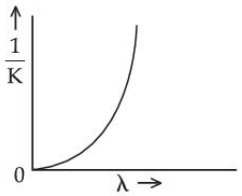
# JEE-MAIN EXAM JANUARY, 2025

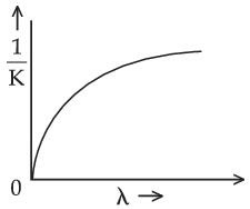
**Date: - 29-01-2025 (SHIFT-1)**

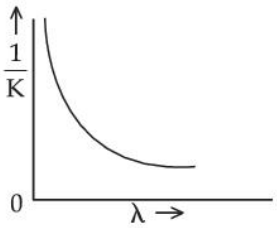
## PHYSICS

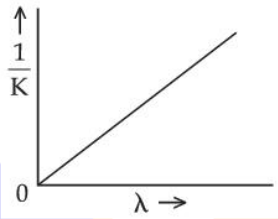
### SECTION-A

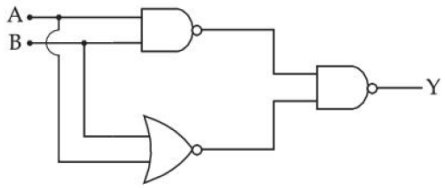
**1.** If $\lambda$ and $K$ are de Broglie wavelength and kinetic energy, respectively, of a particle with constant mass. The correct graphical representation for the particle will be

(1) 


(2) 


(3) 


(4) 


**2.** 


For the circuit shown above, equivalent GATE is :

(1) AND gate (2) NOT gate (3) NAND gate (4) OR gate

**3.** A body of mass '$m$' connected to a massless and unstretchable string goes in vertical circle of radius '$R$'under gravity $g$. The other end of the string is fixed at the center of circle. If velocity at top of circular path is $n\sqrt{gR}$, where, $n \geqslant 1$, then ratio of kinetic energy of the body at bottom to that at top of the circle is

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

**4.** Two projectiles are fired with same initial speed from same point on ground at angles of $\left(45^\circ-\alpha\right)$ and $\left(45^\circ+\alpha\right)$, respectively, with the horizontal direction. The ratio of their maximum heights attained is :

(1) $\frac{1-\sin 2\alpha}{1+\sin 2\alpha}$ (2) $\frac{1+\sin\alpha}{1-\sin\alpha}$ (3) $\frac{1-\tan\alpha}{1+\tan\alpha}$ (4) $\frac{1+\sin 2\alpha}{1-\sin 2\alpha}$

**5.** A coil of area $A$ and $N$ turns is rotating with angular velocity $\omega$ in a uniform magnetic field $\vec{B}$ about an axis perpendicular to $\vec{B}$. Magnetic flux $\varphi$ and induced emf $\varepsilon$ across it, at an instant when $\vec{B}$ is parallel to the plane of coil, are :

(1) $\varphi = \mathrm{AB}, \varepsilon = \mathrm{NAB}\omega$ (2) $\varphi = 0, \varepsilon = \mathrm{NAB}\omega$

(3) $\varphi = 0, \varepsilon = 0$ (4) $\varphi = \mathrm{AB}, \varepsilon = 0$

**6.** Consider a long straight wire of a circular cross-section (radius a) carrying a steady current I. The current is uniformly distributed across this cross-section. The distances from the centre of the wire's cross-section at which the magnetic field [inside the wire, outside the wire] is half of the maximum possible magnetic field, any where due to the wire, will be

(1) $[a/2, 2a]$ (2) $[a/4, 3a/2]$ (3) $[a/4, 2a]$ (4) $[a/2, 3a]$

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

**Assertion (A):** Choke coil is simply a coil having a large inductance but a small resistance. Choke coils are used with fluorescent mercury-tube fittings. If household electric power is directly connected to a mercury tube, the tube will be damaged.

**Reason (R):** By using the choke coil, the voltage across the tube is reduced by a factor $\left(R/\sqrt{R^2+\omega^2L^2}\right)$, where $\omega$ is frequency of the supply across resistor $R$ and inductor L. If the choke coil were not used, the voltage across the resistor would be the same as the applied voltage.

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

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

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

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

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

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

**Assertion (A) :** Emission of electrons in photoelectric effect can be suppressed by applying a sufficiently negative electron potential to the photo emissive substance.

**Reason (R) :** A negative electric potential, which stops the emission of electrons from the surface of a photo emissive substance, varies linearly with frequency of incident radiation.

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

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

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

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

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

**9.** The fractional compression $\left(\frac{\Delta V}{V}\right)$ of water at the depth of 2.5 km below the sea level is _____ %.

