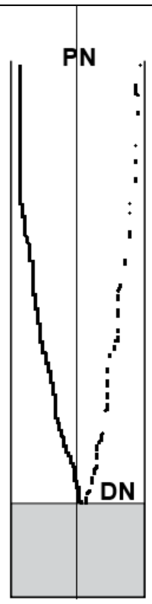
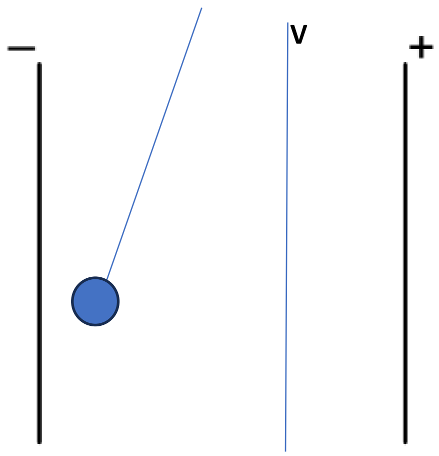
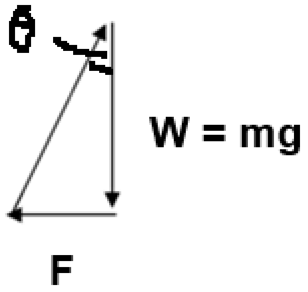
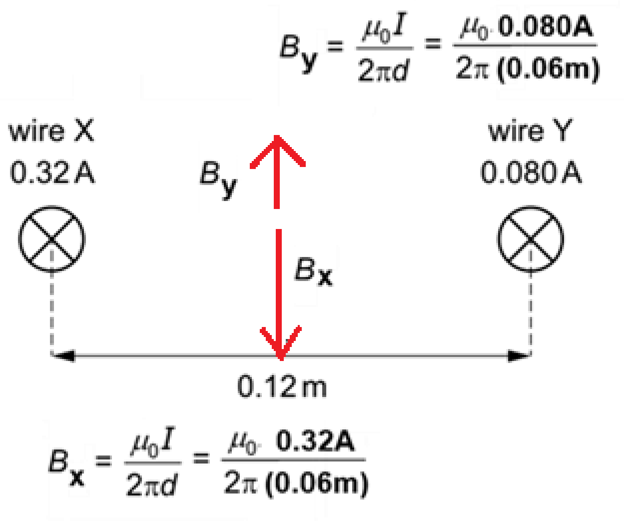
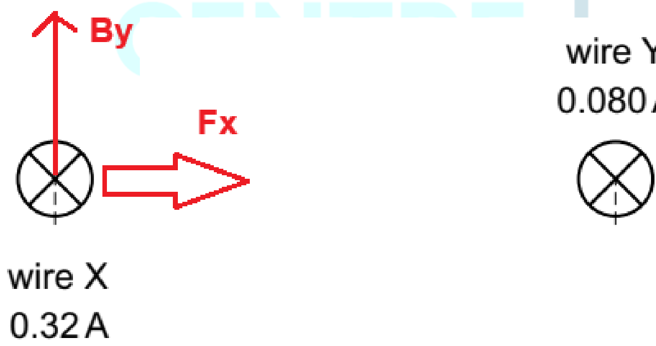
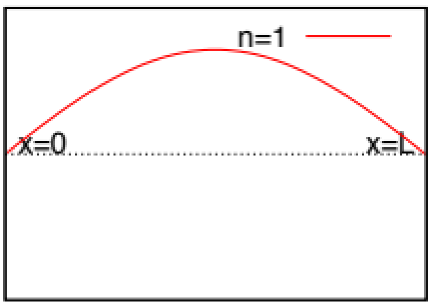
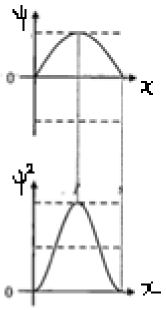
2026 A level H2 Phy Sample P2 Ans

