AQA

General Certificate of Education (A-level) Applied June 2013

Applied Science   **SC02**

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

Unit 2: Energy Transfer Systems

Final

Mark Scheme

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all examiners participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for standardisation each examiner analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, examiners encounter unusual answers which have not been raised they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Question	Part	Sub part	Marking guidance		Mark	Comment
1	(a)	(i)	**Advantages:** No <u>ionising</u> radiation is involved / can be used during pregnancy Not/less harmful Can image soft tissue Able to see moving parts (Equipment) can be portable Can measure flow (using Doppler) **Disadvantage:** Bone (and other hard tissue) is harder to distinguish Poor imaging of tissues containing air Resolution not as good as X-ray	(1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) max 2 (1)(AO1) (1)(AO1) (1)(AO1)	**3**	Mk pt 3: Accept an example of soft tissue e.g. muscle **Disadvantages:** Mk pt 2: Accept reference to inability to view lungs or digestive system
1	(a)	(ii)	**Advantages:** (Much more) readily available Can be used with a wider range of people Quicker imaging **Disadvantage:** <u>Ionising</u> radiation (More) harmful / can cause cancer / can cause cell mutation Poor imaging of soft tissue	(1)(AO1) (1)(AO1) (1)(AO1) max 2 (1)(AO1) (1)(AO1) (1)(AO1) max 1	**3**	**Advantages:** Accept a specific example e.g. metal implants / claustrophobia **Disadvantage:** Accept 2D images unless candidate has referred to CAT scans; Accept '(X-Rays) can't see 3D images' Mk pt 3: Accept cannot image / monitor soft issue
1	(b)	(i)	X-ray	(1)(AO1)	**1**	
1	(b)	(ii)	Magnetic Resonance Imaging / MRI (scan)	(1)(AO1)	**1**	

1	(c)		Injury / risk to patient possible	(1)(AO2)	3	Mk pt 1: Allow 'whether method is too dangerous' / 'side effects' Reject 'religion' on its own – needs some clarification
			Will patient be told it is a trial?	(1)(AO2)		
			Will patients be competent to agree?	(1)(AO2)		
			Objection from religious groups	(1)(AO2)		
			Any reference to getting informed consent from patient	(1)(AO2)		
			Should the patients be paid to take part? / Is insurance in place in case anything goes wrong?	(1)(AO2) max 3		

Total: 11 Marks

| 2 | (a) | (i) | Needs oxygen / takes place in the presence of oxygen / with oxygen / uses oxygen | (1)(AO1) | 1 | Ignore intake of oxygen / breathing |

| 2 | (a) | (ii) | $C_6H_{12}O_6 \ + \ 6O_2 \ \rightarrow \ 6CO_2 \ + 6H_2O$ (ignore any references to energy or ATP) correct inputs (correctly balanced) correct outputs (correctly balanced) | (1)(AO1) (1)(AO1) | 2 | Watch out for correct use of subscripts Ignore word equations |

| 2 | (b) | (i) | The level (of fluid) would be higher in the left arm (compared with the right arm) / the level would move closer to the respiration chamber | (1)(AO3) | 1 | |

2	(b)	(ii)	As the woodlice <u>respire</u> (aerobically) they use up oxygen	(1)(AO3)	2	
			Oxygen used up is not replaced by carbon dioxide produced by the woodlice (as carbon dioxide is absorbed by soda lime)	(1)(AO3)		
			The fluid in the manometer rises up the left arm to replace the oxygen (removed from the air) / pressure is lowered (that causes the fluid in the left arm to rise)	(1)(AO3) max 2		

| 2 | (c) | (i) | **B**: (Fluid at equal height / level in left and right arms of manometer) | (1)(AO3) | 1 | Accept '**B**' if written in 2(c) (ii) |

| 2 | (c) | (ii) | The volume of O_2 consumed (by woodlice) equals the volume of CO_2 given out | (1)(AO3) | 2 | |
| | | | No CO_2 will be absorbed | (1)(AO3) | | |

| 2 | (d) | | RQ (for woodlice): 1 | (1)(AO2) | 1 | Accept 1:1 or 6:6 |

| 2 | (e) | (i) | (RQ) higher (for peas) / RQ lower for woodlice (compared with peas) | (1)(AO2) | 1 | Ignore any reference to anaerobic respiration not requiring oxygen |

| 2 | (e) | (ii) | Volume of CO_2 given off (by peas) will be higher than volume of O_2 consumed / Volume of O_2 consumed by woodlice is equal to volume of CO_2 produced / RQ greater than 1 for anaerobic respiration | (1)(AO2) | 1 | Ignore any reference to anaerobic respiration not requiring oxygen |

