



**General Certificate of Education (A-level) Applied
January 2012**

Applied Science

SC02

**(Specification
8771/8773/8776/8777/8779)**

Unit 2: Energy Transfer Systems

Final

Mark Scheme

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Question	Part	Sub Part	Marking guidance		Mark	Comment
1	(a)		<p>P: Atria contract / blood flows into ventricles / small increase in pressure (in ventricles) / atrioventricular valve(s) (bicuspid and/or tricuspid) open</p> <p>QRS: Ventricles contract / large increase in pressure <u>in ventricles</u> / atrioventricular valve(s) closes / blood leaves the heart</p> <p>T: Ventricles relax / heart at rest (relaxes) / pressure falls in <u>ventricles</u> / diastole / semi-lunar valve(s) (aortic and/or pulmonary) closes / atria refill with blood</p>	(1)(AO1) (1)(AO1) (1)(AO1)	3	<p>P: Allow atrial systole Allow A-V valves</p> <p>QRS: Allow ventricular systole</p> <p>Ignore any reference to repolarisation or depolarisation</p>
1	(b)		<p>A: Bradycardia</p> <p>B: Normal (heartbeat)</p> <p>C: Ventricular fibrillation</p> <p>D: Tachycardia</p>	(1)(AO2) (1)(AO2) (1)(AO2) (1)(AO2)	4	
1	(c)	(i)	60 – 80 (bpm)	(1)(AO1)	1	
1	(c)	(ii)	<p>Time taken for pulse rate to return to normal (resting) rate, following a period of exercise (is a measure of cardiovascular fitness)</p> <p>The shorter the time taken for pulse rate to return to normal (resting rate) the fitter the person</p>	(1)(AO2) (1)(AO2)	2	Allow 'healthier' ≡ 'fitter'
1	(d)		<p>Person B (no mark for stating this)</p> <p>Explanation: Peak expiratory flow rate is the highest / within the normal range ($400 - 600 \text{ dm}^3 \text{ min}^{-1}$)</p> <p>Blood pressure is not high (Accept 'BP within the normal range')</p> <p>(Resting) pulse rate is within the normal range / pulse rate is lowest</p> <p>Time taken for pulse rate to return to normal (resting) rate after exercise is the shortest OWTTE / pulse rate has returned to normal (resting) (within 3 minutes)</p> <p>ECG trace for person B is the only trace that is normal</p>	(1)(AO2) (1)(AO2) (1)(AO2) (1)(AO2) (1)(AO2) Max 4	4	<p>N.B. Any answers relating to any person other than B = 0</p> <p>Average ≠ normal</p> <p>Mk pt 2: Allow 'BP below normal' / 'BP is the lowest'</p> <p>Mk pt 3: Allow '60 – 80' ≡ 'normal (resting) pulse rate'</p>

1	(e)		(Aortic) valve prevents backflow of blood / faulty valve does not prevent backflow of blood into the <u>left</u> ventricle A faulty valve will result in less blood being pumped round the body (with every beat of the heart)	(1)(AO1) (1)(AO1) (1)(AO1)	3	
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1	(f)		Electrocardiogram/ ECG/ echocardiogram / stethoscope	(1)(AO1)	1	Do not accept 'electroencephalogram'/ EEG
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1	(g)		Some people's religion / objecting to anything that comes from a pig The length of time the different valves will operate (survive), within the patient, may vary / age of pig valve Potential danger of using parts from one species inside another e.g. unsuspected virus or prion transfer Not wanting an animal to die or suffer / animal welfare issues / animal rights Unnecessary use of non-renewable resources when parts from pigs are available for use (instead) (Greater) risk of organ being rejected	(1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) Max 2	2	N.B. Prion is a pathogen (disease-causing agent)
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Total Marks: 20

