FINAL NEET(UG)–2022 EXAMINATION FOR NRI

(Held On Sunday 17th JULY, 2022)

PHYSICS — TEST PAPER WITH ANSWER

SECTION-A

1. The de Broglie wavelength of a thermal electron at 27°C is λ. When the temperature is increased to 927°C, its de-Broglie wavelength will become:

(1) 4λ (2) $\frac{\lambda}{2}$

(3) $\frac{\lambda}{4}$ (4) 2λ

Ans. (2)

Sol. At $T_1 = 27°C = 300$ K

$\lambda_1 = \lambda$

and $T_2 = 927°C = 1200$ K

$\lambda_2 = ?$

$\because \lambda = \frac{h}{p} = \frac{h}{\sqrt{2mE}}$ and $E = \frac{3}{2}K_BT$

$\therefore \lambda \propto \frac{1}{\sqrt{T}}$

$\frac{\lambda_1}{\lambda_2} = \frac{\sqrt{T_2}}{\sqrt{T_1}} = \sqrt{\frac{1200}{300}} = 2$

$\lambda_2 = \frac{\lambda_1}{2} = \frac{\lambda}{2}$

2. The ratio of the radii of two circular coils is 1 : 2. The ratio of currents in the respective coils such that the same magnetic moment is produced at the centre of each coil:

(1) 2 : 1 (2) 1 : 2

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

Ans. (4)

Sol. $\frac{r_1}{r_2} = \frac{1}{2}$

Since, M = IA

$\therefore M_1 = M_2 \Rightarrow I_1\pi r_1^2 = I_2\pi r_2^2$

$\Rightarrow \frac{I_1}{I_2} = \left(\frac{r_2}{r_1}\right)^2 = \frac{4}{1}$

3. The current in an inductor of self inductance 4 H changes from 4 A to 2 A in 1 second. The e.m.f. induced in the coil is:

(1) 2 V (2) –4 V

(3) 8 V (4) –2 V

Ans. (3)

Sol. L = 4H

$\because \varepsilon = -L\frac{di}{dt} = -4\frac{(2-4)}{1}$

$= -4(-2)$

$= 8$ V

4. An electromagnetic wave is moving along negative z(–z) direction and at any instant of time, at a point, its electric field vector is $3\hat{j}$ V/m. The corresponding magnetic field at that point and instant will be:

(Take $c = 3 \times 10^8$ ms^{-1})

(1) $-10\hat{i}$ nT (2) $\hat{i}$ nT

(3) $-\hat{i}$ nT (4) $10\hat{i}$ nT

Ans. (4)

Sol. Wave is propagating along –z direction

$\vec{E} = 3\hat{j}\,v/m$

$\because B_0 = \frac{E_0}{C}$

$= \frac{3}{3\times10^8}$

$= 10 \times 10^{-9}\,\hat{i}$ T

$= 10\hat{i}$ nT

5. Two amplifiers of voltage gain 20 each, are cascaded in series. If 0.01 volt a.c. input signal is applied across the first amplifier, the output a.c. signal of the second amplifier in volt is:

(1) 4.0 (2) 0.01

(3) 0.20 (4) 2.0

Ans. (1)

Sol. $\because A_V = A_{V_1}A_{V_2}$

$= 20 \times 20 = 400$

$\frac{v_{out}}{v_{in}} = A_v \Rightarrow v_{out} = A_V(v_{in})$

$= 400\ (0.01)$

$= 4$

6. A linearly polarised monochromatic light of intensity 10 lumen is incident on a polarizer. The angle between the direction of polarisation of the light and that of the polariser such that the intensity of output light is 2.5 lumen is:

(1) 75° (2) 30°

(3) 45° (4) 60°

Ans. (4)

Sol. $\because I = I_0 \cos^2\theta$

$2.5 = 10 \cos^2\theta$

$\Rightarrow \frac{25}{100} = \cos^2\theta$

$\Rightarrow \cos\theta = \frac{1}{2}$

$\Rightarrow \theta = 60°$

7. A stone is thrown vertically downward with an initial velocity of 40 m/s from the top of a building. If it reaches the ground with velocity 60 m/s, then the height of the building is:

(Take g = 10 m/s^2)

(1) 140 m (2) 80 m

(3) 100 m (4) 120 m

Ans. (3)

Sol. $v^2 - u^2 = 2gh$

$\Rightarrow h = \frac{v^2 - u^2}{2g} = \frac{3600 - 1600}{2 \times 10}$

$= 100$ m

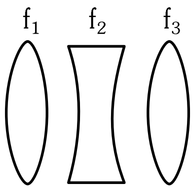
8. A concave lens of focal length, 25 cm is sandwiched between two convex lenses, each of focal length, 40 cm. The power in dioptre of the combined lens would be:

(1) 9 (2) 1

(3) 0.01 (4) 55

Ans. (2)

Sol.