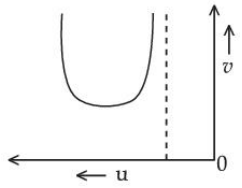
Given, the Bulk modulus of water $=2\times10^{9}\,\mathrm{Nm^{-2}}$, density of water $=10^{3}\ \mathrm{kgmm^{-3}}$, acceleration due to gravity $=\mathrm{g}=10\,\mathrm{ms^{-2}}$.

(1) 1.75 (2) 1.25

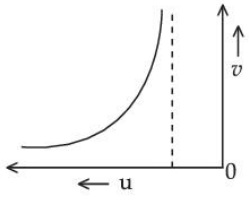
(3) 1.0 (4) 1.5

**10.** Let $u$ and $v$ be the distances of the object and the image from a lens of focal length $f$. The correct graphical representation of $u$ and $v$ for a convex lens when $|u|>f$, is

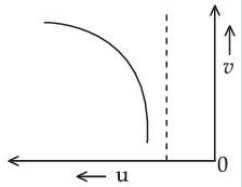
(1)



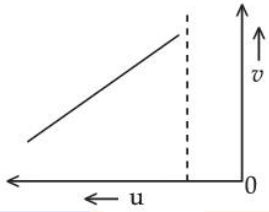

(2)




(3)




(4)




**11.** The work done in an adiabatic change in an ideal gas depends upon only :

(1) change in its specific heat

(2) change in its pressure

(3) change in its temperature

(4) change in its volume

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

**Assertion (A) :** Time period of a simple pendulum is longer at the top of a mountain than that at the base of the mountain.

**Reason (R):** Time period of a simple pendulum decreases with increasing value of acceleration due to gravity and vice-versa.

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

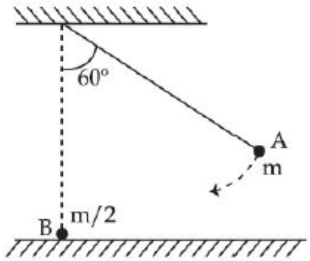
(1) Both (A) and (R) are true but (R) is not the correct explanation of (A)

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

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

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

**13.** As shown below, bob A of a pendulum having massless string of length ' $R$ ' is released from $60^{\circ}$ to the vertical. It hits another bob B of half the mass that is at rest on a friction less table in the center. Assuming elastic collision, the magnitude of the velocity of bob A after the collision will be (take g as acceleration due to gravity.)




(1) $\sqrt{\mathrm{Rg}}$ (2) $\frac{2}{3}\sqrt{\mathrm{Rg}}$ (3) $\frac{4}{3}\sqrt{\mathrm{Rg}}$ (4) $\frac{1}{3}\sqrt{\mathrm{Rg}}$

**14.** The expression given below shows the variation of velocity $(v)$ with time $(\mathrm{t})$, $v = At^2 + \frac{Bt}{C+t}$. The dimension of ABC is :

(1) $\left[\mathrm{M}^0\,\mathrm{L}^1\,\mathrm{T}^{-2}\right]$ (2) $\left[\mathrm{M}^0\,\mathrm{L}^1\,\mathrm{T}^{-3}\right]$ (3) $\left[\mathrm{M}^0\,\mathrm{L}^2\,\mathrm{T}^{-3}\right]$ (4) $\left[\mathrm{M}^0\,\mathrm{L}^2\,\mathrm{T}^{-2}\right]$

**15.** An electric dipole of mass $m$, charge $q$, and length $l$ is placed in a uniform electric field $\vec{\mathrm{E}} = \mathrm{E}_0\hat{i}$. When the dipole is rotated slightly from its equilibrium position and released, the time period of its oscillations will be :

(1) $\frac{1}{2\pi}\sqrt{\frac{\mathrm{m}l}{2\mathrm{qE}_0}}$ (2) $2\pi\sqrt{\frac{\mathrm{ml}}{2qE_0}}$ (3) $2\pi\sqrt{\frac{\mathrm{m}l}{\mathrm{qE}_0}}$ (4) $\frac{1}{2\pi}\sqrt{\frac{2\mathrm{m}l}{\mathrm{qE}_0}}$

**16.** At the interface between two materials having refractive indices $n_1$ and $n_2$, the critical angle for reflection of an em wave is $\theta_{1c}$. The $\mathbf{n}_2$ material is replaced by another material having refractive index $n_3$ such that the critical angle at the interface between $n_1$ and $n_3$ materials is $\theta_{2C}$. If $n_3 > n_2 > n_1; \frac{n_2}{n_3} = \frac{2}{5}$ and $\sin\theta_{2C} - \sin\theta_{1C} = \frac{1}{2}$, then $\theta_{1C}$ is

(1) $\sin^{-1}\left(\frac{1}{6n_1}\right)$ (2) $\sin^{-1}\left(\frac{1}{3n_1}\right)$ (3) $\sin^{-1}\left(\frac{5}{6n_1}\right)$ (4) $\sin^{-1}\left(\frac{2}{3n_1}\right)$

