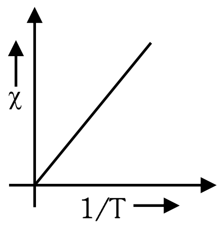
FINAL NEET(UG)–2023 (MANIPUR EXAMINATION)

(Held On Tuesday 6th JUNE, 2023)

PHYSICS | **TEST PAPER WITH ANSWER & SOLUTIONS**

Section-A (Physics)

1. The variation of susceptibility (χ) with absolute temperature (T) for a paramagnetic material is represented as :

(1)


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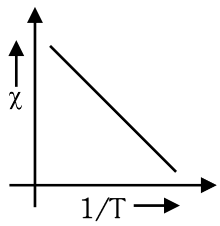

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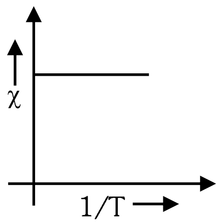

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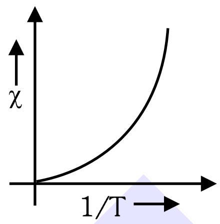


Ans. (1)

Sol. By magnetic property

$\chi \propto \frac{1}{T}$

χ vs $\frac{1}{T}$ graph will be straight line.

2. A bullet of mass m hits a block of mass M elastically. The transfer of energy is the maximum, when :

(1) M = m (2) M = 2m

(3) M << m (4) M >> m

Ans. (1)

Sol. In elastic collision maximum energy is transfer when M = m

3. The ground state energy of hydrogen atom is –13.6 eV. The energy needed to ionize hydrogen atom from its second excited state will be :

(1) 13.6 eV (2) 6.8 eV

(3) 1.51 eV (4) 3.4 eV

Ans. (4)

Sol. $E_n = -13.6\frac{Z^2}{n^2}$ ev for H–atom Z =1

$$\frac{E_2}{E_1} = \left(\frac{n_1}{n_2}\right)^2 = \left(\frac{1}{2}\right)^2 = \frac{1}{4}$$

$$E_2 = \frac{E_1}{4} = \frac{13.6 \text{ eV}}{4} = 3.4 \text{ eV}$$

4. The escape velocity of a body on the earth surface is 11.2 km/s. If the same body is projected upward with velocity 22.4 km/s, the velocity of this body at infinite distance from the centre of the earth will be:

(1) $11.2\sqrt{2}$ km/s

(2) Zero

(3) 11.2 km/s

(4) $11.2\sqrt{3}$ km/s

Ans. (4)

Sol. $V_\infty = \sqrt{V^2 - V_e^2}$

Given than

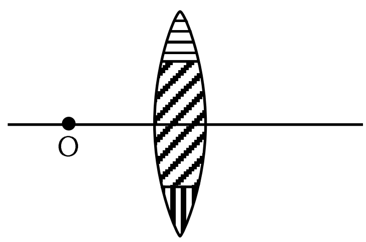
$V = 2V_e$

So,

$V_\infty = \sqrt{(2V_e)^2 - V_e^2}$

$V_\infty = \sqrt{3}V_e = 11.2\sqrt{3}$ km / s

5. A lens is made up of 3 different transparent media as shown in figure. A point object O is placed on its axis beyond $2f$. How many real images will be obtained on the other side ?



(1) 2

(2) 1

(3) No image will be formed

(4) 3

Ans. (4)

Sol. Since lens is made of three materials so three μ and hence three images.

6. The diameter of a spherical bob, when measured with vernier callipers yielded the following values : 3.33 cm, 3.32 cm, 3.34 cm, 3.33 cm and 3.32 cm. The mean diameter to appropriate significant figures is :

(1) 3.328 cm

(2) 3.3 cm

(3) 3.33 cm

(4) 3.32 cm

Ans. **(3)**

Sol. Mean diameter = $\dfrac{d_1+d_2+d_3+d_4+d_5}{5}$

$= \dfrac{3.33+3.32+3.34+3.33+3.32}{5}$

$= 3.328 \approx 3.33$

7. On the basis of electrical conductivity, which one of the following material has the smallest resistivity?

(1) Germanium

(2) Silver

(3) Glass

(4) Silicon

Ans. **(2)**

Sol. Silver is good conductor so its resistivity will be very less.

