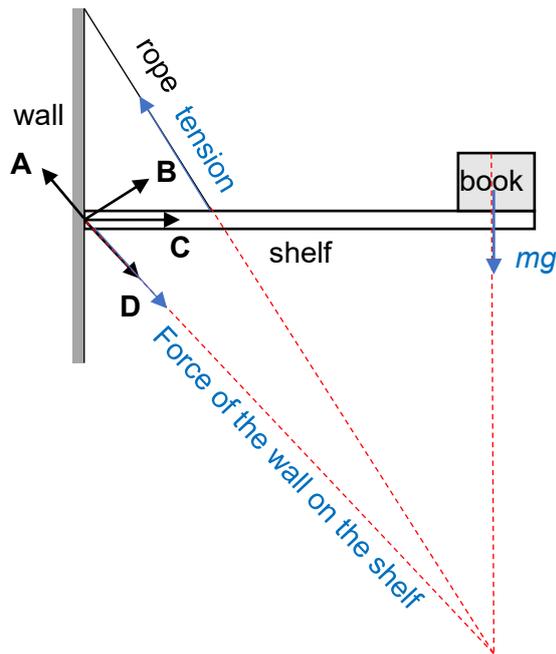


2025 C2 H2 Physics Prelim Exams Paper 1 Suggested Solutions

1	C	6	D	11	C	16	A	21	A	26	D
2	B	7	D	12	A	17	B	22	C	27	B
3	D	8	C	13	B	18	B	23	A	28	C
4	B	9	D	14	B	19	D	24	D	29	A
5	C	10	D	15	C	20	B	25	B	30	D

1	C	volume = $\frac{4}{3}\pi r^3 = \frac{4}{3}\pi(12)^3 = 7200 \text{ cm}^3$
2	B	Upwards direction is taken as negative. Sandbag when released will continue to move upwards but with acceleration downwards. Sandbag will move vertically upwards till it slows down to zero velocity and then it will accelerate downwards.
3	D	Since trolley A is faster than B, and they have the same mass, the net momentum before collision is towards the right and non-zero. Hence Option A is true. Option B is true by Newton's Third Law. Option C is true. If B is moving to the left then so must be A (as A cannot pass through B) and net momentum will be towards the left which is not possible if momentum is conserved. Option D is false. Whether a collision is elastic or not depends on whether kinetic energy is conserved and not on the duration of the collision.
4	B	Taking moments about the left end of the ruler, $k_2x = (0.250)(0.200)g + (0.500)(0.0500)g = 0.075g$ ----- (1) Taking moments about the right end of the ruler, $k_1x = (0.750)(0.200)g + (0.500)(0.0500)g = 0.175g$ ----- (2) Dividing (1) by (2): $\frac{k_2}{k_1} = \frac{0.075}{0.175} = \frac{3}{7} = 0.43$ Distractors (remove from suggested solution for students): A: 1/3 → forget to account for mass of ruler B: 3/7 → Correct C: 7/3 → flipped B D: 3/1 → flipped A
5	C	By the Principle of Floatation (or by considering the net force on the cube), the upthrust on the cube is equal to the weight of the cube. weight of cube = $mg = \rho_0Vg = \rho_0L^3g$
6	D	The shelf is light, so its weight can be neglected. The centre of gravity of the system is thus at the centre of the book.

When the system is in rotational equilibrium, the lines of action of the forces must meet at a point:



The three forces must form a closed vector triangle, so that net force is zero.

7 D
$$F = -\frac{dU}{dx} = -\frac{d(kx^2)}{dx} = -2kx$$

The negative sign indicates that direction of force is towards the reference point O.

8 C

$$(\uparrow): N \sin \theta = mg$$

$$(\rightarrow): N \cos \theta = F_c = ma_c = m(0.8g)$$

$$\tan \theta = 1.25$$

$$\theta = 51.3^\circ$$

Option A: shift cos (0.8)
 Option B: swap the angles in resolving
 Option D: shift sin (0.8)

9 D The rotation of the Earth results in the acceleration of free fall being smaller than the gravitational field strength at the Earth's surface, except at the poles where they are equal.

10 D As the orbital radius r increases,

$$GPE = -\frac{GMm}{r} \text{ becomes less negative (i.e. increases).}$$

Kinetic energy of the satellite decreases since the orbital speed drops as the gravitational pull provides less centripetal acceleration;

