PHYSICS

1. Ratio of density of Oxygen nucleus and Helium nucleus.

(1) 1 (2) 2 (3) 3 (4) 4

Ans. **(1)**

Sol. Density of any nucleus is constant.

2. Root mean square velocity is related to temperature in proportional to:

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

Ans. **(1)**

Sol. $V_{rms} = \sqrt{\frac{3RT}{M}}$

3. A car covers x distance with speed V_1 and same distance x with speed V_2 in same direction. What is the average speed of car.

(1) $\frac{4V_1V_2}{V_1+V_2}$ (2) $\frac{2V_1V_2}{V_1+V_2}$ (3) $\frac{V_1V_2}{V_1+V_2}$ (4) $\frac{V_1V_2}{2V_1+V_2}$

Ans. **(2)**

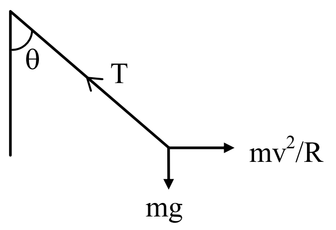
Sol. $t_1 = \frac{x}{V_1}$ $\quad <V> = \frac{2x}{\frac{x}{V_1}+\frac{x}{V_2}} = \left(\frac{2V_1V_2}{V_1+V_2}\right)$

$t_2 = \frac{x}{V_2}$

4. A car is moving in horizontal circular track of radians 40 m with speed 20 m/s. An angle is made by pendulum having from ceiling with vertical is

(1) 45° (2) 60° (3) 30° (4) 37°

Sol.



$T\sin\theta = \frac{mv^2}{R}$

$T\sin\theta = mg$

$T\sin\theta = \frac{v^2}{Rg} = \frac{400}{40\times 10} = 1$

$\theta = 45°$

5. A solenoid of 20 cm length in which 2A current is flowing and total number of turns are 40. Find magnetic field inside the solenoid.

(1) $60\pi \times 10^{-5}$ T
(2) $16\pi \times 10^{-5}$ T
(3) $20\pi \times 10^{-5}$ T
(4) $\pi \times 10^{-5}$ T

Ans. (2)

Sol. $B = \mu_0 ni$

$= 4\pi \times 10^{-7} \times \frac{40}{0.2} \times 2 = 16\pi \times 10^{-5}$ T

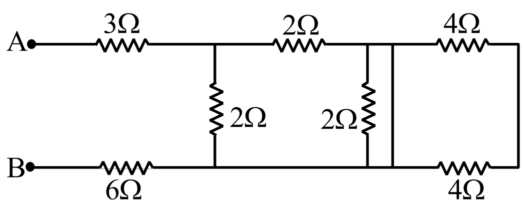
6. In Amplitude modulation frequency of modulating wave is 5 Khz and carrier 2MHz find out band width

(1) 4 MHz (2) 5 KHz (3) 10 KHz (4) 2 MHz

Ans. **(3)**

Sol. $B.W = 2f_m = 2\times 5KHz = 10$ KHz

7. Find the value of equivalent resistance between points A & B in the circuit shown below :-



(1) 10Ω (2) 15Ω (3) 20Ω (4) 5Ω

Ans. (1)

Sol. $R_{eq.} = 10\Omega$

8. In hydrogen like spectrum if wavelength of transition from 3rd to 2nd orbit is λ_0, then wavelength for transition from 4th to 3rd bohr's orbit is λ'. If $\frac{\lambda'}{\lambda_0} = \frac{20}{x}$. Find x?