8. The mechanical quantity, which has dimensions of reciprocal of mass (M^{-1}) is :

(1) angular momentum

(2) coefficient of thermal conductivity

(3) torque

(4) gravitational constant

Ans. **(4)**

Sol. Angular momentum = $[ML^2T^{-1}]$

Coeff of thermal conductivity = $[MLT^{-3}K^{-1}]$

Torque = $[ML^2T^{-2}]$

Gravitational constant = $[M^{-1}L^3T^{-2}]$

So, gravitational constant has power of (–1) of M.

9. The position of a particle is given by

$\vec{r}(t) = 4t\,\hat{i} + 2t^2\,\hat{j} + 5\,\hat{k}$

where t is in seconds and r in metre. Find the magnitude and direction of velocity v(t), at t = 1s, with respect to x-axis

(1) $4\sqrt{2}\ ms^{-1}$, 45° (2) $4\sqrt{2}\ ms^{-1}$, 60°

(3) $3\sqrt{2}\ ms^{-1}$, 30° (4) $3\sqrt{2}\ ms^{-1}$, 45°

Ans. **(1)**

Sol. $\vec{V} = \dfrac{d\vec{r}}{dt} = 4\hat{i} + 4t\hat{j} + 0\hat{k}$

at t = 1sec

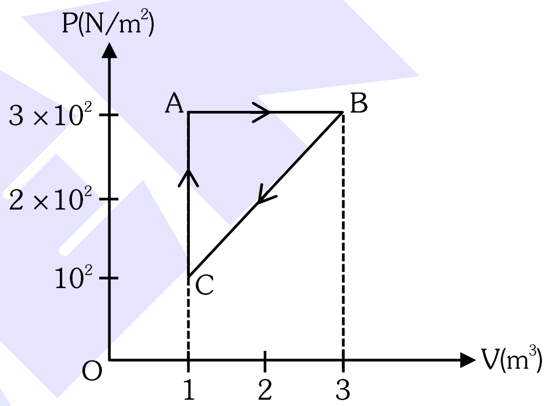
$\vec{V} = 4\hat{i} + 4(1)\hat{j}$

$|\vec{V}| = \sqrt{4^2+4^2} = 4\sqrt{2}$

$\tan\alpha = \dfrac{4}{4} = 1$

$\alpha = 45°$

10. For the given cycle, the work done during isobaric process is :



(1) 200 J

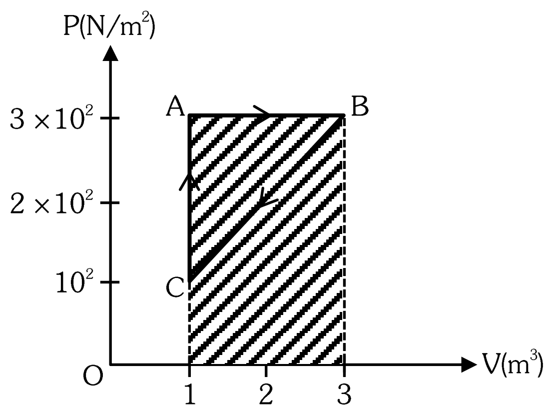
(2) Zero

(3) 400 J

(4) 600 J

Ans. **(4)**

Sol.



AB is isobaric process

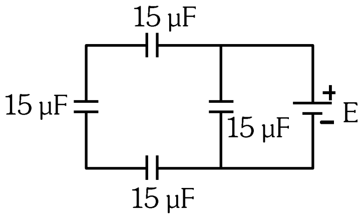
$W_{AB} = P(V_2 - V_1)$

$W_{AB} = 3 \times 10^2\,(3-1)$

$W_{AB} = 3 \times 100 \times 2$

$W_{AB} = 600$ J

11. The equivalent capacitance of the arrangement shown in figure is :



(1) 30 μF

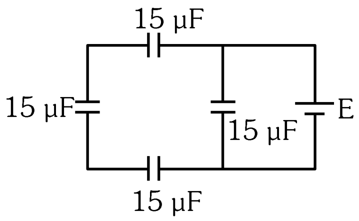
(2) 15 μF

(3) 25 μF

(4) 20 μF

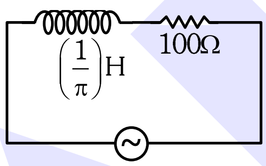
Ans. (4)

Sol.