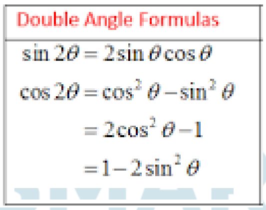
Qn	Ans
1 ai)	s = ut + ½ at^2 u = 0 s = 0.80 = ½ at^2 = ½ a $(0.64)^2$ → a = 3.90625 = 3.9 m/s^2 (2sfg)
ii)	$a = \frac{2s}{t^2}$ $\frac{\Delta a}{a} = \frac{\Delta s}{s} + 2\frac{\Delta t}{t}$ = 0.075 = 7.5% = 8% (1sfg)
iii)	Δa = 0.075 x 3.90625 = 0.232 = 0.2 (1sfg) a = 3.9 ± 0.2 m/s^2
iv)	$v^2 = u^2 + 2as$ = 2 x 3.90625 x 0.80 v = 2.5 m/s
bi)	Inelastic, since KE of block has decreased after collision
ii)	$a = \frac{2.5 - \frac{(-1.8)m}{s}}{0.060s}$ = 71.66667 m/s^2 F_{av} = ma = 0.350kg x a = 418.06 = 420 N (2 sfg)
iii)	Yes; since there is no external force acting on the block and barrier aside from the contact forces between the block and barrier during the collision
2 ai)	PV = nRT → $V \propto T$ since P is constant and no of mol/mass of gas is constant $Tinitial = \frac{2200}{2800}$(105+273.15) = 297.118 K = 23.968 = 24.0 ° C
ii)	Based on zeroth law, when 2 bodies are in a state of thermal equilibrium, the temperature of the 2 bodies are the same Hence temperature of the air in the balloon is the same as the temperature of the material which is the same as the temperature of the atmosphere is 24.0 ° C
bi)	Work done = PΔV = 1.01 x 10^5 (2800-2200) = 6.06 x 10^7 J
ii)	Work done by the gas as it expands ΔW = 60.6 MJ Internal energy increases of the gas in the balloon ΔU = 116 MJ Thermal energy supplied, ΔQ = ΔU + ΔW = 176.6 MJ = 1.77 x 10^8 (3 sfg)
ci)	**The internal energy of a substance** is the sum of kinetic energy due to the random motion of all particles, and the potential energy due to the intermolecular forces of attraction.
ii)	Temperature increases which means KE of the gas particles increases As volume expands, the average distance between the gas particles increases which means the PE of the gas increases
3 a)	• Waves to have the same amplitude • Waves to have the same frequency and speed
bi)	When sound waves propagate from speaker through air, the wave passing through any point will alternate from pushing to pulling air particles to create compression and rarefaction which are regions of higher pressure when air particles concentrate or lower pressure when air particle disperse relative to atmospheric pressure respectively

ii)	
iii)	$\frac{1}{4}\lambda = 0.18m \rightarrow \lambda = 0.18 \times 4 = 0.72m$; $f = 490Hz$ $c = f\lambda = 490 \times 0.72 = 352.8 = 350$ m/s
4 a)	Electric field Strength is defined as the electrostatic force acting per unit positive charge that is stationary
bi)	
ii)	See above attracted towards the lower potential plate on the left
iii)	$E = \frac{\Delta V}{D} = \frac{(5700-0)V}{0.200m} = 28,500\ Vm^{-1}$
iv)	$F = qE = 4.00 \times 10^{-9} \times E = 1.14 \times 10^{-4}$ N
v)	$W = mg = 2.50 \times 10^{-5} \times 9.81$ N $\tan\theta = \frac{F}{W} = 0.46483$ $\theta = 24.9^{\circ}$ 

<table>
<tr><td>c</td><td>Electric field is non-uniform when further away from the centre of the metal plates/at the top end of the metal plates</td></tr>
<tr><td>5 a)</td><td>

Magnitude = 8.0×10^{-7} T
Direction: vertically downward (as per direction of Bx sketched above)</td></tr>
<tr><td>b)</td><td>Magnetic field by wire Y on X is directed vertically upward
By Fleming's left hand rule (as shown in sketch below), direction of force is towards the right or from left to right

</td></tr>
<tr><td>6 ai)</td><td>
</td></tr>
<tr><td>ii)</td><td>n = 1
ψ = A sin nkx = A sin kx
x = L, ψ = 0 = A sin k(L)
kL = π
k = π</td></tr>
</table>

<table>
<tr><td></td><td>L</td></tr>
<tr><td>bi)</td><td>The square of the matter wave $|\Psi|^2$ in one dimension gives the probability that a particle will be found at a particular position and time per unit length, also called the probability density</td></tr>
<tr><td>ii)</td><td>
<table>
<tr><td>Graph 1


Graph 2

Double Angle Formulas
$\sin 2\theta = 2\sin\theta\cos\theta$
$\cos 2\theta = \cos^2\theta - \sin^2\theta$
$= 2\cos^2\theta - 1$
$= 1 - 2\sin^2\theta$</td>
<td>(a) ½ (half the total area)

