
A-LEVEL

APPLIED SCIENCE

SC02 Energy Transfer Systems
Mark scheme

8770
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Version 1.0: Final

Mark schemes are prepared by the Lead Assessment Writer 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 associates 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 associate understands and applies it in the same correct way. As preparation for standardisation each associate 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, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

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.

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Question	Part	Sub-part	Marking guidance		Mark	Comment
1	(a)		A: Aorta / aortic arch B: Pulmonary artery	(1) AO1 (1) AO1	2	
1	(b)		Blood leaving <u>right</u> ventricle is under less pressure than blood leaving <u>left</u> ventricle / there is a higher pressure on the <u>left</u> side of the heart (Accept converse) Blood leaving <u>right</u> ventricle travels only to lungs / blood leaving <u>left</u> ventricle travels further / blood leaving <u>left</u> ventricle travels to rest of body Wall of left ventricle needs to be thicker than the wall of the right ventricle in order to create a <u>higher</u> pressure	(1) AO1 (1) AO1 (1) AO1 Max 2	2	
1	(c)		(During each cardiac cycle) the blood travels through the <u>heart</u> 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	Mk pts 2 & 3: Ignore any incorrect reference to side of heart e.g. 'left side pumps blood to lungs' (should be right side) / 'right side pumps blood to rest of body' (should be left side)

1	(d)		<p>P: <u>Atria</u> contract / atrial systole / blood flows into ventricles / small increase in pressure (in ventricles) / atrioventricular valve(s) (bicuspid and/or tricuspid) open</p> <p>QRS: <u>Ventricles</u> contract / ventricular systole / large increase in pressure in <u>ventricles</u> / atrioventricular valve(s) closes / blood leaves the heart</p> <p>T: Ventricles relax / ventricular diastole / heart at rest (relaxes) / pressure falls in <u>ventricles</u> / semi-lunar valve(s) (aortic and/or pulmonary) closes / atria refill with blood</p>	(1) AO1 (1) AO1 (1) AO1	3	<p>P: Allow A-V or atrio-ventricular Ignore any reference to repolarisation or depolarisation</p> <p>Mk pt 2 Ignore 'atrial diastole'</p>
1	(e)		<p>A: Bradycardia B: Normal (heartbeat) C: Ventricular fibrillation D: Tachycardia</p>	(1) AO2 (1) AO2 (1) AO2 (1) AO2	4	
1	(f)		133 / 85 (mm Hg)	(1) (AO1)	1	
1	(g)		<p>Vital capacity lower than <u>normal</u> / <u>normal</u> vital capacity = 3.1 dm³ Person D has faster than <u>normal</u> heart beat /too fast / tachycardia</p>	(1) AO2 (1) AO2	2	<p>Reject 'low' Accept 'too low' and 'very low' Do not accept 'average' for 'normal' Reject 'fast heart beat'</p>

Total: 16 marks

2	(a)	(i)	A: <u>intercostal</u> muscle B: diaphragm	(1) (AO1) (1) (AO1)	2	Allow correct phonetic spellings
2	(a)	(ii)	Intercostal muscles <u>contract</u> Ribs move up (and or out) / rib cage expands Diaphragm <u>contracts</u> Diaphragm moves down / flattens Thoracic / chest cavity increases in size Pressure surrounding lungs lowers compared with atmospheric pressure / a vacuum is created / pressure in lungs lowers compared with pressure outside the lungs	(1) (AO1) (1) (AO1) (1) (AO1) (1) (AO1) (1) (AO1) max 4	4	Ignore any reference to lungs expanding Mk pt 5 Accept 'volume' for 'size'
2	(b)		Walls broken down between alveoli / larger alveoli (in person with emphysema) / smaller alveoli in healthy person More alveoli in healthy person / fewer alveoli in sick person (Fewer alveoli means) less surface area So less efficient oxygen absorption / less diffusion Reduced amounts of oxygen entering the <u>blood</u>	(1) (AO2) (1) (AO2) (1) (AO2) (1) (AO2) (1) (AO2) max 4	4	Ignore any reference to respiration Allow converse arguments 'Less oxygen diffuses into the blood' = 2 marks (mk pts 4 & 5)

2	(c)		<p>Possible risk of surgical procedure / adverse reactions following surgery The transplant (new organs) might be rejected The origin of the organs / whether organs from an animal (or not) The boy will need to take (immunosuppressive) drugs for the rest of his life / might need a second transplant (in the future) The success rate Length of recovery time Without surgery, life expectancy might be reduced</p>	<p>(1) (AO2) (1) (AO2) (1) (AO2) (1) (AO2) (1) (AO2) (1) (AO2) max 2</p>	2	Mk pt 1 Allow 'survival rate'
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Total: 12 marks