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

**Assertion (A) :** Electromagnetic waves carry energy but not momentum.

**Reason (R) :** Mass of a photon is zero.

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

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

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

**18.** Consider $I_1$ and $I_2$ are the currents flowing simultaneously in two nearby coils 1 & 2, respectively. If $L_1 =$ self inductance of coil $1, M_{12} =$ mutual inductance of coil 1 with respect to coil 2, then the value of induced emf in coil 1 will be

(1) $\varepsilon_1 = -L_1 \frac{dI_2}{dt} - M_{12} \frac{dI_1}{dt}$

(2) $\varepsilon_1 = -L_1 \frac{dI_1}{dt} + M_{12} \frac{dI_2}{dt}$

(3) $\varepsilon_1 = -L_1 \frac{dI_1}{dt} - M_{12} \frac{dI_1}{dt}$

(4) $\varepsilon_1 = -L_1 \frac{dI_1}{dt} - M_{12} \frac{dI_2}{dt}$

**19.** Match List - I with List - II.

**List - I**

(A) Electric field inside (distance $r > 0$ from center) of a uniformly charged spherical shell with surface charge density $\sigma$, and radius R .

(B) Electric field at distance $r > 0$ from a uniformly charged infinite plane sheet with surface charge density $\sigma$.

(C) Electric field outside (distance $r > 0$ from center) of a uniformly charged spherical shell with surface charge density $\sigma$, and radius R .

(D) Electric field between 2 oppositely charged infinite plane parallel sheets with uniform surface charge density $\sigma$.

**List - II**

(I) $\sigma / \epsilon_0$

(II) $\sigma / 2\epsilon_0$

(III) 0

(IV) $\frac{\sigma}{\epsilon_0 r^2}$

Choose the correct answer from the options given below :

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

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

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

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

**20.** The pair of physical quantities not having same dimensions is :

(1) Surface tension and impulse

(2) Pressure and Young's modulus

(3) Angular momentum and Planck's constant

(4) Torque and energy

## SECTION-B

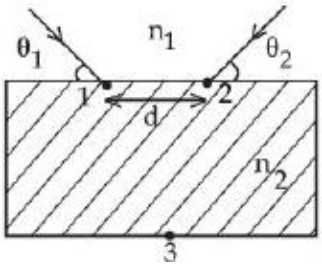
**21.** The coordinates of a particle with respect to origin in a given reference frame is $(1,1,1)$ meters. If a force of $\vec{F}=\hat{i}-\hat{j}+\hat{k}$ acts on the particle, then the magnitude of torque (with respect to origin) in z-direction is _____ .

**22.** A container of fixed volume contains a gas at $27^{\circ}\mathrm{C}$. To double the pressure of the gas, the temperature of gas should be raised to _____ $^{\circ}\mathrm{C}$.

**23.** In a hydraulic lift, the surface area of the input piston is $6\,\mathrm{cm}^2$ and that of the output piston is $1500\,\mathrm{cm}^2$. If 100 N force is applied to the input piston to raise the output piston by 20 cm , then the work done is _____ kJ .

**24.** The maximum speed of a boat in still water is $27\,\mathrm{km/h}$. Now this boat is moving downstream in a river flowing at $9\,\mathrm{km/h}$. A man in the boat throws a ball vertically upwards with speed of $10\,\mathrm{m/s}$. Range of the ball as observed by an observer at rest on the river bank, is _____ cm . (Take $g=10\,\mathrm{m/s}^2$ )

**25.** Two light beams fall on a transparent material block at point 1 and 2 with angle $\theta_1$ and $\theta_2$, respectively, as shown in figure. After refraction, the beams intersect at point 3 which is exactly on the interface at other end of the block. Given : the distance between 1 and 2 , $d=4\sqrt{3}\,\mathrm{cm}$ and $\theta_1=\theta_2=\cos^{-1}\left(\frac{n_2}{2n_1}\right)$, where refractive index of the block $n_2>$ refractive index of the outside medium $n_1$, then the thickness of the block is _____ cm .




## NTA ANSWERS

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | (1) | 2. | (4) | 3. | (2) | 4. | (1) | 5. | (2) | 6. | (1) | 7. | (2) |
| 8. | (3) | 9. | (2) | 10. | (2) | 11. | (3) | 12. | (4) | 13. | (4) | 14. | (3) |
| 15. | (2) | 16. | *(2) | 17. | (1) | 18. | (4) | 19. | (3) | 20. | (1) | 21. | (2) |
| 22. | (327) | 23. | (5) | 24. | (2000) | 25. | (6) | | | | | | |

***Qs. 16. Provisional Answer- (2), Final answer by NTA Bonus***