JEE Main 2024 Physics Question Paper April 5 Shift 1

| Time Allowed :3 Hours | Maximum Marks :300 | Total Questions :90 |

Physics

1. There is a pulley mass system, find tension in the string as shown in the figure.
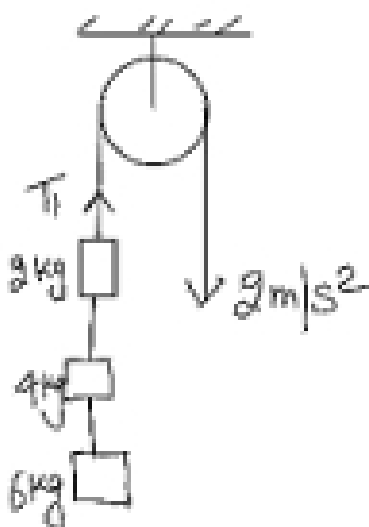
2. Find the ratio of electrostatic force and gravitational force between an electron and a proton.

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3. If the time period of a pendulum at a distance R from the Earth's surface is 4 units, find the time period of the pendulum at $2R$ distance from Earth's surface.

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4. If the magnetic field is perpendicular to the plane of rotation of the rod, then find the potential difference between points P and Q in the given figure.

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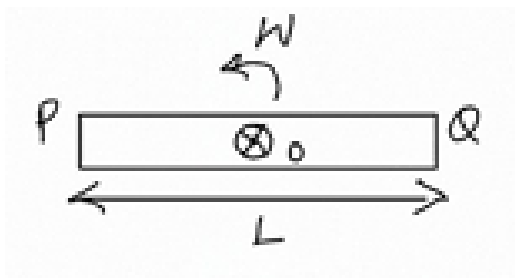
5. Statement-1: slope is given by $\frac{h}{e}$.
Statement-2: comparison of kinetic energy $(K_1 > K_2)$ at constant frequency.

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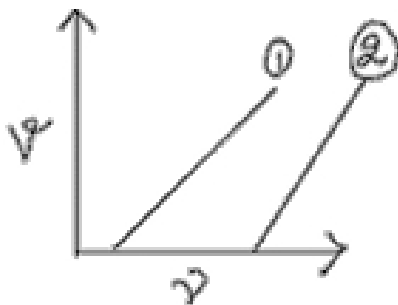
6. If the ratio of radius of gyration of hollow sphere and solid cylinder about the axis as shown in the figure is $\sqrt{\frac{8}{x}}$, then the value of x is:

Hollow sphere

Solid Cylinder

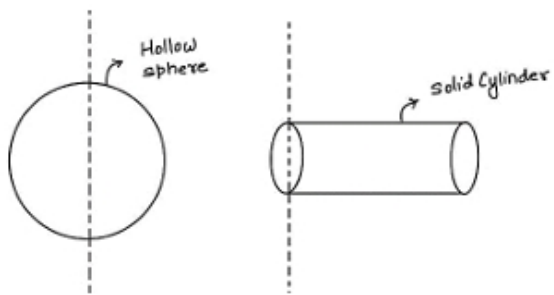7. An ideal gas undergoes a cyclic process given in the P-V curve. Find the work done by the gas in the given cyclic process.

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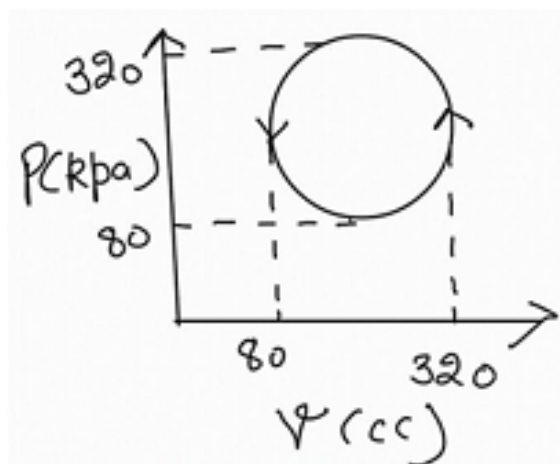
8. Truth table for a logic gate system is given below. Choose the correct option for which bulb will glow.
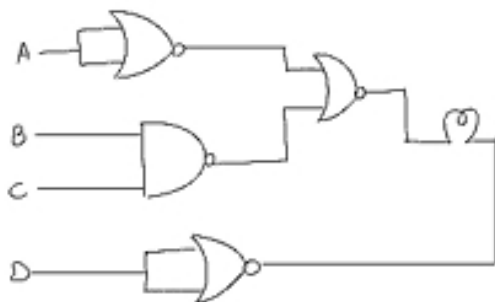
A	B	C	D
1	0	1	1
0	1	1	0
1	1	0	1
0	0	1	1

9. There are two concentric conducting circular loops of radius a and b. If $a \ll b$, then find the mutual inductance of the given system.

10. In YDSE, the distance between two slits is 0.3 mm and the distance of the screen from the plane of slits is 200 cm. If the wavelength of light used is 5000Å, then find the distance of the 3rd bright fringe from the central maxima.
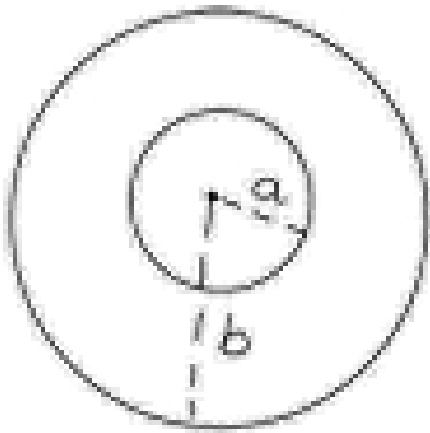
11. If a particle starts from rest with constant acceleration, find the ratio of distance covered by the particle in n-th second to the distance covered in $(n-1)$-th second.