(1) 5 (2) 6 (3) 7 (4) 8

Ans. **(3)**

Sol. $\frac{1}{\lambda_0} = R\left(\frac{1}{4}-\frac{1}{9}\right)$

$\frac{1}{\lambda_0} = R\left(\frac{5}{36}\right)$

$\frac{1}{\lambda'} = R\left(\frac{1}{9}-\frac{1}{16}\right)$

$\frac{1}{\lambda'} = R\left(\frac{7}{9\times16}\right)$

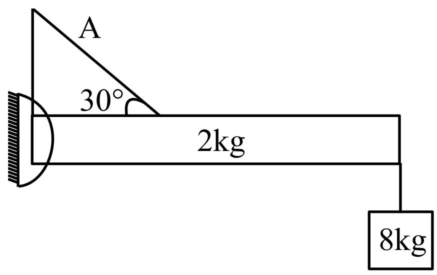
$\frac{\lambda'}{\lambda_0} = \frac{R\frac{5}{36}}{R.\frac{7}{9\times16}}$

$\frac{\lambda'}{\lambda_0} = \frac{5\times9\times16}{36\times7}$

$\frac{\lambda'}{\lambda_0} = \frac{20}{7}$

$\frac{\lambda'}{\lambda_0} = \frac{20}{x}$

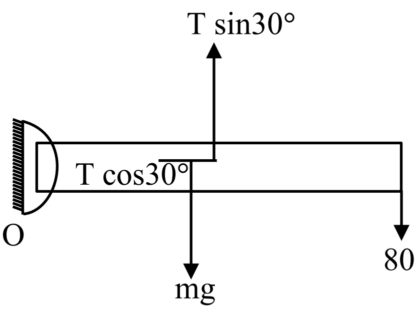
9. Rod of length 1m shown is figure is in equilibrium and string is attached 60 cm from hinge point. Choose the correct value of tension is string A.



(1) 300 N (2) 240 N (3) 30 N (4) 90 N

Ans. **(1)**

Sol.



Net τ about O is zero $\vec{\tau}_0 = 0$

$80(100) + 20(50)$

$= T \sin 30° \times 60$

$T = 300$ N

10. Efficiency of Carnot engine is 50%. When sink temperature is 600K. Find out temperature of sink for which efficiency will become 70%?

(1) 360 K (2) 460 K (3) 500 K (4) 350 K

Ans. **(1)**

Sol.

$$n = 1 - \frac{T_C}{T_H}$$

$$\frac{1}{2} = 1 - \frac{600}{T_H}$$

$$\frac{600}{T_H} = \frac{1}{2}$$

$$T_H = 1200\text{K}$$

$$\frac{7}{10} = 1 - \frac{T_C}{1200}$$

$$\frac{T_C}{1200} = 1 - \frac{7}{10}$$

$$\frac{T_C}{1200} = \frac{3}{10}$$

$$\boxed{T_C = 360\text{K}}$$

11. A light is incident from air on glass slab at its critical angle. If thickness of slab is $\sqrt{3}$ m and refractive index $\sqrt{2}$ then lateral displacement of light is (in m) [Given sin15°=0.259]

Ans. 0.518

Sol. $L = t\dfrac{\sin(i-r)}{\cos r}$ $\sin i = \dfrac{1}{v} = \dfrac{1}{\sqrt{2}}$

i=45°

$\sin i = \mu \sin r$

r = 30°

$$\Rightarrow L = \frac{\sqrt{3}\sin(45-30)}{\sin 30°}$$

$= 2 \sin 15°$

$= 0.518$

12. **Assertion :** Photodiodes are generally used for measuring light intensity

Reason : Forward biased current is more than reverse biased current in PN junction diode.

(1) A and R both are correct and R is correct explanation.

(2) A and R both are correct and R is not correct explanation.

(3) A is correct R is incorrect.

(4) A is incorrect, R is correct.

Ans. **(2)**

13. A body cools from 96°C to 84°C in 2 min. Find out time required for body to cool from 74°C to 68°C. Take surrounding temp. as 22°C.

(1) 1 min (2) 2 min (3) 1.4 min (4) 2.4 min

Ans. **(3)**

Sol. $\frac{T_2 - T_1}{\Delta t} = k\left(\frac{T_1 + T_2}{2} - T\right)$

$\frac{12}{2} = k\left(\frac{84+96}{2} - 22\right)$

6 = K (68)

$\boxed{K = \frac{6}{68}}$

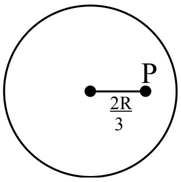
$\frac{6}{\Delta t} = \frac{6}{68}\left(\frac{74+68}{2} - 22\right)$

$\frac{1}{\Delta t} = \frac{1}{68}(71-22)$

$\Delta t = \frac{68}{49}$

Δt = 1.4 min.

