Sec 4 Physics

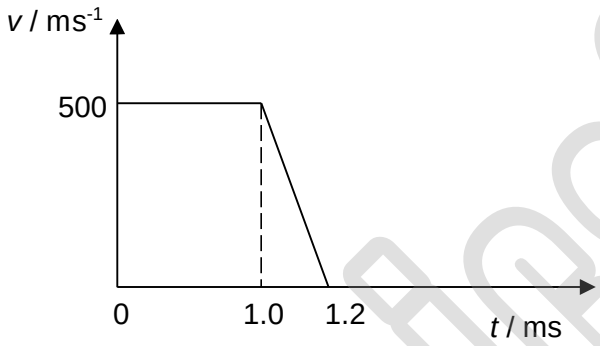
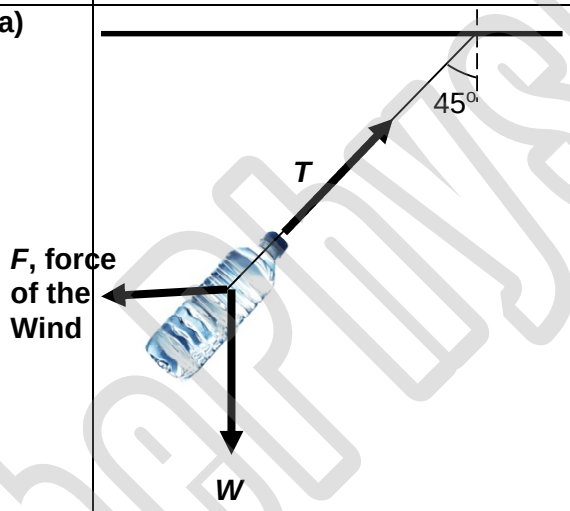
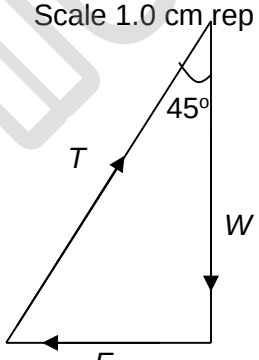
Exam papers with worked solutions

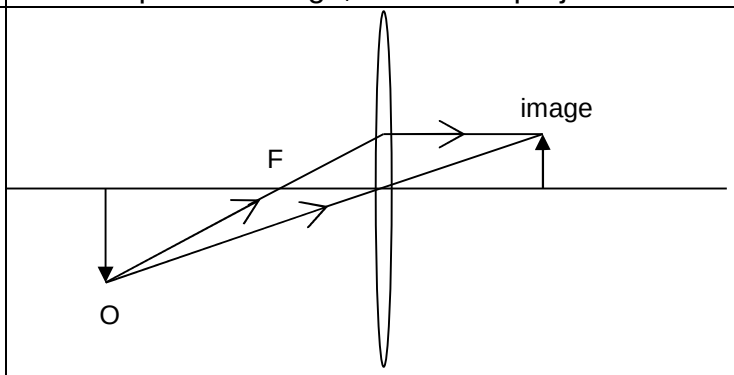
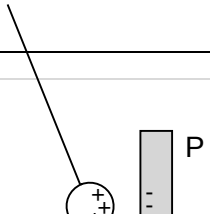
SET C
PAPER 2
ANSWER

