Paper 1 – Multiple Choice Questions

1	**Answer: C**
	The average value is 47.78 mm which is not close to the true value so not accurate. There is a variation in measurements. So it is not precise.

2	**Answer: D**
	time taken to travel first 90 km = $\dfrac{\text{distance}}{\text{<speed>}} = \dfrac{90}{80} = 1.125 \text{ hour}$ time taken for remaining 110 km = 0.875 hour $< speed > = \dfrac{\text{total distance}}{\text{total time}} = \dfrac{110 \text{ km}}{0.875 \text{ hour}} = 126 \text{ km h}^{-1}$

3	**Answer: A**
	$3kx = mg \quad ---(1)$ $2kx' = mg \quad ---(2)$ $\dfrac{(2)}{(1)} : \dfrac{2x'}{3x} = 1$ $x' = \dfrac{3}{2}x$ $x' - x = \dfrac{3}{2}x - x = 0.5x = 0.5(0.40) = 0.20 \text{ cm}$

4	**Answer: A**
	$mg - T = ma$ $(0.50)(9.81) - T = (0.50)a - - - (1)$ $T - friction = m'a$ $T - 3.5 = (0.20)a - - - (2)$ Solving (1) and (2): $a = 2.0 \text{ m s}^{-2}$

5	**Answer: B**
	Change in velocity = final velocity – initial velocity $= \sqrt{0.40^2 + 0.30^2} = 0.50 \text{ m s}^{-1}$ Change in momentum = $m\,\Delta v$ = (0.20)(0.50) = 0.10 kg m s^{-1}

6	**Answer: C**
	$Thrust = weight$ $4\dfrac{m}{t}\Delta v = mg$ $4\left(\dfrac{0.400}{1.00}\right)(v - 0) = 1.20(9.81)$ $v = 7.36 \text{ m s}^{-1}$

7	**Answer: B**
	$(3m)(4) = mv\sin\theta$ $(2m)(6) = mv\cos\theta$ $\tan\theta = 1$ $\theta = 45°$

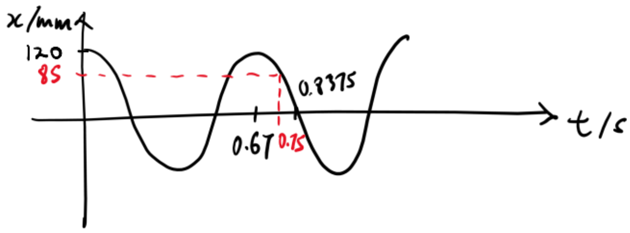
8	**Answer: B**
	Constant speed, so no change in E_k. $E_p = mgh$ $\frac{dE_p}{dt} = mg\frac{h}{t} = mgv$ hence constant gradient

9	**Answer: A**
	$F_{drive} = F_{resistive} + W\sin\theta$ $\frac{60}{100}\frac{P}{v} = F_{resistive} + mg\sin\theta$ $\frac{60}{100}\times\frac{80000}{6.5} = F_{resistive} + (1000)(9.81)(\sin 45^o)$ $F_{resistive} = 450$ N

10	**Answer: A**
	Vertical equilibrium: $kx\cos\theta = mg$ --- (1) Vertical component of tension = weight Horizontal component of tension provides centripetal force $kx\sin\theta = mr\left(\frac{2\pi}{T}\right)^2$ --- (2) $\frac{(2)}{(1)}: \tan 27^o = \frac{4\pi^2(0.108\sin 27^o)}{T^2(9.81)}$ T = 0.62 s

11	**Answer: A**
	For satellite in orbit, *TE* = – *KE*, so option A is correct. Since $KE = \frac{GMm}{2r}$, larger *m* with same *KE* requires larger *r*, so option B is incorrect. Since $T^2 = \frac{4\pi^2}{GM}r^3$, larger *r* will result in larger *T*, so option C is incorrect. Since $\omega = \frac{2\pi}{T}$, larger *T* means smaller *ω*, so option D is incorrect.

12	**Answer: C**
	"It has a property that varies linearly with temperature" is **not strictly essential** but rather an **assumption** used in constructing **empirical centigrade scales.**

13	**Answer: D**
	$T = \frac{1}{f} = \frac{1}{1.5} = 0.67$ s $x = x_0 \cos \omega t$ $x = 0.12 \cos[(2\pi)(1.5)(0.75)]$ $x = 0.0848 \text{ m} = 85 \text{ mm}$  Distance = 120 × 4 + (120 – 85) = 515 mm

14	**Answer: C**
	Particles are displaced away from the equilibrium positions towards the centre of the compression. Right is taken to be positive (distance from P) Particles displaced rightwards have positive displacements and leftwards have negative displacements.

15	**Answer: C**
	$I = (I_0 \cos^2(30^o))(\cos^2(60^o))$ $I = 0.19 I_0$

16	**Answer: C**
	$A_{net} = A_P + A_Q = A + A = 2A$ $I = kx_0{}^2 \rightarrow I = k(2A)^2 ---(1)$ $A_{net} = A_P + A_Q = 2A + A = 3A$ $I = kx_0{}^2 \rightarrow I' = k(3A)^2 ---(2)$ $\frac{(2)}{(1)} : \frac{I'}{I} = \frac{k(3A)^2}{k(2A)^2} \rightarrow I' = 2.3I$

17	**Answer: C**
	$x = \frac{\lambda D}{a} = \left(\frac{3.00\times10^{8}}{1.5\times10^{12}}\right)\left(\frac{4.0}{80\times10^{-3}}\right) = 10 \text{ mm}$ $2.5x$ = 25 mm