$C_{eq} = 5 + 15 = 20\mu F$

12. An ac source is connected in the given circuit. The value of ϕ will be :



V=220 sin(100πt + φ) volt

(1) 60°

(2) 90°

(3) 30°

(4) 45°

Ans. (4)

Sol. $\tan\phi = \frac{X_L}{R}$

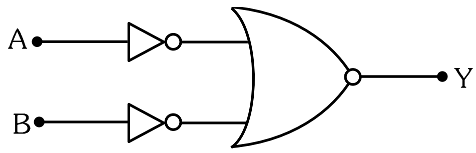
$X_L = \omega l = 100\pi \times \frac{1}{\pi} = 100\Omega$

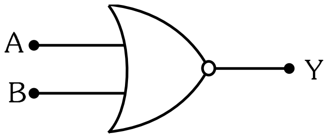
$R = 100\Omega$

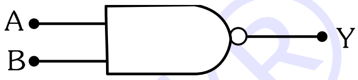
$\tan\phi = \frac{100}{100} = 1$

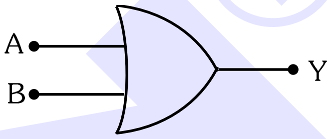
$\phi = 45°$

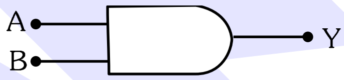
13. The given circuit is equivalent to :



(1) 

(2) 

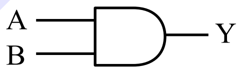
(3) 

(4) 

Ans. (4)

Sol. $Y = \overline{\overline{A}+\overline{B}} = \overline{\overline{A}}.\overline{\overline{B}} = A.B$

AND gate

for AND gate 

14. A particle moves with a velocity $\left(5\hat{i}-3\hat{j}+6\hat{k}\right)$ m s^{-1} horizontally under the action of constant force $\left(10\hat{i}+10\hat{j}+20\hat{k}\right)$N. The instantaneous power supplied to the particle is :

(1) 200 W (2) Zero

(3) 100 W (4) 140 W

Ans. (4)

Sol. $P = \vec{F}.\vec{V}$

$P = (10\hat{i}+10\hat{j}+20\hat{k}).(5\hat{i}-3\hat{j}+6\hat{k})$

$P = 50 - 30 + 120$

$\boxed{P = 140\ W}$

15. A certain wire A has resistance 81 Ω. The resistance of another wire B of same material and equal length but of diameter thrice the diameter of A will be :

(1) 81 Ω (2) 9 Ω (3) 729 Ω (4) 243 Ω

Ans. (2)

Sol. $R = \frac{\rho L}{A}$ If diameter becomes thrice then cross Section area will become 9 times so

$R \propto \frac{1}{A}$ Resistance will become $\frac{1}{9}$ times

$R' = \frac{81\Omega}{9} = 9\Omega$

16. ϵ_0 and μ_0 are the electric permittivity and magnetic permeability of free space respectively. If the corresponding quantities of a medium are $2\epsilon_0$ and $1.5\mu_0$ respectively, the refractive index of the medium will nearly be :

(1) $\sqrt{2}$ (2) $\sqrt{3}$ (3) 3 (4) 2

Ans. (2)

Sol. $\mu = \frac{C}{v} = \frac{\frac{1}{\sqrt{\mu_0 \epsilon_0}}}{\frac{1}{\sqrt{1.5\mu_0 \times 2\epsilon_0}}} = \sqrt{3}$

17. The amount of elastic potential energy per unit volume (in SI unit) of a steel wire of length 100 cm to stretch it by 1 mm is (if Young's modulus of the wire = 2.0×10^{11} Nm^{-2}) :

(1) 10^{11} (2) 10^{17} (3) 10^{7} (4) 10^{5}

Ans. (4)

Sol. $\frac{E.P.E}{Volume} = \frac{1}{2}(\text{stress})(\text{strain})$

$= \frac{1}{2}(Y)(\text{strain})^2$

$= \frac{1}{2}(Y)\left(\frac{\Delta L}{L}\right)^2$

$= \frac{1}{2}(2 \times 10^{11})\left(\frac{1 \times 10^{-3}}{100 \times 10^{-2}}\right)^2$

$= 10^5$

18. The 4^{th} overtone of a closed organ pipe is same as that of 3^{rd} overtone of an open pipe. The ratio of the length of the closed pipe to the length of the open pipe is :

(1) 8 : 9 (2) 9 : 7

(3) 9 : 8 (4) 7 : 9

Ans. (3)