14.



Moment of inertia of disc mass m and radius R about centre of mass and perpendicular to plane is I_{cm} and moment of inertia of disc about P and perpendicular to plane is I_{AB}, then $\frac{I_{AB}}{I_{cm}}$ is

Ans. $\frac{9}{17}$

Sol. $I_{cm} = \frac{mR^2}{2}$

$I_{cm} = \quad I_{cm} + md^2$

$I_{cm} = \frac{mR^2}{2} + m\left(\frac{2R}{3}\right)^2$

$I_{cm} = \frac{mR^2}{2} + \frac{m4R^2}{9} = \frac{17mR^2}{18}$

$R = \frac{I_{cm}}{I_{AB}} = \frac{18}{2\times 17} = \frac{9}{17}$

15. **Column-I** **Column-II**

Column-I	Column-II
(A) Surface tension	(P) $ML^{-1}T^{-2}$
(B) Pressure	(Q) MT^{-2}
(C) Viscosity	(R) MLT^{-1}
(D) Impulse	(S) $ML^{-1}T^{-1}$

Match the quantities in column-I with it's correct dimensions mentioned in column-II.

(1) (A) $\rightarrow$ Q; (B) $\rightarrow$ P; (C) $\rightarrow$ S; (D) $\rightarrow$ R

(2) (A) $\rightarrow$ R; (B) $\rightarrow$ P; (C) $\rightarrow$ Q; (D) $\rightarrow$ R

(3) (A) $\rightarrow$ Q; (B) $\rightarrow$ Q; (C) $\rightarrow$ P; (D) $\rightarrow$ R

(4) (A) $\rightarrow$ S; (B) $\rightarrow$ P; (C) $\rightarrow$ R; (D) $\rightarrow$ R

Ans. **(1)**

Sol. Surface tension (T) = $\frac{F}{L} = \frac{MLT^{-2}}{L^2} = MT^{-2}$

Pressure (P) = $\frac{F}{A} = \frac{MLT^{-2}}{L^2} = ML^{-1}T^{-2}$

Viscosity = $\frac{F}{A\frac{dv}{dh}} = ML^{-1}T^{-1}$

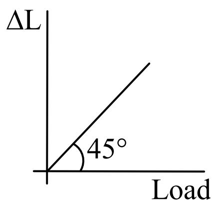
Impulse = MLT^{-1}

16. A straight line graph passing from origin at angle 45° is drawn between extension and stress applied if young's modulus is $x \times 10^4$ N/m^2. Find the value of x. If length of wire is 62.8 cm diameter of cross section is 4 mm.

(1) 5 (2) 10 (3) 15 (4) 20

Ans. **(1)**

Sol.



$\frac{F}{A} = \gamma\frac{\Delta L}{L}$

$\frac{L}{A} = \gamma\frac{\Delta L}{F}$

$\frac{L}{A} = \gamma(1)$

$= \frac{62.8\times10^{-2}}{\pi\times(2\times10^{-3})^2} = 5 \times 10^4$ N/m^2

x = 5

17. Two points separated by 6 cm on string has phase difference of 60°. If frequency of oscillation is 500 Hz. Find velocity (in m/sec) of wave?

(1) 200 (2) 180 (3) 100 (4) 80

Ans. **(2)**

Sol. $\Delta\phi = \Delta x \dfrac{2\pi}{\lambda}$

$\dfrac{\pi}{3} = (6\text{ cm})\dfrac{2\pi}{\lambda}$

$\lambda = 36$ cm

$v = f\lambda$

$v = 500 \times \dfrac{36}{100}$

$v = 180$ m/sec

18. A tunnel is dig inside the earth along its diameter. A particle is released from rest and performing SHM. Find time period.

