PHYSICS
JEE-MAIN (July-Attempt) 25 July
(Shift-2) Paper

SECTION - A

1. Two vectors $\vec{X}$ and $\vec{Y}$ have equal magnitude. The magnitude of $(\vec{X}-\vec{Y})$ is n times the magnitude of $(\vec{X}+\vec{Y})$. The angle between $\vec{X}$ and $\vec{Y}$ is -

(1) $\cos^{-1}\left(\frac{n^2+1}{n^2-1}\right)$ (2) $\cos^{-1}\left(\frac{n^2-1}{-n^2-1}\right)$ (3) $\cos^{-1}\left(\frac{-n^2-1}{n^2-1}\right)$ (4) $\cos^{-1}\left(\frac{n^2+1}{n^2-1}\right)$

Sol. **2**

2. A heat engine has an efficiency of $\frac{1}{6}$. When the temeprature of sink is reduced by 62°C, its efficiency get doubled. The temeprature of the source is -

(1) 37°C (2) 99°C (3) 62°C (4) 124°C

Sol. **2**

3. Two spherical soap bubbles of radii r_1 and r_2 in vacuum combine under isothermal conditions. The resulting bubble has a radius equal to -

(1) $\frac{r_1r_2}{r_1+r_2}$ (2) $\sqrt{r_1^2+r_2^2}$ (3) $\sqrt{r_1r_2}$ (4) $\frac{r_1+r_2}{2}$

Sol. **2**

4. A balloon was moving upwards with a uniform velocity of 10 m/s. An object of finite mass is dropped from the balloon when it was at a height of 75m from the ground level. The height of the balloon from the ground when object strikes the ground was around. (Takes the value of gas 10 m/s^2)

(1) 125 m (2) 250 m (3) 300 m (4) 200 m

Sol. **1**

5. When radiation of wavelength λ is incident on a metallic surface, the stopping potential of ejected photoelectrons is 4.8 V. If the same surface is illuminated by radiation of double the previous wavelength, then the stopping potential becomes 1.6 V. The threshold wavelength of the metal is -

(1) 4λ (2) 2λ (3) 8λ (4) 6λ

Sol. **1**

6. A force $\vec{F}=(40\hat{i}+10\hat{j})$N acts on a body of mass 5kg. If the body starts from rest, its position vector $\vec{r}$ at time t = 10 s, will be -

(1) $(100\hat{i}+400\hat{j})$m (2) $(400\hat{i}+100\hat{j})$m (3) $(100\hat{i}+100\hat{j})$m (4) $(400\hat{i}+400\hat{j})$m

Sol. **2**

7. A prism of refractive index μ and angle of prism A is placed in the postion of minimum angle of deviation. If minimum angle of deviation is also A, then in terms of refractive index value of A is

(1) $\sin^{-1}\left(\frac{\mu}{2}\right)$ (2) $2\cos^{-1}\left(\frac{\mu}{2}\right)$ (3) $\sin^{-1}\left(\sqrt{\frac{\mu-1}{2}}\right)$ (4) $\cos^{-1}\left(\frac{\mu}{2}\right)$

Sol. **2**

8. A 10 Ω resistance is connected across 220 V – 50 Hz AC supply. The time taken by the current to change from its maximum value to the rms value is -

(1) 2.5 ms (2) 1.5 ms (3) 4.5 ms (4) 3.0 ms

Sol. **1**

9. The relation between time t and distance x for a moving body is given as $t = mx^2 + nx$, where m and n are constants. The retardation of the motion is –
(Where υ stands for velocity)

(1) $2n^2\upsilon^3$ (2) $2m\upsilon^3$ (3) $2n\upsilon^3$ (4) $2mn\upsilon^3$

Sol. **2**

10. The instantenous velocity of a particle moving in a straight line is given as $\upsilon = \alpha t + \beta t^2$, where α and β are constants. The distance travelled by the particle between 1 s and 2s is -

