JEE-MAIN EXAM APRIL, 2025

Date: - 07-04-2025 (SHIFT-2)

PHYSICS

SECTION-A

1. A helicopter flying horizontally with a speed of $360\,\mathrm{km/h}$ at an altitude of 2 km, drops an object at an instant. The object hits the ground at a point O, 20s after it is dropped. Displacement of 'O' from the position of helicopter where the object was released is : (use acceleration due to gravity $g = 10\,\mathrm{m/s^2}$ and neglect air resistance)

(1) $2\sqrt{5}\,\mathrm{km}$ (2) 7.2 km (3) 4 km (4) $2\sqrt{2}\,\mathrm{km}$

2. Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A) : Magnetic monopoles do not exist.

Reason (R): Magnetic field lines are continuous and form closed loops.

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

(1) (A) is correct but (R) is not correct

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

(3) (A) is not correct but (R) is correct

(4) Both (A) and (R) are correct but (R) is not the correct explanation of (A)

3. A photo-emissive substance is illuminated with a radiation of wavelength λ_i so that it releases electrons with de-Broglie wavelength λ_e. The longest wavelength of radiation that can emit photoelectron is λ_o. Expression for de-Broglie wavelength is given by : (m : mass of the electron, h : Planck's constant and c : speed of light)

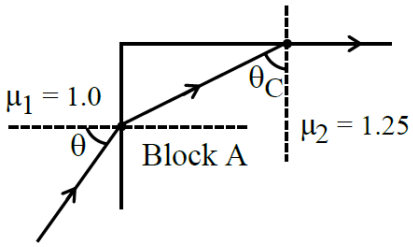
(1) $\lambda_e = \dfrac{h}{\sqrt{2mc\left(\dfrac{1}{\lambda_i}-\dfrac{1}{\lambda_o}\right)}}$ (2) $\lambda_e = \sqrt{\dfrac{h\lambda_i}{2mc}}$

(3) $\lambda_e = \sqrt{\dfrac{h}{2mc\left(\dfrac{1}{\lambda_i}-\dfrac{1}{\lambda_o}\right)}}$ (4) $\lambda_e = \sqrt{\dfrac{h\lambda_o}{2mc}}$

4. The unit of $\sqrt{\frac{2I}{\epsilon_0 C}}$ is : ($I =$ intensity of an electromagnetic wave, c : speed of light)

(1) Nm (2) Vm (3) NC (4) NC^{-1}

5. A transparent block A having refractive index $\mu = 1.25$ is surrounded by another medium of refractive index $\mu = 1.0$ as shown in figure. A light ray is incident on the flat face of the block with incident angle θ as shown in figure. What is the maximum value of θ for which light suffers total internal reflection at the top surface of the block?



(1) $\tan^{-1}(4/3)$ (2) $\cos^{-1}(3/4)$ (3) $\sin^{-1}(3/4)$ (4) $\tan^{-1}(3/4)$

6. Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A) : The density of the copper $\left(^{64}_{29}Cu\right)$ nucleus is greater than that of the carbon $\left(^{12}_{6}C\right)$ nucleus.

Reason (R): The nucleus of mass number A has a radius proportional to $A^{1/3}$.

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

(1) Both (A) and (R) are correct but (R) is not the correct explanation of (A)

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

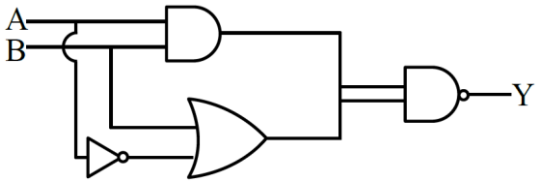
(3) (A) is correct but (R) is not correct

(4) (A) is not correct but (R) is correct

7. Which one of the following forces cannot be expressed in terms of potential energy?

(1) Restoring force (2) Frictional force (3) Coulomb's force (4) Gravitational force

8. Consider the following logic circuit.



The output is Y = 0 when :

(1) $A = 0$ and $B = 1$ (2) $A = 0$ and $B = 0$

(3) $A = 1$ and $B = 0$ (4) $A = 1$ and $B = 1$

9. Match List - I with List - II.

List – I	**List - II**
(A) Mass density	(I) $\left[ML^2 T^{-3}\right]$
(B) Impulse	(II) $\left[MLT^{-1}\right]$
(C) Power	(III) $\left[ML^2 T^0\right]$
(D) Moment of inertia	(IV) $\left[ML^{-3} T^0\right]$

Choose the correct answer from the options given below :

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

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

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

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

10. Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A) : Refractive index of glass is higher than that of air.

Reason (R): Optical density of a medium is directly proportionate to its mass density which results in a proportionate refractive index.

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

(1) (A) is correct but (R) is not correct

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

(3) (A) is not correct but (R) is correct

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

11. Match List - I with List - II.

List – I	**List - II**
(A) Isothermal	(I) ΔW(work done) = 0
(B) Adiabatic	(II) ΔQ(supplied heat) = 0
(C) Isobaric	(III) ΔU (change in internal energy) $\neq 0$
(D) Isochoric	(IV) $\Delta U = 0$

Choose the correct answer from the options given below :

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

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

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

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

12. Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A) : The outer body of an air craft is made of metal which protects persons sitting inside from lightning-strikes.

Reason (R): The electric field inside the cavity enclosed by a conductor is zero.

