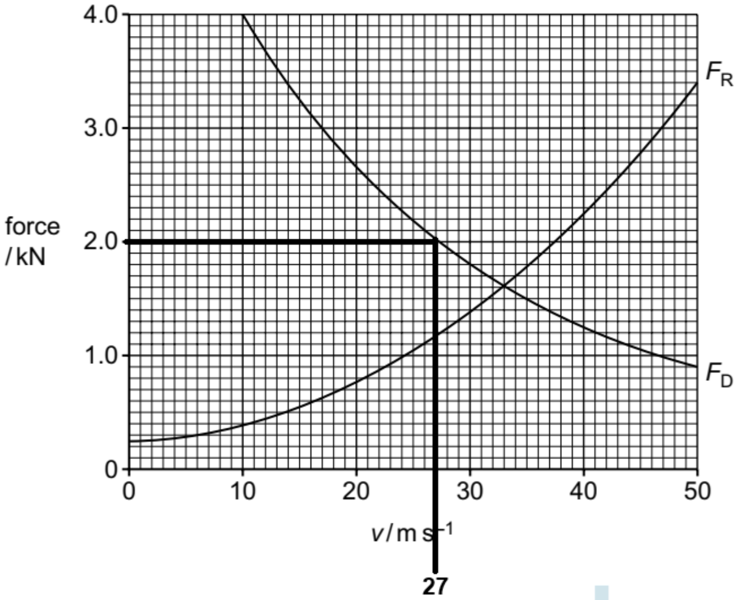
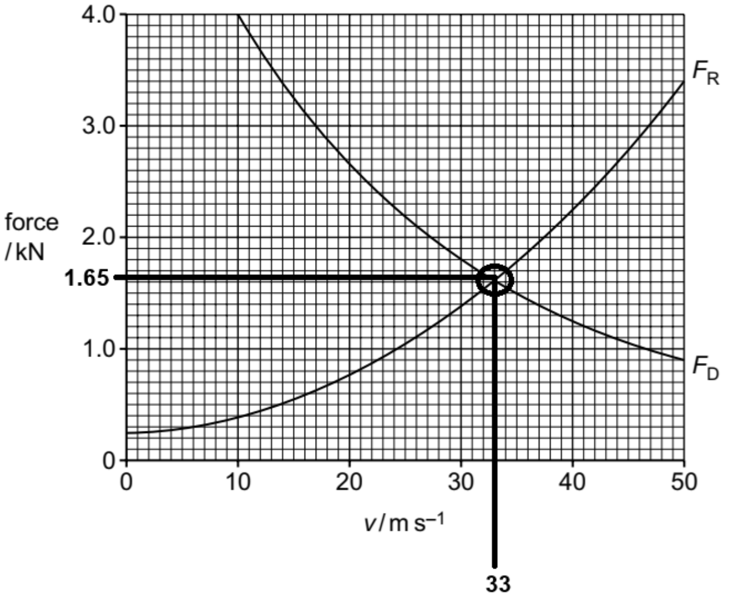
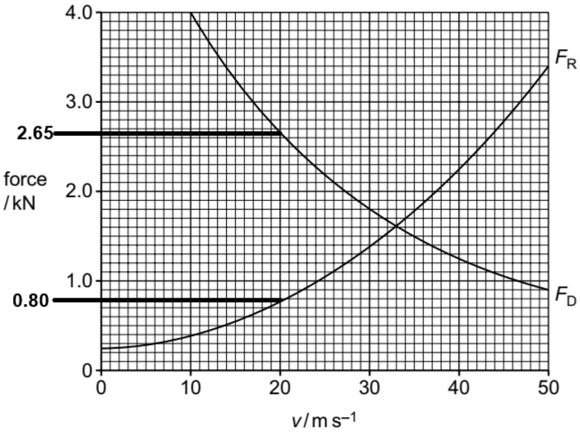
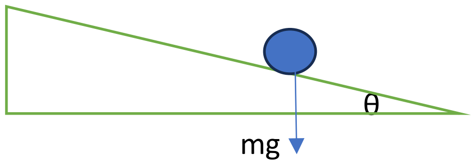
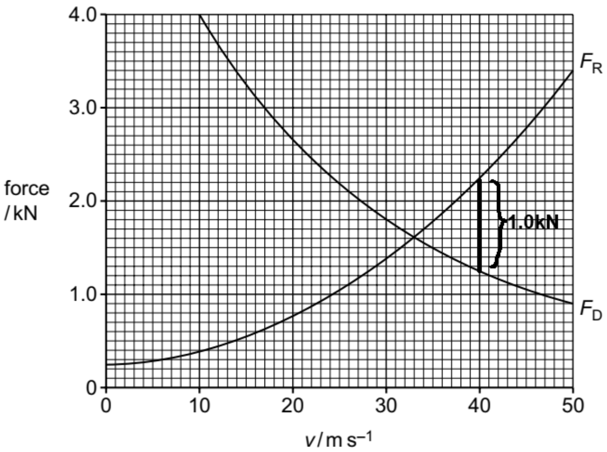
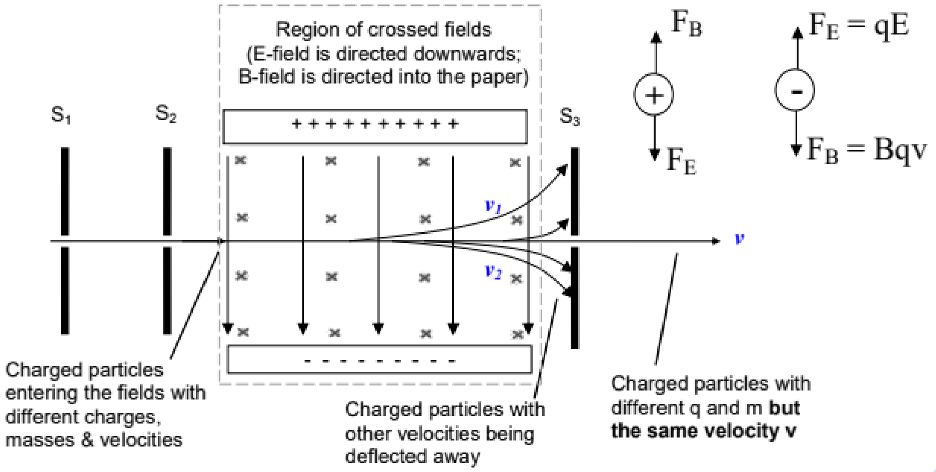
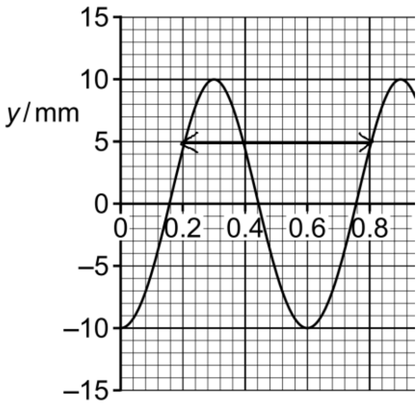
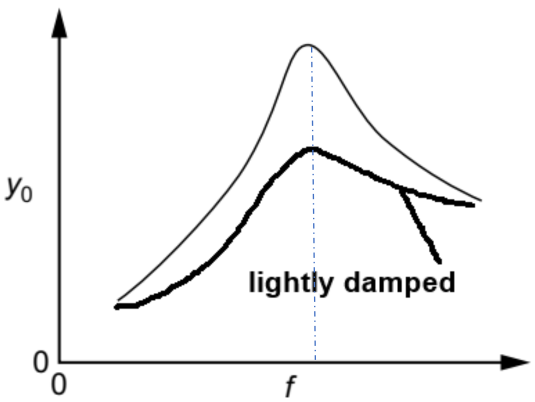
2026 A level H2 Phy Sample P3 Ans