Total: 12 Marks

3	(a)	(i)	Vital capacity (female) = 3.1 (dm^3) Expiratory peak flow rate = 400 – 600 (dm^3 min^{-1}) **OR** Allow any single figure within this range	(1)(AO1) (1)(AO1)	**2**	

3	(a)	(ii)	The results would support a diagnosis of asthma (no mark for stating this) Explanation: Vital capacity is lower (than normal) / Expiratory peak flow rate is lower (than normal) / the values (in the table) are lower (than normal) / too low / very low	(1)(AO1)	**1**	No error carried forward from (a) (i) Do not accept ' below average' for 'below normal'

3	(a)	(iii)	Breathing rate: increases / faster / higher Breathing depth: decreases / reduces / shallower / lower	(1)(AO2) (1)(AO2)	**2**	Breathing depth: Accept 'shorter'

3	(b)	(i)	Increase in depth (of breathing) / increase in tidal volume Increase in rate (of breathing)	(1)(AO2) (1)(AO2)	**2**	Do not accept 'heavier' breaths for 'deeper' Allow 'bigger' breaths for 'deeper'. Accept for 2 marks: No change in rate or depth of breathing because carbon dioxide is the primary stimulus controlling breathing

3	(b)	(ii)	Increased (heart rate) / Tachycardia	(1)(AO2)	**1**	

3	(c)	(i)	Supports / prevents collapse of / protects trachea / keeps trachea/lumen open Allows breathing / prevents suffocation	(1)(AO1) (1)(AO1)	**2**	Mark this answer as a whole For 'breathing' allow 'ventilation' or any clear indication that they are referring to breathing Mk pt 1:Allow 'protects lumen' Reject 'windpipe' for 'trachea'

3	(c)	(ii)	Wafts away (removes) mucus Removes particles/dust/bacteria Prevents damage to lung tissue / stops dust/ dirt / bacteria getting into <u>lungs</u> / reduces incidence of (lung) infections	(1)(AO1) (1)(AO1) (1)(AO1) max 2	2	Mark this answer as a whole Do not allow 'traps' for 'removes' Mk pt 3 Reject 'Prevents Infections'

3	(d)	(i)	surfactant (presence) large surface area moist well supplied with blood (capillaries) Alveoli <u>walls</u> 1 cell thick / thin <u>walls</u> (of alveoli)	(1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) max 2	2	Do not allow 'membrane' for ' walls'

3	(d)	(ii)	Blood vessels surround / are attached to alveoli <u>Short</u> diffusion <u>path</u> Oxygen carried in blood / CO_2 carried in blood Venule returns blood to heart / Arteriole takes blood from heart Capillary <u>walls</u> 1 cell thick / thin <u>walls</u> (of capillary) Maintain diffusion <u>gradient</u>	(1)(AO2) (1)(AO2) (1)(AO2) (1)(AO2) (1)(AO2) (1)(AO2) max 3	3	Mk pt 3: Allow 'oxygenated blood'; Allow 'blood vessels' = 'blood' Do not allow 'membrane' for ' walls'

Total: 17 Marks

4	(a)		Water (rain) is free / diesel fuel is expensive Diesel engine is noisy / water power is quiet Diesel is a <u>fossil</u> fuel / diesel will run out / (water) is renewable Burning (using) diesel creates CO_2 (greenhouse gas)	(1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) max 3	3	

4	(b)		Little (no) <u>friction</u> / energy is not lost / less energy is lost / water is not slowed down (as much)	(1)(AO1)	1	

4	(c)		4000 (J) / 4 (kJ) / 3924 (J) / 3.92 (kJ) / 3.90 (kJ) Max 1: GPE = m g h OR GPE = 8 x 10 x 50 / 8 x 9.81 x 50 / 8 x 10 x 50 Max 2 for correct answer without unit (or with wrong unit) Stand alone mark for correct unit: Joule /J / kilojoule / kJ	(2)(AO2) (1)(AO2)	3	Stand-alone mark for unit must match figures

4	(d)		Sound Heat / thermal Kinetic	(1)(AO1) (1)(AO1) (1)(AO1) max 2	2	Mk pt 1: Ignore 'noise'

4	(e)	(i)	0.3 Allow 30 % 2 marks for correct answer alone 1 compensation mark for: efficiency = <u>useful</u> power out / <u>total</u> power in **OR** 600 ÷ 2000	(2)(AO2)	2	Only 1 mark if a unit is added to 0.3 No mark for '30' alone

