Version 1.0

General Certificate of Education (A-level) Applied
June 2012

Applied Science SC02

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

Unit 2: Energy Transfer Systems

Report on the Examination

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Set and published by the Assessment and Qualifications Alliance.

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General Comments

The performance of candidates in this exam compared well with that in June 2011.

It is of come concern that some centres seem to be operating by rote teaching of answers, which does not actually work. In addition, there is still an inability to rearrange equations which students consistently cannot do. It is disappointing to see that candidates are still referring to 'heat rising' rather than 'hot air rising'.

Several scripts scanned very faintly, perhaps caused by the use of blue ink. The rubric on the paper specifies that black ink or black ball-point pen is to be used and centres should ensure that candidates are aware of this before the examination. Some candidates tend to write in incredibly small handwriting which often becomes unreadable. It would be useful to remind candidates that illegible writing will result in no marks being awarded for their answer. Those candidates whose handwriting skills are known to be less than perfect could possibly be advised to write in block capitals to ensure that their work is able to be read and marked.

Question 1

(a) Many correct answers. However, a significant minority gave correct answers to A and B but the wrong way round. Also, many confused 'tricuspid' with 'bicuspid', while some just mentioned 'valves' without naming them and others put 'tendons' instead of valve. Some hedged their bets and wrote 'tricuspid/bicuspid' as their answer to B. Others, when in doubt, wrote the same answer for both A and B.

(b) Well known and well answered generally, but many incorrect answers such as 'allow blood into the heart' or 'to make the blood flow in one direction' which is not the same as 'prevent backflow'. A worrying number of candidates thought that the valves act as pumps or that they stop blood from going in and out of the heart.

(c) Quite well answered with many candidates getting one mark, usually for knowing that blood from the left ventricle goes to the body. Marks were often lost for saying that 'blood flow will be affected' rather than 'reduced'. Only the best candidates related a thinner wall with a reduced systemic blood pressure. Many failed to refer to the left ventricle, in the context of pressure generated, and hence lost this mark.

(d) Poorly answered on the whole. Some very confused accounts were seen where the heart sounds were apparently caused by the opening and closing of valves, rather than closure only. Many described the cardiac cycle of the heart, either in terms of electrical activity, or otherwise, which was not creditworthy. Many talked about the first heart sound being caused by the valves opening and the second sound by the valves closing, while others attributed the sounds to events in the heart linked to the double circulation. Others explained the cause in terms of the contraction and relaxation of the atria and ventricles.

Most candidates knew that valves were involved and hence got one mark. Many candidates answered in terms of hearing blood flow/heart muscle contraction/electrical activity of SAN/AVN. Candidates commonly associated the first sound with A-V valves and the second sound with semi-lunar valves so gained two marks but only the better candidates related valve closure to the activity of the ventricles. Some candidates thought that there were three heart sounds instead of just two. A mark was often lost for talking about the heart relaxing or contracting, rather than the ventricle.

The overwhelming majority of the candidates failed to link the heart noises to the different valves closing and explained 'how the heart beats' rather than 'how it makes a noise'. Candidates should be reminded to chain their answer to the precise question set, and avoid general comments around the topic. A good discriminator.

(e)(i) This was poorly answered. It is just simple recall and these values have not been well learned.

(e)(ii) Well answered although all six letters were seen, with C being the most common error as candidates thought (incorrectly) that the blood pressure was too high.

(e)(iii) Well answered but 'average' was often given as equivalent to 'normal' and blood pressure was described as simply 'low', neither of these being creditworthy.
Also, comparison with the group average is irrelevant to an individual's health.

(f) Many good responses, which scored four marks, although only a handful were entirely correct. There appears to be huge confusion in this area. Common responses included references to sweating and thermoregulation which somehow then reduced heart rate, control of breathing which then may (or may not) control heart rate and the idea that heart rate is dependent upon oxygen levels.

Too many answers were based on 'the brain sends a message to the heart to slow down' rather than explaining exactly how this is done. Many tried to explain using oxygen levels rather than carbon dioxide levels, or even confused heart and lung actions. Few candidates showed an understanding of the role of chemoreceptors, the cardiovascular centre, the S-A node and their locations.

This was a good discriminator as only the better candidates achieved the mark for saying that there was 'an <u>increased</u> frequency of impulses travelling in the parasympathetic nerve' rather than just 'impulses travel' with no reference to frequency. Often the roles of the parasympathetic and sympathetic nerves were reversed.

