2 A. The ratio of primary and secondary windings is 1:25. Then the current in the primary is

1. a. 25 A
2. b. 50 A
3. c. 15 A
4. d. 12.5 A

Solution:

1. **Answer: (b)**

   No. of primary winding = 1

   No. of secondary winding = 25

   Used formula

   $N_P / N_S = I_S / I_P$

   So,

   $I_P = I_S \times (N_S / N_P)$

   Substitute values

   $I_P = 2 \times (25 / 1)$

   $I_P = 50A$

Question 41: The number of photons falling per second on a completely darkened plate to produce a force of 6.62×10^{-5} N is 'n'. If the wavelength of the light falling is 5×10^{-7} m, then n = _____ $\times 10^{22}$. (h = 6.62×10^{-34} J–s)

1. a. 1
2. b. 5
3. c. 0.2
4. d. 3.3

Solution:

1. **Answer: (b)**

   Wavelength (λ) = 5×10^{-7}

   Force (F) = 6.62×10^{-5} N

   h = 6.62×10^{-34} J.S

   Used formula

   P = (n / t) . (hc / λ)

   Fc = (n / t) . (hc / λ)

   (n / t) = (Fλ / h)

   = $(6.62 \times 10^{-5} \times 5 \times 10^{-7}) / (6.62 \times 10^{-34})$

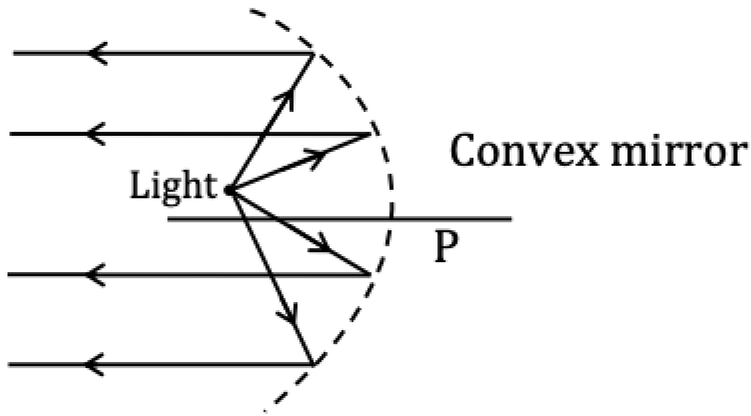
   = 5×10^{22} V

Question 42: An object is placed at the principal focus of a convex mirror. The image will be at

1. a. Centre of curvature
2. b. Principal focus
3. c. Infinity
4. d. No image will be formed

Solution:

1. **Answer: (c)**



When the object is placed at the focus the image is formed at infinity & highly emerged.

Question 43: An object is placed at a distance of 20 cm from the pole of a concave mirror of focal length 10 cm. The distance of the image formed is

1. a. + 20 cm
2. b. + 10 cm
3. c. –20 cm
4. d. – 10 cm

Solution:

1. **Answer: (a)**

   Apply mirror formula

   u = - 20 cm

   F = 10 cm

   (1 / f) = (1 / v) + (1 / u)

Question 44: A candle placed 25 cm from a lens forms an image on the screen placed 75 cm on the other side of the lens. The focal length and type of the lens should be

1. a. + 18.75 cm and convex lens
2. b. – 18.75 cm and concave lens
3. c. + 20.25 cm and convex lens
4. d. –20.25 cm and concave lens

Solution:

1. **Answer: (a)**

   Using mirror formula

$(1 / f) = (1 / v) + (1 / u)$

Given:-

Object initial distance (u) = – 25 cm

Image distance (v) = +75 cm

Substitute values

$(1 / f) = (1 / 75) - (1 / -25)$

$(1 / f) = (1 / 75) + (1 / 25) \Rightarrow (1 / f) = (1 + 3) / 75 \Rightarrow (1 / f) = 4 / 75$

After solving f = + 18.75 cm and convex lens

Question 45: A plane wavefront of wavelength λ is incident on a single slit of width a. The angular width of the principal maximum is