<u>Step 1: Equation of sinusoidal graph</u>

$\mathbf{\Psi = A \sin (kx)}$

$\mathbf{\Psi^2 = A^2 \sin^2 (kx) = \frac{1}{2} A^2 [\, 1 - \cos (2kx)\,]}$

<u>Step 2: Integration of full graph</u>

Probability of finding electron between 0 and l = 1

$\int_0^l |\Psi|^2\, dx = \int_0^l \frac{1}{2} A^2 [\, 1 - \cos (2kx)\,]dx = 1$

Replace k = $\frac{\pi}{L}$

$\frac{1}{2} A^2 \int_0^L [\, 1 - \cos (2\pi/L\, x)\,]dx = 1$
$\frac{1}{2} A^2 [x - \frac{1}{2} L/\pi \sin (2\pi/L\, x)\,]_0^L = 1$
$\frac{1}{2} A^2 ([L] - [0]) = 1$
$\frac{1}{2} A^2 L = 1$

$A = \sqrt{(2/L)}$</td></tr>
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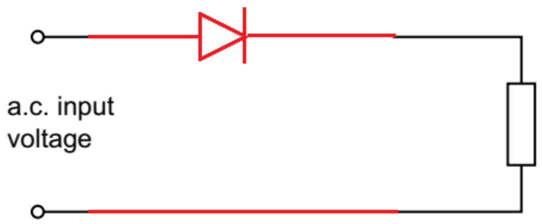
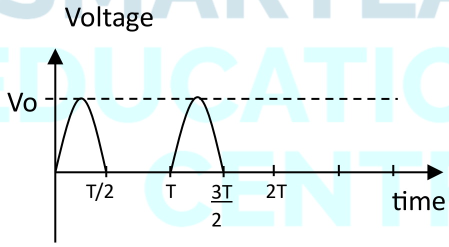
</td></tr>
<tr><td>7 ai)</td><td>The average range of a car using an ICE is 800 km. The average cost to refuel an ICE car is S$80 → cost to travel 1.0 km in an ICE car = 80/800 = $0.10

The home battery charger for the typical EV uses an a.c. supply to provide power of 7.2 kW … The battery takes 10 hours to fully charge – the manufacturer describes this as a ‘charging speed’ of 40 km h^{-1}
→ 1 hr of charging; energy provided = 7.2 kW x 1hr = 7.2kWh
→ cost to travel 1.0 km in a typical EV = $\frac{7.2 \times \$0.23}{40}$ = $0.0414

Ratio = $\frac{\$0.0414}{\$0.10}$ = 0.414 = 0.41 (2 sfg)</td></tr>
<tr><td>ii)</td><td>In Singapore, a car typically travels 290 km a week

Range of single charge is 400km > 290 km per week.</td></tr>
<tr><td>bi)</td><td>An equivalent direct current of 32 A
→ 2 A x 16 sets of batteries in parallel</td></tr>
</table>

	home battery charger for the typical EV uses an a.c. supply to provide power of 7.2 kW **→ P = 7200W = I x E → Emf, E = 225V → total number of cells = 225V/3.0V = 75** **Arrangement of cell: 16 sets of 75 cells arranged in parallel**
ii)	By charging for 1 hr, the range for the EV/distance travel by EV is 40km
iii)	Amount of energy stored (Wh is equivalent to J) in the EV battery per unit mass of the battery
iv)	1 hr of charging; energy provided = 7.2 kW x 1hr = 7.2kWh = 7200 Wh Mass of battery x 141 W h kg^{-1} = 7200 Wh Mass of battery = 51.064 = 51 kg (2sfg)
v)	Lower Centre of gravity for the car improves stability and prevent toppling of car
ci)	
ii)	
d)	KE = ½ mv^2 = ½ $(1685kg)(25)^2$ = energy stored in battery = 526,562.5 J For 400km range, energy stored in battery = 72kWh = 72000 x 60 x 60 J For regenerated braking system, Calculated range = $\frac{½ (1685kg)(25)^2}{72000 \times 60 \times 60}$ x 400 = 0.8126 = 0.81 km (2sfg)
ei)	Constantly changing magnetic field so that magnetic flux is constantly changing and an induced emf is generated to charge the battery
ii)	Concentrate the magnetic field strength in order that the rate of change in magnetic flux is sufficiently large enough to produce an induced emf large enough to charge the EV battery
fi)	maximum output torque = 395 N m = 2 x F x ½ d = F x d = NBIL x d = NBIA 395 N m = NBIA = 1200 x B x 96A x $(0.0061m^2)$ → B = 0.5621 = 0.56 T (2sfg)
ii)	Magnetic field is more radial, which ensures that the current flow through the coil is subjected to a uniform magnetic field that is perpendicular to the current flow. The force is thus perpendicular to the coil at all times and enables a consistent torque/moment to be applied to the rotating coil