3	(a)		36.8 (°C) Accept any figure between 36.5 and 37.2 (inclusive) (°C) / Accept the range 36.5 – 37.2	(1) (AO1)	1	
3	(b)	(i)	The ability (of an organism) to maintain a constant internal environment	(1) (AO1)	1	
3	(b)	(ii)	Physiological processes: pH / CO ₂ / blood pressure / blood sugar (glucose) / breathing rate / pulse rate / (secretion of) hormones / water, ion or salt balance	(1) (AO1)	1	Accept any named hormone e.g. insulin
3	(c)		Take each reading more than once (in same part of body)	(1) (AO3)	1	Any reference to working out an average negates the mark Any reference to comparing with own temperature negates the mark
3	(d)	(i)	(Temperature is at its lowest) at 5 <u>a.m.</u>	(1) (AO2)	1	
3	(d)	(ii)	Temperature is at its highest when a person is at their most active / temperature follows a diurnal rhythm	(1) (AO2)	1	Ignore any reference to eating
3	(d)	(iii)	2.00 <u>p.m.</u>	(1) (AO2)	1	

3	(e)		Conduction Convection Radiation Evaporation / sweating Urine / excretion Faeces Exhaled air / breathing <u>out</u> / expiration Vomiting	(1) (AO1) (1) (AO1) (1) (AO1) (1) (AO1) (1) (AO1) (1) (AO1) (1) (AO1) (1) (AO1) max 3	3	Mk pt 4 Allow 'perspiration' and 'sweat' Ignore 'vasodilation'
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3	(f)		<u>Temperature</u> of the surroundings How much (surface area of) skin is exposed The level of activity of the body / exercise Clothing worn Wetness of skin Air movement (locally) <u>Colour</u> of clothing	(1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) max 2	2	Mk pt 5: 'amount of sweating alone is insufficient'
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Total: 12 marks

4	(a)		Advantage to driver: Being able to charge (battery) at home Advantage to environment: <u>Less</u> CO ₂ / SO _x / NO _x generated <u>Less</u> fossil fuel used / fossil fuel will last longer N.B. Chemical formulae must be written correctly	(1) (AO1) (1) (AO1) (1) (AO1) Max 2	2	Advantage to driver: Accept: Cheaper / cost effective No congestion charge Quieter Advantage to environment: Accept: Quieter N.B. Only accept 'quieter' once N.B. Do not accept 'carbon emissions' for 'carbon dioxide'
4	(b)	(i)	Heat / thermal (energy) Sound	(1) (AO1) (1) (AO1) max 1	1	
4	(b)	(ii)	315 000 (J) 2 marks for correct answer alone 1 mark for correct equation or correct substitution: $ke = \frac{1}{2} m v^2$ $ke = \frac{1}{2} \times 700 \times (30)^2$	(2) (A02)	2	No credit for working using $ke = \frac{1}{2} m v$: No square, no marks
4	(b)	(iii)	Momentum = mass x velocity Assuming same (braking) force Greater amount of momentum (to transfer) Greater (stopping) time needed Correct link made between greater stopping time and greater stopping distance	(1) (AO1) (1) (AO1) (1) (AO1) (1) (AO1) (1) (AO1) max 3	3	Ignore reference to greater mass Ignore reference to lower friction force Accept 'speed' for 'velocity' Mk pt 4 Allow 'longer' refers to "time"
4	(c)	(i)	Chemical	(1) (A01)	1	Reject: 'potential' alone Accept 'chemical potential (energy)'
4	(c)	(ii)	Less/little <u>heat</u> energy wasted / Energy which is normally wasted is available to (propel the car)	(1) (A02)	1	No credit for comments about cost Reject any answer that does not refer to energy

4	(d)	(i)	The stopping distance OWTTE	(1) (A03)	1	
4	(d)	(ii)	Use the same car / use same driver Use same tyres/ same tread Always empty / same mass Dry road / not slippery / not icy / good grip (for tyres) / same road (surface) No wind effects / same <u>weather</u> conditions	(1) (A03) (1) (A03) (1) (A03) (1) (A03) (1) (A03) Max 3	3	Mk pt 1 Reject 'same type of car'
4	(d)	(iii)	Systematic – All too high/ all too low / all on one side Caused by the same/repeated error / mistake Asymmetric / biased Caused by the equipment / use of wrong scale / offset error / zeroing error Random – (Equally) spread above and below / on both sides Scattered about the true value Caused by rounding / unpredictable / unexpected	(1) (A03) (1) (A03) (1) (A03) (1) (A03) Max 1 (1) (A03) (1) (A03) (1) (A03) Max 1	2	One mark for answer to “systematic”, one for answer to “random”