Sol. $n_{cop} = (2M+1)^{th}$ Har. $= (2 \times 4 + 1) \times \frac{V}{4\ell_c} = \frac{9V}{4\ell_c}$

$n_{oop} = (M+1)^{th}$ Har. $= (3 + 1)\frac{V}{2\ell_0} = \frac{4V}{2\ell_0}$

now $\frac{9V}{4\ell_c} = \frac{4V}{2\ell_0}$

$\frac{\ell_c}{\ell_0} = \frac{18}{16} = \frac{9}{8}$

19. A long straight wire of length 2 m and mass 250 g is suspended horizontally in a uniform horizontal magnetic field of 0.7 T. The amount of current flowing through the wire will be ($g = 9.8\ ms^{-2}$) :

(1) 2.45 A

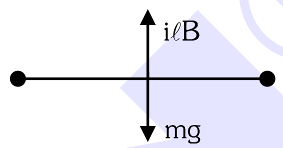
(2) 2.25 A

(3) 2.75 A

(4) 1.75 A

Ans. (4)

Sol.



$mg = i\ell B$

$250 \times 10^{-3} \times 9.8 = i \times 2 \times 0.7$

$i = \frac{0.250 \times 9.8}{2 \times 0.7} = 0.250 \times 7$

i = 1.75 A

20. According to Gauss law of electrostatics, electric flux through a closed surface depends on :

(1) the area of the surface

(2) the quantity of charges enclosed by the surface

(3) the shape of the surface

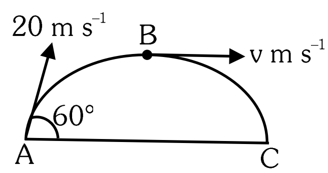
(4) the volume enclosed by the surface

Ans. (2)

Sol. $\phi = \frac{q_{inside}}{\varepsilon_0}$

only depends on charge enclosed by surface.

21. A ball is projected from point A with velocity 20 m s^{-1} at an angle 60° to the horizontal direction. At the highest point B of the path (as shown in figure), the velocity v m s^{-1} of the ball will be:



(1) 20

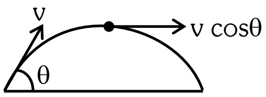
(2) $10\sqrt{3}$

(3) Zero

(4) 10

Ans. (4)

Sol.



At the top most point of its trajectory particle will have only horizontal component of velocity

V at top = v cos θ

$= 20 \times \frac{1}{2}$

= 10 m/s

22. Which of the following statement is not true ?

(1) Coefficient of viscosity is a scalar quantity

(2) Surface tension is a scalar quantity

(3) Pressure is a vector quantity

(4) Relative density is a scalar quantity

Ans. (3)

Sol. Pressure is a scalar quantity.

23. A uniform electric field and a uniform magnetic field are acting along the same direction in a certain region. If an electron is projected in the region such that its velocity is pointed along the direction of fields, then the electron:

(1) will turn towards right of direction of motion

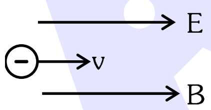
(2) will turn towards left of direction of motion

(3) speed will decrease

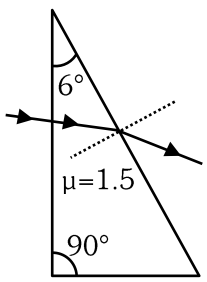
(4) speed will increase

Ans. (3)

Sol. Speed of electron will decrease due to electric force magnetic force of electron is zero.



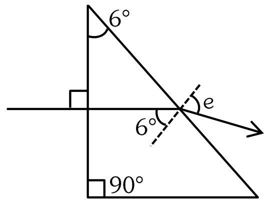
24. A horizontal ray of light is incident on the right angled prism with prism angle 6°. If the refractive index of the material of the prism is 1.5, then the angle of emergence will be:



(1) 9° (2) 10° (3) 4° (4) 6°

Ans. (1)

Sol.



$A = r_1 + r_2 = 6°$

$\mu = 1.5 \frac{\sin e}{\sin r_2} = \frac{\sin e}{\sin 6}$

$\sin e = 1.5 \times 6°$

$e \simeq 9°$

25. A p-type extrinsic semiconductor is obtained when Germanium is doped with:

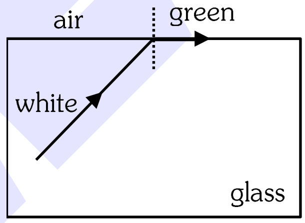
(1) Antimony (2) Phosphorous

(3) Arsenic (4) Boron

Ans. (4)

Sol. For p type semiconductor trivalent impurity added

26.



