



**General Certificate of Education (A-level) Applied
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Applied Science

SC02

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Unit 2: Energy Transfer Systems

Final

Mark Scheme

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Question	Part	Sub-part	Marking guidance		Mark	Comment
1	(a)	(i)	A: Trachea B: Intercostal muscle(s)	(1)(AO1) (1)(AO1)	2	A: Reject 'windpipe'
1	(a)	(ii)	Diaphragm relaxes Diaphragm moves up / becomes curved Intercostal muscles relax Ribs move in / down Thoracic (chest) cavity decreases in size Pressure surrounding lungs increases (compared with atmospheric pressure) Passive process	(1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) max 4	4	
1	(b)		1. Supply oxygen 2. Remove CO ₂	(1)(AO1) (1)(AO1)	2	Ignore where oxygen or CO ₂ is going to/coming from N.B. 'Gaseous exchange' is neutral Ignore 'inhale' and 'exhale' as insufficient
1	(c)	(i)	Tidal volume: The volume of <u>air</u> that is inhaled OR exhaled in one breath	(1)(AO1)	1	Do not accept: 'the volume of air that is inhaled and exhaled'.
1	(c)	(ii)	400 – 500 cm ³ Allow any single figure within this range	(1)(AO1)	1	
1	(c)	(iii)	24 (%) Accept 24.4 and 24.5 (%) Correct answer gets 2 marks Max 1 for 0.244 / 0.24	(2)(AO1)	2	450 – 340 = 110 110 ÷ 450 = 0.244 0.244 x 100 = 24.4 (%)

1	(d)		Vital capacity decreases with age (Allow converse) Vital capacity increases with height / size (Allow converse)	(2)(AO3)	2	
1	(e)	(i)	12 - 15 (breaths per minute)	(1) AO1	1	Correct answer only
1	(e)	(ii)	When you exercise you use more oxygen / more oxygen needed by the body during exercise Oxygen needed by muscles (when contracting) After exercise more oxygen still needed by the body (Extra) oxygen needed (after exercise) to break down lactic acid More oxygen is needed (after exercise) than is supplied / oxygen debt It takes time for CO ₂ to move out of the bloodstream	(1)(AO2) (1)(AO2) (1)(AO2) (1)(AO2) (1)(AO2) (1)(AO2) Max 4	4	
2	(a)		36.8 (°C) Accept range: 36.5 – 37.2 (°C) or any single figure within this range	(1)(AO1)	1	
2	(b)		(Heat stroke starts to develop at) 38 (°C)	(1)(AO1)	1	General marked
2	(c)		Expired air / breathing <u>out</u> / exhaling Urine / excretion Faeces Accept vomiting	(1)(AO1) (1)(AO1) (1)(AO1) Max 3	3	'Breathing' is neutral 'Breathing in' is incorrect Ignore evaporation / vasodilation / conduction / convection / radiation N.B. If more than 3 answers given adopt the list principle: Deduct a mark for each wrong answer if more than 3 answers given

2	(d)		Blood diverted to the skin Vasodilation OWTTE (More) heat lost by radiation / conduction / convection (from the skin) Sweat produced by sweat <u>glands</u> Sweat / water / moisture <u>evaporates</u> Heat lost (from body) during evaporation / sweating Latent Heat of Vaporisation	(1)(AO2) (1)(AO2) (1)(AO2) (1)(AO2) (1)(AO2) (1)(AO2) (1)(AO2) max 4	4	Mk pt. 2 Allow 'blood vessels dilate' = 'vasodilation' Ignore reference to mechanisms of vasodilation
2	(e)		(Fever classed as above) 37.2°C	(1)(AO1)	1	General marked
3	(a)	(i)	(Manual/electronic digital) sphygmomanometer	(1)(AO1)	1	Accept any reasonable spellings Reject 'spirometer' Ignore 'manometer'
3	(a)	(ii)	135/85 (mmHg)	(1)(AO1)	1	General marked
3	(b)		Increase in heart rate Increase in stroke volume Increase in rate of breathing Increase in depth of breathing Faint	(1)(AO2) (1)(AO2) (1)(AO2) (1)(AO2) (1)(AO2) Max 3	3	N.B. Looking for corrective measures as opposed to symptoms Ignore 'dizziness' / 'feeling faint'

3	(c)		<p>Take pulse rate at rest Measure pulse rate for a given time (minimum 30 seconds) Engage in exercise Take pulse rate after exercise Time how long it takes for pulse rate to return to normal (or resting rate / pulse rate before exercise began) The time taken is an indication of the person's level of fitness / the shorter the time taken, the fitter the person</p>	<p>(1)(AO2) (1)(AO2) (1)(AO2) (1)(AO2) (1)(AO2) (1)(AO2)</p>	6	
4	(a)		<p>Air is an insulator / poor conductor Air is trapped / in pockets in <u>small</u> pockets (so) no / little <u>convection</u></p>	<p>(1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) max 3</p>	3	Mk Pt 1: Allow 'glass fibre is a poor conductor'. Ignore 'glass fibre is an insulator'
4	(b)		<p>Snow (surface) is white / shiny (so) <u>radiation</u> from Sun is <u>reflected</u> (so) no (little) <u>radiation</u> is <u>absorbed</u> (so) no (little) heat (energy) is transferred to (absorbed by) the snow OWTTE The sun is also shining on (all) the other houses</p>	<p>(1)(AO2) (1)(AO2) (1)(AO2) (1)(AO2) (1)(AO2) (1)(AO2) max 2</p>	2	Accept 'infra-red' for 'radiation' Ignore 'rays' and 'light' reflected / absorbed
4	(c)	(i)	<p>Longer heat path OWTTE More air for heat to pass <u>through</u> / more air therefore conduction is limited Lower <i>U</i> value</p>	<p>(1)(AO2) (1)(AO2) (1)(AO2) max 1</p>	1	Mk pt 3 'better' ≠ 'lower'

