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**General Certificate of Education  
June 2010**

**APPLIED SCIENCE**

**SC02**

**Unit 2      Energy Transfer Systems**

***Mark Scheme***

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**Question 1**

(a)(i)	(Manual / electronic) <u>sphygmomanometer</u>	(1) (AO1)	<b>1</b>
(a)(ii)	123 / 80 (mm Hg) Accept answers within the range: 115 – 130 (systolic) 75 – 85 (diastolic)	(1) (AO1)	<b>1</b>
(a)(iii)	(females) usually have (slightly) lower blood pressure (than males) Accept converse answer Accept if give normal value for females 123/80 <u>and</u> males 125/80	(1) (AO1)	<b>1</b>
(b)(i)	Electrocardiogram / ECG / stethoscope	(1) (AO1)	<b>1</b>
(b)(ii)	In ventricular fibrillation (V.F.) the ventricles do not contract in a co-ordinated way / heartbeat is uncoordinated / heart loses all rhythm / heart beats abnormally / heart beats with an irregular rhythm No blood is pumped from the heart / reduced blood flow from heart / V.F. is a form of cardiac arrest / V.F. is a form of heart attack	(1) (AO2)  (1) (AO2) max 1	<b>1</b>
(b)(iii)	Ventricular fibrillation is fatal (unless treated immediately) / collapses / becomes unconscious / faints	(1) (AO2)	<b>1</b>
(c)	Right ventricle pumps blood to lungs / left ventricle pumps blood round the body	(1) (AO1)	<b>1</b>
(d)(i)	Most arteries have no valves / Most veins have valves Artery <u>walls</u> are thicker than veins Artery walls are more elastic than veins OWTTE Artery walls contain more muscle tissue than veins Arteries have (relatively) narrow lumens / veins have (relatively) wide lumens N.B. Accept converse argument where relevant	(1) (AO1) (1) (AO1) (1) (AO1) (1) (AO1)  (1) (AO1) max 2	<b>2</b>
(d)(ii)	Arteries carry blood away <u>from the heart</u> / veins carry blood <u>to the heart</u> OWTTE Arteries (mostly) carry oxygenated blood / veins (mostly) carry deoxygenated blood Arteries transport blood under higher pressure than veins / arteries have to withstand a higher pressure than veins / arteries help to maintain blood pressure (while veins do not)	(1) (AO1)  (1) (AO1)  (1) (AO1) max 2	<b>2</b>
(e)(i)	Blood pressure lowest when sleeping / resting / relaxing	(1) (AO1)	<b>1</b>
(e)(ii)	More active / start to exercise Become nervous / scared / fearful Become excited Become stressed	(1) (AO1) (1) (AO1) (1) (AO1) (1) (AO1) max 2	<b>2</b>
(f)(i)	Correct plotting of points (half square tolerance) Correctly drawn curves of best fit Accept any graph where correctly plotted points are joined	(1) (AO3) (1) (AO3)	<b>2</b>

(f)(ii)	<p>Resting pulse (pulse at the start) lower in person 1 than person 2                  Highest pulse rate reached in person 1 = 102 compared with highest pulse rate in person 2 = 140 /                  pulse rate of person 2 increases more than person 1 / pulse rate of person 2 increases faster than person 1                  In person 1 pulse rate has returned to resting rate 2 minutes after exercise has finished compared with patient 2 whose pulse rate has not returned to resting rate 5 minutes after exercise has finished /                  person 2 pulse rate only returns to resting rate 4 minutes after exercise has finished /                  (Resting) pulse rate returned to normal more quickly in person 1 compared with person 2 / person 1 pulse rate drops more quickly than person 2 (after exercise)</p>	<p>(1) (AO2)                  (1) (AO2)                  (1) (AO2)</p>	<b>3</b>
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**Total Mark: 19**