2	(a)	(i)	A: Trachea B: Lung	(1)(AO1) (1)(AO1)	2	
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2	(a)	(ii)	Diaphragm relaxes Diaphragm moves up (becomes dome-shaped) Intercostal muscles relax Ribs move in / down Thoracic (allow 'chest') cavity decreases in size (or volume) Pressure surrounding lungs (allow 'in thoracic cavity') increases compared with atmospheric pressure	(1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) Max 4	4	
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2	(b)	(i)	Breathing rate increases as the (percentage) concentration of CO ₂ increases Gradual (slow) increase in rate up to 5.48 % / rapid increase at 6.02% (or after 5.48%) / at the highest concentration of CO ₂ the breathing rate approximately doubles	(1)(AO2) (1)(AO2)	2	Allow 'more breaths' ≡ 'increased breathing rate'
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2	(b)	(ii)	Chemoreceptors (Chemoreceptors) in aortic body / aortic arch / aorta / carotid body / carotid artery / medulla Stimulated by decrease in pH / increase in hydrogen ions / increase in acidity More impulses to medulla / medulla stimulated More impulses to intercostal muscles (or diaphragm)	(1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) Max 3	3	Allow 'chemical receptor' ≡ 'chemoreceptor'
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Total Marks: 11

3	(a)		Homeostasis	(1)(AO1)	1	
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3	(b)	(i)	He will suffer from heat exhaustion / heat stroke	(1)(AO2)	1	Ignore 'hyperthermia'
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3	(b)	(ii)	Take each reading more than once (in same part of body)	(1)(AO3)	1	Accept 'take readings under the same conditions' Ignore any references to averages
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3	(b)	(iii)	Digital thermometer (No mark) Less chance of human error Because scale does not have to be interpreted It gives smaller intervals of temperature Reads to 0.1 (a decimal point) / more precise Allow: faster response time (so) more readings in any given time period (so) better at recording fluctuating temperatures	(1)(AO3) (1)(AO3) (1)(AO3) (1)(AO3) (1)(AO3) (1)(AO3) (1)(AO3) (1)(AO3) Max 2	2	Mk pt 1: 'Less chance of human error' ≡ 'easier to read' Mk pt 2: Allow: 'provides a (numerical) objective value'
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3	(c)	Conduction Convection Radiation Evaporation / sweating Urine / excretion Faeces Exhaled air / breathing <u>out</u> Vomiting	(1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) Max 2	2	Mk pt 4 Allow 'perspiration' Ignore 'vasodilation'
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3	(d)	Dimensions: How much surface area of body is exposed <u>Surface area</u> ratio Volume Temperature: Temperature of surroundings Temperature of body Moisture: Humidity of surroundings Wetness of skin / clothes Hydration levels of body (e.g. whether dehydrated) Heat transfer: Amount of body fat Amount of clothing / insulation Colour of surface of body Movement of air in the surroundings Level of activity of body (basal) metabolic rate	(1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) Max 2	2	Apply 'list principle' If give 1 incorrect answer then 2 correct answers: only 1 mark Reject 'exercise' alone
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Total Marks: 9

4	(a)	Hot water is less dense (or reverse argument) (so) cold water falls Hot water is lifted / rises Convection (currents)	(1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) Max 3	3	Do not accept comments about hot air
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4	(b)	(i)	Metal / copper is a conductor (of heat) / a poor insulator Short heat path / thin pipe Large surface area (of pipes) Dark / black is a (good) radiator (from pipes) Large temperature difference (between water and air)	(1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) Max 3	3	
4	(b)	(ii)	U -value = 8.0 3 marks for correct answer alone 1 compensation mark for correct substitution: $480 = U \times 1.2 \times 50$ AND/OR correct re-arrangement: [$U = 480 / (1.2 \times 50)$] = 2 marks max 2 for 0.008, 6.7 Allow 1 mark for 0.0067	(3)(AO2)	3	Allow 0.48 kW = 480 W Allow 6.66 or 6.6 recurring but NOT 6.6
4	(c)		(more) wasted energy / cools faster (at higher temperatures) / heat lost	(1)(AO1)	1	Ignore 'takes longer to heat up' Reject 'uses up more energy'
4	(d)		use plastic plastic is a better insulator = 2 use a thicker (walled) pipe thicker pipe will increase path length = 2 fit lagging / foam / insulation lagging contains air gaps = 2 polish copper / paint pipe white (silver) to reduce radiation reduce water temperature less temp. difference (water to air) shorten pipes less (surface) area fit reflector near pipe to reflect heat back (into the pipes)	(1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) Max 4	4	