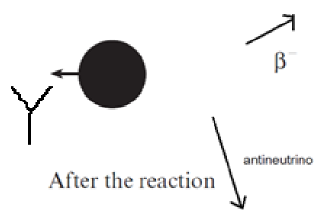
Qn	Ans
1 ai)	 F_R = 2000 N = A + 1.25(27)^2 → A = 1088.8 = 1100 = 1.1 kN (2sfg)
ii)	 Max speed = 33 m/s F_R = F_D →net force = 0N, object moves at constant speed since acceleration = 0. Speed is lower than 33m/s, net force > 0, car accelerates. Speed is more than 33m/s, net force <0, car decelerates.
iii)	Power output = F_D x Vmax = 1650N x 33 m/s = 54,450 = 54,000 W

iv)	 Fnet = $F_D - F_R$ = 2650 – 800 = ma = 1250kg x a → a = 1.48 = 1.5 m/s^2
b)	 For max speed, Fnet = $F_D - F_R$ + mg sinθ = 0N $F_R - F_D$ = mg sinθ = 1250 x 9.81 x sin 4.7° = 1005 N = 1.0N  Max possible speed = 40m/s
2 a)	Gravitational Potential Energy + Minimum Kinetic Energy = 0 [when object escape from the gravitational field strength of the planet] $-GMm/R + \frac{1}{2} m v_{escape}^2 = 0$ $v_{escape}^2 = \frac{2GM}{R}$ $v = \sqrt{\frac{2GM}{R}}$
b)	M = 6.0x10^{24}kg, v = 11000m/s R = 6.615 x 10^6 m Average density = $\frac{M}{\frac{4}{3}\pi R^3}$ = 4948.77 = 4900 kgm^{-3}
c)	Similarity: both experience a vertical downward acceleration of g due to gravity

