2018 H2 9749 Physics Paper 1

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

1	**Ans A** $g = 4\pi^2 \frac{L}{T^2}$ $\frac{\Delta g}{g} = 2\frac{\Delta T}{T} + \frac{\Delta L}{L}$ $2\% = 2\frac{\Delta T}{T}\% + \frac{0.05}{6.25} \times 100\%$ $\frac{\Delta T}{T}\% = 0.6\%$ Common mistake: Fail to make g the subject (required in the question when it mentioned "such that g can be determined with…"). Failure to do so will get another answer.	
2	**Ans A** Net area under v-t graph = displacement [consider direction] Hence, displacement of P is different from that of Q. Distance travelled = sum of magnitudes of areas of triangles between the graph line and the time axes Hence, the total distance by P is larger than that of Q. Common mistake: Failure to calculate areas of triangles and adding correctly for the distance covered.	
3	**Ans B** Impulse = change in momentum magnitude of impulse = $\lvert mv_f - mv_i \rvert$ $= \frac{80}{1000}\lvert -18 - 23 \rvert$ $= 3.3$ N	

4	**Ans C** taking rightwards as positive total initial momentum $= 5.0(4.0) + 2.0(-3.0) = 14$ kg ms^{-1}(rightwards) By conservation of linear momentum total initial momentum = total final momentum $14 = 7(v_f)$ $v_f = 2.0$ kg ms^{-1}(rightwards)	
5	**Ans: A** Before tying the 200 g mass, the broom is balanced, hence the CG of the broom is at O. After tying the 200 g mass and shifting the broom to balance again, by principle of moments: mass of broom x g x 0.27 = 0.2 x g x (1.05 – 0.10 – 0.27) mass of broom = 0.503 kg	
6	**Ans: A** Weight of water displaced = Upthrust on barge = Weight of barge	
7	**Ans: C** Constant speed, hence no resultant force driving force $F =$ resistive force f $F = kv^2$ $P = Fv = kv^2(v) = kv^3$ $P \propto v^3$ $\frac{P_1}{P_2} = \frac{{v_1}^3}{{v_2}^3}$ $P_1 = \frac{40^3}{20^3} \times 23$ kW $= 184$ kW	
8	**Ans: B** S is lower than R,, hence GPE at S is lower Electrons move from S to R as seen from the polarity of the cell. By COE, electrons will gain KE and lose EPE, hence EPE at S is higher.	
9	**Ans: D** Angular velocity of all points on the disc must be the same. So P and Q have the same angular velocity. After a quarter of revolution, both P and Q will move through the same angular displacement of π/2.	
10	**Ans A** At the top: $T + W = Mr\omega^2$ $T = Mr\omega^2 - W$	

11	**Ans C** The spacecraft can move in any circular orbit that with centre of Earth as centre of the circular orbit. So options A, B and D are possible. Option C is not possible, as it cannot be part of a circular orbit with centre of Earth at the centre.	
12	**Ans D** pV = nRT p = nRT/V 1/p = V/nRT Gradient of graph = 1/nRT If n and T are both doubled, the gradient is ¼ of the original.	
13	**Ans D** The difference in length of the arrows represents the net flow of thermal energy to the objects. An object at a lower temperature than the ambient will have a net flow of thermal energy into the object. The converse is true. X – Net flow into. i.e. X is **<u>below</u>** ambient temperature of 30°C Y – No net flow i.e. Y is **<u>same</u>** as ambient temperature of 30°C Z – Net flow out i.e. Z is **<u>above</u>** ambient temperature of 30°C	
14	**Ans C** *<u>Process 1:</u>* By first law of thermodynamics, Increase in internal energy $\Delta U_1 = Q_1 + W_1$ $\Delta U_1 = 2800 + (-600) = 2200$ kJ [Note: WD on system = −600 kJ] *<u>Process 2:</u>* Since this is system returns to original state, $\Delta U_1 + \Delta U_2 = 0$ or $\Delta U_2 = -2200$ kJ By first law of thermodynamics, Increase in internal energy $\Delta U_2 = Q_2 + W_2$ $-2200 = 1000 + W_2$ $W_2 = -3200$ kJ [Note: WD on system = −3200 kJ] Hence work done by system = $-W_2$ = 3200 kJ	

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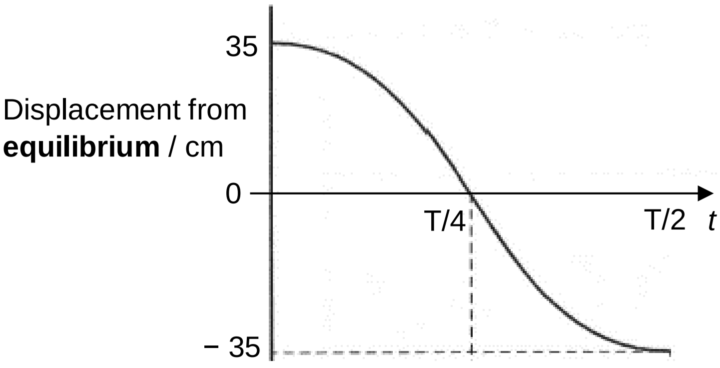
Ans D