12. If μ represents energy density and G represents the gravitational constant, then find the dimension of $\sqrt{\mu G}$.

13. There is a conducting wire of radius 4 mm whose resistance is given as $R = 2\,\Omega$. Now, the radius is halved, keeping the length of the wire the same. Then find the resistance of the new wire.

14. In the given LCR circuit, find the voltage across the capacitor ($\omega = 100$).


20uF   300Ω   IH

$5\sqrt{2}\sin(\omega t + \phi)$

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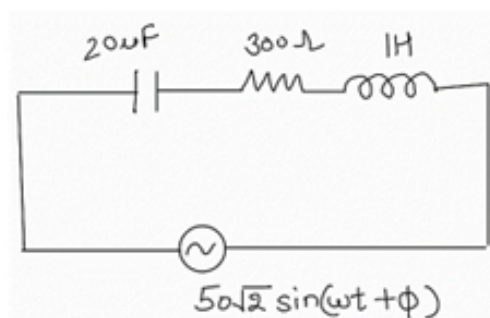
15. Statement-1: Capillary tube is inserted in liquid and then contact angle may be 0°.
**Statement-2:** Contact angle depends on the property of the liquid.

(1) Statement-1 and Statement-2 both are correct with explanation of 1st statement.
(2) Statement-1 and Statement-2 both are correct but explanation of 1st statement is wrong.
(3) Statement-1 is correct and Statement-2 is wrong.
(4) Statement-1 is incorrect and Statement-2 is correct.

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16. In the given circuit, find the equivalent resistance across the cell (neglect internal resistance of the cell).



10Ω

12V

8Ω   4Ω   8Ω

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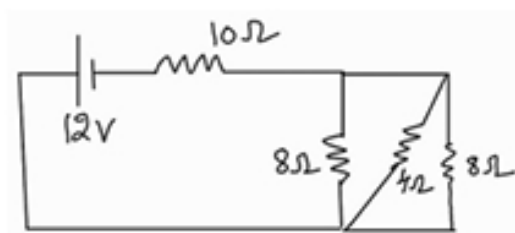
17. There is a two-block system placed on a platform which is moving downward with an acceleration of $2\,\text{m/s}^2$. Find the normal force on the block by the platform.

10Kg

90 Kg

$a = 2\text{ms}^{-2}$
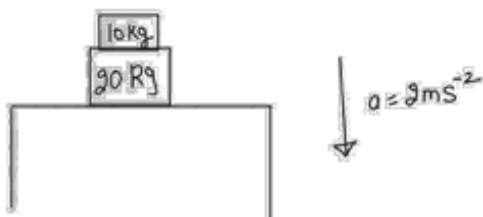
18. If $2p + 2Q = r_1$ and $2Q - 2p = r_2$, then the angle between the resultant vector of $r_1 + r_2$ and Q is:

19. An electron is moving in an orbit, total energy of the electron is E, then find the potential energy.

20. A point source is placed at the first principal focus of a convex lens. The shape of the wavefront of light emerging from the convex lens is:
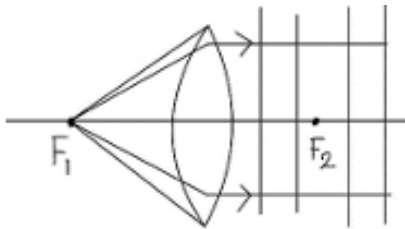
21. Three capacitors having capacitance 25 µF, 45 µF, and 30 µF are connected in parallel and the energy stored in the given combination is E. Now the given capacitors are connected in series and the energy stored in the given combination is $\frac{9E}{x}$. Find the value of x (consider same power supply in both cases).

22. Collision frequency of gas particles at 27°C is **2**. What is the collision frequency of the gas particles at **127°C**?

23. Sun of mass M is at a distance r from earth surface. The mass and radius of the earth are m and R respectively. Then choose the appropriate option. Match the column.

(1) Escape velocity   (a) $\frac{GMm}{2a}$
(2) Kinetic energy   (b) $\frac{GMm}{2a}$

(3) Gravitational potential energy   (c) $\frac{2GM}{a}$

(4) Total energy   (d) $\frac{GMm}{a}$

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24. A block is moved up on a smooth wedge inclined at $60°$ and another block is moved vertically upward up to the same height, find the ratio of work done by gravitational force in both the cases.

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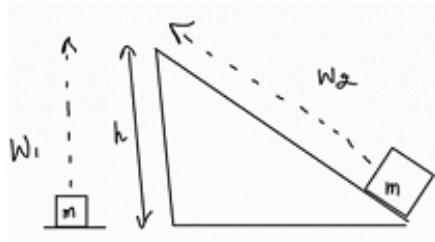
25. Potential difference between the plates of a capacitor of capacitance 12 µF is 40V. The frequency is 40 KHz. Find the displacement current.

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26. Find the arithmetic mean of 4.623, 4.6, 4.62, and 4.69. (Using significant figures)