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

(1) Both (A) and (R) are correct but (R) is not the correct explanation of (A)

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

(3) (A) is correct but (R) is not correct

(4) (A) is not correct but (R) is correct

13. An object with mass 500 g moves along x-axis with speed $v = 4\sqrt{x}\,\mathrm{m/s}$. The force acting on the object is :

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

14. The equation of a wave travelling on a string is $y = \sin[20\pi x + 10\pi t]$, where x and t are distance and time in SI units. The minimum distance between two points having the same oscillating speed is :

(1) 5.0 cm (2) 20 cm (3) 10 cm (4) 2.5 cm

15. The dimension of $\sqrt{\frac{\mu_0}{\epsilon_0}}$ is equal to that of : (μ_0 = Vacuum permeability and ε_0 = Vacuum permittivity)

(1) Capacitance (2) Resistance (3) Inductance (4) Voltage

16. The helium and argon are put in the flask at the same room temperature (300K). The ratio of average kinetic energies (per molecule) of helium and argon is:

(Give : Molar mass of helium $= 4\,\mathrm{g/mol}$, Molar mass of argon $= 40\,\mathrm{g/mol}$)

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

17. A mirror is used to produce an image with magnification of $\frac{1}{4}$. If the distance between object and its image is 40 cm, then the focal length of the mirror is

(1) 10 cm (2) 15 cm (3) 12.7 cm (4) 10.7 cm

18. A capillary tube of radius 0.1 mm is partly dipped in water (surface tension $70\,\mathrm{dyn/cm}$ and glass water contact angle $\approx 0^\circ$) with 30º inclined with the vertical. The length of water risen in the capillary is _____ cm . (Take $g = 9.8\,\mathrm{m/s^2}$)

(1) $\frac{82}{5}$ (2) $\frac{57}{2}$ (3) $\frac{68}{5}$ (4) $\frac{71}{5}$

19. A dipole with two electric charges of 2μC magnitude each, with separation distance 0.5μm, is placed between the plates of a capacitor such that its axis is parallel to an electric field established between the plates when a potential difference of 5 V is applied. Separation between the plates is 0.5 mm. If the dipole is rotated by 30º from the axis, it tends to realign in the direction due to a torque. The value of torque is :

(1) 2.5×10^{-9}Nm (2) 5×10^{-9}Nm (3) 2.5×10^{-12}Nm (4) 5×10^{-3}Nm

20. Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A) : The radius vector from the Sun to a planet sweeps out equal areas in equal intervals of time and thus areal velocity of planet is constant.

Reason (R): For a central force field the angular momentum is a constant.

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

(1) (A) is not correct but (R) is correct

(2) (A) is correct but (R) is not correct

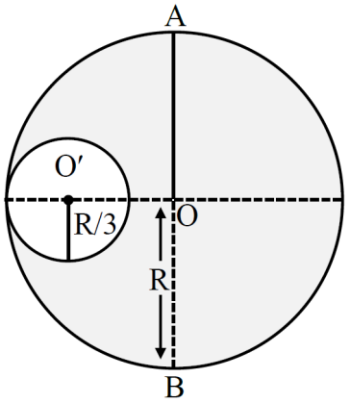
(3) Both (A) and (R) are correct and (R) is the correct explanation of (A)

(4) Both (A) and (R) are correct but (R) is not the correct explanation of (A)

SECTION-B

21. A parallel plate capacitor has charge 5 × 10^{-6}C. A dielectric slab is inserted between the plates and almost fills the space between the plates. If the induced charge on one face of the slab is 4 × 10^{-6}C then the dielectric constant of the slab is ____ .

22. M and R be the mass and radius of a disc. A small disc of radius R/3 is removed from the bigger disc as shown in figure. The moment of inertia of remaining part of bigger disc about an axis AB passing through the centre O and perpendicular to the plane of disc is $\frac{4}{x}MR^2$. The value of x is _____.



23. The electric field in a region is given by $\vec{E} = (2\hat{i} + 4\hat{j} + 6\hat{k}) \times 10^3 \, N/C$. The flux of the field through a rectangular surface parallel to x-z plane is $6.0 Nm^2C^{-1}$. The area of the surface is _____ cm^2.

24. An inductor of reactance 100Ω, a capacitor of reactance 50Ω, and a resistor of resistance 50Ω are connected in series with an AC source of 10V, 50Hz. Average power dissipated by the circuit is _____

25. Two cylindrical rods A and B made of different materials, are joined in a straight line. The ratios of lengths, radii and thermal conductivities of these rods are: $\frac{L_A}{L_B} = \frac{1}{2}, \frac{r_A}{r_B} = 2$ and $\frac{K_A}{K_B} = \frac{1}{2}$. The free ends of rods A and B are maintained at 400 K, 200 K, respectively. The temperature of rods interface is _____K, when equilibrium is established.

NTA ANSWER

1.	**(4)**	**2.**	**(2)**	**3.**	**(3)**	**4.**	**(4)**	**5.**	**(3)**	**6.**	**(4)**	**7.**	**(2)**
8.	**(4)**	**9.**	**(4)**	**10.**	**(1)**	**11.**	**(2)**	**12.**	**(2)**	**13.**	**(2)**	**14.**	**(1)**
15.	**(2)**	**16.**	**(2)**	**17.**	**(4)**	**18.**	**(1)**	**19.**	**(2)**	**20.**	**(3)**	**21.**	**(5)**
22.	**(9)**	**23.**	**(15)**	**24.**	**(1)**	**25.**	**(360)**						