(g) Most candidates got the full four marks. A minority gave only a description of a type of exercise that could be performed.

Question 2

(b)(ii) Generally well answered but many confused heart and breathing rates, or used key words (e.g. tidal volume, vital capacity) vaguely or just plain incorrectly. Comments about 'lung volume' did not make for a clear meaning. Most candidates gained the mark for increase in frequency of breathing rate but fewer got the 'increase in depth' mark. Also, some talked about an 'increase in breathing' without saying whether they meant rate or depth. Others confused tidal volume with stroke volume and some thought that an increase in breathing rate was tachycardia.

A significant number of candidates took the Y axis to be breathing rate and talked about fluctuating breathing rates. There seems to be a general lack of understanding of the idea that rate is equivalent to frequency so candidates wrote 'breathing rate started at 0.5 litres'. Many candidates observed either the increase in rate or the increase in tidal volume but relatively few saw both. The weakest candidates simply said that 'breathing increased'.

(c)(i) On the whole, very poorly answered. Many zero mark responses relating to ventilation and its control, presumably interpreting aerobic as aerobics (i.e. exercise classes). In a similar vein, there were many descriptions of gas exchange in alveoli (most of them quite accurate) but scoring zero despite references to oxygen. A few candidates confused respiration with perspiration and described sweating. At worst 'oxygen is converted into glucose' was seen.

A common error was stating that 'oxygen is supplied to make energy'. Many said that oxygen is needed by the muscles with no mention of it being used with glucose; indeed some thought that oxygen creates glucose. Many accounts described gaseous exchange instead of aerobic respiration. Some thought that aerobic respiration meant 'in the absence of oxygen', while others said that 'respiration is breathing using oxygen', confusing respiration with inspiration.

There were many non-attempts and very few four mark answers.

(c)(ii) Candidates tended either to show this equation letter perfect, or not to know it at all hence getting two marks or none. Common errors were $C_6H_{12}O_2$, $\underline{6}\ C_6H_{12}O_6$, confusion between O_2 and CO_2, and incorrect numbers of molecules e.g. $\underline{2}\ CO_2$ or $\underline{3}H_2O$. Some candidates gave word equations despite the question clearly asking for a chemical equation. Often one mark only was awarded for correctly balanced output. Some omitted to insert a plus sign where needed. A fair number failed to answer the question at all.

Question 3

(b) Poorly answered. Few candidates realised that everybody has body fat so that it is the thickness/depth of this fat which is important i.e. little understanding shown that they should be making a comparison between people who have better/poorer insulation. Lots of answers were brief to the point of incomprehensible, e.g. 'fat' or 'body fat' or 'skin'. Many candidates wrote about piloerection without realising that wet hair does not trap air. Many incorrect references to 'more muscle', the amount of blood flowing', 'core body temperature'. Also, a poor understanding, generally, of S.A.:Vol ratio.

(c) Not well answered given that it is pure recall. Many candidates wrote about shivering but surprisingly few talked about muscle contraction (preferring to use terms like movement) and even fewer realised that the heat results from respiration (the mythical (?) idea that muscle friction produces heat was popular). Vasoconstriction was often described in terms of blood vessels (almost any blood vessel) sinking deeper into the body, rather than blood being diverted away from the skin surface. Piloerection was generally well known and explained although some candidates thought that erect hairs trap heat rather than air.

Too many candidates referred to stopping/preventing heat loss rather than reducing/decreasing it. Many inappropriate answers such as 'huddling together', 'homeostasis', 'breathe faster', 'cover with blankets'. Some gave 'vasoconstriction' correctly, then described it in terms of vasodilation or said that blood vessels dilate rather than constrict. Some failed to read the question properly and talked about 'moving people to another room'. A small number thought that the hairs were laying flat in order for the air to be trapped. Also, many thought that it is the contraction of the muscle that produces heat, rather than respiration that produces energy for contraction and heat as a by-product.

There were some excellent answers, gaining all six marks, but these were in the minority, making this a good discriminating question.

Question 4

(a) Generally well done, with most candidates getting full marks. The usual mistake was to lose track of the 'squared' i.e. 0.5 x 3 x 6; others used 'm x v' or shifted to grams instead of kg. More practice is needed with this sort of calculation.

(b) Relatively few candidates realised that *most* of the energy is transferred to the post as kinetic energy and confined themselves to vague statements about energy being used/converted. Many candidates realised that some energy would be lost as heat or sound but few said where this went, failing to say that it was transferred or equivalent. Many said 'energy transferred to the post' but didn't give an energy form. Many made a vague reference to potential energy - it's not clear what they meant by this. A few (correctly) mentioned k.e. of post or soil. Some still think that friction is an energy form.

