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Applied Science SC02

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Unit 2: Energy Transfer Systems

Report on the Examination

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General Comments

The performance of candidates in this exam compared well with that in June 2010.

Most questions were well attempted, although there was still a noticeable tendency for candidates to confuse blood pressure with other parameters such as peak flow readings and breathing rate. Many candidates appear to have failed to learn values and ranges for lung volumes and normal blood pressure and subsequently did not perform well on these questions.

There was some confusion between the role of mucus and cilia in the trachea with many answers being written the wrong way round.

The balanced equation for aerobic respiration was often incorrect or written as a word equation.

There was a poor understanding amongst many regarding the production of carbon dioxide by germinating seeds and the role of aerobic and anaerobic respiration. Virtually no-one realised that covering the flask containing the seeds with a black cloth would prevent photosynthesis from taking place.

The understanding of ethics and how this impacts on the rights of people to be given necessary operations was generally poor.

Designing an experiment to assess cardiovascular fitness was very well addressed by candidates across the spectrum of ability. Likewise, there was a very good understanding of how the body maintains its temperature in hot surroundings.

The role of the artery in maintaining blood pressure was not covered well and there was much confusion regarding how the wall of the artery behaved when the blood pressure was rasied or lowered.

Weaker students sometimes had difficulty with the equations, either putting the numbers into their calculators correctly but dividing the numbers the wrong way round or misreading the final answer by adding too many or too few zeros.

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.

Question 1

(a)(i) With respect to the normal values for tidal volume and expiratory peak flow rate, mostly a correct range was given or a correct figure within the range. However, many candidates appear not to have learnt the normal value for vital capacity. A lot of candidates used the old values from a previous specification, suggesting that teachers need to look at values for lung volumes provided in the most recent specification.

(ii) There was a good understanding that the test values indicated that a diagnosis of asthma would be supported, but not all answers gave a satisfactory explanation for their choice. Some candidates stated that the test results would support a diagnosis of asthma or explained discrepancies in the values. However, they did not always provide the two statements together and hence failed to gain the mark.

(b)(i) The function and importance of the gland in the trachea was often well documented, although little mention was made of the fact that mucus moistens air that is taken in. There was much mention of saliva instead of mucus and many candidates appeared to be unaware of the function of the gland. Quite a few candidates talked about mucus clearing dust, as opposed to trapping it. The term 'foreign body' was used more than expected and was not acceptable, a more specific answer being required.

(ii) There was some confusion between the role of the gland in the trachea, and that of the cilia. Cilia were often described, incorrectly, as being responsible for trapping dust, rather than removing it. Most answers correctly identified the cilia as preventing damage to the lungs by stopping dust or dirt from getting in. Few talked about wafting or removing mucus and many talked about phlegm instead of mucus.

(c) This question was a good discriminator, with stronger candidates gaining three or four marks and weaker ones gaining only one or two marks. There was a common mistake in some answers whereby the presence of fewer alveoli in people with emphysema was thought to result in a larger surface area, rather than a smaller surface area. Having stated correctly that alveoli are larger in sick people, the assumption was often made that larger alveoli resulted in a larger surface area for oxygen absorption. There were some erroneous references to blood being diffused, instead of oxygen. A large number talked about seeing fewer capillaries and that this reduced blood flow and many simply missed the fact that oxygen is transported in the blood. Gaseous exchange was a very popular answer instead of diffusion.

Question 2

(a)(i) There was mostly correct realisation that aerobic respiration involves the use of oxygen. Answers that were not creditworthy included those where the chemical equation for aerobic respiration was given, with no explanation, or where 'air' was given instead of 'oxygen'. There was confusion, in some cases, between aerobic respiration and aerobic exercises.

(ii) A correct balanced chemical equation for aerobic respiration was mostly given, although some candidates chose to write a word equation, for which they received no marks.

(b)(i) Stronger candidates appreciated that the soda lime in flask A would absorb any carbon dioxide entering flask B, causing the limewater to remain clear, while weaker ones tended to state that the limewater remained clear but failed to explain why.

Many answers correctly stated that the limewater in flask D would turn cloudy due to carbon dioxide produced by the germinating seeds in flask C. However, answers failed to provide any explanation for the colour change, merely stating that the limewater turned cloudy. For instance, some candidates understood what happened to the limewater but missed details such as 'seeds respired producing carbon dioxide' or 'no carbon dioxide because absorbed' and therefore missed both available marks. Quite a number seemed to think that the peas were in some way passed over into the limewater which changed its colour.

(ii) Very few candidates realised that flask C was covered with a black cloth in order to prevent photosynthesis from occurring. Some thought that it absorbed heat radiation and somehow speeded up the processes.

(c)(i) The RQ value was mostly calculated correctly. However, there were indications that some candidates did not possess a calculator or were unable to use one as the correct equation was often given but resulted in the wrong answer. This was evident in all calculation questions, resulting in the needless loss of marks.

(ii) The fact that some anaerobic respiration is taking place was often understood, although few understood that anaerobic respiration results in an RQ greater than 1. There was very little mention that less oxygen was used than expected, with many answers merely repeating the question to say that more carbon dioxide was given off than oxygen was used.

Question 3

(a)(i) This was a good discriminating question with most answers gaining one of the two available marks, with the better candidates understanding more fully the ethical reasons for refusing necessary operations. The weaker answers tended to talk about people bringing their conditions on themselves.

(ii) Many candidates failed to appreciate that some conditions might prevent people from exercising, thus making it difficult for them to lose weight. The fact that people contribute to the NHS, by paying taxes, led some candidates to assume that this alone made it ethically wrong to refuse necessary operations for smokers or obese people, with no reference to the fact that paying taxes should automatically entitle a person to the operation; therefore, their answers were often incomplete.