$f_1 = f_3$

$f_2 = -25$ cm

$f_1 = f_3 = 40$ cm

$\because \frac{1}{f_{net}} = \frac{1}{f_1} + \frac{1}{f_2} + \frac{1}{f_3}$

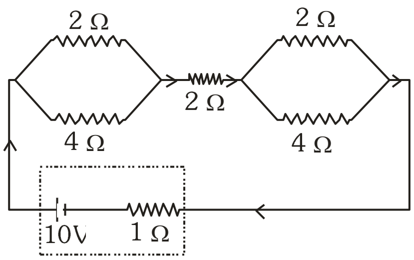
and $P = \frac{1}{f_{net}(m)}$

$\therefore \frac{1}{f_{net}} = \frac{1}{40} - \frac{1}{25} + \frac{1}{40}$

$= \frac{2}{40} - \frac{1}{25} = \frac{1}{100\,cm}$

$\therefore P = \frac{100}{100} = 1D$

9. A network of resistors is connected across a 10 V battery with internal resistance of 1 Ω as shown in the circuit diagram. The equivalent resistance of the circuit is:

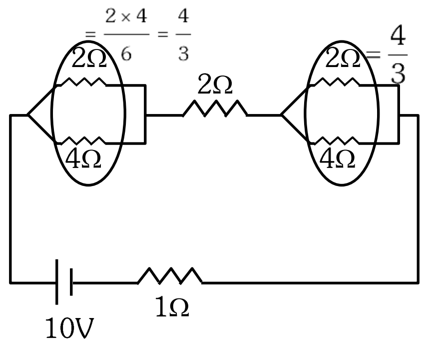


(1) $\frac{14}{3}\Omega$ (2) $\frac{12}{7}\Omega$

(3) $\frac{14}{7}\Omega$ (4) $\frac{17}{3}\Omega$

Ans. (4)

Sol.



$R_{eq.} = \frac{4}{3} + 2 + \frac{4}{3} + 1$

$= \frac{8}{3} + 3 = \frac{17}{3}\Omega$

10. The correct statement about the variation of viscosity of fluid with increase in temperature:

(1) viscosity of both liquids and gases increases

(2) viscosity of liquids increases

(3) viscosity of liquids decreases

(4) viscosity of gases decreases

Ans. (3)

Sol. Viscosity of liquid decreases with increase of temp.

11. Let L_1 and L_2 be the orbital angular momentum of an electron in the first and second excited states of hydrogen atom, respectively. According to the Bohr's model, the ratio $L_1 : L_2$ is:

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

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

Ans. (3)

Sol. I^{st} and 2^{nd} excited state of hydrogen corresponds to 2^{nd} and 3^{rd} orbital.

$n_1 = 2$ and $n_2 = 3$

$\because L = \frac{nh}{2\pi}$

$\therefore \frac{L_1}{L_2} = \frac{n_1}{n_2} = \frac{2}{3}$

12. During simple harmonic motion of a body, the energy at the extreme positions is:

(1) is always zero

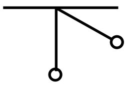
(2) purely kinetic

(3) purely potential

(4) both kinetic and potential

Ans. (3)

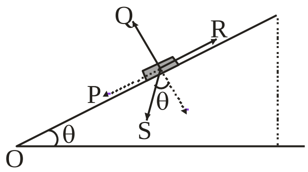
Sol.



$\therefore$ At extreme position K.E. = 0

So, Total energy = Purely Potential Energy

13.



When a body of mass 'm' just begins to slide as shown, match list-I with List-II:

List-I	List-II
(a) Normal reaction	(i) P
(b) Frictional force (f_S)	(ii) Q
(c) Weight (mg)	(iii) R
(d) mgsinθ	(iv) S

Choose the correct answer from the options given below:

(1) (a)-(iv), (b)-(ii), (c)-(iii), (d)-(i)

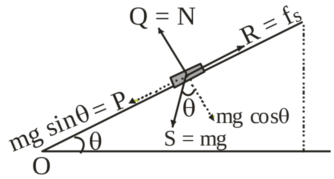
(2) (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)

(3) (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i)

(4) (a)-(ii), (b)-(i), (c)-(iii), (d)-(iv)

Ans. (3)

Sol.



Q = Normal reaction

P = mg sinθ

R = Friction force

S = Weight (mg)

(a)-(ii), (b)-(iii), (c)-(iv) and (d)-(i)

14. Twelve point charges each of charge q coulomb are placed at the circumference of a circle of radius r with equal angular spacing. If one of the charges is removed, the net electric field (in N/C) at the centre of the circle is : (ε_0 – permittivity of free space)

(1) $\frac{13q}{4\pi\varepsilon_0 r^2}$ (2) zero

(3) $\frac{q}{4\pi\varepsilon_0 r^2}$ (4) $\frac{12q}{4\pi\varepsilon_0 r^2}$

Ans. (3)