	Difference: trajectory of stone B is a curve while A is vertical line Stone B is throw further away horizontally from the point of launch as opposed to A which falls vertically
3 a)	• In reality, all molecules will be moving in three dimensions equally • Splitting the velocity into its components c_x, c_y and c_z to denote the amount in the x, y and z directions, c^2 can be defined using pythagoras' theorem in 3D: $\mathbf{c^2 = c_x^2 + c_y^2 + c_z^2}$ • Since there is nothing special about any particular direction, it can be determined that: $\mathbf{<c_x^2> = <c_y^2> = <c_z^2>}$ • Therefore, $<c_x^2>$ can be defined as: $<c_x^2> = \frac{1}{3} <c^2>$ $pV = ⅓Nm<c^2>$
bi)	Nm = mass of the gas = 20.2 g = 20.2 x 10^{-3} kg P = 1.01 x 10^5 Pa V = 2.24 x 10^4 cm^3 = 2.24 x 10^4 x 10^{-6} m^3 T = 273 K **c_{rms} = 579.66 = 580m/s**
ii)	T = 273.15 + 27.0 = 300.15 K $pV = ⅓Nm<c^2>$ & pV = NkT **$\frac{1}{3}$ m <579.66²> = k(273)** **$\frac{1}{3}$ m <c'²> = k(300.15)** **c'_{rms} = 607.796 = 608m/s**
4 a)	**Capacitance** is defined as the **charge stored per unit potential difference**. Capacitance is a means of quantifying the charge storing ability of a conductor.
bi)	charging a capacitor $Q = Q_0\left[1 - e^{-\frac{t}{\tau}}\right]$ RC time constant $\tau = RC$ τ = RC = 50 Ω x 120 x 10^{-6} F Q = 0.95 Q_o → 0.95 = $(1 - e^{-t/RC})$ $e^{-t/RC}$ = 0.05 - t/RC = ln 0.05 → t = 0.017974 = 0.0180 s
ii)	$Q_o = CV_{max}$ = 120 x 10^{-6} F x 240 V = 0.0288C Q = 0.95Q_o **E = ½ Q^2/C = 3.119 = 3.12 J**
5 ai)	Single slit 1st minima $\sin\theta_1 = \frac{n\lambda}{d} = \frac{(1)(590 \times 10^{-9})}{0.20 \times 10^{-3}}$ → θ_1 = 0.169 °
ii)	$\sin\theta_1 = \frac{n\lambda}{d} = \frac{(2)(590 \times 10^{-9})}{0.20 \times 10^{-3}}$ → θ_1 = 0.338 °
b)	Width = 2 x D x tan θ_1 = 2 x 0.75m x tan 0.169 ° = 4.4250 x 10^{-3} = 4.43 x 10^{-3} m
c)	$\theta \approx \frac{\lambda}{b}$ for the resolving power of a single aperture

	$\theta \sim \frac{\lambda}{b} = 0.00295$ radians
6 a)	Uniform E and B fields (electric and magnetic fields respectively) could be set up **perpendicular** to each other such that they exert equal forces of opposite directions on a moving charged particle. This setup may be referred to as ***crossed* fields**, as shown below. The velocity selector is an instrument that makes use of such crossed fields to select and emit a stream of charged particles (e.g. electrons) of a *specific velocity*.  velocity selector For the particles to pass through undeflected, the electric force and magnetic force must be **equal in magnitude**: Magnetic Force = Electric Force $Bqv = qE$ i.e. $v = \frac{E}{B}$
bi)	$F = \frac{Mv^2}{R} = \frac{M\,(96{,}000)^2}{0.124} = Bqv = 0.320\text{ T} \times 1.6 \times 10^{-19}\text{ C} \times 96{,}000$ $M = 6.6133 \times 10^{-26}\text{ kg} = 6.6 \times 10^{-26}\text{ kg}$
ii)	$Mv = BqR \rightarrow R = \frac{Mv}{Bq}$ v and B are constant Reason 1: mass of the ion is lower than those on path B Reason 2: charge of the ion is higher than those on path B (e.g. $2 \times 1.6 \times 10^{-19}$ C)
7a)	Power $= 3.2 \times 10^{-3}\text{ W} = (N/t) \times (hf) = \frac{(N/t)\,(6.63 \times 10^{-34} \times 3 \times 10^{8})}{430 \times 10^{-9}}$ $(N/t) = 6.918 \times 10^{15} = 6.9 \times 10^{15}\text{ s}^{-1}$
b)	$p\lambda = h$ for 1 photon, $p = \frac{h}{\lambda}$ In 1.00s, total momentum of photons $= \frac{6.9 \times 10^{15} \times 6.63 \times 10^{-34}}{430 \times 10^{-9}} = 1.067 \times 10^{-11} = 1.07 \times 10^{-11}$ Ns
8a)	Simple Harmonic Motion (SHM) occurs when the force is proportional to the displacement of the body in motion [1] and acts in the opposite direction to the direction of movement of the body [1].
bi)	Period, T = 6.0s → f = 1/T = 1.67 = 1.7Hz