4	(e)	(ii)	The speed of water flow varies Amount of water (in the reservoir) varies / rainfall varies Demand for power varies The amount of power generated depends on demand	(1)(AO2) (1)(AO2) (1)(AO2) (1)(AO2) max 2	2	

| 4 | (f) | | 0.4 kW / 400 W   3 marks for correct answer alone
Deduct 1 mark for incorrect or missing unit
2 marks max for power = 4320 ÷ 10800 OR 4320 ÷ (15 x 720)
1 compensation mark for (total) cost = unit cost x power x time
OR 4320 = 15   x   power   x   720 | (3)(AO2) | 3 | 400 kW = 2 max
400 (any units) = 2 max
0.4 W   = 2 max
0.4 (any units) = 2 max |

Total: 16 Marks

| 5 | (a) | | Chemical | (1)(AO1) | 1 | Allow 'chemical potential energy'
Reject 'chemical internal energy' |

| 5 | (b) | | Flame is burning <u>gas</u>/hot <u>gas</u>
<u>Hot</u> gas is less dense (than cold air)
<u>Hot</u> gas/particles rise(s)
Convection (current) formed | (1)(AO1)
(1)(AO1)
(1)(AO1)
(1)(AO1)
max 3 | 3 | Allow 'hot air' = 'hot gas'
Mk pt 2: Reject 'hot particles'
Mk pt 3: No mark for 'cold air sinks'
Reject 'lighter' for 'less dense' |

| 5 | (c) | | Air is an insulator/poor conductor
Paper conducts heat (to the outside) / air outside keeps the paper cool
Heat is shared throughout the air / paper
<u>Flame</u> doesn't touch paper / flame is distant from paper / long path for heat to travel | (1)(AO1)

(1)(AO1)
(1)(AO1)

(1)(AO1)
max 2 | 2 | |

| 5 | (d) | | Black is a (better) <u>absorber</u>
Of radiation / radiated heat / infra-red (radiation) | (1)(AO1)
(1)(AO1) | 2 | Accept reverse argument
Mk pt 1: Reject 'attract'
Mk pt 2: Reject 'of heat' Do not accept any other named form of radiation e.g. ultraviolet radiation |

| 5 | (e) | | 24 (W)   2 marks for correct answer alone
1 compensation mark for correct substitution:
Rate of heat loss = 0.3 x 4 x 20 | (2)(AO2) | 2 | |

| 5 | (f) | (i) | An alternative heat source (to candle)
Attempting to measure temperature / power /
voltage / current / energy | (1)(AO3)
(1)(AO3) | 2 | N.B. The presence of a thermometer
does not necessarily mean that it is
being used to measure temperature |

| 5 | (f) | (ii) | A measurement(s) inside <u>and</u> outside (the lantern)
Repeats (measurements) | (1)(AO3)
(1)(AO3) | 2 | |

| 5 | (g) | | Danger of starting fires (after lanterns land)
Possible danger to aircraft (if lanterns fly high
enough)
Danger to animals (that might try to eat the landed
lanterns)
Visual pollution (after lanterns land and get blown
about) | (1)(AO2)

(1)(AO2)

(1)(AO2)

(1)(AO2)
max 2 | 2 | Mk pt 4: Accept 'littering' |

Total: 16 Marks

| 6 | (a) | | Less distance / time to stop
Greater acceleration
(Same) momentum is lost
Greater rate of change of momentum
Greater force (on jumper) | (1)(AO2)
(1)(AO2)
(1)(AO2)
(1)(AO2)
(1)(AO2)
max 3 | 3 | Mk pt 2: Accept 'deceleration' |

| 6 | (b) (i) | | 31.6 (ms^{-1})   3 marks for correct answer alone
Max 2 for v = 1000 (ms^{-1})
1 max compensation mark for correct substitution:
45000 = ½ x 90 x v^2
OR correct equation: ke = ½ m v^2 | (3)(AO2) | 3 | Accept anything between 31.6 and 32
ms^{-1}

Accept 45000 = 45 x v^2 |

| 6 | (b) (ii) | | | 15 000 (W)　　Accept 15 kW
2 marks for correct answer alone
1 mark max for:
power = energy changed ÷ time taken
OR power = 45000 ÷ 3 | (2)(AO2) | **2** | Allow: Energy changed ≡ work done
Accept work done = power x time |

Total: 8 Marks