4	(e)	Take water temp. at fixed location (same place) Same (named) equipment / thermometer Temp readings repeated several <u>days / nights</u> same temperature outside tank same starting temperature (for water) / same heating time same amount of water (in tank) same tank size / material / thickness / insulation	(1)(AO3) (1)(AO3) (1)(AO3) (1)(AO3) (1)(AO3) (1)(AO3) (1)(AO3) Max 5	5	Mk pt 3: Ignore 'repeat readings' alone
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4	(f)	172.8 p / £1.728 / 173 p / £ 1.73 2 marks for correct answer alone (with units) 1 compensation mark for correct substitution: cost = 0.48 x 15 x 24 max 1 for £172.8 / £173 / 1.73 p OR any of the above answers without a unit	(2)(AO2)	2	Allow 172p or £1.72
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Total Marks: 21

5	(a)	Longer distance to stop / longer time to absorb (or transfer) (same) energy to change (same) momentum less acceleration so less force no ricochets / do not bounce off	(1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) Max 3	3	'Less rate of change of momentum' = 2 (mk pts 1 + 3) Mk pt 4 Allow 'smaller deceleration' Reject 'decelerate less' Mk pt 6 Allow 'do not deflect a bullet'
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5	(b)	7500 (J) 3 marks for correct answer alone max 2 for 7500 000 1 compensation mark for correct substitution AND/OR 1 compensation mark for k.e. = $\frac{1}{2} m v^2$ k.e = 0.5 x 0.06 x 500 ² → 2 marks	(3)(AO2)	3	
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5	(c)	(i)	8000 (m) 3 marks for correct answer alone Accept range 8000 – 8165 for 3 marks (Accept 8.0 – 8.165 for 2 <u>max</u>) allow 1 for 'gpe gain = k.e lost' OR allow 1 for 'gpe = m g h' OR allow 1 for 'm g h = 4800' Allow use of 9.8 instead of 10 (8163 m)	(3)(AO2)	3	Allow $E_p \equiv GPE$ and $E_k \equiv KE$
5	(c)	(ii)	friction with air / air resistance (means) bullet loses energy energy turns to heat energy lost in air / atmosphere	(1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) Max 3	3	Mk pt 1: Ignore reference to gun barrel Mk pt 2: Ignore 'wind resistance'
Total Marks: 12						
6	(a)		25% of the input energy/power (is given out) as useful (energy/power)	(1)(AO1) (1)(AO1)	2	Reject any answers which refer to diesel / fuel Accept numerical examples e.g. '100J input only 25J given out as useful energy'
6	(b)		danger (from moving blades) / distraction air friction / air resistance / drag / lower top speed / less streamlined lower mpg / more fuel used capital cost not recovered	(1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) max 2	2	Mk pt 2: Allow 'less aerodynamic' Allow 'turbine expensive' / 'expensive to set up'
6	(c)		solar cells / photo-voltaic cells Allow: alternator / solar panels / solar power	(1)(AO1)	1	Reject 'solar' alone

6	(d)	<p>CO₂ given off (which is) a greenhouse gas waste heat produced Allow 'energy used in manufacture may be generated using fossil fuels'</p>	<p>(1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) max 2</p>	2	<p>Ignore any reference to carbon monoxide / NO_x / SO_x / greenhouse <u>effect</u></p>
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Total Marks: 7