Question 1

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.1	**X** – step-up transformer **Y** – transmission cable **Z** – step-down transformer	**2** marks for 3 correct answers **1** mark for 1 or 2 correct answers	2	AO1 3.6.2 a

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.2	the electricity distribution is more efficient		1	AO1 3.6.2 b

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.3	0.02 s		1	AO2 3.6.3 b c

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.4	$\text{frequency} = \dfrac{1}{0.02}$ 50 (Hz)	allow ecf from **Question 01.3**	1 1	AO2 3.6.3 b c

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.5	the current continually changes direction		1	AO1 3.6.3 b

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.6	0.40 × 2		1	AO2 3.6.5 f
	0.80 (kW h)	allow 0.8	1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.7		allow ecf from **Question 01.6**		AO2 3.6.5 f
	0.80 × 0.12		1	
	$ 0.096	allow 0.10	1	

Total Question 1		11

Question 2

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.1	energy		1	AO1 3.3.1 a

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.2	**A** has a higher frequency	allow shorter wavelength allow there are more peaks / waves on the screen	1	AO1 3.3.3 b g

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.3	**B** has a greater amplitude	allow higher peaks	1	AO1 3.3.3 b g

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.4	$330 = f \times 0.11$		1	AO2 3.3.1 h
	$f = \dfrac{330}{0.11}$		1	
	3000 (Hz)		1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.5	bar drawn to height 4500 for glass **and** bar drawn to height 3300 for gold **and** bar drawn to height 1500 for water	allow + or – ½ square for each bar **1** mark if 2 bars drawn correctly	2	AO2 3.3.1a

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.6	material is a categoric variable	allow data is not continuous	1	AO4 3.3.1 a

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.7	the particles in a liquid are closer together (than the particles in a gas)	allow a liquid has a higher density than a gas	1	AO3 3.3.3.a 3.4.1 a

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.8	20 000 Hz		1	AO1 3.3.3 a

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.9	reflection		1	AO1 3.3.3 c

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.10	330 × 0.0020		1	AO2 3.3.3 g
	0.66 (m)		1	
	66 (cm)		1	
		allow a maximum of 2 marks if the distance / time is halved		

Total Question 2		15

Question 3

Question	Answers	Mark	AO/ Spec. Ref.
03.1	**Level 3:** The plan would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5–6	AO1 3.5.1 n
	Level 2: The plan would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.	3–4	
	Level 1: The plan would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	
	No relevant content	0	
	Indicative content: • resistor connected to battery • variable resistor connected in series • variable resistor or variable power supply used to vary the potential difference • ammeter connected in series • voltmeter connected in parallel • change the value of the variable resistor or variable power supply • use the ammeter to measure the current (through resistor) • use voltmeter to measure the potential difference (across resistor) • take readings as the value of the variable resistor is changed • plot a graph of current against potential difference • graph should be a straight line through the origin some indicative content can be obtained by drawing a circuit diagram.		

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.2	10 = 0.40 × R		1	AO2
	$R = \dfrac{10}{0.40}$		1	AO1
	25		1	AO1
	Ω		1	AO1
		3 calculation marks can be gained by using any pair of readings from the line in Figure 7		3.5.1 h

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.3	both have a constant resistance at low currents		1	AO1 3.5.1 i m
	the resistor has a constant resistance at high currents		1	
	the resistance of the filament lamp increases (as the temperature increases)		1	

Total Question 3		13

Question 4

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.1	resultant force is zero		1	AO1 3.1.1 a
	two forces are equal in size		1	
	and opposite in direction	allow weight and tension	1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.2	from **A** to **B** gravitational potential energy is transferred to kinetic energy	allow from **A** to **B** gravitational potential energy decreases and kinetic energy increases	1	AO1 3.2.2 b
	from **B** to **C** kinetic energy is transferred to gravitational potential energy	allow from **B** to **C** kinetic energy decreases and gravitational potential energy increases	1	
	kinetic energy is at a maximum at **B and** kinetic energy is zero at **A** and **C** **or** gravitational potential energy is at a maximum at **A** and **C and** gravitational potential energy is at a minimum at **B**		1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.3	during one swing the pendulum bob moves from **B** to **C** to **A** and back to **B**	allow during one swing the pendulum bob moves from **A** to **C** and back again	1	AO4 3.2.2 b
	use the stop clock to time multiple swings		1	
	divide the number of (complete) swings by the time taken	allow counting the number of swings in a longer time period	1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.4	air resistance	allow friction / drag	1	AO3 3.2.1 b
	(does work on the paper cone) dissipating energy to the surroundings		1	

Total Question 4		**11**

Question 5

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.1	visible light and X-rays travel at the same speed through a vacuum	allow they can both be diffracted/reflected/refracted allow they both transfer energy	1	AO1 3.3.2 b

