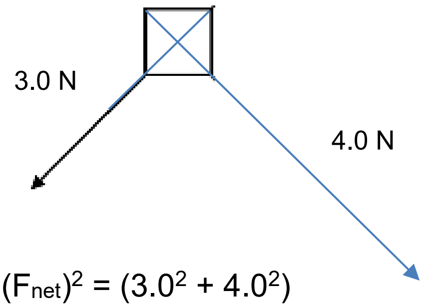
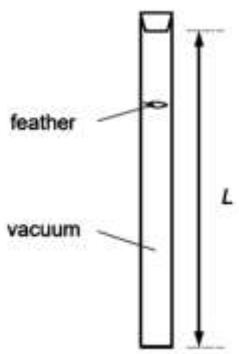
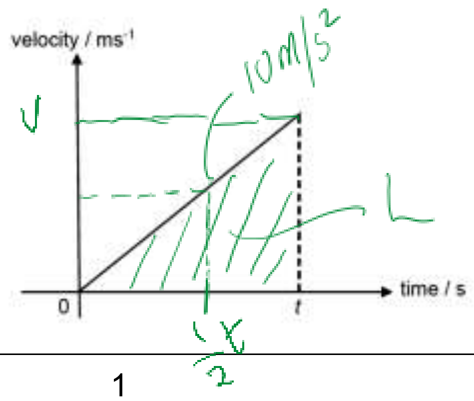
Solution to Sec 4 Physics Prelim 2025 Paper 1

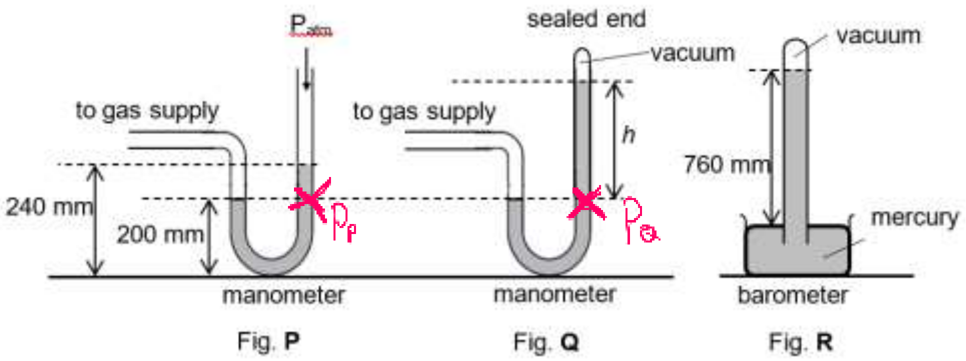
1	**C**	6	**D**	11	**B**	16	**C**	21	**B**	26	**D**	31	**B**	36	**B**
2	**C**	7	**C**	12	**D**	17	**D**	22	**B**	27	**B**	32	**C**	37	**D**
3	**A**	8	**B**	13	**A**	18	**B**	23	**D**	28	**A**	33	**C**	38	**C**
4	**C**	9	**D**	14	**C**	19	**C**	24	**D**	29	**C**	34	**C**	39	**C**
5	**B**	10	**A**	15	**A**	20	**B**	25	**C**	30	**A**	35	**B**	40	**B**

Qn	**Solution**	**Ans**
1	Derived: Energy, Force, Speed, Weight, Acceleration Base: Length, Mass, Time	C
2	12 kHz is within the human hearing range (20 Hz–20 kHz)	C
3	Weight, velocity and displacement are vectors; area, volume, distance, pressure, and temperature are scalars.	A
4	Graph with decreasing slope (gradient) = decreasing velocity.	C
5	Highest point reached is at 20 hr Area under v-t graph (triangle) = 0.5 × 20 × 5000 = 50,000 km.	B
6	Constant speed means net force is 0 → friction = 22 N.	D
7	Between 7.0 N and 4.0 N, the net force is 3.0 N in the direction of the 7.0 N.  $(F_{net})^2 = (3.0^2 + 4.0^2)$ $F_{net} = 5.0$ N	C
8	Free fall – Acceleration due to gravity – 10 ms^{-2}  	B

<table>
<tr><td></td><td colspan="2"></td><td></td></tr>
<tr><td></td><td>At t,
Acceleration is a constant
$a = (v - u)/(t)$
$u = 0$
$v = at$

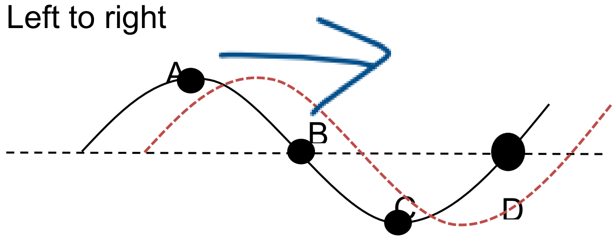
$L = \frac{1}{2} vt = \frac{1}{2}(at)t = \frac{1}{2}at^2$</td><td>At 0.5t,
Acceleration is a constant
$a = (v - u)/(\frac{1}{2}t)$
$u = 0$
$v_{(\frac{1}{2}t)} = \frac{1}{2}at$