Equilibrium point is at mid-point of 100 cm and 30 cm mark. i.e. 65 cm.
Recalibrating graph:



Option A: Wrong. Amplitude = 35 cm
Option B: Wrong. At T/2 oscillation at amplitude i.e. kinetic energy = 0 J
Option C: Wrong. Acceleration is maximum at amplitude positions (e.g. 0 T/2) and minimum at equilibrium positions (e.g. T/4). Acceleration is a result of restoring force.
Option D: Correct. Mass at equilibrium position where speed is fastest.

16

Ans C

$I \propto A^2$

$$\frac{I_X}{I_Y} = \left(\frac{A_X}{A_Y}\right)^2 = 4$$

i.e. **intensity** of wave X is **four times** compared to that of wave Y.

$$\lambda = \frac{v}{f}$$

$$\frac{\lambda_X}{\lambda_y} = \frac{f_Y}{f_X} = \frac{1}{2}$$

i.e. **wavelength** of wave X is **half** compared to that of wave Y.

17

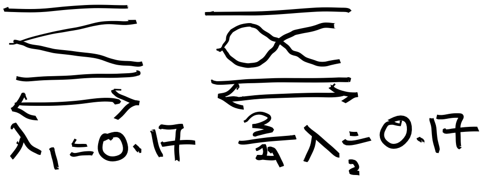
Ans: D

$$x = \frac{\lambda d}{a}$$

$$\frac{x_2}{x_1} = \frac{\lambda_2}{\lambda_1}$$

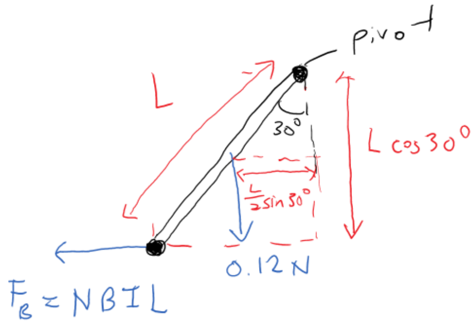
$$x_2 = \frac{\lambda_2}{\lambda_1} \times x_1 = \frac{600}{450}(1.2 \times 2) = 3.2mm$$

Comments: Please take note that 1.2 mm was the center to fringe value. You need to multiply by 2 to get the new fringe to fringe distance.

18	Ans: C. Since $v = f\lambda$, with constant v,as frequency is increased, the original first node will now become the second node of the new wavelength(where $\lambda_2 = \frac{1}{3}\lambda_1$).  $f_1 = \frac{340}{4\times 0.17} = 500$ $\frac{f_2}{f_1} = \frac{\lambda_1}{\lambda_2}$ $f_2 = 3\times 500 = 1500 Hz$	
19	**Ans: C.** Definition of electric field strength : electric force experienced per unit positive charge	
20	**Ans: A** Separation of equipotential gets smaller nearer to the 2 charges. Thus the rate at which potential changes with respect to distance increases→ magnitude of E increases since magnitude of E =dv/dr. Together with the fact that E field is always pointing to the right, A is the answer.	
21	**Ans A** $R = \frac{\rho L}{A}$ $P = I^2 R = I^2\left(\frac{\rho L}{A}\right)$ $\rho = \frac{PA}{I^2 L}$ $= \frac{400\times 10^{-3}(1.2\times 10^{-3})(1.5\times 10^{-2})}{(40\times 10^{-3})^2(1.8\times 10^{-2})} = 0.25\ \Omega m$	
22	**Ans A** Emf of cells = 1.5 x 3 = 4.5 V Internal resistance = $\left(\frac{1}{0.2\times 3} + \frac{1}{0.2\times 3}\right)^{-1} = 0.3\ \Omega$	
23	**Ans D** $V_{9.0\Omega} = 0.5\times 9.0 = 4.5\ V$ $V_{1.0\Omega} = 0.5\times 1.0 = 0.5\ V$ Hence $V_R = V_{6.0\Omega} = 6.0 - 4.5 - 0.5 = 1.0\ V$ $I_{6.0\Omega} = \frac{1.0}{6.0} = 0.166A$ $I_R = 0.5A - 0.166A = 0.334A$ $R_R = \frac{1}{0.334} = 2.99\ \Omega$ Common misconception is that current must spilt equally at the junction, hence opting for either B or C.	

24

Ans: A



By Principle of Moments, net moment about pivot is zero.

