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Applied Science SC02

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Unit 2: Energy Transfer Systems

Mark Scheme

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Question	Part	Sub-part	Marking guidance	AO	Mark	Comment
1	(a)		**A: Box 1** tricuspid valve shown on right side of heart between the atrium and ventricle **C: Box 2** bicuspid valve shown on left side of heart between the atrium and ventricle **B: Box 3** semilunar valves shown where the arteries leave the heart	1(AO1) 1(AO1) 1(AO1)	3	
1	(b)		(During each cardiac cycle) the blood travels through the heart twice Blood travels from the heart to the lungs (and back) / blood travels via the pulmonary circulation Blood travels from the heart to the body (and back) / blood travels via the systemic circulation	1(AO1) 1(AO1) 1(AO1) max 2	2	
1	(c)	(i)	Increased frequency of impulses travel in sympathetic nerve / accelerator nerve from cardiovascular centre (in) brain / medulla (oblongata) to S-A node In <u>right</u> atrium (of heart)	1(AO1) 1(AO1) 1(AO1) 1(AO1) 1(AO1) 1(AO1) max 3	3	
1	(c)	(ii)	Man **X** (No mark for identifying the correct employee) Blood pressure for man **X** is within the <u>normal</u> range for his age (accept 'average' for 'normal') / **X** has the lower blood pressure (accept the converse)	1(AO1)	1	

1	(c)	(iii)	Systolic: the pressure in the arteries when the heart is forcing blood through them / pressure when heart contracts / pressure when ventricles contract Diastolic: the pressure in the arteries when the heart relaxes / pressure when ventricles relax Accept answers that do not refer directly to pressure	1(AO1) 1(AO1)	2	

1	(d)	(i)	More data collected / more representative sample Results (obtained) were <u>more</u> reliable / <u>more</u> valid / allows <u>calculation</u> of a more accurate <u>mean</u> (or <u>average</u>) Reject 'more accurate mean/average' on its own	1(AO3) 1(AO3)	2	

1	(d)	(ii)	Within the (normal) range (400-500 cm^3)	1(AO1)	1	

1	(d)	(iii)	Lower (than normal)	1(AO1)	1	

1	(e)		The (typical) range of heart rate for men is lower than women. Accept the converse There is very little change in (typical) heart rate as age increases The (typical) heart rate is always lower for athletes compared with non-athletes. Accept the converse.	1(AO3) 1(AO3) 1(AO3)	3	

2	(a)	(i)	**Advantage:** Readily available / quick procedure / outpatient procedure Provides <u>clear</u> / <u>good</u> images (of bones) / good (bone) resolution Ability to penetrate materials (and view things otherwise not visible) Non-invasive N.B. Ignore any reference to cost	 1(AO1) 1(AO1) 1(AO1) 1(AO1) max 2	2	

2	(a)	(ii)	**Disadvantage:** Potential health risk due to over exposure to X-rays (of operator or patient) / cannot be used too many times Uses ionising radiation / could cause cell damage / could cause cancer Poor images of soft tissue	 1(AO1) 1(AO1) 1(AO1) max 2	2	

2	(b)		Injury / risk to patient possible Will patient be told it is a trial? Consideration of ethics of animal testing Will patients be competent to agree? Objection from religious groups Any reference to necessity for gaining informed consent from patient How would the patients be chosen for the trial?	1(AO1) 1(AO1) 1(AO1) 1(AO1) 1(AO1) 1(AO1) 1(AO1) max 3	3	

2	(c)	(i)	Small amounts of tracers needed You can label specific atoms (say carbon- 4 in glucose) to follow where each one goes Can make just about any biomolecule in a radioactive form Real time images / tracer can be monitored continuously Can go directly to organs to be investigated Excreted from the body over time Allows clear / good images of soft tissue / tumours (cancer) Ignore any reference to cost	1(AO2) 1(AO2) 1(AO2) 1(AO2) 1(AO2) 1(AO2) 1(AO2) max 2	2	

2	(c)	(ii)	Hazardous to patient / ionise cells / damage cells / cancer risk Patient may remain radioactive for a short time / radioactive patient may be dangerous for others around them Need to be stored safely Need to be disposed of safely / disposal hazard May have short (small) half lives/need to be used quickly / activity falls quickly Ignore any reference to cost	1(AO2) 1(AO2) 1(AO2) 1(AO2) 1(AO2) max 2	2	

3	(a)	(i)	Water Carbon dioxide Accept chemical formula i.e. H_2O / CO_2 Do not allow 'heat'	1(AO1) 1(AO1)	2	

3	(a)	(ii)	Energy / ATP	1(AO1)	1	

3	(b)		Fat = 35.71 cm^3 Allow 35.7 Two marks for correct answer alone Allow 1 mark for correct rearrangement: Vol of O_2 = 25 ÷ 0.7	2(AO1)	2	

3	(c)		Expired air / breathing out Urine / excretion Faeces Vomiting	1(AO1) 1(AO1) 1(AO1) 1(AO1) max 3	3	

3	(d)		Surgery / anaesthesia is likely to be <u>more</u> risky / more dangerous (for an obese person) Recovery likely to be longer Likely to be <u>more</u> cost effective with a non-obese person owtte Patient needs to demonstrate commitment (losing weight) Patient may have heart problems again in the future if they don't lose weight	1(AO2) 1(AO2) 1(AO2) 1(AO2) 1(AO2) max 2	2	

