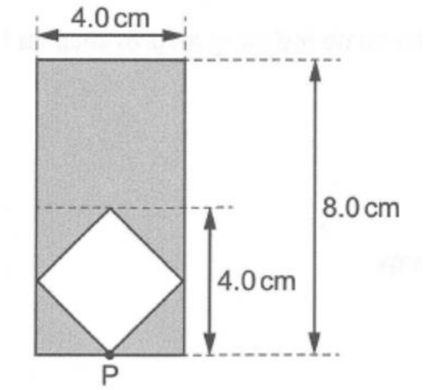
Suggested solutions to 2023 A-Level H2 Physics Paper 1

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

Q	Ans	Working
1	C	Person's reaction time using a stopwatch- person could either be fast or slow in pressing the stopwatch (at the start or at the end of operating stopwatch). This could lead to random error instead of systematic error.
2	D	Displacement of car can be found from the area under v-t graph. Hence, the trapezium area = $\frac{1}{2}(p+q)r$
3	A	By Newton's 2nd law; $F_{av}=\frac{\Delta mv}{\Delta t}=\frac{m(v-0)}{t}$ ------ (1) Kinetic energy E = ½ mv^2 ----(2) Combining (1) and (2) $Ft=mv$; but $v=\sqrt{\frac{2E}{m}}$ $Ft=m\sqrt{\frac{2E}{m}}$ $Ft=\sqrt{2Em}$ Since m is constant $Ft\propto\sqrt{E}$ Please note that impulse ($F\Delta t$) is not equal to work done.
4	C	For an elastic collision relative speed of approach = relative speed of separation $u_1-(-u_2)=v_2-v_1$ $u_1+u_2=v_2-v_1$

5	**B**	 Consider the sheet of metal is broken to 2 parts: Part 1: mass = 2m; c.g. is located 6.0 cm from point P Part 2: mass = m; c.g. is located 2.0 cm from point P Hence, taking moments about point P; Net moments due to part 1 and part 2 = 2m (6.0) + m (2.0) -------- (1) Assume the net c.g. is x away from point P Net moments due to entire shape (at the net c.g. position) = 3m (x) ----- (2) equating (1) and (2) 2m (6.0) + m (2.0) = 3m (x) x = 4.7 cm
6	**B**	Energy lost by wind per second = $\frac{1}{2}(9.7)\left(4.0^2 - 1.5^2\right) = 66.7$ J Power generated $= 0.60 \times 66.7 = 40.0$ W
7	**C**	Angular displacement in one year is 2π . Therefore, in half a year the angular displacement is $\frac{1}{2}(2\pi) = \pi$
8	**B**	Definition of gravitational field strength.
9	**C**	For path C, there must be a force exerted on the rocket to balance the gravitational force acting on the rocket in order for it to continue travelling as shown. For path D, it is possible for the shuttle to travel as shown without firing its rockets – it would just be slowing down.

10	**A**	Time interval between the molecule hitting the shaded wall $= \dfrac{2p}{v}$ Force exerted by N molecules on the shaded wall $= \dfrac{\Delta p}{\Delta t}$ $= \dfrac{N\left(mv - m(-v)\right)}{\frac{2p}{v}}$ $= \dfrac{2Nmv}{\frac{2p}{v}}$ $= \dfrac{Nmv^2}{p}$
11	**B**	U $\propto$ T (note: T must be in K not °C) initially when T = 273 K (0 °C), internal energy is U later when T = 273+273 K, i.e. doubled, internal energy is also doubled hence answer 2U
12	**C**	steeper gradient $\Rightarrow$ smaller specific heat capacity (since temperature rises more for the same heat), so P has smaller specific heat capacity longer horizontal line $\Rightarrow$ larger specific latent heat (since requires more heat to completely melt the solid), so P has larger specific latent heat
13	**B**	max KE = ½ m ω^2 x_0^2 m = $\dfrac{2.9 \times 10^{-2}}{6.02 \times 10^{23}}$ ω = $\dfrac{2\pi}{3 \times 10^{-3}}$ $x_0 = 2 \times 10^{-6}$ substituting gives max KE = 4.2×10^{-31} J
14	**D**	compare the peak times for wave X, the peak happens at t = 5 units for wave Y, the peak happens at t = 15 units period = 30 units so phase difference = $\dfrac{\Delta t}{T} \times 360° = \dfrac{10}{30} \times 360° = 120°$ intensity $\propto$ (amplitude)^2 so ratio of intensities = (ratio of amplitudes)^2 = $\left(\dfrac{3}{2}\right)^2$ = 2.25
15	**B**	intensity unchanged after the first polarising filter (horizontal) after the second polarising filter (45°), intensity becomes $I_0 \cos^2 45°$ after the last polarising filter (vertical), intensity becomes $I_0 \cos^2 45° \cos^2 45° = 0.25\, I_0$