Compiled by

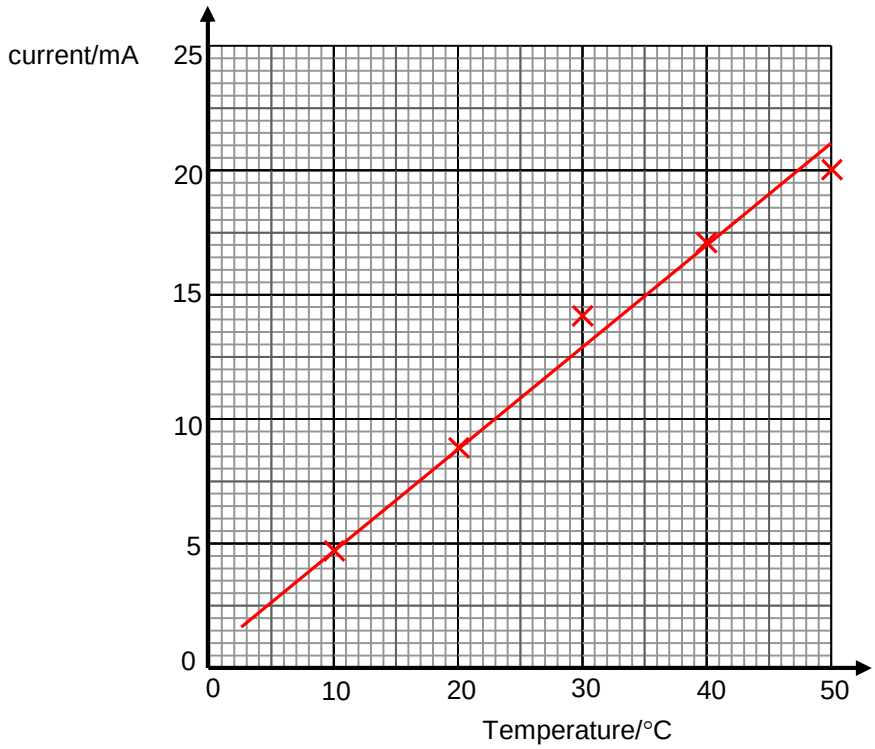
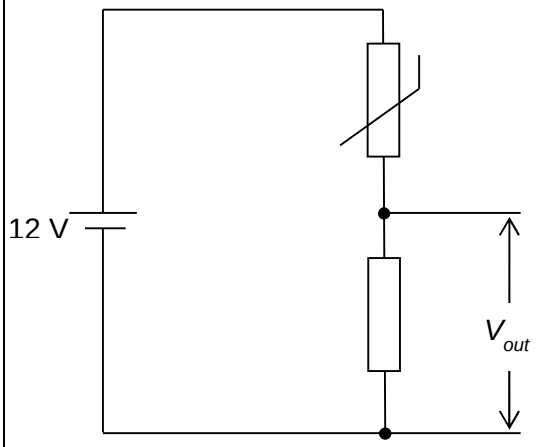
THE PHYSICS CAFE

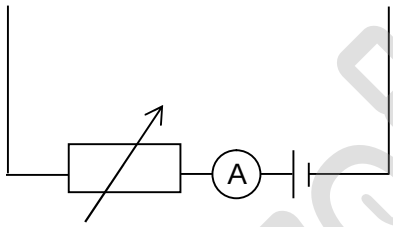
Section A

1	**(a)**	$KE = ½ mv^2$ $= ½ (0.030)(500)^2$ $= 3750$ J
	(b)	KE = work done by retarding force $3750 = F \times 0.05$ $F = 75\,000$ N
	(c)	$F = ma = 0.030 \left(\frac{v-u}{t}\right)$ $-75\,000 = 0.030 \left(\frac{0-500}{t}\right)$ $t = 0.00020$ s or 2.0×10^{-4} s
	(d)	
2	**(a)**	
	(b)	Scale 1.0 cm rep 2.0 N  $T = 21.213$ N $= 21.2$ N (3 sf) (19.2 N to 23.2 N accepted)
	(c)	$F = ma$ $a = \frac{F}{m} = \frac{21.2}{1.5} = 14.142 = 14.1$ m s^{-2}

3	**(a)**	As the distance to the hinge is longer, less force would be needed to apply the same turning effect.
	(b)(i)	**Taking moments about the hinge H** Clockwise moments = Anticlockwise moments $F \times 0.03 = 4.0\ (0.14)$ $F = 18.6667\ \text{N} = 18.7\ \text{N}$
	(b)(ii)	The ratio of force applied to force on nut is ratio of the respective distances from the pivot. $(d_{applied} / d_{nut})^{-1} =$ **0.214**.
	(c)	The force on the left handle serves to keep the nutcracker **<u>stationary</u>** as the **<u>force on the right handle pushes against the nut.</u>**
4	**(a)(i)**	Pressure is defined as the force acting per unit area.
	(a)(ii)	$p = h\rho g$ $= (0.70)(1.26 \times 10^{-3}/1 \times 10^{-6})(10)$ $= 8820\ \text{Pa}$
	(b)(i)	The particles at X <u>gain heat from the Bunsen Burner flame. Their average kinetic energy increases. The kinetic energy is transferred to the neighouring particles and also through free electron diffusion.</u> Hence the <u>particles at Y are driven into more vigorous vibration. Since temperature is directly proportional to the average kinetic energy of the particles, the temperature increases.</u>
	(b)(ii)	The value of *t* will <u>increase</u>. A longer time is required for the Bunsen flame to supply <u>a larger amount of energy so as to result in the same increase in temperature</u> of the metal rod.
5	**(a)**	Radiation and convection
	(b)(i)	$E = (500)(60)(60)$ $= 1.8 \times 10^6\ \text{J}$
	(b)(ii)	Mass of air $= 5 \times 4 \times 3 \times 1.25 = 75\ \text{kg}$
	(b)(iii)	$E = mc\Delta\theta$ $1.8 \times 10^6\ \text{J} = 75 \times 1000 \times \Delta\theta$ $\Delta\theta = 24\ ^{o}\text{C}$
	(c)	When the fan is placed at the bottom of the bedroom, it will heat up the air there. <u>When temperature of the air increases, its volume expands and its density decreases. This causes it to rise and the cooler air at the top of the room, being denser will sink. Convection currents are set up to effectively heat up the room.</u>
6	**(a)(i)**	Magnifying glass
	(a)(ii)	Photocopier to enlarge, over-head projector
	(b)	
	(c)	Any one of the following: No dispersion of light / optimum use of space (smaller instrument) / cheaper than lens / work over wider wavelength
7	**(a)**	