$$\text{or by } KE = \frac{GMm}{2r}, KE \text{ decreases.}$$

11	C	<p>From kinetic theory of gas,</p> $p = \frac{1}{3} \rho \langle c^2 \rangle$ <p>Since the oxygen gas is 16 times as dense as hydrogen gas, the corresponding root-mean-square speed of its molecules must be 4 times as slow, meaning that the root-mean-square speed of the hydrogen molecules are 4 times as fast.</p>
12	A	<p>By First law of thermodynamics, besides cooling, the internal energy can also be decreased by mechanical work through expanding the gas, as it does work on its surroundings.</p> <p>Option D is true only for ideal gas, which has zero microscopic PE.</p> <p>Option B is true, except during change of state. E.g. when ice melts, its internal energy is increased because of the increase in its microscopic PE. But there is no change in its microscopic KE, and thus no temperature change.</p> <p>Option C Temperature is a measure of the <u>average</u> (microscopic) KE (not KE+PE).</p>
13	B	<p>By Newton's 2nd law, F_{net} on piston = ma Since gas exerts an upward force $F_{\text{net}} = F_{\text{gas}} - mg$ where mg is the piston's weight</p> <p>Hence</p> $F_{\text{net}} = F_{\text{gas}} - mg = ma$ $F_{\text{gas}} = m(g + a) = 0.75 (9.81 + 3.5) = 9.983 \text{ N}$ <p>Work done by the gas = $F_{\text{gas}} \times s = 9.983 \times 0.12 = 1.20 \text{ J}$</p>
14	B	<p>Using $v_0 = \omega x_0$, $3 = \frac{2\pi}{12} x_0$ giving $x_0 = 5.730 \text{ cm}$</p> <p>Using $a_0 = \omega^2 x_0$, $a_0 = \left(\frac{2\pi}{12}\right)^2 \times 5.730 = 1.571 \text{ cm s}^{-2}$</p> <p>Hence maximum restoring force = $3.0 \times 1.571 \times 10^{-2} = 4.7 \times 10^{-2} \text{ N}$</p> <p>Option C: wrong $T = 15/1.5 = 10 \text{ s}$ Option D: forgot to square omega, and mass multiply by max $v = 3.0 \times 0.03$</p>
15	C	<p>Since the wave pulse is travelling to the right, the last point on the displacement time graph will be the first point on the displacement position graph. Correspondingly, the first point on the displacement time graph will be the last point on the displacement position graph. The sequence follows through for the points in between.</p>
16	A	<p>As the light passes through the first sheet half of the intensity of the light is lost. The second sheet will need to reduce the intensity by another half in order for the emerging light to be $0.25I_0$. So,</p>

$$\frac{I_o}{2} \cos^2 \theta = \frac{I_o}{4}$$

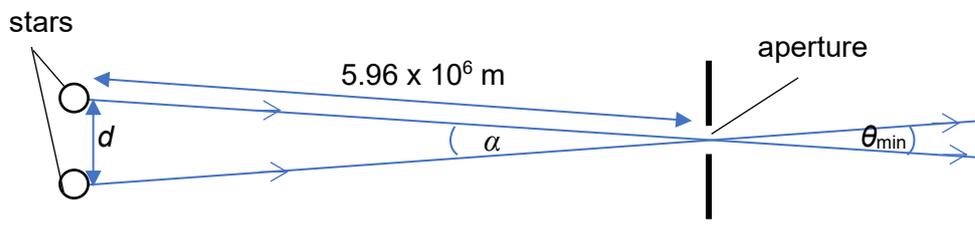
$$\cos^2 \theta = \frac{1}{2}$$

$$\cos \theta = \sqrt{\frac{1}{2}}$$

$$\theta = \cos^{-1} \sqrt{\frac{1}{2}} = 45^\circ$$

Either sheet could be moved as both will reduce the intensity by half each time the light passes through.

17 B Using small angle approximation,



$$\alpha \approx \theta_{\min}$$

$$\frac{d_{\text{between the stars}}}{D_{\text{from telescope}}} = \frac{\lambda}{b}$$

$$\begin{aligned} d_{\text{between the stars}} &= \frac{\lambda D_{\text{from telescope}}}{b} \\ &= \frac{(630 \times 10^{-9})(5.9 \times 10^{16})}{45 \times 10^{-2}} \\ &= 8.3 \times 10^{10} \text{ m} \end{aligned}$$

18 B The distance from the node to the end of the tube is $\frac{\lambda}{4}$. Since $\frac{\lambda}{4} = 0.17 \rightarrow \lambda = 0.68 \text{ m}$. The frequency to generate this stationary wave is $f = \frac{v}{\lambda} = \frac{340}{0.68} = 500 \text{ Hz}$

The wavelengths of $\frac{\lambda}{4}, \frac{3\lambda}{4}, \frac{5\lambda}{4}, \frac{7\lambda}{4}, \dots$ are equal to 0.17 m to obtain a next node at the same position.

The corresponding resonant frequencies would then be 500 Hz, 1500 Hz, 2500 Hz, 3500 Hz, 4500 Hz, 5500 Hz... etc.