16	**D**	Using $b\sin\theta = \lambda$ If x is small compared to D, $\sin\theta \approx \dfrac{\frac{1}{2}x}{D} = \dfrac{x}{2D}$ Note that $\lambda = \dfrac{c}{f}$ So $b = \dfrac{c}{f} \times \dfrac{2D}{x} = \dfrac{2cD}{fx}$
17	**A**	Using $d\sin\theta = n\lambda$ $n = 2$ $\theta = 30^o$ $d = \dfrac{2 \times 500 \times 10^{-9}}{\sin 30^o} = 2 \times 10^{-6}$ m Number of lines per millimetre, N: $\dfrac{1 \times 10^{-3}}{N} = d$ $N = \dfrac{1 \times 10^{-3}}{d} = \dfrac{1 \times 10^{-3}}{2 \times 10^{-6}} = 500$
18	**A**	Using $x = \dfrac{\lambda D}{a}$ As D increases at a constant rate, x also increases at a constant rate. Note that the graph does not start from zero because at time $t = 0$, the screen is already some distance to the slits and the fringe separation is not zero.
19	**C**	Since the acceleration is constant the path is parabolic. The plate X is at higher potential as compared to Y, and so the electrons will be attracted towards X.
20	**B**	Using $V = \dfrac{Q}{4\pi\varepsilon_0 r}$ The distance from S to R is $\sqrt{2}$ units while the distance from S to P is 3 units. Thus, $636 = \dfrac{Q}{4\pi\varepsilon_0 \times \sqrt{8}}$ $V_p = \dfrac{Q}{4\pi\varepsilon_0 \times 3}$ V_p = 600 V
21	**B**	Definitions. The e.m.f of a cell is equal to the energy converted into electrical energy from other forms per unit charge. The p.d across the resistor is equal to the energy converted from electrical energy to other forms per unit charge.

22	**D**	For the galvanometer to be at null deflection at balance length, the polarity of the cell E and the polarity of the cell in the potentiometer circuit must be the same (i.e. opposing each other).
23	**C**	For a light-dependent resistor, resistance decreases when intensity increases. The effect of having another resistor of fixed resistance only results in the resistance of the circuit never reaching zero no matter how high intensity is.
24	**A**	The south pole of the magnet will be attracted to the north pole of the non-uniform magnetic field, causing it to rotate clockwise. The force of attraction on the south pole of the magnet is stronger and hence the magnet will move to the left.
25	**D**	For the beam to move upwards and to the right, there will be a component of the net force pointing upwards and a component of the net force pointing to the right. By Fleming's LHR, we can then determine the direction of B-field that provides the component of the net force pointing upwards. Direction of B-field is to the right. Since it is an electron, then the direction of E-field pointing to the left will result in a component of net force pointing to the right. (It is also possible that the direction of B-field is pointing downwards which results in the component of the net force pointing to the right. And since it is an electron, then the direction of E-field pointing to downwards will result in a component of net force pointing to upwards. No such option given in this case).
26	**C**	Recall unit for magnetic flux density is tesla. Since magnetic flux is the product of the flux density normal to the surface and the area of the surface, unit for magnetic flux is tesla metre^2.
27	**D**	Graph shows a half-wave rectification involving a sinusoidal voltage. Therefore, both diodes must allow current in only one direction for half of the incoming a.c. input passing through the resistor.
28	**A**	$\Delta E = E_{\text{higher}} - E_{\text{lower}} = hf = \dfrac{hc}{\lambda}$ [-30.6 - (-122.4)] x (1.6 x 10^{-19}) = [(6.63 x 10^{-34}) x (3.0 x 10^{8})] / λ λ = 1.35 x 10^{-8} m
29	**A**	$\lambda = \dfrac{h}{p}$ Since $\lambda p = h$ which is a constant, λp is independent of its p.
30	**C**	For one period, the V_0^2 is constant horizontal straight-line graph. As such, the mean of V_0^2 is also V_0^2. Therefore, $V_{rms} = V_0$.