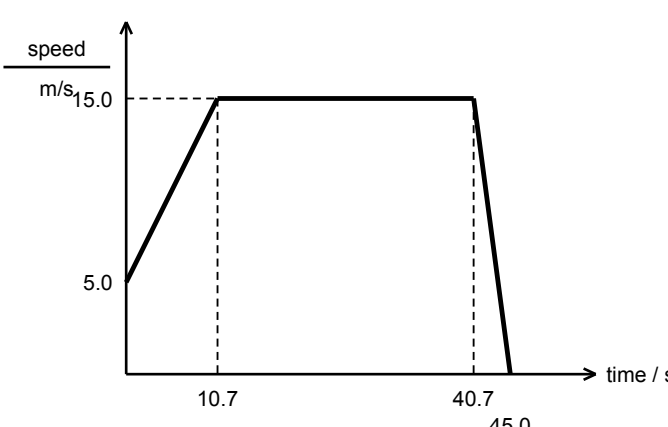


Science (Physics) 5078 – Set I
Mark Scheme

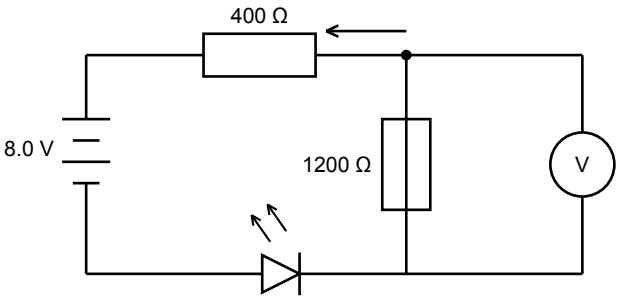
Paper 1

1	2	3	4	5	6	7	8	9	10
D	C	B	B	B	B	C	C	A	C
11	12	13	14	15	16	17	18	19	20
C	D	D	B	D	C	A	B	B	B

Paper 2 – Section A

Qn	Answer	Mark	Comments
1a	0.087 MSHU	[1]	
1b	Pungency is a <u>scalar</u> quantity. It has only magnitude and <u>no direction</u> as observed from the SHUs that <u>do not have any negative values</u> .	[1] [1]	Need to demonstrate understanding that the scale is not vector quantity.
2ai	$F_R = ma$ $1500 = (1600)(a)$ $a = 0.938 \text{ m/s}^2$	[1] [1]	
2aii	$a = (v - u) / t$ $0.938 = (15.0 - 5.0) / t$ $t = 10.7 \text{ s}$	[1] [1]	ecf from 2ai
2aiii	 [1] – constant acceleration drawn as a straight line to 10.7 s [1] – constant speed drawn as a horizontal line to 40.7 s [1] – constant deceleration drawn as a straight line to 45.0 s	[3]	ecf from 2aii
2b	Since the <u>resultant force acting on the truck remains the same</u> , the <u>smaller mass of the truck</u> will mean that the <u>acceleration will be greater</u> , in line with Newton's 2 nd Law ($F_R = ma$).	[1] [1]	
3a	$W = mg$ $= (60)(10)$ $= 600 \text{ N}$	[1]	Must show working.
3b	$M = Fd$ $= (600)(2.5)$ $= 1500 \text{ N m}$	[1] [1]	ecf from 3a. Must show working.

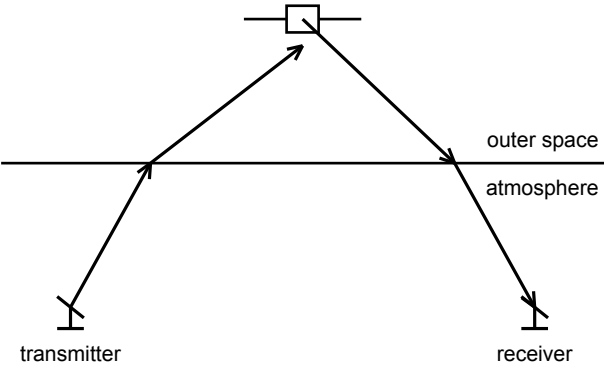
3c	Using Principle of Moments, Anticlockwise moments = clockwise moments $S(0.4) = 1500 + (500)(1.0)$ $S = 5000 \text{ N}$ Since the force exerted on the spring is 5000 N which is less than the maximum force of 8000 N, <u>it is safe</u> for the man to dive from the board.	[1] [1] [1]	ecf from 3b Answer must be supported by correct calculations.
4a	$T = 2500 \text{ N}$	[1]	
4b	$P = Wd / t$ $7500 = mgh / 12$ $7500 = (2500)(h) / 12$ $h = 36 \text{ m}$	[1] [1]	ecf from 4a
4c	Due to presence of <u>friction</u> between the cable and electric motor, <u>energy is lost</u> to the surrounding in the form of heat. Hence, the reduced efficiency of the motor will cause the elevator to be carried up a <u>smaller height</u> than the calculated value.	[1] [1]	
5a	Water nearest to the immersion heater gains heat, expands, becomes less dense and rises. Cooler surrounding water that is denser sinks to replace the rising heated water, thus setting up convection currents that will heat all the water in the mug.	[1] [1]	
5b	Water at the bottom of the cup is mainly heated by conduction which will take a long time since water is a poor heat conductor.	[1]	
6ai	BC and DE		
6aii	EF		
6b	Between D and E, the substance is undergoing freezing. <u>Intermolecular forces of attraction are formed</u> as particles come together. The <u>internal potential energy decreases while the internal kinetic energy remains the same</u>. The temperature of the substance thus remains the same during freezing.	[1] [1]	
6c	There is a lot of space between particles in the gaseous state along AB, thus the particles can come much closer causing contraction to be more significant. The particles are quite closely packed in the liquid state along CD, thus the particles cannot come any closer. Contraction is more limited.	[1] [1]	
7a	There is repulsion between the like charges.	[1]	
7b	Less paint is needed since the object is evenly coated with a thin layer of paint. OR The paint will be evenly coating the object.	[1]	
8a	The work done to drive 1 C of charge across the entire circuit is 8.0 J.	[1]	Units for charge and work done must be correct.