(b) This question was very well answered with most gaining three and many four of the available four marks. Instances where an answer received no credit included those where the candidate had used blood pressure or peak flow readings, rather than heart rate, as an indicator for measuring cardiovascular fitness.

(c) The greater proportion of candidates appear not to have learned the normal blood pressure values and resorted to guesswork. Some gave values for heart rate or breathing rate instead of blood pressure, while others gave the correct values but in the wrong order or gave only one figure.

(d)(i)&
(ii)(iii) These questions were generally poorly answered with much confusion between the different answers. There was a lack of understanding of how the artery wall is involved in controlling blood pressure. In 3(d)(iii) most answers failed to refer to how high or low blood pressure could be normalised by the artery. Instead they made general comments without saying whether they were talking about low or high blood pressure. Also, many answers failed to make any reference to existing blood pressure and talked vaguely about muscles relaxing and contracting. In addition, some seemed to think that the artery wall would relax in response to a fall in blood pressure and would contract in response to a rise in blood pressure.

Many students appeared to have never thought of an artery as an example of a situation where pressure is equivalent to force/area; hence, if the blood pressure was too high, reducing the diameter of the lumen was erroneously thought to be capable of lowering the pressure for the same force. Quite a few mentioned that pressure was created by the heart pumping and missed the idea of the effect caused by the artery.

(e) There were some very good accounts of how body temperature is regulated. However, references to hairs lying flat, or blood vessels moving closer to the surface of the skin, rather than blood being diverted to the surface, failed to gain credit. Also, a large number of answers talked about heat being evaporated from the skin instead of water or sweat being evaporated. Many referred to the body sweating and omitted to mention that sweat is produced by the sweat glands, thus failing to gain the mark.

Question 4

(a) This question was mostly well answered with either two marks being awarded for the correct answer or one mark for providing the correct equation or correct substitution.

(b) Most answers gained one mark by mentioning that the engine is not 100% efficient, that heat is created, or that air resistance was responsible for more energy being required to lift the skydiver to the required height.

(c) The calculation was mostly carried out correctly with the weaker candidates often gaining one mark for correct substitution. Marks were sometimes lost due to a failure to use the correct equation and to use K.E. = ½ x mass x speed (½ x 90 x 8) instead of K.E. = ½ x mass x speed^2 (½ x 90 x 8^2). In some cases the equation was correctly quoted but the calculation failed to square the speed.

(d) Good understanding was demonstrated by most candidates concerning the different ways in which energy could be lost by the skydiver at the point of landing. Some thought that the plane had to go higher than the parachutist and so had more gravitational potential energy or alternatively that the parachutist landed higher up than the airfield.

(e) Most answers gained two marks for stating that the time taken to come to rest when landing increased and that this, in turn, resulted in less force on the parachutist. Correct statements relating to momentum were seldom seen.

(f) Stronger candidates gained the full two marks for a correct calculation, while the weaker ones often gained one mark for correct substitution.

Question 5

(a) Two acceptable advantages of using a wood-burning stove, compared with a gas-powered central heating boiler, were mostly given.

(b) Most answers gained the mark.

(c) Black was given correctly as the colour to use for a stove, in order to maximise the radiation from its surface. However, approximately one third of candidates chose other inappropriate colours such as white, and even shiny, which is not a colour at all.

(d) Many answers failed to gain the mark here by mentioning that metal is a conductor but failing to say that it is a good conductor.

(e) There was largely good appreciation that hot air is less dense than cold air and consequently rises, although quite a few candidates referred to 'lighter' rather than 'less dense' with no reference to volume of gas. Many answers failed to gain a mark by talking about 'heat rising' rather than 'hot air rising'. Convection was often correctly mentioned.

(f) This was a good discriminating question with stronger candidates gaining the full three marks and the weaker ones losing a mark by inserting an incorrect unit.

(g) This was well answered with the correct calculation being carried out. Where the answer was incorrect, a mark was usually awarded for correct substitution.

(h) The advantage of using hydroelectric energy to generate electricity was often correctly given as the fact that rain water is free, although some incorrect answers referred to the fact that it is reusable. One disadvantage occasionally given was that it is not always sunny and therefore energy cannot be produced at night, suggesting that the candidate had confused hydroelectric energy with solar panels. Many answers incorrectly gave the cost of setting up the facility as a disadvantage; any new installation incurs cost.

(i) This was often poorly answered. Where solar panels were given as a device, radiation from the Sun was often given to explain energy flow involved, with no reference to heating water. Many candidates referred to photovoltaic cells which would not be adequate to heat a house as was specified in the question.

Question 6

(a) This question mostly gained one of the two marks available, with only the stronger candidates getting the second mark. Keeping the temperature of the heater constant was often suggested, instead of keeping its power constant.

(b)(i) Very well answered. Occasionally the mark was lost when the answer mentioned that the frequency of taking the temperature could be altered to improve the experiment, but failed to say that the frequency should be increased.

(ii) Well answered on the whole. A number of quite clever answers talked about the use of data-logging and taking temperatures from outside without the need to open the doors.

(c)(i) Answers to this question tended to be awarded the full two marks or none at all. Where the final answer was incorrect the substitution tended also to be incorrect. Many incorrect answers had inverted the equation. Relatively few answers showed clear mathematical method.

(ii) This was well answered, with mention being made of the fact that hot air rises and that most heat is lost through the roof. Careless use of 'heat rises' instead of 'hot air rises' often lost a mark.

(d) Mentioning that air is an insulator or a poor conductor often gained one mark while, to a lesser extent, a second mark was awarded for realising that small cells reduce convection. Many candidates referred incorrectly to 'air trapping heat in'.

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