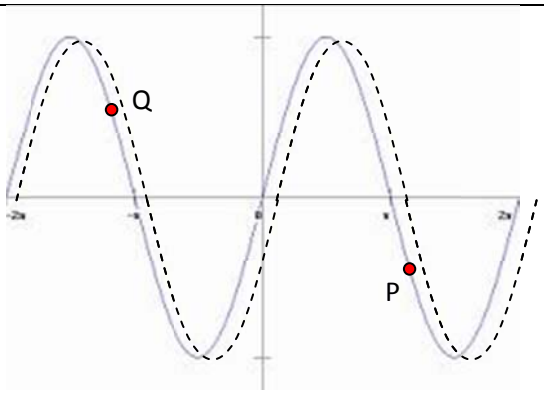
Innova Junior College
2011 Prelims 2
H1 Physics Paper 1 solutions

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

Qn	Solution	Qn	Solution
1	$\rho = \frac{M}{V} = \frac{M}{\pi\left(\frac{D}{2}\right)^2 L} = \frac{4M}{\pi D^2 L}$ $\frac{\Delta\rho}{\rho} = \frac{\Delta M}{M} + 2\frac{\Delta D}{D} + \frac{\Delta L}{L}$ $\frac{\Delta\rho}{814.89} = \frac{1}{20} + 2\frac{0.1}{2.5} + \frac{0.1}{5.0}$ $\Delta\rho = 122.2335 \approx 100$ (to 1 S.F.) Hence, density = 800 ± 100 (round off 814.89 to the same digit placing as 100)	11	Torque of couple = F x d = 8.0 x (0.60 sin60°) = 4.2 N m
2	GPE = mgh = (70) x (9.81) x (4 x 3.5) = 96138 J Approximately 100 kJ	12	By definition, power = rate of work done. Instantaneous power = Force x velocity
3	For a uniformly increasing speed, the acceleration is constant.	13	Minimum Work Done = increase in GPE = 50 x 9.81 x 1.6 = 780 J
4	Horizontal distance traveled = 12 m Vertical distance traveled = 2.0 m (taking downwards as positive) Time taken, t = (12 / v) Using s = ut + ½ a t^2, 2.0 = (0) + ½ (9.81) (12 / v)^2, v = 19 m s^{-1}	14	$\Delta\phi = \frac{\Delta x}{\lambda} \times 2\pi$ $\Delta\phi = \frac{3.0}{5.0} \times 2\pi = 3.8$ rad
5	Draw a tangent to the curve at t = 3s, then estimate the gradient of this tangent. Acceleration = gradient = 1.0 m s^{-2}	15	Infra-red: low f, large λ X-rays: high f, small λ Speed of all EM radiation in vacuum is the same (speed of light)
6	For elastic collision, the total momentum of the system (2 masses m) and kinetic energy of the system is conserved. Total KE before collision = ½ mv^2 + ½ mv^2 = mv^2.	16	 Wave is moving from left (Q) to right (P). P has to be in this quarter since it is displaced downwards but moving upwards. Q has to be in this quarter as it is 1.25λ away from P. Given its position, it is displaced upwards and moving upwards.
7	Net force vertically = 10000 – 9000 = 1000 N (upwards)	17	For X: A quarter wave is formed in the tube such that: λ = 4L and hence fundamental frequency for X,

	Net force horizontally = 500 N (right wards) Resultant force = $\sqrt{1000^2 + 500^2}$ = 1100 N		$f_x = \frac{v}{4L}$ For Y: Half a wave is formed in the tube such that λ = 2L and hence fundamental frequency for Y, $f_y = \frac{v}{2L}$ Hence, the ratio will be 1:2
8	Ave F = $\Delta P/\Delta t$ = $(P_1 - P_2) / (t_2 - t_1)$	18	Since the waves came from the same source at O (started in phase) and constructive interference occurred at X, this means that the path difference must be equal to integer times of the wavelength. Wavelength = 28 mm Path OX = 400 mm Path OY must be equal to 400 + n(28) Only possible answer is 456 mm (D)
9	Taking moments about the pivot, W (1.0) = 50 N (0.5) W = 25 N	19	Amplitude of vibration is minimum at nodes (destructive interference always). Amplitude of vibration is maximum at anti-nodes (constructive interference always).
10	The spring constant k of each spring is W/3 = kx k = W / 3x Now that 2W is hung with 2 springs, then each spring will carry a load of W. Let the new extension be y. For each spring, W = (W / 3x) y y = 3x	20	Charge flows = area under the graph = ½ (100 mA + 20 mA) (8) = 480 mC

Qn	Solution	Qn	Solution
21	Definition of Ohm's Law		
22	The minimum resistance of variable resistor is zero. Hence the p.d. across it is zero. The maximum resistance of variable resistor is 50 kΩ. Hence p.d. is V = 9.0 V x 50 kΩ / (50 kΩ + 10 kΩ) = 7.5 V		
23	At 4.0 V, the resistances of P is 4.0 / 1.0 = 4.0 Ω. At 4.0 V, the resistances of Q is 4.0 / 0.5 = 8.0 Ω. The effective resistance of P and Q is $(1/4 + 1/8)^{-1}$ = 2.67 Ω		
24	Using right hand grip rule for currents in A and C, both magnetic fields at O are pointing towards B (tangent to circular field pattern). So the resultant field will also point in that same direction.		
25	B field due to P is also circular in pattern, which will coincide with current in Q. Since current in Q is parallel (or in the same direction) as the B field that P applies on Q, there is no force induced.		
26	Distance is halved means that the field strength experienced by each wire is doubled. Both currents are further doubled means that the force experienced by each wire will be 4 times. In total, the force will be 8 times.		
27	Force = $\frac{\Delta P}{\Delta t} = \frac{N}{t} \times (\text{change in momentum of each photon})$ $= \frac{N}{t} \times \left(2\frac{h}{\lambda}\right)$ Hence rate of photon arrival $\frac{N}{t}$ $= 2.50 \times 10^{-20} \div \left(2 \times \frac{6.63 \times 10^{-34}}{580 \times 10^{-9}}\right) =$ 1.1 x 10^7 s^{-1}		
28	hf = eV_s + Φ eV_s = hf - Φ V_s = (h/e)f - Φ/e Hence, gradient = h/e h = gradient x e = $eV_1 / (f_1 - f_0)$		
29	Φ = hf - eV_s = (6.63 x 10^{-34})(3 x 10^8)/(150 x 10^{-9}) – (1.6 x 10^{-19}) x (1.9) = 1.022 x 10^{-18} J = 6.4 eV		
30	$eV = \frac{1}{2}mv^2 = \frac{p^2}{2m} = \frac{\left(\frac{h}{\lambda}\right)^2}{2m}$		

	This means that $V \propto \frac{1}{\lambda^2}$ and hence $\lambda \propto \frac{1}{\sqrt{\lambda}}$		