		When the plate is brought near to the sphere, the electrons in plate P are drawn towards the side nearer the sphere. The opposite side of P becomes positively charged but is neutralised as P is connected to the ground.
	(b)	The sphere is attracted to P as a result as they are of opposite charge.
8	**(a)**	Current in fuse X = current in bulbs A and B = 2(*P*/*V*) = 2(60/240) = 0.5 A Current in fuse Y = current in kettle = 840/240 =3.5 A Current in Z = 0.5 + 3.5 = 4.0 A
	(b)	Fuse X will be unaffected since there is no change in the amount of current flowing through it and it is less than its current rating. (I = 0.5 A) Fuse Y will melt and break the circuit because the amount of current flowing through it is more than its current rating. (I = 10 A) Fuse Z will be unaffected because the amount of current flowing through it is less than its current rating. (I = 10.5 A)
9	**(a)**	Resistance of thermistor = 0.85×10^3 Ω $I = \frac{V}{R}$ $I = \frac{12}{0.85 \times 10^3}$ = 0.014118 A ≈ 0.014 A

	(b)	
	(c)(i)	
	(c)(ii)	$8 = \frac{R}{R + 0.85 \times 10^3} \times 12$ R = 1700 Ω
	(d)	Used to regulate temperature in automobiles Regulate temperature in heater, refrigerator Used as resistance thermometer
10	**(a)(i)**	N and S
	(a)(ii)	When the magnet is rotated, the <u>strength of the induced magnet will continuously vary</u> which would cause a <u>rate of change of magnetic flux linking the coil</u> which would in turn induce an emf. When emf is induced, current will flow.
	(a)(iii)	As the magnet turns, the <u>magnetic flux is always changing</u> (i.e as a pole approaches the end of the iron core, the magnetic flux linkage is increasing and as it moves away from the ends of iron core, the magnetic flux linkage is decreasing). This <u>increase and decrease in magnetic flux linkage would mean that the induced emf will always be alternating</u>, as mentioned in Lenz's Law, hence the current flow will be alternating as well.

	(a)(iv)	Slip rings and brushes are not needed in the set up. They contribute to total resistance in the whole circuit.
	(b)(i)	V = 4V T = 0.04 s $f = 1/T$ = 25 Hz
	(b)(ii)	Amplitude doubles while period is halved
11E	**(a)(i)**	B: North C: South
	(a)(ii)	Anticlockwise
	(a)(iii)	With the magnetic field pointing from B to C and the current moving from P to Q, using Fleming's Left Hand rule, where the index finger is pointing in the N-S direction and the middle finger in the direction of the current, the thumb will show the direction of the force, in which the coil will turn.
	(a)(iv)	The current flowing in the coil would produce a magnetic field around the coil. This magnetic field will interact with the external magnetic field that would give rise to a resultant magnetic field of different strength. A force will always be produced in the direction of the stronger to the weaker field strength.
	(a)(v)	The coil will turn in the opposite direction (Clockwise)
	(b)	Diagram (Ext circuit) 
		Include a battery, ammeter and a variable resistor in the external circuit Set the resistor to its maximum value so that the current flowing in the coil is small enough not to make the coil turn. Slowly reduce the amount of resistance and note the current in which the coil begins to turn through the ammeter. The current will be the smallest current that would rotate the coil
11O	**(a)**	microwave, infrared, visible, ultraviolet
	(b)	In a transverse wave, the direction of oscillations of wave particles is perpendicular to the direction of propagation of the wave.
	(c)	Ultrasound wave travels through air medium. There is only vacuum in outer space.
	(d)(i)	Any possible 2: sunbeds, sterilisation of medical equipment, purification of water, checking of counterfeit currency, forensics, etc.
	(d)(ii)	$f = v/\lambda = (3.0 \times 10^8)/(350 \times 10^{-9})$ $= 8.57 \times 10^{14}$ Hz
	(d)(iii)	Ionisation is the process of forming an ion by the addition or removal of charged particles such as electrons or ions. The cells and tissues of the astronauts may be modified and damaged.