(1) $\frac{\alpha}{2} + \frac{\beta}{3}$ (2) $\frac{3}{2}\alpha + \frac{7}{3}\beta$ (3) $3\alpha + 7\beta$ (4) $\frac{3}{2}\alpha + \frac{7}{2}\beta$

Sol. **2**

11. The force is given in terms of time t and displacement x by the equation
F = A cosBx + C sin Dt

The dimensional formula of $\frac{AD}{B}$ is -

(1) $[M^2L^2T^{-3}]$ (2) $[ML^2T^{-3}]$ (3) $[M^1L^1T^{-2}]$ (4) $[M^0LT^{-1}]$

Sol. **1**

12. An electron moving with speed υ and a photon moving with speed c, have same D-Broglie wavelength. The ratio of kinetic energy of electron to that of photon is -

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

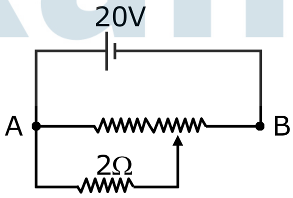
Sol. **3**

13. Two ions having same mass have charges in the ratio 1 : 2. They are projected normally in a uniform magnetic field with their speeds in the ratio 2 : 3. The ratio of the radii of their circular trajectories is -

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

Sol. **1**

14. the given potentiometer has its wire of resistance 10Ω. When the sliding contact is in the middle of the potentiometre wire, the potential drop across 2Ω resistor is -

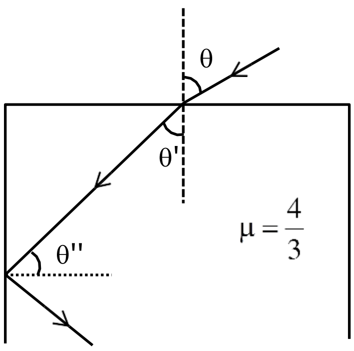


(1) $\frac{40}{11}$V (2) 10 V (3) $\frac{40}{9}$V (4) 5V

Sol. **3**

15. A ray of light entering from air into a denser medium of refractive index $\frac{4}{3}$, as shown in figure.

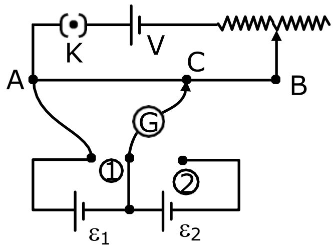
The light ray suffers total internal reflection at the adjacent surface as shown. The maximum, value of angle θ should be equal to -



(1) $\sin^{-1}\frac{\sqrt{5}}{3}$ (2) $\sin^{-1}\frac{\sqrt{7}}{3}$ (3) $\sin^{-1}\frac{\sqrt{7}}{4}$ (4) $\sin^{-1}\frac{\sqrt{5}}{4}$

Sol. **2**

16. In the given potentiometer circuit arrangement, the balancing length AC is measured to be 250 cm. When the galvanometer connection is shifted from point (1) to point (2) in the given diagram, the balancing length becomes 400 cm. The ratio of the emf of two cells, $\frac{\varepsilon_1}{\varepsilon_2}$ is -



(1) $\frac{4}{3}$ (2) $\frac{3}{2}$ (3) $\frac{5}{3}$ (4) $\frac{8}{5}$

Sol. 3

17. Two ideal electric dipoles A and B having their dipole moment p_1 and p_2 respectively are placed on a plane with their centres at O as shown in the figure. At point C on the axis of dipole A, the resultant electric field is making an angle of 37° with the axis. The ratio of the dipole moment of A and B, $\frac{P_1}{P_2}$ is (take sin 37° = $\frac{3}{5}$)

(1) $\frac{3}{2}$ (2) $\frac{2}{3}$ (3) $\frac{3}{8}$ (4) $\frac{4}{3}$

Sol. 2

18. In a simple harmonic oscillation, what fraction of total mechanical energy is in the form of kinetic energy, when the particle is midway between mean and extreme position.

