JEE-MAIN EXAM JANUARY, 2025

Date: - 28-01-2025 (SHIFT-2)

PHYSICS

SECTION-A

1. Match List - I with List - II.

List – I	**List-II**
(A) Angular Impulse	(I) $\left[M^0 L^2 T^{-2}\right]$
(B) Latent Heat	(II) $\left[ML^2 T^{-3} A^{-1}\right]$
(C) Electrical resistivity	(III) $\left[ML^2 T^{-1}\right]$
(D) Electromotive force	(IV) $\left[ML^3 T^{-3} A^{-2}\right]$

Choose the correct answer from the options given below :

(1) (A)-(III), (B)-(I), (C)-(IV), (D)-(II) (2) (A)-(I), (B)-(III), (C)-(IV), (D)-(II)

(3) (A)-(III), (B)-(I), (C)-(II), (D)-(IV) (4) (A)-(II), (B)-(I), (C)-(IV), (D)-(III)

2. The magnetic field of an E.M. wave is given by $\vec{B}=\left(\frac{\sqrt{3}}{2}\hat{i}+\frac{1}{2}\hat{j}\right)30\sin\left[\omega\left(t-\frac{z}{c}\right)\right]$ (S.I. Units).

The corresponding electric field in S.I. units is :

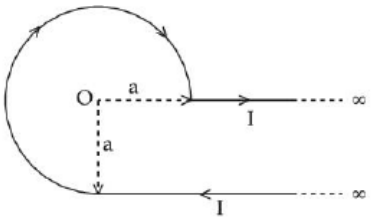
(1) $\vec{E}=\left(\frac{1}{2}\hat{i}+\frac{\sqrt{3}}{2}\hat{j}\right)30c\sin\left[\omega\left(t+\frac{z}{c}\right)\right]$ (2) $\vec{E}=\left(\frac{1}{2}\hat{i}-\frac{\sqrt{3}}{2}\hat{j}\right)30c\sin\left[\omega\left(t-\frac{z}{c}\right)\right]$

(3) $\vec{E}=\left(\frac{\sqrt{3}}{2}\hat{i}-\frac{1}{2}\hat{j}\right)30c\sin\left[\omega\left(t+\frac{z}{c}\right)\right]$ (4) $\vec{E}=\left(\frac{3}{4}\hat{i}+\frac{1}{4}\hat{j}\right)30c\cos\left[\omega\left(t-\frac{z}{c}\right)\right]$

3. Earth has mass 8 times and radius 2 times that of a planet. If the escape velocity from the earth is $11.2\,km/s$, the escape velocity in km/s from the planet will be :

(1) 8.4 (2) 5.6 (3) 11.2 (4) 2.8

4.



An infinite wire has a circular bend of radius a, and carrying a current I as shown in figure. The magnitude of magnetic field at the origin O of the arc is given by :

(1) $\frac{\mu_0}{4\pi}\frac{I}{a}\left[\frac{3\pi}{2}+2\right]$ (2) $\frac{\mu_0}{4\pi}\frac{I}{a}\left[\frac{3\pi}{2}+1\right]$ (3) $\frac{\mu_0}{4\pi}\frac{I}{a}\left[\frac{\pi}{2}+1\right]$ (4) $\frac{\mu_0}{2\pi}\frac{I}{a}\left[\frac{\pi}{2}+2\right]$

5. A uniform rod of mass 250 g having length 100 cm is balanced on a sharp edge at 40 cm mark. A mass of 400 g is suspended at 10 cm mark. To maintain the balance of the rod, the mass to be suspended at 90 cm mark, is

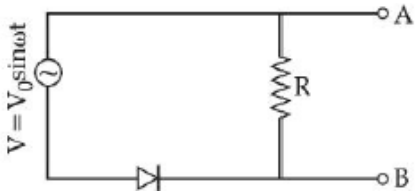
(1) 300 g (2) 290 g (3) 190 g (4) 200 g

6. A 400 g solid cube having an edge of length 10 cm floats in water. How much volume of the cube is outside the water ?

(Given : density of water $=1000\,\mathrm{kg\,m^{-3}}$)

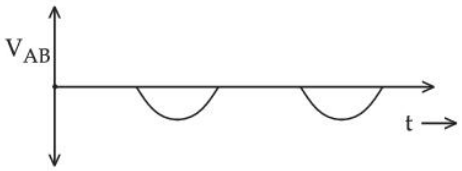
(1) $400\,\mathrm{cm^3}$ (2) $1400\,\mathrm{cm^3}$ (3) $600\,\mathrm{cm^3}$ (4) $4000\,\mathrm{cm^3}$

7.