1. a. λ / a
2. b. 2λ / a
3. c. a / λ
4. d. a / 2λ

Solution:

1. **Answer: (a)**

   Fringe width $\Rightarrow \beta = \lambda D / d$

   Angular width $\theta \Rightarrow \beta / D$

   $\therefore \theta = (\lambda D / dD)$

   $\theta = \lambda / d$
   d = a (given)

   Angular width $\theta = \lambda / a$

Question 46: In a Fraunhofer diffraction at a single slit, if yellow light illuminating the slit is replaced by blue light, then diffraction bands

1. a. Remain unchanged
2. b. Become wider
3. c. Disappear
4. d. Become narrower

Solution:

1. **Answer: (d)**

When the blue light is used instead of yellow, decreases & hence, diffraction bands become narrower.

Question 47: In Young's double-slit experiment, two wavelengths λ_1 = 780 nm and λ_2 = 520 nm are used to obtain interference fringes. If the n^{th} bright band due to λ_1 coincides with $(n + 1)^{th}$ bright band due to λ_2, then the value of n is

1. a. 4
2. b. 3
3. c. 2
4. d. 6

Solution:

1. **Answer: (c)**

   λ_1 = 780 nm

   λ_2 = 520 nm

   We know that,

   The distance from the central maxima to n^{th} bright band

   $y_n = n\lambda D / d$

   $n\lambda_1 D / d = (n + 1) (\lambda_2 D / d)$

   $n_1\lambda_1 = (n + 1) \lambda_2$

   $(n + 1) / n = (\lambda_1 / \lambda_2) \Rightarrow 780 / 520$

   $(n + 1) / n = 78 / 52$

   52 n + 52 = 78 n

   26 n = 52

   n = 2

Question 48: In Young's double-slit experiment, slits are separated by 2 mm and the screen is placed at a distance of 1.2 m from the slits. Light consisting of two wavelengths 6500 Å and 5200 Å is used to obtain interference fringes. Then the separation between the fourth bright fringes of two different patterns produced by the two wavelengths is

1. a. 0.312 mm
2. b. 0.123 mm
3. c. 0.213 mm
4. d. 0.412 mm

Solution:

1. **Answer: (a)**

   $\lambda_1 = 6500$ Å

   $\gamma_1 = 4\lambda_1 D / d$

   $\lambda_2 = 5200$ Å

   $\gamma_2 = 4\lambda_2 D / d$

   $\gamma_1 - \gamma_2 = (4D / d)(\lambda_1 - \lambda_2)$

   $= \{[4 \times 1.2] / [2 \times 16^{-3}]\} (6500 - 5200)$

   $= [4 \times 1.2 \times 1300 \times 10^{-10}] / [2 \times 10^{-3}]$

   After solving = 0.312 mm.

Question 49: The maximum kinetic energy of emitted photoelectrons depends on

1. a. Intensity of incident radiation
2. b. Frequency of incident radiation
3. c. Speed of incident radiation
4. d. Number of photons in the incident radiation

Solution:

1. **Answer: (b)**

   By Einstein’s photoelectric equation

   K.E. of the photoelectron is

   $\frac{1}{2} mv^2 = hv$

   K.E. of emitted photoelectrons depends on the frequency of incident radiations.

Question 50: A proton and an α particle are accelerated through the same potential difference V. The ratio of their de Broglie wavelengths is

1. a. $\sqrt{2}$
2. b. $2\sqrt{2}$
3. c. $\sqrt{3}$
4. d. $2\sqrt{3}$

Solution:

1. **Answer: (b)**

   De-Broglie wavelength

$\lambda = h / mv$ [$\therefore P = mv$]

De-Broglie wavelength of a proton:-

Mass = m_1

$\lambda_1 = h / \sqrt{2m_1k}$ [$\therefore P = \sqrt{2mk}$]

[$k = qv$]

$\therefore \lambda_1 = h / \sqrt{2m_1kv}$ ----- (1)