Sol. $\vec{E}$ at centre = 0

Because of symmetry when one charge is removed

$\vec{E} = \frac{kq}{r^2}$

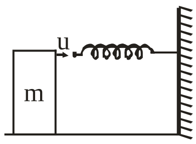
$= \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}$

($\because$ $\vec{E}$ due to 10 charges will cancel and out each other

$\therefore$ E_{net} will be only because of 11^{th} charge)

15. A block of mass m is moving with initial velocity u towards a stationary spring of stiffness constant k attached to the wall as shown in the figure. Maximum compression of the spring is:

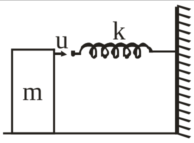
(The friction between the block and the surface is negligible)



(1) $4u\sqrt{\frac{m}{k}}$ (2) $2u\sqrt{\frac{m}{k}}$

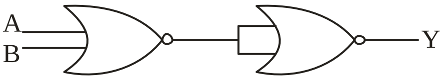
(3) $\frac{1}{2}u\sqrt{\frac{k}{m}}$ (4) $u\sqrt{\frac{m}{k}}$

Ans. (4)

Sol. 

$\frac{1}{2}mu^2 = \frac{1}{2}kx^2$

$x = u\sqrt{\frac{m}{k}}$

16. 

The output of the logic circuit shown is equivalent to a/an:

(1) NOR gate (2) AND gate

(3) NAND gate (4) OR gate

Ans. (4)

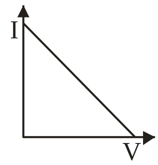
Sol. $y = \overline{\overline{(A+B)}+\overline{(A+B)}}$

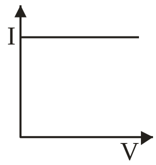
$= \overline{\overline{(A+B)}}\cdot\overline{\overline{(A+B)}}$ (By De'Morgans theorem)

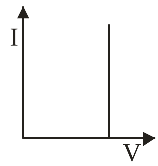
$= (A + B).(A + B)$

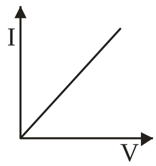
$= A + B \Rightarrow$ OR Gate

17. The plot of current I flowing through a conductor versus the applied voltage V across the ends of a conductor is:

(1) 

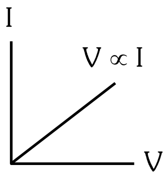
(2) 

(3) 

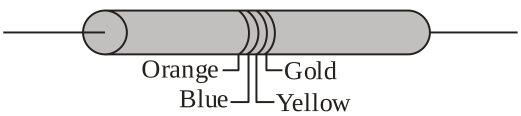
(4) 

Ans. (4)

Sol. By Ohm's law : $V = IR \Rightarrow V \propto I$



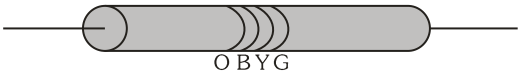
18. The value of resistance for the colour code of the given resistor is:



(1) (470 ± 47) kΩ (2) (360 ± 36) kΩ

(3) (360 ± 18) kΩ (4) (36 ± 36) kΩ

Ans. (3)

Sol. 

	B	B	R	O	Y	G	B	V	G	W
	0	1	2	3	4	5	6	7	8	9
Multiplier	1	10	10^2	10^3	10^4	10^5	10^6	10^7	10^8	10^9

Tolerance (%) : Gold, Silver, None
5 10 20

(360 ± 18) kΩ

19. An inductor coil of self inductance 10 H carries a current of 1 A. The magnetic field energy stored in the coil is:

(1) 2.5 J (2) 20 J

(3) 5 J (4) 10 J

Ans. (3)

Sol. $E = \frac{1}{2}LI^2$

$= \frac{1}{2}\times 10 \times 1^2$

$= \frac{10}{2} = 5$ J

20. The dimensions of mutual inductance (M) are:

(1) $[MLT^{-2}A^2]$ (2) $[M^2L^2T^{-2}A^2]$

(3) $[ML^2T^{-2}A^{-2}]$ (4) $[M^2LT^{-2}A^{-2}]$

Ans. (3)

Sol. Dimensional formula of mutual inductance

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

21. A strong magnetic field is applied along the direction of velocity of an electron. The electron would move along:

(1) the original path (2) a helical path

(3) a circular path (4) a parabolic path

Ans. (1)

Sol. $\because F = q\left(\vec{v}\times\vec{B}\right)$

Since $\vec{v}$ and $\vec{B}$ are parallel

$\therefore \theta = 0°$

$F_m = Bqv \sin 0° = 0$

$\therefore$ Original path

22. In a photoelectric experiment, blue light is capable of ejecting a photoelectron from a specific metal while green light is not able to eject a photoelectron. Ejection of photoelectrons is also possible using light of the colour:

(1) Red (2) Violet

(3) Orange (4) Yellow

Ans. (2)

Sol. ∵ Wavelength of blue, indigo and violet light is less than green light

∴ Energy of blue, indigo and violet light is more than green light

Hence, violet light is capable of ejecting of photoelectron.