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

Sol. 3

19. If q_f is the free charge on the capacitor plates and q_b is the bound charge on the dielectric slab of dielectric constant k placed between the capacitor plates, then bound charge q_b can be expressed as -

(1) $q_b = q_f\left(1-\frac{1}{k}\right)$ (2) $q_b = q_f\left(1-\frac{1}{\sqrt{k}}\right)$ (3) $q_b = q_f\left(1+\frac{1}{\sqrt{k}}\right)$ (4) $q_b = q_f\left(1+\frac{1}{k}\right)$

Sol. 1

20. Consider a planet in some solar system which has a mass double the mass of earth and density equal to the average density of earth. If the weight of an object on earth is W, then weight of the same object on that planet will be -

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

Sol. 4

Section - B

1. A message signal of frequency 20 kHz and peak voltage of 20 volt is used to modulate a carrier wave of frequency 1 MHz and peak voltage of 20 volt. The modulation index will be _______.

Sol. **1**

2. The nuclear activity of a radioactive element becomes $\left(\frac{1}{8}\right)^{th}$ of its initial value in 30 years. The half-life of radioactive element is _______ years.

Sol. **10**

3. From the given data, the amount of energy required to break the nucleus of aluminium $^{27}_{13}Al$ is ___________ x × 10^{-3} J.

Mass of neutron = 1.00866 u

Mass of proton = 1.00726 u

Mass of aluminium nucleus = 27.18846 u

(Assume 1u corresponds to x J of energy)

(Round off to the nearest integer)

Sol. **27**

4. A solid disc of radius 20 cm and mass 10 kg is rotating with an angular velocity of 600 rpm, about an axis normal to its circular plane and passing through its centre of mass. The retarding torque required to bring the disc at rest in 10 s _________ $\pi \times 10^{-1}$ Nm.

Sol. **4**

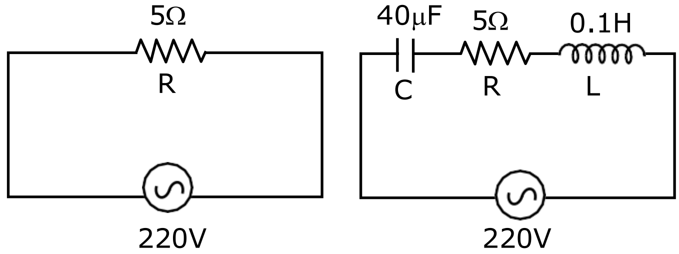
5. A 16Ω wire is bend to form a square loop. A 9V supply having internal resistance of 1Ω is connected across one of its sides. The potential drop across the diagonals of the square loop is ________ × 10^{-1} V.

Sol. **45**

6. A system consists of two types of gas molecules A and B having same number density 2 × $10^{25}/m^3$. The diameter of A and B are 10 Å and 5 Å respectively. They suffer collision at room temperature. The ratio of average distance covererd by the molecule A to that of B between two successive collision is ________ × 10^{-2}.

Sol. **25**

7. Two circuit are shown in the figure (a) and (b). At a frequency of ________ rad/s the average power dissipated in one cycle will be same in both the circuits.



figure(a) figure(b)

Sol. **500**

8. A force of F = $(5y+20)\hat{j}$N acts on a particle. The work done by this force when the particle is moved from y = 0 m to y = 10 m is _________ J.

Sol. **450**

9. In a semiconductor, the number density of intrinsic charge carriers at 27°C is $1.5 \times 10^{16}/m^3$. If the semiconductor is doped with impurity atom, the hole density increase to $4.5 \times 10^{22}/m^3$. The electron density in the doped semiconductor is _________ $\times 10^9/m^3$

Sol. **5**

10. A light beam of wavelength 500 nm is incident on a metal having work function of 1.25 eV, placed in a magnetic field of intensity B. The electrons emitted perpendicular to the magnetic field B, with maximum kinetic energy are bent into circular arc of radius 30 cm. The value of B is ________ $\times 10^{-7}$ T.

Given $hc = 20 \times 10^{-26}$ J-m, mass of electron $= 9 \times 10^{-31}$ kg

Sol. **125**