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.2	Any 3 from: • X-rays have a higher frequency than visible light • X-rays have a shorter wavelength than visible light • X-rays are ionising and visible light is not • X-rays are more penetrating than visible light	allow X-rays can cause cancer, visible light does not allow X-rays are higher energy waves than visible light	3	AO1 3.3.2 j

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.3	(a wave which its) oscillations are perpendicular to the direction of energy transfer of the wave	allow 90° for perpendicular	1	AO1 3.3.1 a

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.4	X-rays can be transmitted through soft-sided container	allow non-metal for soft-sided container	1	AO3 3.3.2 k
	but X-rays are strongly absorbed by metal		1	
	X-rays affect photographic film so the contrast can be seen	allow the contrast can be detected on a computer / CCD	1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.5	any **two** from: • only receives a small dose • low dose of X-ray does not harm cells • very low risk of causing cancer • X-ray scanner turned on after the driver has gone through • driver in metal cab which absorbs the X-rays.		2	AO3 3.3.2 i

Total Question 5		10

Question 6

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.1	meter detects background radiation		1	AO1 3.7.2 a d
	which is not constant	dependent on the 1st mp	1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.2	222, 4		1	AO2 3.7.2 f
	86, 2		1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.3	reduce the amount of gamma radiation leaving the box		1	AO1 3.7.2 c

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.4	any **two** from: • wear eye protection • wear gloves • keep at arm's length • use tongs to handle source • point away from doctor • put signs on the door • keep source out of box for as little time as possible • wear a lead-lined vest.	allow wear goggles	2	AO1 3.7.2 i

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.5	$\dfrac{6400}{1600}$ = 4 half lives		1	AO2 3.7.2 h
	$\left(\dfrac{1}{2}\right)^4 \times 80$	allow 80 – 40 – 20 – 10 – 5	1	
	5 (counts per second)		1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.6	irradiation is when an object is exposed to ionising radiation		1	AO1 3.7.2 i
	contamination is when an object has unwanted radioactive material deposited on it		1	
	contaminated objects become radioactive but irradiated objects do not		1	

Question	Answers	Mark	AO/ Spec. Ref.
06.7	**Level 2:** Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account.	3–4	AO3 3.7.2 g j
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	
	No relevant content	0	
	Indicative content: • Technetium-99 has a shorter half-life so does not stay in body long enough to harm it • Technetium-99 has a long enough half-life to be transported around the body • Technetium-99 does not emit alpha which is highly ionising • Technetium-99 emits gamma radiation which can penetrate the body and be detected outside the body • Argon-39 has a half-life that is too long and therefore would stay in the body too long and cause harm to it • Lanthanum-117 has a half-life that is too short and so there would not be enough time for it to be transported around the body • Radium-226 has a half-life that is too long and therefore would stay in the body too long and cause harm to it • Radium-226 emits alpha radiation which is highly ionising • Radium-226 emits alpha radiation so is most dangerous when ingested • Technetium-99 is the most suitable tracer. To score in level 2 both half-life and type of emission need to be discussed.		

Total Question 6		**17**

Question 7

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.1	energy transferred is directly proportional to time	allow **1** mark for as time increases the energy increases if directly proportional not scored	2	AO2 3.6.5 a b

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.2	change in energy = 1 800 000 J		1	AO2 3.6.5 b c
	power = $\dfrac{1\ 800\ 000}{1500}$	allow correct substitution using an incorrectly / not converted value for energy	1	
	power = 1200	allow a correct calculation using an incorrectly / not converted value for energy	1	
	1200 = 230 × I	allow correct substitution using their calculated value of power from the correct equation	1	
	$I = \dfrac{1200}{230}$	allow correct rearrangement using their calculated value of power from the correct equation	1	
	I = 5.2 (A)	allow correct calculation using their calculated value of power from the correct equation	1	
	OR change in energy = 1 800 000 J (1) $230 = \dfrac{1\ 800\ 000}{Q}$ (1) $Q = \dfrac{1\ 800\ 000}{230}$ (1)	allow correct substitution using an incorrectly / not converted value for energy		

		allow a correct rearrangement using an incorrectly / not converted value for energy		
	Q = 7826 (1)			
		allow a correct calculation using an incorrectly / not converted value for energy		
	$I = \dfrac{7826}{1500}$ (1)	allow correct substitution using their calculated value of charge from the correct equation		
	I = 5.2 (A) (1)			
		allow correct calculation using their calculated value of charge from the correct equation		

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.3	65% of 380 000 = 247 000 J		1	AO2 3.4.1 b
	247 000 = m × 4200 × 19		1	
	$m = \dfrac{247\,000}{4200 \times 19}$		1	
	m = 3.095 (kg)		1	
	m = 3.1 (kg)	allow any correctly rounded answer from a reasonable calculation

allow maximum of 2 calculation marks if E=380000 J used to calculate mass | 1 | |

Total Question 7		13