23. When the circular scale of a screw gauge completes 2 rotations, it covers 1 mm over the pitch scale. The total number of the circular scale divisions is 50. The least count of the screw gauge in metre is:

(1) 10^{-5} (2) 10^{-2}

(3) 10^{-3} (4) 10^{-4}

Ans. (1)

Sol. Pitch = $\frac{1\text{mm}}{2}$ = 0.5 mm

$$\text{L.C.} = \frac{\text{Pitch}}{\text{No. of division of circular scale}}$$

$$= \frac{0.5\times10^{-3}}{50}$$

$= 10^{-5}$

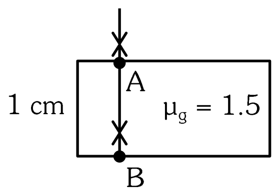
24. A beam of light is incident vertically on a glass slab of thickness 1 cm, and refractive index 1.5. A fraction 'A' is reflected from the front surface while another fraction 'B' enters the slab and emerges after reflection from the back surface. Time delay between them is:

(1) 5×10^{-10} s (2) 10^{-11} s

(3) 5×10^{-11} s (4) 10^{-10} s

Ans. (4)

Sol.



$v = \frac{s}{t}$ $\mu_{ga} = \frac{\mu_g}{\mu_a} = \frac{c}{v_g}$

s = 2 (Thickness of slab)

$$t = \frac{s}{v_g} = \frac{(2\times10^{-2})\times3}{3\times10^{8}\times2}$$ $$\Rightarrow v_g = \frac{c\mu_a}{\mu_g} = \frac{2c}{3}$$

$= 10^{-10}$ s

25. Given below are two statements: One is labelled as **Assertion (A)** and the other is labelled as **Reason (R).**

Assertion (A): A standing bus suddenly accelerates. If there were no friction between the feet of a passenger and the floor of the bus, the passenger would move back.

Reason (R): In the absence of friction, the floor of the bus would slip forward under the feet of the passenger.

In the light of the above statements, choose the most appropriate answer from the options given below:

(1) (A) is false but (R) is true

(2) Both (A) and (R) are true and (R) is the correct explanation of (A)

(3) Both (A) and (R) are true and (R) is not the correct explanation of (A)

(4) (A) is true but (R) is false

Ans. (1)

Sol. ∵ There is no friction between feet of passenger and floor of bus so passenger will not move back when seen from ground

So Assertion is false but reason is true.

26. A gas undergoes an isothermal process. The specific heat capacity of the gas in the process is:

(1) 0.5 (2) zero

(3) 1 (4) infinity

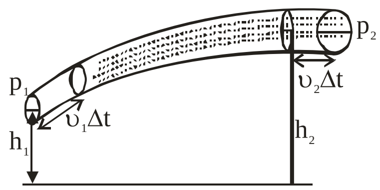
Ans. (4)

Sol. ∵ $Q = ms\,\Delta T$

as $\Delta T = 0$

$s = Q/m\Delta T = \infty$

27. A fluid of density ρ is flowing in a pipe of varying cross-sectional area as shown in the figure. The Bernoulli's equation for the motion becomes:



(1) $p+\frac{1}{2}\rho\upsilon^2$ = constant

(2) $\frac{1}{2}\rho\upsilon^2 + \rho gh$ = constant

(3) $p + \rho gh$ = constant

(4) $p+\frac{1}{2}\rho\upsilon^2+\rho gh$ = constant

Ans. (4)

Sol. By using Bernoullis equation

$$p + \frac{1}{2}\rho v^2 + \rho gh = \text{constant}$$

28. At some instant, the number of radioactive atoms in a sample is N_0 and after time 't' the number decreases to N. It is found that the graphical representation 'ln N' versus 't' along the y and x axes respectively is a straight line. Then the slope of this line is:

(1) $-\lambda$ (2) λ^{-1}

(3) $-\lambda^{-1}$ (4) λ

Ans. **(1)**

Sol. $N = N_0 e^{-\lambda t}$

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

$\ln N = -\lambda t + \ln N_0$

$\therefore$ Slope $= -\lambda$

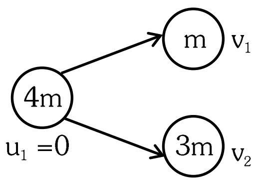
29. A particle of mass 4 M kg at rest splits into two particles of mass M and 3 M. The ratio of the kinetic energies of mass M and 3M would be:

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

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

Ans. **(4)**

Sol.