**Question 2**

(a)(i)	<p>A: intercostal muscle                  B: diaphragm</p>	<p>(1) (AO1)                  (1) (AO1)</p>	<b>2</b>
(a)(ii)	<p>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                  Air rushes (OWTTE) into lungs (down the trachea)  <b>Any 4 of above</b></p>	<p>(1) (AO1)                  (1) (AO1)                  (1) (AO1)                  (1) (AO1)                  (1) (AO1)                  (1) (AO1)                  (1) (AO1)                  (1) (AO1)                  max 4</p>	<b>4</b>
(b)(i)	<p>Increase in depth (of breathing) / increase in tidal volume                  Increase in rate (of breathing)                  Accept for two marks:                  no change in rate or depth of breathing because carbon dioxide is the primary stimulus controlling breathing</p>	<p>(1) (AO2)                  (1) (AO2)                  (2) (AO2)                  max 2</p>	<b>2</b>
(b)(ii)	<p>Increased (heart rate)</p>	<p>(1) (AO2)</p>	<b>1</b>
(c)	<p>Blood vessels carry blood to alveoli                  Lots of alveoli / large surface area of alveoli                  Blood vessels (network of capillaries) surround / are attached to alveoli                  1 cell thick (thin walls) capillaries aid diffusion / maintain diffusion gradient                  Short diffusion path                  Carbon dioxide at higher concentration in blood than alveoli                  Carbon dioxide leaves blood / enters alveoli <u>by diffusion</u></p>	<p>(1) (AO2)                  (1) (AO2)                  (1) (AO2)                  (1) (AO2)                  (1) (AO2)                  (1) (AO2)                  (1) (AO2)                  (1) (AO2)                  max 3</p>	<b>3</b>

**Total Mark: 12**

**Question 3**

(a)	Body temperature (much) lower than normal / below 36.5°C (bottom of normal range) Body temperature lower than 32°C / hypothermia starts at 32°C	(1) (AO1) (1) (AO1)	<b>2</b>
(b)	Drowsiness / fatigue / loss of coordination Slowness of speech Amnesia / memory loss Poor judgement / irrational behaviour Hallucinations Dilated (enlarged) pupils Decreased heart rate Decreased breathing rate Stupor / loss of consciousness Pale / blue skin	(1) (AO1) (1) (AO1) (1) (AO1) (1) (AO1) (1) (AO1) (1) (AO1) (1) (AO1) (1) (AO1) (1) (AO1) (1) (AO1) max 1	<b>1</b>
(c)(i)	Wrap (person) in appropriate material e.g. foil, bubble wrap etc / huddle (with other people)	(1) (AO1)	<b>1</b>
(c)(ii)	Explanation must relate to answer in part 3(c) (i) e.g. foil: body heat <u>reflected</u>	(1) (AO1)	<b>1</b>
(d)	The ability (of an organism) to maintain a constant internal equilibrium / environment Regardless of the external environment By adjusting its physiological processes	(1) (AO2) (1) (AO2) (1) (AO2) max 2	<b>2</b>
(e)	Shivering Hairs become erect / piloerection takes place Vasoconstriction / blood diverted away from skin (surface) Metabolic rate increases / respiration rate increases	(1) (AO1) (1) (AO1) (1) (AO1) (1) (AO1) max 2	<b>2</b>

**Total Mark: 9****Question 4**

(a)	Radiation	(1) (AO1)	<b>1</b>
(b)	Shiny / white	(1) (AO1)	<b>1</b>
(c)	Black	(1) (AO1)	<b>1</b>
(d)	Energy = 75 000 2 marks for correct answer alone N.B. Joules (J) is a stand alone mark For 1 compensation mark: Energy = power x time / 250 x 300 / 250 x 5 / 0.25 x 5 2 marks max for: 1.25 kJ	(2) (AO2)  (1) (AO2)	<b>3</b>
(e)	$U = 12.5 \text{ (W m}^{-2} \text{ K}^{-1}\text{)}$ 2 marks for correct answer alone 1 compensation mark for: $250 = 4 \times U \times 5 / 250 \div (4 \times 5)$	(2) (AO2)	<b>2</b>

(f)	<p>Cost <u>of energy</u> (is higher)  CO<sub>2</sub> is generated at <u>power stations</u>  Global warming / greenhouse effect / more fossil fuels used  More electricity has to be generated at power stations  More power stations have to be built</p>	<p>(1) (AO1)  (1) (AO1)  (1) (AO1)  (1) (AO1)  (1) (AO1)  max 2</p>	<b>2</b>
(g)	<p>Cost = 10.75 (Allow 10.80)  2 marks for correct answer alone</p> <p>1 compensation mark for correct equation:  (cost = KW x hours x cost of one unit)  OR  Correct substitution:  = 0.2 x 336 x 0.16</p>	(2) (AO2)	<b>2</b>