Which set of colours will come out in air for a situation shown in figure?

(1) Yellow, Orange and Red

(2) All

(3) Orange, Red and Violet

(4) Blue, Green and Yellow

Ans. (1)

Sol. $\text{Sin } i_c = \frac{1}{\mu} \propto \lambda$

$i_c \propto \lambda$

Yellow, orange, red emerge from air.

27. If Z_1 and Z_2 are the impedances of the given circuits (a) and (b) as shown in figures, then choose the **correct** option

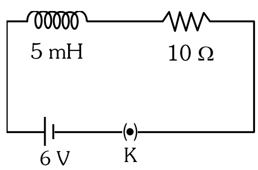


figure (a)

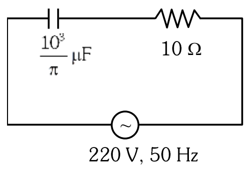


figure (b)

(1) $Z_1 < Z_2$ (2) $Z_1 + Z_2 = 20\ \Omega$

(3) $Z_1 = Z_2$ (4) $Z_1 > Z_2$

Ans. (1)

Sol. $Z_1 = \sqrt{X_L^2 + R^2}$ $X_L = O$ (D.C. circuit)

$Z_1 = 10\Omega$

$Z_2 = \sqrt{X_C^2 + R^2}$

$$X_C = \frac{1}{2\pi \times 50 \times \frac{10^3}{\pi} \times 10^{-6}} = 10\Omega$$

$Z_2 = \sqrt{(10)^2 + (10)^2}$

$= 10\sqrt{2}$

$Z_1 < Z_2$

28. The wavelength of Lyman series of hydrogen atom appears in:

(1) visible region

(2) far infrared region

(3) ultraviolet region

(4) infrared region

Ans. **(3)**

Sol.

$$\frac{1}{\lambda} = R\left(\frac{1}{(1)^2} - \frac{1}{n^2}\right) \quad n = 2, 3, 4, \ldots\ldots.$$

$$\left(\frac{1}{\lambda_L}\right)_{max} = R\left(\frac{1}{(1)^2} - \frac{1}{(2)^2}\right) \quad \left(\because \frac{1}{R} \simeq 912\text{Å}\right)$$

$$(\lambda_L)_{max} = \frac{4}{3}\frac{L}{R}$$

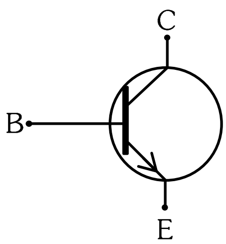
$$(\lambda_L)_{max} = \frac{4}{3} \times 912\text{Å} = 4 \times 304\ \text{Å} = 1216\text{Å}$$

$$\left(\frac{1}{\lambda_L}\right)_{min} = R\left(\frac{1}{(1)^2} - \frac{1}{(\infty)^2}\right)$$

$$(\lambda_L)_{min} = \frac{1}{R} \simeq 912\text{Å}$$

Range of λ is 912Å to 1216Å which lies in U.V. region.

29.



The above figure shows the circuit symbol of a transistor. Select the **correct** statements given below:

(A) The transistor has two segments of p-type semiconductor separated by a segment of n-type semiconductor.

(B) The emitter is of moderate size and heavily doped.

(C) The central segment is thin and lightly doped.

(D) The emitter base junction is reverse biased in common emitter amplifier circuit.

(1) (C) and (D) (2) (A) and (D)

(3) (A) and (B) (4) (B) and (C)

Ans. **(4)**

Sol. In given symbol, emitter current leave from emitter so transistor is NPN
order of doping $E > C >> B$
order of size $C > E >> B$
for active mode emitter base junction is forward bias and base-collector junction is reverse bias.

30. The de Broglie wavelength associated with an electron, accelerated by a potential difference of 81 V is given by:

(1) 13.6 nm (2) 136 nm

(3) 1.36 nm (4) 0.136 nm

Ans. **(4)**

Sol. $\lambda_e = \frac{12.27}{\sqrt{V}}\text{Å} = \frac{12.27}{\sqrt{81}}\text{Å} = \frac{12.27}{9}\text{Å}$

$= 1.36\ \text{Å} \left(\because 1\text{Å} = \frac{1}{10}\text{nm}\right)$

$= 0.136$ nm

31. The maximum power is dissipated for an ac in a/an:

(1) resistive circuit (2) LC circuit

(3) inductive circuit (4) capacitive circuit

Ans. **(1)**

Sol. Power dissipated is maximum of purely resistive circuit.