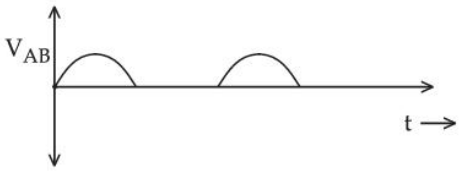


In the circuit shown here, assuming threshold voltage of diode is negligibly small, then voltage V_{AB} is correctly represented by :

(1)

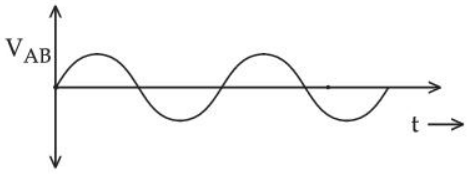


(2)



(3) V_{AB} would be zero at all times

(4)



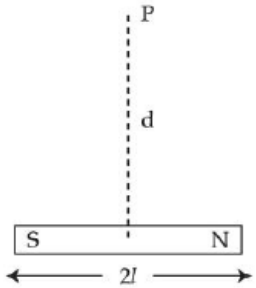
8. The frequency of revolution of the electron in Bohr's orbit varies with n, the principal quantum number as

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

9. Which of the following phenomena can not be explained by wave theory of light ?

(1) Diffraction of light (2) Compton effect (3) Refraction of light (4) Reflection of light

10.



A bar magnet has total length $2l = 20$ units and the field point P is at a distance $d = 10$ units from the centre of the magnet. If the relative uncertainty of length measurement is 1%, then uncertainty of the magnetic field at point P is :

(1) 4% (2) 5% (3) 10% (4) 3%

11. A body of mass 4 kg is placed on a plane at a point P having coordinate $(3,4)\text{m}$. Under the action of force $\vec{F}=(2\hat{i}+3\hat{j})\text{N}$, it moves to a new point Q having coordinates $(6,10)\text{m}$ in 4 sec. The average power and instantons power at the end of 4 sec are in the ratio of :

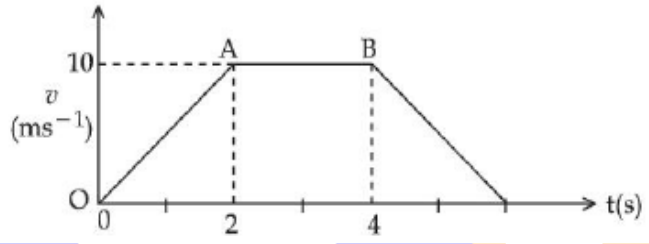
(1) 4: 3 (2) 13: 6 (3) 1: 2 (4) 6: 13

12. The ratio of vapour densities of two gases at the same temperature is $\frac{4}{25}$, then the ratio of r.m.s. velocities will be:

(1) $\frac{4}{25}$ (2) $\frac{2}{5}$

(3) $\frac{25}{4}$ (4) $\frac{5}{2}$

13. The velocity-time graph of an object moving along a straight line is shown in figure. What is the distance covered by the object between $t=0$ to $t=4\text{s}$?



(1) 11 m (2) 30 m (3) 10 m (4) 13

14. In a long glass tube, mixture of two liquids A and B with refractive indices 1.3 and 1.4 respectively, forms a convex refractive meniscus towards A. If an object placed at 13 cm from the vertex of the meniscus in A forms an image with a magnification of $'-2'$ then the radius of curvature of meniscus is:

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

15. A parallel plate capacitor of capacitance $1\mu\text{F}$ is charged to a potential difference of 20 V. The distance between plates is $1\mu\text{m}$. The energy density between plates of capacitor is.

(1) $2\times10^{-4}\,\text{J/m}^3$ (2) $2\times10^{2}\,\text{J/m}^3$

(3) $1.8\times10^{3}\,\text{J/m}^3$ (4) $1.8\times10^{5}\,\text{J/m}^3$

16. A concave mirror produces an image of an object such that the distance between the object and image is 20 cm . If the magnification of the image is ' -3 ', then the magnitude of the radius of curvature of the mirror is :

(1) 7.5 cm (2) 30 cm (3) 3.75 cm (4) 15 cm

17. The kinetic energy of translation of the molecules in 50 g of CO_2 gas at 17°C is

(1) 3582.7 J (2) 4102.8 J (3) 3986.3 J (4) 4205.5 J

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

Assertion (A) : Knowing initial position x_0 and initial momentum p_0 is enough to determine the position and momentum at any time t for a simple harmonic motion with a given angular frequency ω.