For an α-particle

Mass = m_2

Charge = q_0

$\therefore \lambda_2 = h / \sqrt{2m_2q_0v}$

For α – particle

${}_2^4He \Rightarrow q_0 = 2q$

$M_2 = 4m_1$

$\therefore \lambda_2 = h / \sqrt{[2 \times 4m_1 \times 2q_{\times\, v]}}$ ------ (2)

Equation (1) and (2),

$[\lambda_1 / \lambda_2] = h / \sqrt{2m_1qv} = \sqrt{[2 \times 4m_1 \times 2q_{\times\, v] / h}}$

After solving,

$[\lambda_1 / \lambda_2] = 2\sqrt{2}$

Question 51: The total energy of an electron revolving in the second orbit of the hydrogen atom is

1. a. – 13.6 eV
2. b. –1.51 eV
3. c. –3.4 eV
4. d. Zero

Solution:

1. **Answer: (c)**

   Energy:-

   $E_n = – 13.62 / n^2$

   For hydrogen atom

   $Z = 1$; $n = 2$

   $E_n = [– 13.62 \times 1^2] / 2^2$

$= – 13.6 / 4$

$= – 3.4eV$

Question 52: The period of revolution of an electron in the ground state of the hydrogen atom is T. The period of revolution of the electron in the first excited state is

1. a. 2 T
2. b. 4 T
3. c. 6 T
4. d. 8 T

Solution:

1. **Answer: (d)**

   Time period (T) = (2πr / v)

   $= r \times (n^2 / z)$

   So,

   $T \times (n^3 / z^2)$

   First excited state, n = 2

   $(T_2 / T_1) = (n_2 / n_1)^3 = (2 / 1)^3$

   $T_2 = 8T$

Question 53: The energy equivalent to a substance of mass 1 g is

1. a. 18×10^{13} J
2. b. 9×10^{13} J
3. c. 18×10^6 J
4. d. 9×10^6 J

Solution:

1. **Answer: (b)**

   $M = 1g \Rightarrow 10^{-3}$ kg

   Using Einstein’s equation:-

   $E = mc^2$

   $= 10^{-3} \times (3 \times 10^8)^2$

   $= 10^{-3} \times 9 \times 10^{16}$

   $E = 9 \times 10^{13}$

Question 54: The half-life of tritium is 12.5 years. What mass of tritium of initial mass 64 mg will remain undecayed after 50 years?

1. a. 32 mg
2. b. 8 mg
3. c. 16 mg
4. d. 4 mg

Solution:

1. **Answer: (d)**

   Un-decayed

   $(N / N_0) = (1 / 2x)$

   $X = 50 / 12.5 = 4$

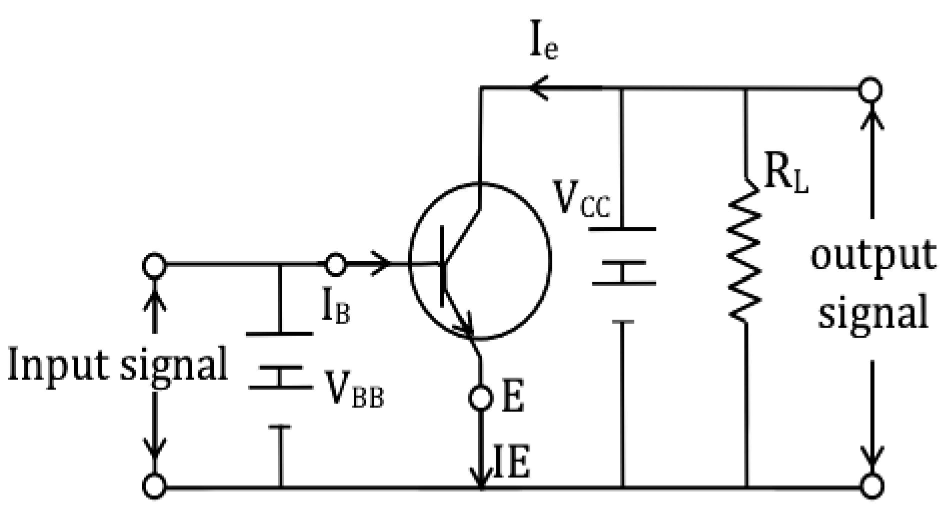
   $N = N_0 / 16 = 64 / 16 = 4mg$

Question 55: In a CE amplifier, the input ac signal to be amplified is applied across