19 D We cannot use Coulomb's Law because that is for point charges (or charge distributions with spherical symmetry), but we have metal plates.

$$\text{Uniform electric field strength between the metal plates, } E = \frac{\Delta V}{d} = \frac{3V}{r_1 + r_2}$$

		<p>Electric force on charged oil drop = $qE = q\left(\frac{3V}{r_1 + r_2}\right)$</p> <p>Distractors (remove from suggested solution for students): A → formula for electric potential energy if the plates were point charges B → formula for electric force if the plates were point charges C → calculated electric field strength due to each plate separately D → correct</p>
20	B	<p>work done by external force = $\Delta U = q\Delta V$</p> <p>The net potential at a point is the scalar sum of the potentials due to the first two point charges. ΔU is independent of the path.</p> <p>Since the charges have opposite polarity,</p> <ul style="list-style-type: none"> the electric potential is positive near $+2q$ and negative near $-q$. the point where the electric potential is zero is between the two charges, and nearer to $-q$. <p>A: always equidistant from $+2q$, starts and ends about the same distance from $-q$. $\Delta V \approx 0$ C: starts and ends about equidistant from both $+2q$ and $-q$. $\Delta V \approx 0$ D: $V_{initial}$ is a large negative number, and V_{final} is a smaller negative number. ΔV is positive. B: $V_{initial}$ is a large negative number, and V_{final} is a large positive number. ΔV is the greatest.</p>
21	A	<p>Resistance R is the ratio of V to I.</p> <p>To determine the change of R, analyse the ratio $\frac{I}{V}$ i.e. the gradient of the line from origin to the desired point on the graph.</p> <p>From W to X: $\frac{I}{V}$ is constant, thus the inverse of the ratio, R is constant.</p> <p>From X to Y: $\frac{I}{V}$ is increasing, thus the inverse of the ratio, R is decreasing.</p> <p>From Y to Z: $\frac{I}{V}$ is decreasing, thus the inverse of the ratio, R is increasing.</p>
22	C	<p>The readings of V_2 and V_3 are both zero.</p> <p>No current flows through the resistor that V_2 is connected across and the resistance of a diode is zero.</p>
23	A	<p>When the ammeter is zero, p.d. across the section of the wire on the left of the sliding contact is equal to that of the p.d. across the fixed resistor on the left. p.d. across the section of the wire on the right of the sliding contact is equal to that of the p.d. across the LDR on the right. (LDR is in bright light, its resistance is low)</p> <p>LDR in the dark has higher resistance, thus by potential divider principle, the p.d. across it will become higher.</p> <p>To return the ammeter reading to zero, we have to move the sliding contact to the left</p>

24	D	<p>The current in P produces a magnetic field along the circumference of coil Q in the clockwise direction.</p> <p>This magnetic field produced is parallel to the current in each part of coil Q, hence by Fleming's left hand rule, there is no magnetic force induced on coil Q in all directions.</p> <p>Options A and B: wrongly use 'Like currents attract' concept.</p>
25	B	<p>n is the number of turns per unit length of solenoid.</p> $n = \frac{N}{\text{solenoid length}} = \frac{4000}{200 \times 10^{-3}} = 20000 \text{ turns per unit length}$ $B = \mu_0 n I = \mu_0 n \left(\frac{V}{R} \right)$ $= (4\pi \times 10^{-7})(20000) \frac{6.0}{(3.26 \times 10^3)}$ $= 4.6 \times 10^{-5} \text{ T}$ <p>Option A: uses $R = 3.26 \Omega$ instead of $R = 3.26 \text{ k}\Omega$ Option C: wrong n, use $n = 4000$ turns and wrong $R = 3.26 \Omega$ instead of $R = 3.26 \text{ k}\Omega$ Option D: wrong n, use $n = 4000$ turns.</p>
26	D	<p>By Faraday's Law,</p> <p>e.m.f. induced, $\varepsilon = \frac{d\phi}{dt}$</p> $\varepsilon \approx \frac{\Delta\phi}{\Delta t} = \frac{1.2 \times (\pi(0.2)^2 - \pi(0.1)^2)}{0.1} = 1.2 \times \pi(0.04 - 0.01) \times 10 \text{ V}$
27	B	<p>$V_o = 320 \text{ V}$</p> $V_{rms} = \frac{320}{\sqrt{2}} = 226 = 230 \text{ V}$ <p>The root-mean-square voltage is the equivalent d.c. voltage that would give the same average power.</p>
28	C	<p>From photoelectric equation, $eV_s = hf - \Phi$</p> <p>Using the same ultraviolet source is used, the energy of each photon remains the same, thus the stopping potential remains the same.</p> <p>Lower intensity implies that the rate of photons incident on the metal is less. The rate of electron emission is less, and the rate of electrons reaching the collector plates also decreases. Thus, the new saturation current is less than the original.</p>
29	A	<p>When the potential difference is decreased, the energy of the most energetic x-ray photon decreases. Hence, minimum wavelength increases.</p> <p>The probability of the incoming electron knocking off the innermost electrons decreases, hence the intensity of the peaks also decreases.</p>
30	D	<p>λ is associated with the equation $A = \lambda N$</p>