18	**Answer: A**
	$d\sin\theta = n\lambda$ 4 orders are observed and for max angle of 90^o, $d\sin 90^o = (4)(5.50\times10^{-7})$ $d = 2.20\times10^{-6}$ m If 5 orders were to be observed, $d\sin 90^o = (5)(5.50\times10^{-7})$ $d = 2.75\times10^{-6}$ m Larger the value of d results in more orders observed. OR $4 \le \left[\frac{d\sin 90^o}{\lambda} = n\right] < 5$ $4\lambda \le d < 5\lambda$ $2.20\times10^{-6} \le d < 2.75\times10^{-6}$

19	**Answer: C**

$$\frac{s}{r} = \frac{\lambda}{b}$$

$$\frac{s}{20 \times 3.00 \times 10^8 \times 365 \times 24 \times 60 \times 60} = \frac{550 \times 10^{-9}}{3.0}$$

$s = 3.47 \times 10^{10}$ m

20	**Answer: A**

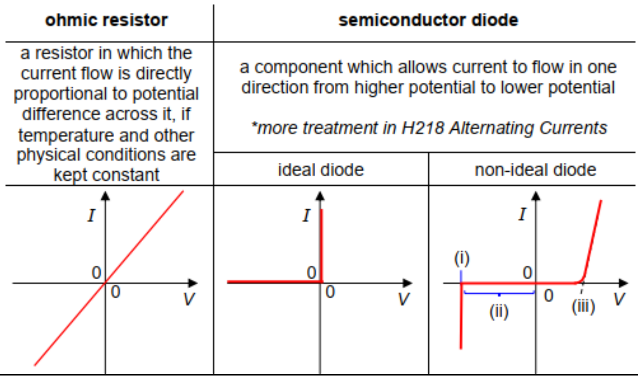
$I = nAve, where\ n\ is\ electron\ density$

$I = \frac{N}{AL} Ave\ , where\ N\ is\ the\ number\ of\ electrons$

$v = \frac{IL}{Ne} = \frac{5 \times 2}{1.5\ \times 10^{24} \times 1.6 \times 10^{-19}} = 4.17\ \times 10^{-5}\ ms^{-1}$

21	**Answer: D**

After overcoming the threshold voltage, the diode's resistance become negligible. The resistance of the fixed resistor is shown by having a constant V to I ratio, i.e. a straight line graph that cuts through the origin.



ohmic resistor	semiconductor diode	
a resistor in which the current flow is directly proportional to potential difference across it, if temperature and other physical conditions are kept constant	a component which allows current to flow in one direction from higher potential to lower potential *more treatment in H218 Alternating Currents*	
	ideal diode	non-ideal diode

22	**Answer: C**

$$R = \frac{\rho l}{A} = \frac{\rho V^{\frac{1}{3}}}{V^{\frac{2}{3}}} == \frac{\rho}{V^{\frac{1}{3}}}$$

23	**Answer: A**
	Since both branches have the same ratio vertically downwards, there is no current flowing through the middle horizontal wire. $\frac{1}{R_{eff}} = \frac{1}{10k + 30k} + \frac{1}{6.0k + 18k}$ $R_{eff} = 15\ k\Omega$ **OR** Since p.d. across the 10 kΩ and 6 kΩ resistors are the same, they can be treated as being a parallel connection. Similarly the 30 kΩ and 18 kΩ resistors can be viewed as a parallel connection also. $R_{eff} = \left(\frac{1}{10} + \frac{1}{6.0}\right)^{-1} + \left(\frac{1}{30} + \frac{1}{18}\right)^{-1}$ $= 15\ k\Omega$ The 1st method only works if resistors in both branches have the same ratio. The 2nd method always works.

24	**Answer: A**
	$V_{15\Omega} = V_R + V_{2.0\Omega}$ and using $V = IR$ $(0.48)(15) = (0.45)R + (0.45)(2.0)$ $R = 14\ \Omega$ $V_{15\Omega} = E - V_r$ $(0.48)(15) = 10 - (0.45 + 0.48)r$ $r = 3.0\ \Omega$

25	**Answer: B**
	For particle *Y* to be undeflected, electric force and magnetic force acting on *Y* must be in opposite direction. E field direction must be upwards for the electric force acting on particle *Y* to be in the opposite direction as the magnetic force (applying Fleming's Left Hand Rule) regardless of the polarity of particle *Y*.

26	**Answer: C**
	Increasing current I_S increases the magnetic force on *XY*. This increases the moment from the magnetic force pushing *XY* into the paper. Sliding the weight towards *WZ* increases the the perpedicular distance between the weight and pivot *KL*. This helps to counter-balance the increased moment from the magnetic force.

27	**Answer: A**
	By Faraday's Law, $\|E\| = \frac{N\Delta BA}{\Delta t}$ $= \frac{50(0.40)(0.08\times 0.05)}{0.20}$ $= 0.40\text{ V}$ By Lenz's Law, current flows in a direction to oppose the decrease in magnetic flux density (into page). This means that it should flow to produce more magnetic flux into page. By right hand grip rule, the induced current flows clockwise.

28	**Answer: C**
	For sine wave, $V_{rms\_1} = \sqrt{\dfrac{\frac{V_o^{\ 2}}{2} \times T}{T}} = \dfrac{V_o}{\sqrt{2}}$ For half-wave square wave, $V_{rms\_2} = \sqrt{\dfrac{V_o^{\ 2} \times \frac{T}{2}}{T}} = \dfrac{V_o}{\sqrt{2}}$ Ratio required = $\dfrac{\frac{V_o}{\sqrt{2}}}{\frac{V_o}{\sqrt{2}}} = 1$

29	**Answer: D**
	The is not enough energy between the highest and lowest energy levels of a Hydrogen atom to emit X-rays.

30	**Answer: C**
	This is because most of the alpha particles go through the empty space undeflected. Most of the atom's mass must be concentrated.