4	(a)		will run out / non-renewable / a fossil fuel creates CO_2 / global warming / greenhouse gases creates SO_x / creates acid rain	1(AO1) 1(AO1) 1(AO1) max 2	**2**	

4	(b)		GPE = 3 x 10^{13} 2 marks for correct answer alone unit = J / Joule(s) – stand alone mark one compensation mark for correct equation or numbers: Energy = mass x g x height (change) / Energy / work / PE = weight x height / Work / energy / PE = force x distance / 6 x 10^9 x 10 x 500	1(AO2) 1(AO2) 1(AO2)	**3**	

4	(c)		Energy lost / <100% efficient (Energy) turned to other forms (e.g. heat/sound) Friction	1(AO1) 1(AO1) 1(AO1) max 2	**2**	

4	(d)		time = 40 000 (seconds) / 11.11 (hours) (allow ecf) 2 marks for correct answer alone Max 1: Time = energy ÷ power / time = answer (b) ÷ 7.5 x 10^8 (allow ecf)	1(AO2) 1(AO2)	**2**	

4	(e)		efficiency = 600 ÷ 750 OR efficiency = <u>useful energy output</u> OR total energy input efficiency = <u>useful power output</u> total power input = 80 % (accept 0.8) 2 marks for correct answer alone Do not accept: efficiency = power ÷ energy	1(AO2) 1(AO2)	**2**	

4	(f)		Rain fills <u>upper</u> reservoir / increases mass of water (or volume) of water in <u>upper</u> reservoir adding extra g.p.e. (to the water in upper reservoir) Allow 'energy' and 'P.E.' as an alternative to g.p.e. less water has to be pumped uphill	1(AO1) 1(AO1) 1(AO1) max 2	**2**	

4	(g)		(cost of raising water =) 7.5 x 10^6 x 5p = 37 500 000 p (or £375 000) income = 6 x 10^6 units at 15 p = 90 000 000 p (or£900 000) net profit = £525 000 (or 52 500 000 p) max 2 if not correct units showing working for either cost or income gains 1 mark max correct answer for either cost or income gains 2 marks correct answer for profit gains all three marks.	1(AO2) 1(AO2) 1(AO2) max 3	**3**	

5	(a)		k.e. = 225 000 (J): 3 marks k.e. = 2.5 x 300^2 (alone): max 2 k.e. = ½ mv^2 (alone): max 1 If use 2000 kg instead of 5kg award marks as follows: k.e. = 90, 000 000 (J): max 2 k.e. = 1000 x 300^2 (alone): max 1	1(AO2) 1(AO2) 1(AO2)	**3**	

5	(b)		"cannon recoils / goes backwards" The cannon and cannonball gain momentum in opposite directions OWTTE OR Total momentum is constant / remains zero Evidence of calculation of recoil velocity (0.75 ms^{-1})	1(AO1) 1(AO1) 1(AO1) max 2	**2**	

5	(c)		more distance to slow down / more time to slow down (or decelerate) so less deceleration (of the cannonball) material absorbs energy so less force (on the wall / cannonball) so momentum changes more slowly force = rate of change of momentum (<u>change of momentum</u>) time	1(AO1) 1(AO1) 1(AO1) 1(AO1) 1(AO1) 1(AO1) max 3	**3**	

5	(d)		same amount of gunpowder same (mass) cannonball same cannon range measured over level ground / fired from a height repeat each reading several times and calculate an average range for each angle Accept: 'keep <u>everything</u> the same apart from the angle of fire' gets max 1, only if scored no other marks	1(AO3) 1(AO3) 1(AO3) 1(AO3) 1(AO3) 1(AO3) 1(AO3) max 4	**4**	

5	(e)		both axes with a suitable scale 5 points plotted correctly (+/- one grid square) Line of best fit	1(AO3) 1(AO3) 1(AO3)	**3**	

5	(f)		need more readings / repeat readings / 5 results is not enough / need readings that are more accurate / need to explore more angles / hard to interpolate a curve accurately	1(AO3)	**1**	

6	(a)		hot air rises by convection / by convection current(s) making temperature (difference) near the roof greater than that lower down / near walls the lower the *U*-value, the lower the conduction (Accept the converse)	1(AO1) 1(AO1) 1(AO1) 1(AO1) max 3	**3**	

6	(b)	(i)	foam / fibre / polystyrene (in the cavity / between the bricks) replace brick/air sandwich with Thermalite / Aircrete block Allow 'change air gap' Walls white or silver (foil)	1(AO1) 1(AO1) 1(AO1) max 1	**1**	

6	(b)	(ii)	trapped air air is an insulator / poor conductor / <u>non-metals</u> are poor	1(AO1) 1(AO1)	**3**	

			conductors small air pockets (small air pockets) prevent convection currents Allow 'longer air path (less heat loss)' / 'smaller gap means less convection' White /silver surfaces don't radiate or absorb heat well	 1(AO1) 1(AO1) 1(AO1) max 3		

6	(c)		15 x 1.5 x 40 = 900 (W) 2 marks for correct answer alone	1(AO2) 1(AO2)	**2**	