32. The maximum kinetic energy of the emitted photoelectrons in photoelectric effect is independent of :

(1) work function of material

(2) intensity of incident radiation

(3) frequency of incident radiation

(4) wavelength of incident radiation

Ans. **(2)**

Sol. Maximum kinetic energy of emitted electron is independent of intensity of radiation.

33. Two particles A and B initially at rest, move towards each other under mutual force of attraction. At an instance when the speed of A is v and speed of B is 3v, the speed of centre of mass is :

(1) 2v (2) zero

(3) v (4) 4v

Ans. (2)

Sol. Final velocity of centre of mass = Initial velocity of centre of mass = 0 because net external force on system is zero.

34. A charge Q μC is placed at the centre of a cube. The flux coming out from any one of its faces will be (in SI unit) :

(1) $\frac{Q}{\epsilon_0} \times 10^{-6}$ (2) $\frac{2Q}{3\epsilon_0} \times 10^{-3}$

(3) $\frac{Q}{6\epsilon_0} \times 10^{-3}$ (4) $\frac{Q}{6\epsilon_0} \times 10^{-6}$

Ans. (4)

Sol. Total flux from cube = $\frac{q}{\varepsilon_0}$

∴ So flux of any one surface of cube

$= \frac{q}{6\varepsilon_0} = \frac{Q \times 10^{-6}}{6\varepsilon_0}$

35. The viscous drag acting on a metal sphere of diameter 1 mm, falling through a fluid of viscosity 0.8 Pa s with a velocity of 2 m s^{-1} is equal to :

(1) 15×10^{-3} N

(2) 30×10^{-3} N

(3) 1.5×10^{-3} N

(4) 20×10^{-3} N

Ans. (1)

Sol. F = 6πrηv

$= (6)(3.14)\left(\frac{1 \times 10^{-3}}{2}\right)(0.8 \times 10^{-1})(2)$

$= 1.5 \times 10^{-3}$ N

Section-B (Physics)

36. If R is the radius of the earth and g is the acceleration due to gravity on the earth surface. Then the mean density of the earth will be :

(1) $\frac{\pi RG}{12g}$ (2) $\frac{3\pi R}{4gG}$ (3) $\frac{3g}{4\pi RG}$ (4) $\frac{4\pi G}{3gR}$

Ans. (3)

Sol. $g = \frac{4}{3}\pi G R \rho$

$\rho = \frac{3g}{4\pi GR}$

37. A copper wire of radius 1 mm contains 10^{22} free electrons per cubic metre. The drift velocity for free electrons when 10 A current flows through the wire will be (Given, charge on electron = 1.6×10^{-19} C) :

(1) $\frac{6.25 \times 10^4}{\pi}$ m s^{-1} (2) $\frac{6.25}{\pi} \times 10^3$ m s^{-1}

(3) $\frac{6.25}{\pi}$ m s^{-1} (4) $\frac{6.25 \times 10^5}{\pi}$ m s^{-1}

Ans. (2)

Sol. $I = neAV_d$

$V_d = \frac{I}{neA} = \frac{10}{10^{22} \times 1.6 \times 10^{-19} \times \pi \times 10^{-6}}$

$V_d = \frac{6.25}{\pi} \times 10^3$ m / sec

38. An object is mounted on a wall. Its image of equal size is to be obtained on a parallel wall with the help of a convex lens placed between these walls. The lens is kept at distance x in front of the second wall. The required focal length of the lens will be :

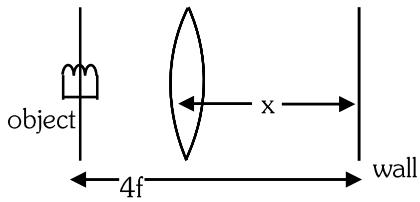
(1) less than $\frac{x}{4}$

(2) more than $\frac{x}{4}$ but less than $\frac{x}{2}$

(3) $\frac{x}{2}$

(4) $\frac{x}{4}$

Ans. (3)



Sol.

x = 2f

f = x/2

39. If a conducting sphere of radius R is charged. Then the electric field at a distance r(r > R) from the centre of the sphere would be, (V = potential on the surface of the sphere)