4	(c)	(ii)	Not enough space (in loft) / too big for space (Greatly) increased cost / not cost effective / long payback time / expensive It may not make much difference (to heat flow rate) (More) heat may / will be lost by other routes	(1)(AO2) (1)(AO2) (1)(AO2) (1)(AO2) max 2	2	
4	(d)		Electricity is (mainly) generated by burning fossil fuels Much heat is wasted <u>at the power station / in transmission</u> Electrical generation(or transmission) process is inefficient	(1)(AO1) (1)(AO1) (1)(AO1) max 2	2	
4	(e)	(i)	$U = 0.6$ Correct answer alone gains 2 marks 1 max compensation mark for correct substitution: $240 = 80 \times U \times 5$ OR $U = 0.5$ (follows from incorrect temperature difference) OR $U = 0.429 / 0.43$ (incorrect temperature) OR for correct rearrangement: $U = 240 \div (80 \times 5)$ OR $U = \text{rate of heat loss} \div (\text{temp. diff.} \times \text{area})$	(2)(AO2)	2	N.B. Watch for brackets for last point

4	(e)	(ii)	time = 10 hours / 600 minutes / 36000 seconds Correct answer alone gains 2 marks BUT incorrect or no unit gains 1 mark max Allow one compensation mark for equation: <ul style="list-style-type: none"> • heat = power x time OR • time = heat ÷ power OR • power = heat ÷ time / work ÷ time OR Allow one compensation mark for correct substitution: time = $(8.64 \times 10^6) \div 240$	(2)(AO2)	2	
5	(a)		Longer distance / time to stop Lower rate of change of momentum / less acceleration So less force Allow 'force = rate of change of momentum' Allow 'fender absorbs energy'	(1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) max 3	3	
5	(b)		Advantages (max 2) No (local) chemical pollution OWTTE Doesn't use up fossil fuels / the wind is a renewable energy source No (direct) cost / wind is free Little (no) noise / heat Disadvantage (max 1) Wind doesn't always blow / wind might be too weak (or strong) / wind direction might be wrong	(1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) max 2 (1)(AO1)	3	Mk pt. 1: Accept reference to CO ₂ Reject 'gases' alone Mk pt. 3: Allow 'cheaper'

5	(c)		Warm <u>water</u> is less dense/cold <u>water</u> is more dense Warm <u>water</u> rises / cold <u>water</u> sinks Sun heats <u>water</u> near surface Convection (currents)	(1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) max 2	2	Reject 'heat rises' Reject comments about 'air'
5	(d)	(i)	No units shown LOBF should (could) be curved / not a good fit Mark pt 2: Allow LOBF extends well beyond data	(1)(AO3) (1)(AO3) max 2	2	Ignore comments about large dots on graph Mk pt 2: Accept 'LOBF is wrong'
5	(d)	(ii)	Repeat the readings <u>and</u> take an average Take more readings at smaller intervals (i.e. between 0 – 30 m) Take more readings deeper (than 30 m) Take more readings <u>at a different place</u> / grid ref. Use the <u>same thermometer</u> Max 1 for 'take more readings' alone	(1)(AO3) (1)(AO3) (1)(AO3) (1)(AO3) (1)(AO3) max 3	3	
6	(a)		12.5 Accept 12.67 and 12.8 Correct answer alone gains 2 marks Allow one compensation mark for correct substitution: $15\,000 = 120 \times 10 \times \text{height}$ OR $\text{height} = 15\,000 / (120 \times 10)$ OR correct equation in symbols/words/rearranged e.g. GPE (E_p) = mgh	(2)(AO2)	2	
6	(b)	(i)	15.81 Allow 15.8 /16 Correct answer alone gains 3 marks Up to a max of 2: 1 compensation mark each for correct equation: $(KE) = \frac{1}{2} mv^2$ correct substitution: $15\,000 = \frac{1}{2} \times 120 \times v^2$ correct rearrangement: $v^2 = 2 \times KE \div m$ OR $v^2 = 2 \times 15\,000 \div 120$	(3)(AO2)	3	2 marks max for 16.0 / 15.80 Max 2 for more than 2 decimal places N.B. '250' = 2 marks max

6	(b)	(ii)	Friction / drag from the air / sprinkler head Air resistance = 2 marks	(1)(AO1) (1)(AO1)	2	
6	(c)		30% Allow 0.3 Correct answer alone gains 3 marks Correct answer with incorrect unit = max 2 1 compensation mark for correct equation: Efficiency = <u>useful</u> energy output / <u>total</u> energy input 1 compensation mark for correct substitution: Efficiency = 15 000 / 50 000	(3)(AO2)	3	
6	(d)		(current) cost per unit = 11 p OR cost for 12p units = £2016.00 / 201600 p Correct answer alone gains 3 marks Correct answer with incorrect unit = max 2 Max 2 compensation marks: Mark 1: (kWh) = 2.1 x 8000 Mark 2: Total cost = 2.1 x 8000 x 12 OR cost per unit = 184800 ÷ (2.1 x 8000)	(3)(AO2)	3	