8b & c	 [1] – circuit of LED must be correct, placed in series to battery and be in the correct direction. [1] – arrow of electron flow must be in correct direction and within the circuit.	[2]	
8d	$V = IR$ $8.0 = (I)(400 + 1200)$ $I = 0.0050 \text{ A}$	[1] [1]	
8e	$P = VI$ $= (IR)(I)$ $= (0.0050)(1200)(0.0050)$ $= 0.030 \text{ W}$	[1] [1] [1]	ecf from 8d
9a	J: north K: south	[1]	
9b	The magnitude of the electric current may have been reduced, causing a weaker downward force on XY. To return XY to original position, the weights in the pan must be reduced so that the moments about the pivot are balanced.	[1] [1]	
10ai	Source Z. Gamma rays can penetrate steel but some of the gamma rays are absorbed by the coal, thus reducing the level of radiation detected on the other side of the hopper.	[1] [1]	
10aii	Any two of the following: • Shield the body using lead-lined gloves and coats to limit exposure to radiation • Use long tongs and stand behind concrete walls to increase distance between radioactive source and body • Use remote-controlled devices to limit exposure to radiation • Any other sensible suggestions [1] – each correct suggestion	[2]	

10bi	[1] – accurate plotting of points [1] – accurate drawing of best-fit curve	[2]	
10bii	Time taken for activity to be halved = 1.025 min Time taken for activity to be halved again = 2.075 min Average half-life = $[(2.075 - 1.025) + 1.025] / 2$ = 1.04 min	[1] [1]	Must show broken lines on graph.
10biii 1.	$^{218}_{87}\text{Fr}$	[1]	
10biii 2.	Neutrons = $218 - 87$ = 131	[1]	ecf from 10biii1. Must show calculation.

Section B

Qn	Answer	Marks	Comments
11a	Television mast: radio waves Satellite: microwaves [1] – both are correct		
11b	$3 \times 10^8 \text{ m/s}$	[1]	
11c	$v = f\lambda$ $3 \times 10^8 = (2 \times 10^9)(\lambda)$ $\lambda = 0.15 \text{ m}$	[1] [1]	

11d	 [1] – signal is correctly drawn with ray bent away from normal as it passes into outer space, and bending towards normal as it re-enters the atmosphere. [1] – direction of signal shown using arrows from transmitter to receiver.	[2]	
11e	Any one of the following: • The light cannot penetrate clouds in wet weather. • The light signals will interfere with our vision on the ground. • any other sensible responses.	[1]	
11fi	The ratio of the speed of light in vacuum to the speed of light in the glass cable is 1.5.	[1]	
11fii	$n = 1.5 = \sin i / \sin r$ $1.5 = \sin (90 - 65) / \sin r$ $r = 16^\circ$	[1] [1]	
12ai	When the switch is closed, a current flows in the coil, creating a magnetic field in the iron core and inducing it to be an electromagnet. The iron core then attracts the iron bar to the core, causing the hammer to strike the gong. However, current will stop flowing once the fixed contact is separated from the iron bar. Due to the springy metal, the iron bar will return to original position and close the circuit, thus repeating the striking of the gong until the switch is opened.	[1] [1] [1]	
12aii	It is not a good idea as the stainless steel is a hard magnetic material that will not be easy to magnetise, causing the bell not to ring as loud nor as frequently. Furthermore, once the switch is turned off, the steel may retain its magnetism and cause the iron bar to be permanently attracted to the core.	[1] [1]	
12bi	The larger current will cause the striking of the gong to be louder.	[1]	
12bii	There is no effect on the electric bell.	[1]	
12ci	When the bell is struck, energy is transferred outwards from the bell as a longitudinal wave in a series of compressions and rarefactions. The air particles around the bell vibrate parallel to the direction of the sound wave.	[1] [1]	
12cii	$v = d / t$ $320 = 250 / t$ $t = 0.78 \text{ s}$	[1]	