$\because F_{ext} = 0 \therefore \Delta P = 0$

$\Rightarrow P_1 + P_2 = 0$

$\Rightarrow P_1 = -P_2$

and $E = \frac{P^2}{2m}$

$\therefore E \propto \frac{1}{m}$

$\Rightarrow \frac{E_1}{E_2} = \frac{3m}{m} = \frac{3}{1}$

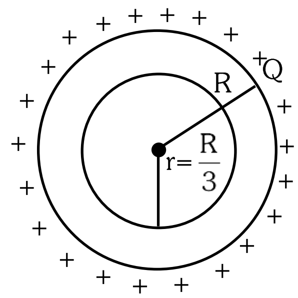
30. A hollow metal sphere of radius R is given '+Q' charge to its outer surface. The electric potential at a distance $\frac{R}{3}$ from the centre of the sphere will be:

(1) $\frac{3}{4\pi\varepsilon_0}\frac{Q}{R}$ (2) $\frac{1}{4\pi\varepsilon_0}\frac{Q}{3R}$

(3) $\frac{1}{4\pi\varepsilon_0}\frac{Q}{R}$ (4) $\frac{1}{4\pi\varepsilon_0}\frac{Q}{9R}$

Ans. **(3)**

Sol.



Here potential inside sphere will be equal to potential on surface of sphere.

$v = \frac{kQ}{R}$

$= \frac{1}{4\pi\varepsilon_0}\frac{Q}{R}$

31. Rain is falling vertically downward with a speed of 35 m/s. Wind starts blowing after some time with a speed of 12 m/s in East to West direction. The direction in which a boy standing at the place should hold his umbrella is:

(1) $\tan^{-1}\left(\frac{12}{37}\right)$ w.r.t. wind

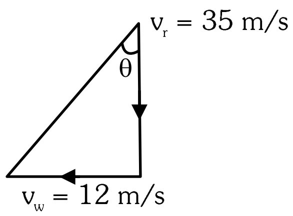
(2) $\tan^{-1}\left(\frac{12}{35}\right)$ w.r.t. rain

(3) $\tan^{-1}\left(\frac{12}{35}\right)$ w.r.t. wind

(4) $\tan^{-1}\left(\frac{12}{37}\right)$ w.r.t. rain

Ans. **(2)**

Sol.



$\tan\theta = \frac{12}{35} \Rightarrow \theta = \tan^{-1}\left(\frac{12}{35}\right)$ w.r.t rain

32. The ratio of the moments of inertia of two spheres about their diameter and having same mass and their radii in the ratio 1 : 2 is:

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

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

Ans. **(3)**

Sol. $\because I \propto mR^2$

$$\frac{m_1}{m_2} = \frac{1}{1}$$

$$\frac{R_1}{R_2} = \frac{1}{2}$$

$$\therefore \frac{I_1}{I_2} = \frac{m_1}{m_2} \times \left(\frac{R_1}{R_2}\right)^2$$

$$= 1 \times \left(\frac{1}{2}\right)^2 = \frac{1}{4}$$

33. A string is wrapped along the rim of a wheel of moment of inertia 0.10 kg-m^2 and radius 10 cm. If the string is now pulled by a force 10 N, then the wheel starts to rotate about its axis from rest. The angular velocity of the wheel after 2 seconds is:

(1) 80 rad/s (2) 10 rad/s

(3) 20 rad/s (4) 40 rad/s

Ans. **(3)**

Sol. $I = 0.1$ Kg m^2

$r = 10 \times 10^{-2}$ m

$F = 10$ N

$t = 2$ sec

$\because \tau = I\alpha = rF$

$$\therefore \alpha = \frac{rF}{I} = \frac{10^{-1} \times 10}{10^{-1}} = 10 \text{ rads}^{-2}$$

$\because \omega = \omega_0 + \alpha t$

$\therefore \omega = 0 + \alpha t$

$\Rightarrow \omega = 10 \times 2 = 20$ rads^{-1}

34. Assuming the earth to be a sphere of uniform density, its acceleration due to gravity acting on a body:

(1) increases with increasing depth

(2) is independent of the mass of the earth

(3) is independent of the mass of the body

(4) increases with increasing altitude

Ans. **(3)**

Sol. Acceleration due to gravity acting on a body is independent of the mass of the body. $\left(\because g = \frac{GM}{R^2}\right)$

35. If λ_X, λ_I, λ_M and λ_γ are the wavelengths of X-rays, infrared rays, microwaves and γ rays respectively, then:

(1) $\lambda_M < \lambda_I < \lambda_X < \lambda_\gamma$ (2) $\lambda_X < \lambda_\gamma < \lambda_M < \lambda_I$

(3) $\lambda_X < \lambda_I < \lambda_\gamma < \lambda_M$ (4) $\lambda_\gamma < \lambda_X < \lambda_I < \lambda_M$

Ans. **(4)**

Sol. R $\rightarrow$ Radio $\lambda \downarrow$

m $\rightarrow$ Micro

I $\rightarrow$ Infrared

V $\rightarrow$ Visible

U $\rightarrow$ UV ray

X $\rightarrow$ X-ray

G $\rightarrow$ γ-ray

$\lambda_m > \lambda_I > \lambda_X > \lambda_\gamma$

SECTION-B

36. The fraction of the original number of radioactive atoms that disintegrates (decays) during the average life time of a radioactive substance will be :