**Total Mark: 9****Question 5**

(a)	<p>(Momentum = mass x velocity =)  = 1.5 (kg ms<sup>-1</sup>)  3 marks for correct answer alone</p> <p>N.B. 60 x 25 = 1,500 = max 2  1 compensation mark for the following (max 2):  Recognising initial momentum = 0  Correct substitution: 0.06 x 25</p>	(3) (AO2)	<b>3</b>
(b)	<p>Force = 7.5 (N)  2 marks for correct answer alone  Allow ecf from Q 5 (a)  1 compensation mark for:  Correct substitution: 1.5 (allow ecf) = force x 0.2</p>	(2) (AO2)	<b>2</b>
(c)	<p>k.e. = = 18.75 (J)  3 marks for correct answer alone  N.B. k.e. = 18,750 = max 2</p> <p>Allow (to a max of 2):  1 compensation mark for correct equation:  k.e. = <math>\frac{1}{2} m v^2</math>  1 compensation mark for correct substitution:  k.e. = <math>\frac{1}{2} \times 0.06 \times 25^2</math></p> <p>N.B. 1 mark max for: k.e. = <math>\frac{1}{2} \times 60 \times 25^2</math></p>	(3) (AO2)	<b>3</b>

(d)(i)	<p>Height = 35 (m)            Allow an answer within 34.95 – 35            3 marks for correct answer alone            Max 2 for 33.95 - 34</p> <p>If they use <math>g = 10</math> instead of <math>g = 9.81</math>:            Allow 3 marks for 34.3 - 34.35 (m)            33.30 - 33.35 (max 2)</p> <p>Allow (to a max of 2):            1 compensation mark for correct equation:  <math>g.p.e. = \text{mass} \times \text{gravity} \times \text{height (gained)}</math>            1 compensation mark for correct substitution:  <math>20 = 0.06 \times 9.81 \times h</math></p>	(3) (AO2)	3
(d)(ii)	Loses energy / air drag / air resistance	(1) (AO2)	1

Total Mark: 12

## Question 6

(a)	Useful output power is 8% / of the total input power	(1) (AO1) (1) (AO1)	2
(b)	<p><b>Advantage:</b>            No CO<sub>2</sub> / global warming produced / no greenhouse gases produced            No cost for <u>energy</u> (from Sun)            Can use in remote areas</p> <p><b>Disadvantage:</b>            Doesn't work at night            Doesn't work when obstructed / cloudy days / not always sunny / in winter            Need frequent cleaning            Need careful positioning / correct angle            Photovoltaic cells are expensive            1 mark for one correct advantage and            1 mark for one correct disadvantage</p>	(1) (AO1) (1) (AO1) (1) (AO1)  (1) (AO1) (1) (AO1) (1) (AO1) (1) (AO1) max 2	2
(c)	Hydroelectric / water turbine Wind turbine Tides Waves Biomass / wood / peat / biogas Geothermal Power generator	(1) (AO1) (1) (AO1) (1) (AO1) (1) (AO1) (1) (AO1) (1) (AO1) (1) (AO1) max 3	3
(d)	Fossil fuels will run out / renewables will not run out Better to conserve resources to use for other things Fossil fuels create CO <sub>2</sub> / global warming / greenhouse gases / renewables do not Fossil fuels create SO <sub>x</sub> /NO <sub>x</sub> / renewables do not Fossil fuels are more expensive than sunshine or water or wind	(1) (AO1) (1) (AO1)  (1) (AO1) (1) (AO1)  (1) (AO1) max 2	2

(e)	Fossil fuels are easily available (Most) renewable sources are not reliable / don't work all the time (Most) renewable sources are more expensive to install Most renewable resources produce lower power / don't generate as much energy We already have the infrastructure for burning fossil fuels Accept converse argument where appropriate	(1) (AO1) (1) (AO1) (1) (AO1) (1) (AO1) (1) (AO1) max 2	<b>2</b>
(f)	Nuclear waste is harmful to people / can cause cancer / death / possibility of reaction getting out of control / danger of an explosion / leakage / named disaster at power station	(1) (AO1)	<b>1</b>
(g)	It is too precise/accurate / too many significant figures The sun does not shine for 24 hours a day Not all days are sunny Cloudy days will give less current / voltage Average (voltage, current, power) will be less than the maximum	(1) (AO3) (1) (AO3) (1) (AO3) (1) (AO3) (1) (AO3) max 2	<b>2</b>
(h)	Use datalogger / joule meter / measure <u>energy</u> output (J) Take measurements over several days in different seasons / weather	(1) (AO3) (1) (AO3) (1) (AO3) max 2	<b>2</b>

**Total Mark: 16**