(c) Generally well answered, although working was not always clear. Common errors were: using the equation for efficiency, converting 1200 W into 1.2 kW (or 12 kW or 120 kW!), starting with a correct equation power = work ÷ time, but then rearranging this to time = work x power. The usual error was to take the correct equation and mangle it while rearranging. Those who substituted **before** rearranging did better than those who rearranged first. For some reason a significant minority got an answer of 30 then multiplied (incorrectly) by 60.

Some failed to carry out simple calculations, giving 36000 ÷ 1200 = 3. Many arrived at the correct answer of 30 but mistakenly thought that this was in minutes so multiplied by 60 to give 1800 seconds.

Many scored part marks by showing some working; answers without working scored poorly.

(d) Generally well answered with about 50% providing correct solutions. Most answers gained either the full two marks or none, while very rarely was anything worth a compensation mark of one seen. A common mistake, that failed to get the compensation mark, was 1200 ÷ 40 = 30, instead of 1200 x 40% or 1200 x 0.4.

Most problems derived from not knowing the correct equation: Efficiency = useful energy out ÷ total energy in or knowing the equation but then failing to correctly rearrange it. Many candidates were 'lost' here, getting the occasional mark from working. There were too few methodical calculations. A significant minority worked out the right answer (480 W) then subtracted it from the total input power, getting a figure for the wasted power which was not what was asked for.

(e) Often well answered, but many referred to 'pollution' without any further explanation. Too many responses are still being couched in 'sound bite' terminology such as 'carbon footprint', 'carbon emissions', 'global warming' and 'Greenhouse effect' with no reference to CO_2 being released, these being unlikely to score marks. 'Carbon emissions' or 'greenhouse gases' is not precise enough to mean 'CO_2'. Most candidates referred to the process being noisy or causing 'sound pollution' but very few realised that post knocking manually is pretty noisy and the important idea is the increase in noise. Several candidates thought that the post-knocker was electrical!

A common error was stating that more fuel was being used with no mention of fossil fuels. Some just wrote 'fossil fuels' without saying that they were used.

(f) Many answers gained two marks. Better candidates realised that this question was about collisions and wrote very sound answers based on ideas about force and momentum. Weaker candidates tried to explain the problem in terms of energy changes or tried to use conservation of momentum as a starting point (sometimes giving stationary hedges momentum to get this to work!). The weakest candidates knew nothing about collisions and fell back on vague ideas about thick hedges being stronger.

Many candidates struggled to link their explanations to hard Physics, focusing their answers on 'reduced rate of change'. Also, many talked about the 'thicker hedge absorbing (the) force better than the thinner hedge' rather than 'less force acting on the thicker hedge' or the converse. Some ignored the question asking them to 'use your knowledge of momentum to explain.'. They often answered in simplistic terms saying that 'the cattle will have to kick harder to kick the thicker hedge down'.

Question 5

(a) Mostly well answered, although weaker candidates often gave incorrect answers including silver, white etc.

(b) Very few candidates got both marks. Many got one mark for saying that 'copper is a good conductor'. A surprising number think that plastic is a good conductor and/or that it would melt in contact with hot water.

A vocal minority stated that copper is an insulator and, while most candidates knew it is a conductor, few explained why. Many candidates spent time explaining why plastic is not suitable; it was more effective to explain why copper **is** suitable. A surprising number claimed that copper is simultaneously a good conductor and an insulator.

(c) Often poorly answered. Many scripts (well over a third) referred to 'hot air' which was not in the question and scored no marks. Candidates need to use their work as a link between the underlying Physics and the specific question set; ignoring either of these makes for a poor answer. Too many referred to 'heat rising' (as opposed to hot water rising) despite this being highlighted in previous reports, and this also scored zero.

About 40% of all answers were couched in terms of hot <u>air</u> moving and so failed to score. There is some evidence that pupils are being taught standard answers by rote, which they just trot out when they see a question on convection. We are still getting 'particles become less dense', 'heat particles' and worse still 'cold particles'. There was often confusion between the properties of hot and cold water with statements such as 'cold water is much denser than hot water' being seen rather often. Occasional reference to 'condensation causing hot/cold water to move up/down' was also seen.

(d) A fairly straightforward calculation that was tackled well by most candidates with many getting full marks. A surprising number made no attempt to answer the question.