(1) $\frac{1}{1+e}$ (2) $\frac{e-1}{e+1}$

(3) $\frac{e-1}{e}$ (4) $\frac{1}{e}$

Ans. **(3)**

Sol. $$\frac{N_0 - N}{N_0} = \frac{N_0 - N_0 e^{-\lambda t}}{N_0}$$

$= 1 - e^{-\lambda t}$

$t = T_{av} = \frac{1}{\lambda}$

So $= 1 - e^{-\lambda/\lambda} = 1 - e^{-1}$

$= \frac{e-1}{e}$

37. Three capacitors, each of capacitance 0.3 μF are connected in parallel. This combination is connected with another capacitor of capacitance 0.1 μF in series. Then the equivalent capacitance of the combination is:

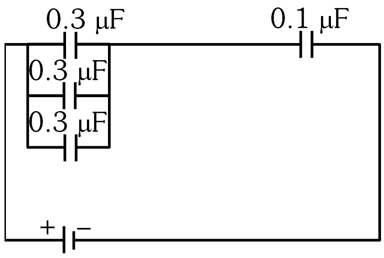
(1) 0.09 μF (2) 0.1 μF

(3) 0.01 μF (4) 0.9 μF

Ans. **(1)**

Sol. $\because C_{eq.} = \frac{C_1 \times C_2}{C_1 + C_2}$

$$C_{eq.} = \frac{0.9 \times 0.1 \times 10^{-12}}{1 \times 10^{-6}} = 0.09 \mu F$$



38. Given below are two statements:

Statement-I: The magnetic field of circular current loop at very far away point on the axial line varies with distance as like that of a magnetic dipole.

Statement-II: The magnetic field due to magnetic dipole varies inversely with the square of the distance from the centre on the axial line.

In light of above statements, choose the most appropriate answer from the options given below:

(1) Statement-I is incorrect and Statement-II is correct.

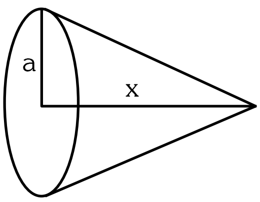
(2) Both Statement-I and Statement-II are correct.

(3) Both Statement-I and Statement-II are incorrect.

(4) Statement-I is correct and Statement-II is incorrect.

Ans. (4)

Sol. $\because B = \frac{\mu_0}{2} \frac{Ia^2}{(a^2 + x^2)^{3/2}}$



When, x >> a

Then, $B = \frac{\mu_0}{2} \frac{Ia^2}{(x^2)^{3/2}} = \frac{\mu_0}{2} \frac{Ia^2}{x^3}$

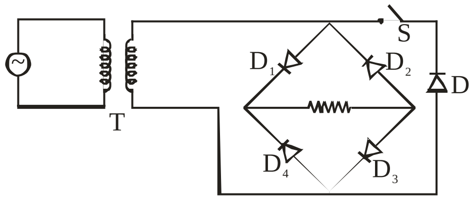
Magnetic field on axis of dipole

$$B = \frac{\mu_0}{2\pi} \frac{M}{x^3}$$

$$B \propto \frac{1}{x^3}$$

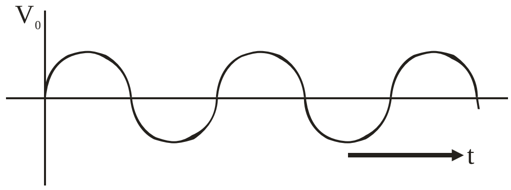
$\therefore$ Statement I correct and statement II incorrect.

39.

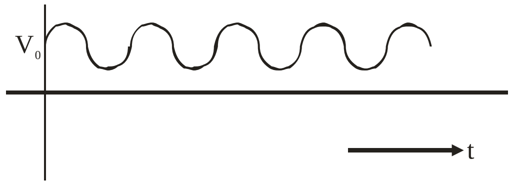


The circuit represents a full wave bridge rectifier when switch S is open. The output voltage (V_0) pattern across R_L when S is closed is:

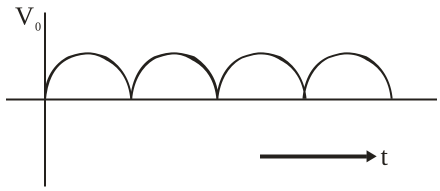
(1)



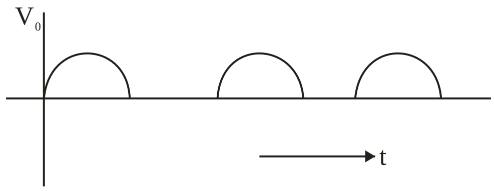
(2)



(3)

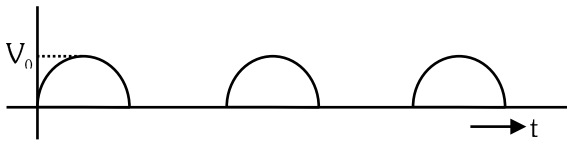


(4)



Ans. (4)

Sol. Consider diode 'D' as ideal diode.