(1) 1 hr 24 min (2) 30 min (3) 40 min (4) 2 hrs 48 min

Ans. **(1)**

Sol. $F = \dfrac{GM_e mr}{R_e^3} = \dfrac{mgr}{R_e} = m\omega^2 r$

$\omega = \sqrt{\dfrac{g}{R_e}}$

$T = 2\pi\sqrt{\dfrac{R_e}{g}} = 2\pi\sqrt{\dfrac{6400 \times 10^3}{10}} = 2\pi \times 800$ sec $\approx$ 1 hr 24 min

19. In a YDSE distance between slit & screen is 1 m. A mono chromatic wave of wavelength 600 nm incident on slit. Distance between central maxima and 5^{th} maxima is 5 cm. Find separation between slits is.

(1) 30 μm (2) 60 μm (3) 15 μm (4) 20 μm

Ans. **(2)**

Sol. $y = \dfrac{nD\lambda}{d}$

$d = \dfrac{nD\lambda}{y} = \dfrac{5 \times 1 \times 600 \times 10^{-9}}{5 \times 10^{-2}} = 6 \times 10^{-5}\text{ m} = 60\ \mu\text{m}$

20. For LCR circuit resonance frequency is 20 Hz, if inductance is made 8 times and capacitance is doubled ratio of new resonance frequency is :

(1) 1 : 1 (2) 4 : 1 (3) 1 : 4 (4) 2 : 1

Ans. **(3)**

Sol. $f_r = \frac{1}{2\pi\sqrt{LC}}$

$f_r' = \frac{1}{2\pi\sqrt{(8L)(2C)}}$

$f_r' = \frac{1}{4} f_r$

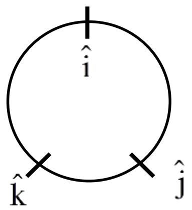
$\frac{f_r'}{f_r} = \frac{1}{4}$

21. An EMW is propagating in negative t axis $(-\hat{k})$ and electric field field is vibrating in +y-axis $(\hat{j})$, for this wave magnetic field is vibrating in

(1) $-\hat{i}$ (2) $\hat{i}$ (3) $\hat{k}$ (4) $-\hat{j}$

Ans. **(2)**

Sol.

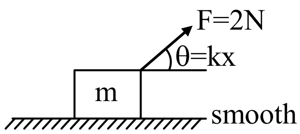


$\hat{E} \times \hat{B} = \hat{v}$

$\hat{j} \times \hat{B} = -\hat{k}$

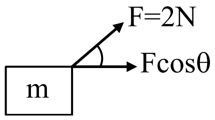
$\Rightarrow \hat{B} = \hat{i}$

22. Kinetic energy at any instant is $\frac{n \sin\theta}{k}$, find n ?



Ans. **(2)**

Sol.



$F = 2\cos\theta$

$\mathbf{a} = \dfrac{2}{m}\cos(kx)$

$\int_0^v v\,dv = \int_0^x \dfrac{2}{m}\cos(kx)\,dx$

$\dfrac{v^2}{2} = \dfrac{2}{m}\dfrac{\sin(kx)}{k}$

$\dfrac{mv^2}{2} = K.E.(x) = 2\dfrac{\sin(kx)}{k}$

the value of n = 2

23. Half-life of a radioactive substance is 30 min. Time after which 75% of the radioactive sample decayed is (min)

(1) 60 min (2) 40 min (3) 80 min (4) 100 min

Ans.

Sol. $T_{1/2} = \dfrac{\ell n 2}{\lambda}$

$T_{75\%} = ?$

$N(t) = N_0 e^{-\lambda t}$

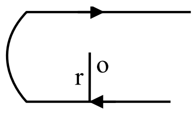
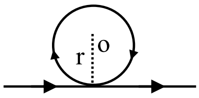
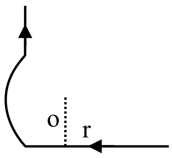
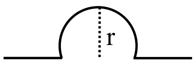
$\dfrac{N_0}{4} = N_0 e^{-\lambda T_{75\%}}$