Most marks were lost by: omitting units, converting 3m into 300cm (or 3000cm) or 20kg into 2000g (or 200g). When units were given, they were often incorrect.

(e) Quite well answered but often lacking in detail and scientific terminology. Some candidates gave the disadvantages of using a solar cell even though the question asked for advantages.

Again sound bites were given such as 'eco-friendly', 'carbon emissions' and 'environmentally friendly' which convey very little meaning. There were many unqualified references to expense/cost. Vague comments about 'environmentally friendly' solar cells scored little, as did references to 'low global warming' and 'greenhouse gases'. At this level, specific mention of 'renewable' or 'non-fossil' energy sources, and 'CO_2 emissions' is required. 'Eco-friendly' or 'it is good for the environment' is just not enough. The bald statement 'it's renewable', with no reference to energy, failed to gain a mark. Other non-creditworthy answers included 'it does not release any fossil fuels into the environment', 'very accessible', 'it is quicker' and 'it is more reliable'.

(f) Generally well answered with many sensible suggestions which scored marks. However, many repeated the same point or hadn't read the question fully. For instance, many answers referred to 'using the same number of panels on each house'. Careful reading of the question stem would have made it clear that each house had exactly one panel fitted.

Common errors were: 'same size panels', with a lack of realisation that we are comparing manufacturers not efficiency. Other incorrect answers, originating from a general failure to read the question, included 'all houses in same area' or 'same number of houses for each panel'. Some students are not quite in touch with reality so statements such as 'ensure the same weather' and 'same distance from the sun' were seen. Other incorrect statements included 'the house should have the same number of occupants' or have the same person install the panels. Marks were often missed for failing to give quite enough information such as 'the amount of water' without saying 'the same amount of water'.

Some candidates gave three precautions even though the question asked for two.

(g) Well answered, with many students getting marks for obtaining averages and knowing that more data lead to increased reliability. Weaker candidates considered practical problems rather than experimental design so they talked about faulty panels and the notion that just one panel would not be adequate to heat a house.

Most candidates understood that multiple data increase the reliability of conclusions but few explained why. Some used 'abnormalities' when they meant 'anomalies', while some merely repeated the stem and failed to say that more reliable results would be obtained.

Question 6

(a) Most candidates started off with a useable equation, gaining one compensation mark, but very few scored full marks. Lack of method cost most candidates here. Many had the right equation but could not manipulate it to calculate the cost per unit. There was evidence that many students either did not have, or did not trust, their calculators. Students must expect to meet calculations such as this at AS and beyond.

Marks were lost by incorrect rearrangement of the equation, failing to convert W to kW or working in £ but then quoting the answer in p.

(b) Well answered, with the majority getting one or two marks. Marks were lost by either failing to rearrange or substitute correctly, getting the equation upside down or simply getting lost in the calculation.

This question separated candidates very effectively. A significant number did not attempt it, and many others could not manipulate the equation. There were many ways of scoring 1 out of 2 but most candidates either got this correct or made no progress. This reinforces the comment about Q6 a. Also, candidates should know that '50 sq m' means 50 units of 1 square metre. There is no need to square the '50' in further calculations.

(c) Generally well answered, though more use of key words would have helped many candidates. This is now a familiar question and we again see rote learned (or not learned) responses. Most candidates got the mark for 'trapped air' and 'air is an insulator' but fewer realised that the small pockets of air are too small for convection. Careless answers included 'foam is an insulator' and ideas that conduction is the loss of hot air.

A clear explanation of the role of small pockets of (insulating) air (in preventing conduction and convection) was necessary for full credit. A common mistake was to refer to 'trapping/absorbing heat' in the air pockets; this does not happen.

There were some very good answers that gained all four marks.

(d) Most candidates took the question literally and only described events which happened as the temperature fell. Better candidates went on to describe subsequent events as the temperature rose again but only the best students realised that these events would cycle repeatedly. Some candidates failed to establish a link between thermostat and heater and others believed that the thermostat itself produced the heat.

Most students linked low temperature to the heaters being switched on or, in some cases, hot water being supplied. There was some confusion between temperature and heat. Many statements said that 'the thermostat heats up the caravan' while many candidates failed to include enough information to gain three marks. This is a 'negative feedback' question and some explanation of the whole cycle is expected.

A number of candidates made no attempt to answer the question, while some gave more detail than was really needed by giving an in-depth description of how a bi-metallic strip works.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.