40. When a particle with charge +q is thrown with an initial velocity v towards another stationary charge +Q, it is respelled back after reaching the nearest distance r from +Q. The closest distance that it can reach if it is thrown with initial velocity 2v, is:

(1) $\frac{r}{2}$ (2) $\frac{r}{16}$

(3) $\frac{r}{8}$ (4) $\frac{r}{4}$

Ans. (4)

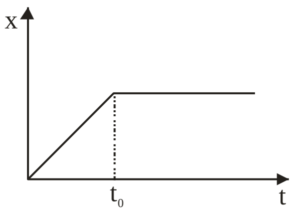
Sol. $\frac{1}{2}mv^2 = \frac{kq_1q_2}{r}$

$\Rightarrow r \propto \frac{1}{v^2}$

$\frac{r_1}{r_2} = \left(\frac{v_2}{v_1}\right)^2 = \left(\frac{2v}{v}\right)^2 = 4$

$\Rightarrow r_2 = \frac{r_1}{4} = \frac{r}{4}$

41. The figure given below shows the displacement and time, (x-t) graph of particle moving along a straight line:



The correct statement, about the motion of the particle is:

(1) The particle is accelerated throughout its motion.

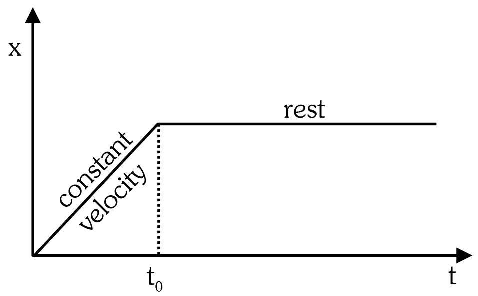
(2) The particle is accelerated continuously for time t_0 then moves with constant velocity.

(3) The particle is at rest.

(4) The particle moves at constant velocity up to a time t_0 and then stops.

Ans. (4)

Sol.



42. The temperature at which the rms speed of atoms in neon gas is equal to the rms speed of hydrogen molecules at 15°C is:

(Atomic mass of neon = 20.2 u, molecular mass of H_2 = 2 u)

(1) 2.9 K (2) 0.15×10^3 K

(3) 0.29×10^3 K (4) 2.9×10^3 K

Ans. (4)

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

$\therefore V_{Ne} = V_{H_2}$

$\Rightarrow \sqrt{\frac{3RT}{20.2}} = \sqrt{\frac{3R(288)}{2}}$

$\Rightarrow \frac{T}{20.2} = \frac{288}{2}$

$\Rightarrow T = 2.9 \times 10^3$ K

43. Air is pushed carefully into a soap bubble of radius r to double its radius. If the surface tension of the soap solution is T, then work done in the process is:

(1) 24 $\pi r^2 T$ (2) 4 $\pi r^2 T$

(3) 8 $\pi r^2 T$ (4) 12 $\pi r^2 T$

Ans. (1)

Sol. Work done $= 8\pi T(r_2^2 - r_1^2)$

$= 8\pi T\,(4r^2 - r^2) = 24\,\pi r^2 T$

44. Given below are two statements: One is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.

Assertion (A): Gauss's law for magnetism states that the net magnetic flux through any closed surface is zero.

Reason (R): The magnetic monopoles do not exist. North and South poles occur in pairs, allowing vanishing net magnetic flux through the surface.

In the light of the above statement, choose the most appropriate answer from the options given below:

(1) (A) is false but (R) is true

(2) Both (A) and (R) are true and (R) is the correct explanation of (A)

(3) Both (A) and (R) are true and (R) is not the correct explanation of (A)

(4) (A) is true but (R) is false.

Ans. (2)

Sol. $\oint \vec{B}.\vec{ds} = 0$

$\because$ Magnetic monopoles do not exist.

45. A monochromatic light of frequency 500 THz is incident on the slits of a Young's double slit experiment. If the distance between the slits is 0.2 mm and the screen is placed at a distance 1 m from the slits, the width of 10 fringes will be:

[THz = 10^{12} Hz]

(1) 15 mm (2) 30 mm

(3) 3 mm (4) 1.5 mm

Ans. (2)

Sol. According to question

$f = 500 \times 10^{12}$ Hz

$d = 0.2 \times 10^{-3}$ m

D = 1 m

n = 10

$\beta = \frac{n\lambda D}{d}$ and $f = \frac{c}{\lambda} \Rightarrow \lambda = \frac{c}{f}$

So, $\beta = n \times \frac{c}{f} \cdot \frac{D}{d}$

$= 10 \times \frac{3 \times 10^7}{500 \times 10^{12}} \times \frac{1}{0.2 \times 10^{-4}}$ = 0.03 m = 30 mm

46. An a.c. source given by $V = V_m \sin \omega t$ is connected to a pure inductor L in a circuit and I_m is the peak value of the ac current. The instantaneous power supplied to the inductor is:

(1) $-\frac{V_m I_m}{2}\sin(2\omega t)$ (2) $V_m I_m \sin^2(\omega t)$

(3) $-V_m I_m \sin^2(\omega t)$ (4) $\frac{V_m I_m}{2}\sin(2\omega t)$

Ans. (1)

Sol. According to question

$V = V_m \sin \omega t$

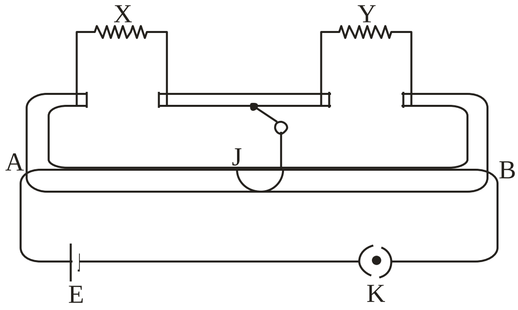
$I = I_m \sin(\omega t - \pi/2) = -I_m \cos \omega t$

$\because P_{inst.} = VI$

$\therefore P_{inst.} = -(V_m \sin \omega t)(I_m \cos \omega t) \times \frac{2}{2}$

$= \frac{-V_m I_m}{2}\sin(2\omega t)$

47. In a metre bridge experiment, the null point is at a distance of 30 cm from A. If a resistance of 16Ω is connected in parallel with resistance Y, the null point occurs at 50 cm from A. The value of the resistance Y is:



(1) $\frac{40}{3}\Omega$ (2) $\frac{64}{3}\Omega$

(3) $\frac{48}{3}\Omega$ (4) $\frac{112}{3}\Omega$

Ans. (2)

Sol. $\frac{\ell_1}{\ell_2} = \frac{30}{70} = \frac{X}{Y}$

$\Rightarrow X = \frac{3}{7}Y$ ..(1)

$\frac{50}{50} = \frac{X}{YR/R+Y} = \frac{1}{1}$

$\Rightarrow X = \frac{YR}{R+Y}$

$\Rightarrow \frac{3}{7}Y = \frac{YR}{Y+R}$

$\Rightarrow 3(Y + R) = 7R$

$\Rightarrow 3Y + 3R = 7R$

$\Rightarrow 3Y = 4R$

$\Rightarrow Y = \frac{4R}{3} = \frac{4 \times 16}{3} = \frac{64}{3}$

48. Two planets are in a circular orbit of radius R and 4R about a star. At a specific time, the two planets and the star are in a straight line. If the period of the closest planet in T, then the star and planets will again be in a straight line after a minimum time:

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

(3) 8 T (4) $(4)^2$ T

Ans. (3)*

Sol. According to question

$\because T^2 \propto R^3$

$\therefore \frac{T^2}{x^2} \propto \frac{R^3}{64R^3}$

$\Rightarrow x^2 = 64T^2$

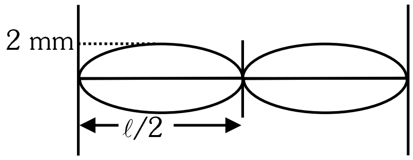
$\Rightarrow x = 8T$

49. A string of length l is fixed at both ends and is vibrating in second harmonic. The amplitude at antinode is 2 mm. The amplitude of a particle at a distance $\frac{l}{8}$ from the fixed end is:

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

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

Ans. (2)



Sol.

$\ell = \lambda$; 2A = amplitude at anti node = 2mm

Amplitude = 2A sinkx

$= 2\text{mm}\sin\frac{2\pi}{\lambda}\left(\frac{\ell}{8}\right)$

$= 2\text{mm}\sin\left(\frac{\pi}{\lambda}\frac{\lambda}{4}\right) = 2\text{mm}\sin\left(\frac{\pi}{4}\right)$

$= \frac{2\text{mm}}{\sqrt{2}} = \sqrt{2}\,\text{mm}$

50. The determination of the value of acceleration due to gravity (g) by simple pendulum method employs the formula,

$g = 4\pi^2\frac{L}{T^2}$

The expression for the relative error in the value of 'g' is:

(1) $\frac{\Delta g}{g} = 4\pi^2\left[\frac{\Delta L}{L} - 2\frac{\Delta T}{T}\right]$

(2) $\frac{\Delta g}{g} = 4\pi^2\left[\frac{\Delta L}{L} + 2\frac{\Delta T}{T}\right]$

(3) $\frac{\Delta g}{g} = \frac{\Delta L}{L} - 2\frac{\Delta T}{T}$

(4) $\frac{\Delta g}{g} = \frac{\Delta L}{L} + 2\frac{\Delta T}{T}$

Ans. (4)

Sol. $g = 4\pi^2\frac{L}{T^2}$

$\therefore \frac{\Delta g}{g} = \frac{\Delta L}{L} + \frac{2\Delta T}{T}$