$L_{(\frac{1}{2}t)} = \frac{1}{2} v_{(\frac{1}{2}t)} (\frac{1}{2}t) = \frac{1}{2}(\frac{1}{2}at)(\frac{1}{2}t)$
$= \frac{1}{2}at^2(\frac{1}{4}) = \frac{1}{4}L$</td><td></td></tr>
<tr><td>9</td><td colspan="2">Acceleration due to gravity is always 10 m/s² downward.</td><td>D</td></tr>
<tr><td>10</td><td colspan="2">Inertia causes the ball to swing backward (towards the left) when the car moves right.</td><td>A</td></tr>
<tr><td>11</td><td colspan="2">The toy is balanced.
CG is directly below the point of contact with the table.</td><td>B</td></tr>
<tr><td>12</td><td colspan="2">Use moments about one point: Tensions are 95.2 N and 74.8 N.
Taking moments about Y,
CW = ACW
$(5.00) \times T_x = (2.50 \times 140) + (4.20 \times 30)$
$T_x = (350 + 126) / 5.00$
$T_x = 95.2$ N

Upward forces = Downward forces
$T_x + T_y = 140 + 30$
$T_y = 74.8$ N</td><td>D</td></tr>
<tr><td>13</td><td colspan="2">Pascal's principle
Force = 60 × (30/2) = 900 N;
Conservation of energy,
distance = (60×15)/900 = 1 cm.</td><td>A</td></tr>
<tr><td>14</td><td colspan="2">

Same level, same liquid, same pressure</td><td>C</td></tr>
</table>

	$P_P = P_Q$ $40 + P_{atm} = P_Q$ $P_{atm} = 760$ mm $P_Q = 760 + 40 = 800$ mm.	
15	Equal mass; density inversely proportional to volume: P = ρQ / 2.	A
16	Using energy conservation: speed when hitting target = 12 m/s. $\text{Initial total energy} = \text{Final total energy}$ • **Initial energy:** $E_i = \frac{1}{2}mv^2 + mgh_1 = \frac{1}{2}m(15)^2 + m \cdot 10 \cdot 1 = \frac{1}{2}m \cdot 225 + 10m = 112.5m + 10m = 122.5m$ • **Final energy:** $E_f = \frac{1}{2}mv^2 + mgh_2 = \frac{1}{2}mv^2 + 10m \cdot 5 = \frac{1}{2}mv^2 + 50m$ • **Equating initial and final energy:** $122.5m = \frac{1}{2}mv^2 + 50m$ Cancel out m from both sides: $122.5 = \frac{1}{2}v^2 + 50$ $\frac{1}{2}v^2 = 122.5 - 50 = 72.5$ $v^2 = 145$ $v = \sqrt{145} \approx \boxed{12.0\,\mathrm{m/s}}$	C
17	Work done = F × d is same → same KE.	D
18	Temperature increase → internal energy increase.	B
19	Power out = 100×20 = 2000 W. Efficiency = 2000 / 3000 = 0.67.	C
20	Compression → more collisions per unit time with walls.	B
21	Brownian motion shows air molecules are in constant random motion.	B
22	X is cooler because a dull surface is a good emitter. Explanation: 1. Surface Texture and Thermal Radiation: • A dull (matte) surface is both a good absorber and a good emitter of thermal radiation.	B

	• A polished (shiny) surface is a poor absorber and a poor emitter of thermal radiation. 2. Cooling Process: • Both cans X (dull surface) and Y (polished surface) are filled with water at the same initial temperature (boiling point) and left in the room. • The cans cool down primarily by emitting thermal radiation to the surroundings. • Can X (dull surface) emits thermal radiation more efficiently than Can Y (polished surface), so it loses heat faster. • As a result, after a short while, the temperature of Can X will be cooler than Can Y.	
23	Same energy, different times → X has lower heat capacity.	D
24	Left to right  A is moving downwards but not with highest speed. B is moving with highest speed but moving upwards. C is moving upwards. D is moving downwards and with highest speed.	D
25	Wavefronts spread out more in deeper region. Larger the wavelength, larger the speed, when frequency remains constant. $v = f\lambda$	C
26	All EM waves same speed in vacuum; X-rays shorter λ.	D
27	Amplitude = 0.7 cm; wavelength = 22.8 cm from given data.	B
28	f = 50 Hz → T = 1/50 = 0.020 s. Rarefaction arrives in 0.010 s.	A
29	Matchstick must move 10 cm right to be at focal point. Application – As a spotlight	C
30	Electron moves opposite to field direction → down.	A
31	Energy = Q × V = 90 × 3×10^{10} = 2.7×10^{12} J.	B
32	X = metallic conductor, Y = diode, Z = filament lamp.	C
33	Voltage divider: V = 20 × R/(R+300) ≥ 12 → R ≥ 450 Ω.	C
34	Fuse should be on live wire to break circuit.	C

35	Compass aligns with field; use right-hand rule.	B
36	Iron affects compass, aluminium does not. Magnetic shielding – Field lines can go through aluminium but not through iron. Iron ring concentrates the magnetic fieldlines	B
37	Use Fleming’s Left-hand Rule: current is into the paper. Field is upwards Force will be from the higher concentration of magnetic field lines to the lower concentration of magnetic field lines	D
38	The relay fails to attract the iron armature when the switch is turned on, meaning the electromagnet is not strong enough. Iron cores magnetize more easily than steel, making the electromagnet stronger. This ensures the armature is attracted when the switch is on. Other options (increasing distance, reducing coil turns, or lowering current) weaken the magnetic field, worsening the problem. Iron’s higher permeability solves the relay’s failure to conduct high current.	C
39	$I = 600$ A → Power loss = $I^2R = 5.4\times10^6$ W → ratio = 0.036.	C
40	60 → 29 is approximately 1 half life = 2.0 s	B