1. a. Forward biased emitter-base junction
2. b. Reverse biased collector-base junction
3. c. Reverse biased emitter-base junction
4. d. Forward biased collector-base junction

Solution:

1. **Answer: (a)**

   The input ac signal to be amplified is applied across the forward-biased emitter-base junction.

Question 56: If A = 1 and B = 0, then in terms of Boolean algebra, $\bar{A}$ + B =

1. a. B
2. b. $\bar{B}$
3. c. A
4. d. $\bar{A}$

Solution:

1. **Answer: (a)**

   A = 1, B = 0

   $\bar{A}+B=\bar{I}+0=0+0=0\bar{A}+B=B$

Question 57: The density of an electron-hole pair in pure germanium is 3 × 10^{16} m^{-3} at room temperature. On doping with aluminium, the hole density increases to 4.5 × 10^{22} m^{-3}. Now the electron density (in m^{-3}) in doped germanium will be

1. a. 1 × 10^{10}
2. b. 2 × 10^{10}
3. c. 0.5 × 10^{10}
4. d. 4 × 10^{10}

Solution:

1. **Answer: (b)**

   n_1 = 3 × 10^{16} m^{-3}

   n_n = 4.5 × 10^{22} m^{-3}

   $n_1^2 = n_n n_e$

   $n_e = n_1^2 / n_n$

   = [3 × 10^{16}]^2 / [4.5 × 10^{22}]

   n_e = [9 × 10^{32}] / [4.5 × 10^{22}]

   n_e = 2 × 10^{10}

Question 58: The dc common-emitter current gain of a n-p-n transistor is 50. The potential difference applied across the collector and emitter of a transistor used in CE configuration is, V_{CE} = 2 V. If the collector resistance, R_C = 4Ω k, the base current (I_B) and the collector current (I_C) are

1. a. I_B = 10 μA, I_C = 0.5 mA
2. b. I_B = 0.5 μA , I_C = 10 mA
3. c. I_B = 5 μA, I_C = 1 mA
4. d. I_B = 1 μA, I_C = 0.5 mA

Solution:

1. **Answer: (b)**

   $I_C = V_{CE} / R_C$

   Given;-

   V_{CE} = 2V

   R_C = 4 K

   Substituting values

   $I_C = 2 / [4 \times 10^3] = 0.5 \times 10^{-3}$ A

   I_C = 0.5 mA

   $\beta = I_C / I_B \Rightarrow I_B = I_C / \beta$

   $= [0.5 \times 10^{-3}] / 50 = 10^{-5}$ A

   I_B = 10μA

Question 59: The radius of the Earth is 6400 km. If the height of an antenna is 500 m, then its range is

1. a. 800 km
2. b. 100 km
3. c. 80 km
4. d. 10 km

Solution:

1. **Answer: (c)**

   Range = √2Rh

   $= \sqrt{}2 \times 6400 \times 10^3 \times 500$

   $= 80 \times 10^3$

   = 80 cm

Question 60: A space station is at a height equal to the radius of the Earth. If 'V_E' is the escape velocity on the surface of the Earth, the same on the space station is _______ times V_E.

1. a. 1 / 2
2. b. 1 / 4
3. c. 1 / √2
4. d. 1 / √3

Solution:

1. **Answer: (c)**

   $[– GMm / (R + R)] + (1 / 2) mv^2 = 0$

   $(1 / 2) mv^2 = [– GMm / 2R]$

   V’ = √GM / R ⇒ √gR

   V_E = √2gR

   V^E / V’ = √(2gR / gR)

   V’ = V_E × (1 / √2)