Question 1

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.1	hydrogen		1	AO1 3.8.1b

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.2	the core		1	AO1 3.8.1c

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.3	nuclear fusion		1	AO1 3.8.1b

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.4	electromagnetic radiation / wave	allow heat or light allow radiation	1	AO1 3.8.1f

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.5	red white black	must be in this order allow **1** mark if 2 are correct allow **1** mark if red is correct but the last two stages are reversed	2	AO1 3.8.1h

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.6	supernova		1	AO1 3.8.1i

Total Question 1		**7**

Question 2

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.1	28		1	AO2 3.7.1f

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.2	+1	allow positive	1	AO1 3.7.1c

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.3	32		1	AO2 3.7.1f

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.4	0	allow neutral	1	AO1 3.7.1c

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.5	a high energy electron ejected from the nucleus		1	AO1 3.7.2e

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.6	the number of protons in the atom changes		1	AO3 3.7.2f

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.7	middle row ticked		1	AO1 3.7.2g

Total Question 2		**7**

Question 3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.1	W = 0.60 × 9.8 W = 5.88 (N)	 allow 5.9 (N)	1 1	AO2 3.1.1e

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.2	the same as the weight of the ball		1	AO1 3.1.3a

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.3	18 = 0.60 × a $a = \frac{18}{0.60}$ a = 30 (m/s^2)		1 1 1	AO2 3.1.3h

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.4	decreases the time it takes for the ball to bounce back to the student's hand.		1	AO3 3.1.3h

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.5	kinetic energy decreases (as the ball slows down) elastic potential energy increases (as the ball changes shape) thermal energy of the ball / air increases	 allow temperature increases	1 1 1	AO1 3.2.2a

Total Question 3		**10**

Question 4

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.1	line starts at 0,0 and is horizontal for 10 minutes		1	AO3 3.4.1
	starts to increase at 10 minutes and continues to 20 minutes	allow curve or straight line	1	
	horizontal line after 20 minutes	line must remain horizontal after 20 minutes	1	
				

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.2	**temperature**			AO4 3.4.1
	measured using a thermometer	allow temperature probe connected to a data-logger/computer	1	
	stir the drink	allow read at eye level (to avoid parallax errors)	1	
	time			
	measured using a stopclock	allow stated times ie every minute	1	
	at regular intervals	allow if seen in answer for temperature	1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.3	$132\ 000 = 0.40 \times L_F$ $L_F = \frac{132\ 000}{0.40}$ $L_F = 330\ 000$ (J/kg)		1 1 1	AO2 3.4.1d

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.4	**Arrangement** the particles in (solid) ice are in a regular pattern the particles in (liquid) water have no fixed arrangement **Movement** the particles in (solid) ice vibrate about fixed position the particles in (liquid) water are free to move	 allow spacing between particles changes	 1 1 1 1	AO1 AO3 3.4.1a

Total Question 4		14

Question 5

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.1	$6.0 \times 10^5 = \frac{Q}{4.0 \times 10^{-6}}$		1	AO1 AO2 3.5.1c
	$Q = 6.0 \times 10^5 \times 4.0 \times 10^{-6}$		1	
	$Q = 2.4$		1	
	coulombs or C		1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.2	$5.0 \times 10^6 = \frac{E}{2.4}$		1	AO2 3.5.1f
	$E = 5.0 \times 10^6 \times 2.4$		1	
	12 000 000		1	
	1.2×10^7 J	allow ecf from question **05.1** allow use of E = IVt	1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.3	distance = speed × time		1	AO3 3.3.3g
	speed of light is so great that time for light to travel to the detector is very small (negligible)		1	
	so distance is time difference × speed of sound in air		1	

Total Question 5		**11**

Question 6

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.1	any two from • volume/mass of water should be the same each time measured with a measuring cylinder • mass/volume of fuel burned should be the same each time measured using a balance • burn each fuel for the same time measured using a stopclock • change in temperature should be the same each time measured using a thermometer	**1** mark for each variable and **1** mark for how each is controlled allow top pan balance for mass allow a measuring cylinder for volume allow distance between the fuel burner and the beaker kept constant by using identical equipment.	4	AO4 3.2.3a