Taking moments about pivot,
F_B (L cos 30°) = 0.12 (L/2 sin 30°)
(50)B(0.40)(0.06)(0.06 cos 30°) = 0.12 (0.03 sin 30°)
B = 0.029 T

Comments:
You need to find the correct perpendicular distance of the magnetic force from the pivot.

Take note that the coil has 50 turns, not 1 turn.

25

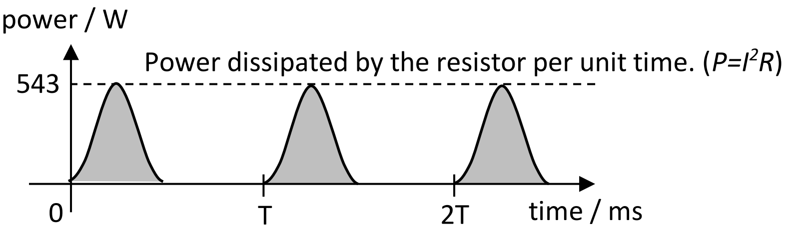
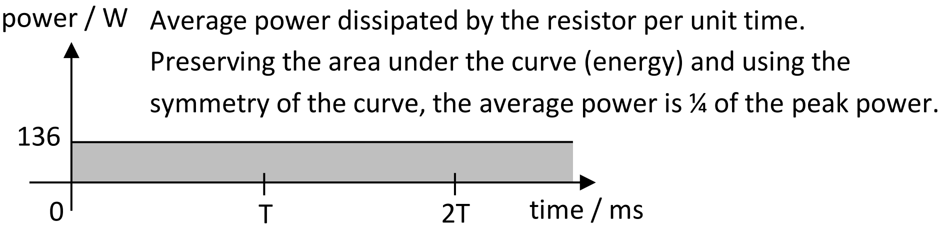
Ans: A

As the magnet moves towards the top of the coil, there is an increase in magnetic flux linking the coil in the upward direction (number of upwards field lines passing through the coil increases). By Lenz's Law, this will result in an induced emf in the coil that would cause a current to flow in a direction so that it generates a magnetic flux in the downward direction to oppose the increase in downwards flux linkage.

As the magnet moves inside the coil, as there is no change in flux linkage through the coil, so no emf is induced.

As the magnet moves away from the bottom of the coil, there is a decrease in flux linkage in the upward direction (number of upwards field lines passing through the coil decreases). By Lenz's Law, this will result in an induced emf in the coil that would cause a current to flow in a direction so that it generates a magnetic flux in the upward direction to oppose the decrease in upwards flux linkage.

Hence the induced emfs are opposite directions for the start (when approaching top of coil) and end (when moving away from bottom of coil) of the fall.
While when magnet is falling inside the coil, induced emf is zero.

26	**Ans: A** For a solenoid, the magnetic flux density at the centre of solenoid is given by B = $\mu_0 n I$, where μ_0 is the permeability of free space (a constant), n is the number of turns per unit length of solenoid and I is the current in the solenoid. For (resultant) magnetic flux density at X to be zero, the flux density due solenoids P and Q respectively must equal in magnitude (and opposite in direction) i.e $B_P = B_Q$ Since the solenoids are connected in series to a power supply, the current I is the same for both solenoids. Hence: $B_P = B_Q$ $\mu_0 n_P I = \mu_0 n_Q I$ Therefore, $n_P / n_Q = 1$ And since both solenoids have same length, and n = N/L, where N is the number of turns on solenoid and L is the length of solenoid, $N_p / N_Q = 1$ Comments: This question requires the consideration of several factors affecting the magnetic flux density associated with two co-axially mounted solenoids and is considered a complex problem.	
27	**Ans C**   Comments: Be wary of the fact that this is a half rectified wave and would not obey $P_{avg} = \frac{1}{2}P_{peak}$, which refers strictly to the full sinusoidal alternating current. All other current waveforms require separate derivations.	

28	**Ans A** $E_{\text{in electron-volts}} = \dfrac{hc}{\lambda e} = \dfrac{(6.63\times10^{-34})(3.0\times10^{8})}{(633\times10^{-9})(1.6\times10^{-19})} = 1.96\text{ eV}$ This corresponds in a de-excitation from W to X.	
29	**Ans B** The notation follows the general form $^{\text{nucleon number}}_{\text{proton number}}X$	
30	**Ans D** $\dfrac{t_{1/2,X}}{t_{1/2,Y}} = \dfrac{\lambda_Y}{\lambda_X}$ $\left(\text{since } t_{1/2} = \dfrac{\ln 2}{\lambda}\right)$ $= \dfrac{A_Y/N_Y}{A_X/N_X}$ $(\text{since } A = \lambda N)$ $= \dfrac{A_Y N_X}{A_X N_Y} = \dfrac{(4.60\times10^{7})(4.00\times10^{19})}{(3.68\times10^{8})(2.00\times10^{19})} = 0.250$	