ii)	
ii)	From data booklet, $v = \pm\omega \sqrt{(y_o^2 - y^2)}$, $KE = ½\, m\, \omega^2 (y_o^2 - y^2)$ At $y = 0$, KE is maximum = total energy = $½\, m\, \omega^2 (y_o^2 - 0^2) = ½\, m\, \omega^2 y_o^2$ $\omega = 2\pi f$ total energy = $½\, m\, (2\pi f)^2 y_o^2$ $E_T = 2\pi^2 m f^2 y_0^2$
iii)	$m = 0.320$ kg, $y_o = 10mm = 0.010m$ $E_T = 0.0017546 = 0.00175$ J
ci)	Resonance
ii)	$f = 1/T = 1.67 = 1.7Hz$
di)	
ii)	Faraday's Law states that *the induced e.m.f.(E) is directly proportional to the rate of change of magnetic flux linkage.*
iii)	As the copper plate oscillates, induced current/eddy current is circulating in the plate to generate a magnetic field either by repelling the magnetic field of the coil when the plate is moving nearer to the coil or attracting the magnetic field of coil when the plate is moving away from the coil. Total energy of the oscillating plate is decreased due to non-conservative opposing forces as a result of the induced current flows that opposes the motion of the magnet. This creates a light damping effect as the amplitude decreases and energy transfer via electrical energy is dissipated as internal store of energy in the electrical wires and galvanometer.

e)	Intensify the strength of the magnetic field produced by the coil which in terms increased the value of the induced current leading to faster rate at which total energy of the oscillating plate decreases Enhanced the damping effect on the oscillating plate
9 ai)	means that the decay cannot be forced and cannot be controlled by any physical and chemical means such as change in temperature and pressure or adding chemicals.
ii)	means that emitted radioactive particles are not emitted at equal intervals of time and in varying quantities and in varying directions.
bi)	$\frac{\Delta N}{\Delta t}$
ii)	$\frac{\Delta N}{N}$
iii)	$\frac{\Delta N}{N \Delta t}$
ci)	**By Conservation of momentum, the velocity of β can be calculated and ought to be a single fixed value, since the summation of the momentum of Y and β after the reaction must be zero (same as the momentum of Sr before nuclear decay).**  **Range of energies imply that velocity of β is varied and are directed in different directions.**  **In order that that the net momentum is zero, there must be another particle (antineutrino) being emitted in the direction as shown below.** 
ii)	$^{90}_{30}Sr \rightarrow ^{90}_{31}Y + ^{0}_{-1}\beta$
di)	Half life is short like 10 days so that after sometime, the radioactivity decreases to a rate that is negligible and thus safe. Emission of 4 α particles per nuclide means that the large number of α particles emitted would have a higher probability of targeting the cancer cells. Finally the daughter nuclei is stable and thus no longer radioactive and thus safe.

ii)	**(A)** Number of mole of Ac = $\frac{0.55}{225}$x10^{-6} mol Number of Ac nuclei, N_o = $\frac{0.55}{225}$x10^{-6} x 6.02 x 10^{23} = 1.47155 x 10^{15}= 1.47 x 10^{15} **(B)** ***$N = N_o exp(-\lambda t)$*** $\lambda = \frac{\ln 2}{10\ days}$ ***After 24 hours,*** ***$N = N_o exp(-\frac{\ln 2}{10\ days}\ x\ 24\ days) = N_o (0.18946)$*** **Number of Ac nuclei that disintegrated =** 1.471 x 10^{15} (1-***0.18946***) = 1.19275 x 10^{15} **Number of α particles released = 4 x** 1.19275 x 10^{15} Max energy absorbed by tumour = **4 x** 1.19275 x 10^{15} x 5.8 x 10^{6} x 1.6x10^{-19} = 4427.5 = 4430 J