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.2	transferred to the surroundings	allow a specific heating effect	1	AO3 3.2.3b

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.3	$\frac{1.91}{8.3}$ = 0.23 (kg/kWh) $\frac{1.37}{5.5}$ = 0.25 (kg/kWh) 0.23<0.25 so methanol is less polluting.	 allow conclusion consistent with their calculations allow answers given to more than 2 significant figures	1 1 1	AO3 3.2.3c

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.4	hydrogen produces no pollution most countries still generate electricity by burning fossil fuels		1 1	AO3 3.2.3c

Total Question 6		**10**

Question 7

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.1	F = 4000 N		1	AO2 3.1.4c
	$4000 = \frac{m \times 80}{0.5}$	allow correct substitution using an incorrectly/not converted value of F	1	
	$m = \frac{4000 \times 0.5}{80}$	allow correct rearrangement using an incorrectly/not converted value of F	1	
	m = 25 kg	allow correct calculation using an incorrectly/not converted value of F allow use of p = mv and $F = \Delta p/t$	1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.2	p = 40 × 90		1	AO2 3.1.4b
	3600 kgm/s		1	
	(momentum of cannon = 3600 kgm/s)			
	3600 = 1600 × v		1	
	v = 2.25 m/s	ignore minus signs	1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.3	friction on the wheels causes a resultant force in the opposite direction to motion causes deceleration **OR** friction on the wheels (1) does <u>work</u> on the cannon (1) reducing the <u>kinetic</u> energy of the cannon (1)		1 1 1	AO3 3.1.1b

Total Question 7		**11**

Question 8

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
08.1	38 Ω resistor has a greater resistance current is the same through both resistors V = I × R therefore product of IR is greater (for 38 Ω) **OR** I = 0.160 A (1) 38 Ω resistor V = 6.08 V **and** 18 Ω resistor V = 2.88 V (1) therefore potential difference across 38 Ω is greater		1 1 1	AO2 AO3 3.5.1h,r

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
08.2	I = 0.160 A V = (18 + 38) × 0.160 8.96 V 9.0 V	 allow correct substitution using an incorrectly/not converted value of I allow correct calculation using an incorrectly/not converted value of I allow 3 calculation marks for two separate V = I × R calculations added together	1 1 1 1	AO2 3.5.1h,r

Question	Answers	Mark	AO/ Spec. Ref.
08.3	**Level 2:** Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account.	3–4	AO3 3.5.1s
	Level 1: Relevant points (reasons/causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	1–2	
	No relevant content	0	
	Indicative content • in the series circuit, potential difference across each resistor is different • in the series circuit, the potential difference across the 6 Ω resistor is greater than the potential difference across the 4 Ω resistor • in parallel circuit the potential difference across each resistor is the same (as the cell) • in the series circuit the current in each resistor is the same • in the parallel circuit the current in each resistor is different • in the parallel circuit the current in the 4 Ω resistor is greater than the current in the 6 Ω resistor. • the current in the cell in the parallel circuit is greater than the current in the cell in the series circuit. • the total resistance of the parallel circuit is less than the total resistance of the series circuit • total resistance of the parallel circuit is less than 4 Ω. To access level 2 there must be a comparison of both potential difference and current between both circuits.		

Total Question 8		**11**

Question 9

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
09.1	refracted ray drawn at appropriate angle		1	AO1 AO4 3.3.5b
	angle of incidence labelled		1	
	angle of refraction labelled		1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
09.2	angle of incidence = 42°	allow 41° to 43° an incorrect angle does not prevent subsequent marks being awarded	1	AO2 3.3.5df
	$n = \frac{1}{sin\,42}$		1	
	n = 1.49	for subsequent marks to be awarded $n = \frac{1}{sin\,c}$ must have been used	1	
	$1.49 = \frac{3.00 \times 10^8}{\text{speed of light in glass}}$	allow correct substitution using their calculated value of n.	1	
	speed of light in glass = $\frac{3.00 \times 10^8}{1.49}$	allow correct rearrangement using their calculated value of n.	1	
	speed of light in glass = 2.0×10^8 m/s	allow correct calculation using their calculated value of n	1	

Total Question 9		**9**