$\dfrac{1}{4} = e^{-\lambda T_{75\%}}$

$\dfrac{\ell n 4}{\lambda} = T_{75\%}$

$t_{1/2} = T_{75\%} = 2 \times 30$ min $= 60$ min

24. Magnetic field at centre in column-I match with column-II.

Column-I		**Column-II**	
(A)		P	$\frac{\mu_0 I}{4\pi r}(\pi+1)$
(B)		Q	$\frac{\mu_0 I}{4r}$
(C)		R	$\frac{\mu_0 I}{4\pi r}(\pi+2)$
(D)		S	$\frac{\mu_0 I}{2r}\left[1-\frac{1}{\pi}\right]$

(1) $A \to R, B \to S, C \to P, D \to Q$

(2) $A \to R, B \to P, C \to S, D \to Q$

(3) $A \to S, B \to P, C \to Q, D \to R$

(4) $A \to Q, B \to S, C \to P, D \to R$

Ans. **(1)**

Sol. $B_A = \frac{\mu_0 I}{4r} + \frac{\mu_0 I}{4\pi r} \times 2 = \frac{\mu_0 I}{4\pi r}(\pi+2)$

$B_B = \frac{\mu_0 I}{2r}\left[1-\frac{1}{\pi}\right]$

$B_C = \frac{\mu_0 I}{4r} + \frac{\mu_0 I}{4\pi r} = \frac{\mu_0 I}{4\pi r}(\pi+1)$

$B_D = \frac{\mu_0 I}{4r}$

25. A parallel plate capacitor of plate separation 2mm and plate area 40 cm^2 is filled with a dielectric whose area is same as plates of capacitor. Thickness is 1mm & dielectric constant is 5. New capacitance is:-

(1) $\frac{3}{10}\varepsilon_0$ F (2) $\frac{10}{3}\varepsilon_0$ F (3) $\frac{20}{3}\varepsilon_0$ F (4) $\frac{3}{20}\varepsilon_0$ F

Ans. **(2)**

26. Time period of simple pendulum on earth's surface is T. Time period at height R(radius of earth) from earth's surface is xT. Find x?

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

Ans. (1)

27. A wire carrying current of 2A when potential difference of 3.4 V is applied across it. If mass of wire is 8.92×10^{-3} kg resistivity is $\rho = 1.7 \times 10^{-8}$ and density is 8.92×10^{3} kg/m^2. Find length of wire.

Ans. 10

Sol. $\rho\frac{\ell}{A} = r$

$$\frac{1.7\times10^{-8}\ell^2}{v} = \frac{3.4}{2}$$

$$\frac{1.7\times10^{-8}\ell^2}{m / dencity} = \frac{3.4}{2} \qquad \left(\frac{m}{v} = \text{density}\right)$$

$$\ell^2 = \frac{3.4}{2(17\times10^{-8})}\frac{8.92\times10^{-3}}{8.92\times10^{3}}$$

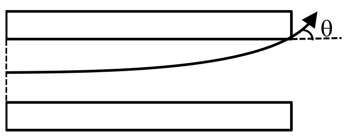
$$\ell^2 = 100$$

28. A e^- is accelerated by 20 V potential difference and for this de-Broglie wavelength is λ_0. If this e^- is now accelerated by 40 V, new de-Broglie wavelength will be (λ)

(1) $\sqrt{2}\lambda$ (2) $\frac{\lambda_0}{\sqrt{2}}$ (3) λ (4) $\frac{\lambda}{2}$

Ans. (2)

29.



An e^+ is projected between the plates of capacitor as shown in the figure. Initial velocity of e^+ was in x-direction & initial kinetic energy was 0.5 eV. If the electric field between the plates is 10N/C & separation between the plates is 10 cm. Value of angle of deviation of the path of e^+ as it comes out of the field

Ans. 45

Sol. $K.Ey = q\Delta v = e(10 \times 0.05) = 0.5$ eV

$$\tan\theta = \frac{Vy}{Vx} = \sqrt{\frac{K.Ey}{K.Ex}} = \sqrt{\frac{0.5}{0.5}} = 1 \qquad \Rightarrow \theta = 45°$$