Total = 16 marks

5	(a)		540 (hours) 3 marks for correct answer alone Max 2 compensation marks for 2 of the following: Equation: $\text{cost} = \text{power} \times \text{time} \times \text{cost per unit}$ Rephrased equation : $\text{time} = \text{cost} \div (\text{power} \times \text{price})$ Correct substitution: $19440 = 3 \times \text{time in hours} \times 12$ or $194.4 = 3 \times \text{time in hours} \times 0.12$ Rephrased substitution: $\text{time in hours} = 19440 \div 36$	(3) (A02)	3	Allow 2 marks max for '5.4 hours' Do not accept $\text{time} = \text{cost} \div \text{power} \times \text{price}$ Accept $19440 \div (3 \times 12)$ Ignore time in days
5	(b)	(i)	So less fuel / energy used / CO ₂ created (in keeping the house warm) Plus one of the following: Less <u>heat</u> loss (rate) (Less <u>heat</u> loss or rate) for given temperature difference (between inside and outside) (Less <u>heat</u> loss or rate) for room of a fixed size / wall area	(1) (AO1) Max 1 (1) (AO1) (1) (AO1) (1) (AO1) Max 1	2	Ignore comments about cost Accept 'thermal' for 'heat'
5	(b)	(ii)	(Thicker walls / roof means) longer heat path (Thicker walls / roof means) lower <u>rate</u> of heat loss <u>Grass</u> layer traps air	(1) (AO1) (1) (AO1) (1) (AO1) max 1	1	No credit for 'grass is an insulator'

5	(b)	(iii)	600 (m ²) 3 marks for correct answer alone Max 2 compensation marks 1 mark for each of the following: Correct substitution: $10\,800 = 1.2 \times \text{area} \times 15$ Rephrased equation: $\text{area} = \text{rate of heat loss} \div (U\text{-value} \times \text{temp difference})$	(3) (A02)	3	Allow 1 mark max for '0.6 m ² ' Do not accept this rearrangement: $\text{area} = \text{rate} \div U\text{-value} \times \text{temp diff}$
5	(b)	(iv)	(Woollen) <u>carpet</u> contains air gaps/pockets of air Air is an insulator / poor conductor (of heat) Hot <u>air</u> rises / cold <u>air</u> falls Accept hot air at top of room / cold air at bottom of room (So) (air) temperature greater at top/ceiling (than at bottom/floor) Temperature <u>difference between outside and inside</u> is greater at top of room compared with bottom	(1) AO1 (1) AO1 (1) AO1 (1) AO1 (1) AO1 max 3	3	Ignore comments about different temperatures in loft and cellar Ignore comments about thickness of carpet and ceiling and their relative conductivity Mp4 accept 'it's hotter at the ceiling'
5	(c)	(i)	White / silver / shiny	(1) (A01)	1	
5	(c)	(ii)	Poor radiator / gives off little radiation	(1) (A01)	1	

Total = 14 marks

6	(a)		480 (kg) 3 marks for correct answer alone Max 2 compensation marks, 1 mark for any of the following: $GPE = \text{mass} \times g \times \text{height (gained)}$ $\text{mass} = GPE \div (g \times \text{height})$ $14400 = \text{mass} \times 10 \times 3$ $\text{mass} = 14400 \div (10 \times 3)$	(3) (A02)	3	NOT mass = $GPE \div g \times \text{height}$ NOT mass = $14400 \div 10 \times 3$
6	(b)		160 seconds / 2 min 40 sec 2 marks for correct answer alone max 1 compensation mark for 160 with wrong or missing units / $14400 \div 90$ / evidence of using the correct equation	(2) (A02)	2	Watch out for wrong or missing units
6	(c)		75% N.B. 75 = 1 mark max 2 marks for correct answer alone max 1 for efficiency = <u>useful</u> output power \div <u>total</u> input power	(2) (A02)	2	Accept '0.75'
6	(d)		Heat/energy lost to environment (Heat/energy lost to environment) at same <u>rate</u> that it is being produced Greater temperature difference between pump & environment (Means) greater <u>rate</u> of heat/energy loss To move towards thermal equilibrium	(1) (A02) (1) (A02) (1) (A02) (1) (A02) (1) (A02) max 3	3	Accept 'power' for 'rate' 'Heat lost to environment at same <u>rate</u> that it is being produced' = 2

Total = 10 marks