Reason (R): The amplitude and phase can be expressed in terms of x_0 and p_0

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

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

(2) Both (A) and (R) are true but (R) is NOT the correct explanation of (A)

(3) $(\mathbf{A})$ is true but (R) is false

(4) Both $(\mathbf{A})$ and $(\mathbf{R})$ are true and $(\mathbf{R})$ is the correct explanation of $(\mathbf{A})$

19. A uniform magnetic field of 0.4 T acts perpendicular to a circular copper disc 20 cm in radius. The disc is having a uniform angular velocity of $10\ \pi\ \text{rads}^{-1}$ about an axis through its centre and perpendicular to the disc. What is the potential difference developed between the axis of the disc and the rim ? $(\pi = 3.14)$

(1) 0.1256 V (2) 0.2512 V (3) 0.0628 V (4) 0.5024 V

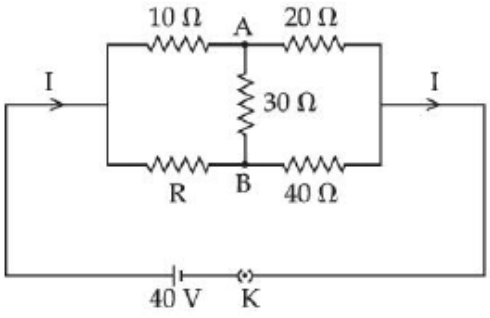
20. A balloon and its content having mass M is moving up with an acceleration 'a'. The mass that must be released from the content so that the balloon starts moving up with an acceleration '3a' will be

(Take ' g ' as acceleration due to gravity)

(1) $\frac{3Ma}{2a-g}$ (2) $\frac{2Ma}{3a+g}$ (3) $\frac{3Ma}{2a+g}$ (4) $\frac{2Ma}{3a-g}$

SECTION-B

21. The value of current I in the electrical circuit as given below, when potential at A is equal to the potential at B, will be _____A.

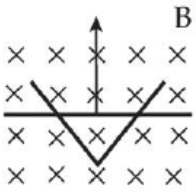


22. An electric dipole of dipole moment $6\times10^{-6}\text{Cm}$ is placed in uniform electric field of magnitude $10^6\ \text{V/m}$. Initially, the dipole moment is parallel to electric field. The work that needs to be done on the dipole to make its dipole moment opposite to the field, will be _____ J.

23. The volume contraction of a solid copper cube of edge length 10 cm, when subjected to a hydraulic pressure of $7\times10^{6}\,\text{Pa}$, would be _____ mm^3.

(Given bulk modulus of copper $=1.4\times10^{11}\,\text{Nm}^{-2}$)

24.



A conducting bar moves on two conducting rails as shown in the figure. A constant magnetic field B exists into the page. The bar starts to move from the vertex at time $t=0$ with a constant velocity. If the induced EMF is $E\propto t^{n}$, then value of n is _____ .

25. A thin transparent film with refractive index 1.4, is held on circular ring of radius 1.8 cm. The fluid in the film evaporates such that transmission through the film at wavelength 560 nm goes to a minimum every 12 seconds. Assuming that the film is flat on its two sides, the rate of evaporation is _____ $\pi\times10^{-13}\,\text{m}^3/\text{s}$.

NTA ANSWERS

1.	**(1)**	**2.**	**(2)**	**3.**	**(2)**	**4.**	**(2)**	**5.**	**(3)**	**6.**	**(3)**	**7.**	**(1)**
8.	**(3)**	**9.**	**(2)**	**10.**	**(4)**	**11.**	**(4)**	**12.**	**(4)**	**13.**	**(2)**	**14.**	**(4)**
15.	**(3)**	**16.**	**(4)**	**17.**	**(2)**	**18.**	**(4)**	**19.**	**(2)**	**20.**	**(2)**	**21.**	**2**
22.	**12**	**23.**	**50**	**24.**	**1**	**25.**	**(54)**						