(1) $\frac{rV}{R^2}$ (2) $\frac{R^2V}{r^3}$ (3) $\frac{RV}{r^2}$ (4) $\frac{V}{r}$

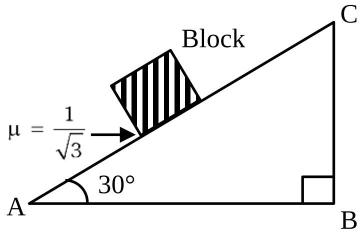
Ans. (3)

Sol. $\therefore V = \frac{KQ}{R}$

$E = \frac{KQ}{r^2}$

$E = \frac{VR}{r^2}$

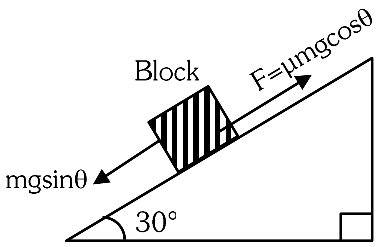
40. A block of mass 2 kg is placed on inclined rough surface AC (as shown in figure) of coefficient of friction μ. If g = 10 m s^{-2}, the net force (in N) on the block will be :



(1) $10\sqrt{3}$ (2) zero
(3) 10 (4) 20

Ans. (2)

Sol.



$$\mu = \frac{1}{\sqrt{3}}$$

$$\tan 30^\circ = \frac{1}{\sqrt{3}}$$

as μ = tanθ

the block is at rest and net force on it must be zero

41. A container of volume 200 cm^3 contains 0.2 mole of hydrogen gas and 0.3 mole of argon gas. The pressure of the system at temperature 200 K ($R = 8.3\ JK^{-1}\ mol^{-1}$) will be :-

(1) 6.15×10^5 Pa
(2) 6.15×10^4 Pa
(3) 4.15×10^5 Pa
(4) 4.15×10^6 Pa

Ans. (4)

Sol. $P_{mix} = \frac{(\mu_1 + \mu_2)RT_{mix}}{V_{mix}}$

$$= \frac{(0.2+0.3)\times 8.3\times 200}{200\times 10^{-6}}$$

$$= \frac{0.5\times 8.3\times 200}{200\times 10^{-6}}$$

$P_{mix} = 4.15 \times 10^6\ P_a$

42. To produce an instantaneous displacement current of 2 mA in the space between the parallel plates of a capacitor of capacitance 4 μF, the rate of change of applied variable potential difference $\left(\frac{dV}{dt}\right)$ must be :-

(1) 800 V/s (2) 500 V/s
(3) 200 V/s (4) 400 V/s

Ans. (2)

Sol. Q = CV

$$\frac{dQ}{dt} = C.\frac{dV}{dt} \Rightarrow \frac{dV}{dt} = \frac{I}{C} = \frac{2\times 10^{-3}}{4\times 10^{-6}}$$

$$= \frac{10^3}{2} = 500\frac{V}{s}$$

43. An emf is generated by an ac generator having 100 turn coil, of loop area 1 m^2. The coil rotates at a speed of one revolution per second and placed in a uniform magnetic field of 0.05 T perpendicular to the axis of rotation of the coil. The maximum value of emf is :-

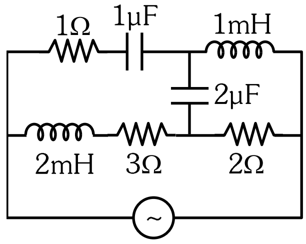
(1) 3.14 V (2) 31.4 V (3) 62.8 V (4) 6.28 V

Ans. (2)

Sol. $\omega = 2\pi \frac{rad}{sec}$

E_{max} = NBAω
= $100 \times 0.05 \times 1 \times 2\pi$
= $10 \times \pi$
= 31.4 V

44. For very high frequencies, the effective impedance of the circuit (shown in the figure) will be :-



(1) 4 Ω (2) 6 Ω (3) 1 Ω (4) 3 Ω

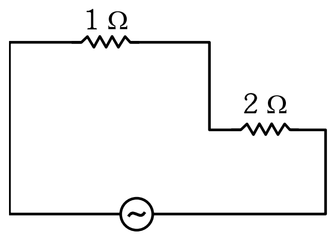
Ans. (4)

Sol. as frequency is very high

$X_C \approx 0$

$X_L \to \alpha$

Effective circuit will be



Effective impedance of circuit will be = 3Ω

45. A constant torque of 100 N m turns a wheel of moment of inertia 300 kg m^2 about an axis passing through its centre. Starting from rest, its angular velocity after 3s is :-

(1) 1 rad/s (2) 5 rad/s (3) 10 rad/s (4) 15 rad/s

Ans. (1)

Sol. $\tau = I\alpha \Rightarrow \alpha = \frac{\tau}{I} = \frac{100}{300} = \frac{1}{3}$ rad/sec^2

$\omega_i = 0$

$\omega_f = \omega_i + \alpha t$

$= 0 + \frac{1}{3} \times 3$

$\omega_f = 1$ rad/sec

46. The emf of a cell having internal resistance 1Ω is balanced against a length of 330 cm on a potentiometer wire. When an external resistance of 2Ω is connected across the cell, the balancing length will be :

(1) 220 cm (2) 330 cm (3) 115 cm (4) 332 cm

Ans. (1)

Sol. $r = \left(\frac{\ell_O - \ell_C}{\ell_C}\right)R$

$1 = \left(\frac{330 - \ell_C}{\ell_C}\right) \times 2$

$3\ell_c = 660$

$\ell_c = 220$ cm

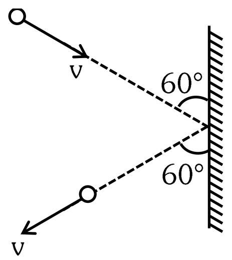
47. A 1 kg object strikes a wall with velocity 1 m s^{-1} at an angle of 60° with the wall and reflects at the same angle. If it remains in contact with wall for 0.1 s, then the force exerted on the wall is :-

(1) $30\sqrt{3}$ N (2) Zero

(3) $10\sqrt{3}$ N (4) $20\sqrt{3}$ N

Ans. (3)

Sol.



$$F = \left|\frac{\Delta\vec{p}}{\Delta t}\right| = \frac{2mv\sin\theta}{t} = \frac{2(1)(1)\sin 60°}{0.1} = 10\sqrt{3}\,N$$

48. The angular momentum of an electron moving in an orbit of hydrogen atom is $1.5\left(\frac{h}{\pi}\right)$. The energy in the same orbit is nearly.

(1) –1.5 eV (2) –1.6 eV (3) –1.3 eV (4) –1.4 eV

Ans. (1)

Sol. Given mvr = $1.5\,\frac{h}{\pi}$

Compare with mvr = $n\frac{h}{2\pi}$

So $\frac{n}{2} = 1.5$ or n = 3

Now $E_3 = -\frac{13.6}{(3)^2}\,eV \simeq -1.5\,eV$

49. A particle is executing uniform circular motion with velocity $\vec{v}$ and acceleration $\vec{a}$. Which of the following is true ?

(1) $\vec{v}$ is a constant; $\vec{a}$ is not a constant

(2) $\vec{v}$ is not a constant; $\vec{a}$ is not a constant

(3) $\vec{v}$ is a constant; $\vec{a}$ is a constant

(4) $\vec{v}$ is not a constant; $\vec{a}$ is a constant

Ans. (2)

Sol. Direction of velocity and centripetal acceleration changes continuously so $\vec{v}$ is not constant and $\vec{a}$ is not a constant.

50. A simple pendulum oscillating in air has a period of $\sqrt{3}$ s. If it is completely immersed in non-viscous liquid, having density $\left(\frac{1}{4}\right)^{th}$ of the material of the bob, the new period will be :-

(1) $2\sqrt{3}$ s (2) $\frac{2}{\sqrt{3}}$ s (3) 2s (4) $\frac{\sqrt{3}}{2}$ s

Ans. (3)

Sol. $T_{air} = 2\pi\sqrt{\frac{\ell}{g}} = \sqrt{3}$ sec

In Liquid → $g_{net} = g\left(1 - \frac{\rho}{\sigma}\right)$

ρ = density of liquid

σ = density of material of bob

so $T_{Liq} = 2\pi\sqrt{\left(\frac{\ell}{g_{net}}\right)} = 2\pi\sqrt{\frac{\ell}{g\left(1 - \frac{\rho}{\sigma}\right)}}$

$$T_{Liq} = \frac{T_{air}}{\sqrt{1 - \frac{\rho}{\sigma}}} = \frac{\sqrt{3}}{\sqrt{1 - \frac{1}{4}}} = \frac{\sqrt{3}}{\frac{\sqrt{3}}{2}} = 2\,sec$$