



# Examiner's Report/ Lead Examiner Feedback

June 2015

NQF BTEC Level 1/Level 2 Firsts in  
Applied Science

Unit 1: Principles in Science (20460E)

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## **Introduction**

This report has been written by the lead examiner for the BTEC Principles of Science unit. It is designed to help you understand how learners performed overall in the exam. For each question, there is a brief analysis of learner responses. You will also find example learner responses from Level 2 Pass and Distinction learners. We hope this will help you to prepare your learners for future examination series.

## Overall comments

Learners that did well this series, did so as in previous series because they had learnt key terms and used good scientific language, they were able understand what would be asked for in the question and therefore apply their knowledge of the science well.

As in previous series, exam technique is still an issue for learners; centres need to prepare learners for the exam better by practicing exam technique, especially in relation to reading the question carefully. Key terms from the specification should be taught so that learners are able to fully access the question.

Teaching the meaning of key questioning terms such as explain and describe, so that the learners understand what is required of the question and can then apply their knowledge correctly, is also important. Learners should be taught that they should be checking that the question set has been addressed in the answer given and that they must use appropriate scientific knowledge and vocabulary. There is also the need for centres to continue to focus on learners learning the key scientific knowledge in the specification, one way this could be achieved would be to practice structuring extended writing questions as this is a skill that the learners are still not proficient in.

## Grade boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link: <http://www.edexcel.com/iwantto/Pages/grade-boundaries.aspx>

Grade	Unclassified	Level 1 Pass	Level 2		
			Pass	Merit	Distinction
Boundary Mark	0	13	22	31	41

## Feedback on Specific Questions

### Q01a<sup>iii</sup>

Learners found this question more difficult than the preceding two. Many could not correctly give a type of energy wasted.

The following shows some correct responses such as sound and thermal for 1 mark.

(iii) Name **one** type of energy wasted when the kettle is boiling.

(1)

Sound energy

---

(iii) Name **one** type of energy wasted when the kettle is boiling.

(1)

Thermal

---

Unfortunately a very common misconception was that the steam released by the kettle was a form of energy that was wasted.

---

(iii) Name **one** type of energy wasted when the kettle is boiling.

(1)

Steam

---

**Q02ai**

Many learners were able to give a form of renewable energy such as solar energy.

Charlotte visits a hydroelectric power plant.



(a) (i) Hydroelectricity is a form of renewable energy.

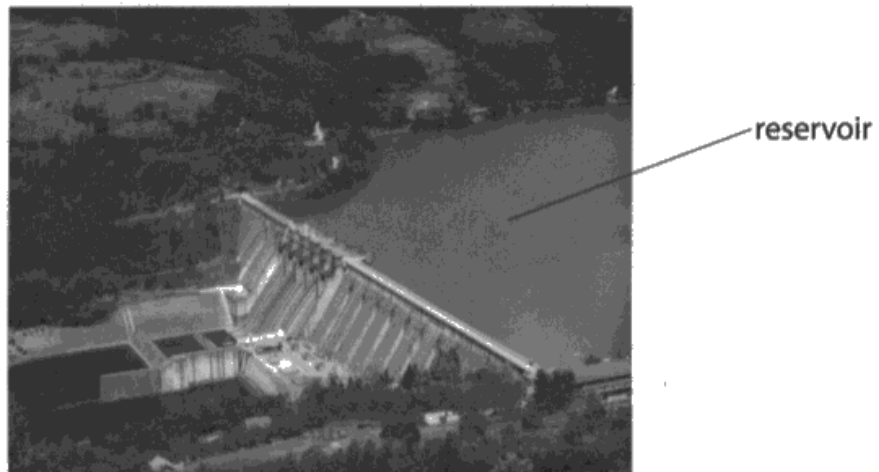
Give **one** other form of renewable energy.

(1)

Solar energy.

Learners who lost marks on this question did so as they gave a form of energy, but not related to the question regarding renewable energy.

**2** Charlotte visits a hydroelectric power plant.



(a) (i) Hydroelectricity is a form of renewable energy.

Give **one** other form of renewable energy.

(1)

Heat

## Q02bi

Learners found the first of the two calculation questions on this paper easier than the second.

In this example, the learner substituted the values of energy and time into the equation. Unfortunately they have not converted the minutes into seconds and so only gained one mark.

(b) Charlotte makes a model of a hydroelectric power plant.

In 10 minutes her model produced 2700 joules of energy in total.

(i) Calculate the power produced by her model.

$$\text{power(watts)} = \frac{\text{energy(joules)}}{\text{time(seconds)}}$$

(2)

$$2700 \div 10 = 270$$

$$\underline{270 \text{ w}}$$

The following answer scored both marks, even without the working shown. However, learners should always show their working so that credit can be given for working that might be correct.

In 10 minutes her model produced 2700 joules of energy in total.

(i) Calculate the power produced by her model.

$$\text{power(watts)} = \frac{\text{energy(joules)}}{\text{time(seconds)}}$$

(2)

$$\text{power} = \underline{4.5}$$

In this case, the learner has written the wrong answer on the answer line. However as the learner has written their working, credit can be scored for showing how they have substituted the values into the equation given.

(i) Calculate the power produced by her model.

$$\text{power(watts)} = \frac{\text{energy(joules)}}{\text{time(seconds)}}$$

$$\frac{2700}{10}$$

(2)

$$27000 \text{ w}$$

### Q02bii

Learners found calculating the useful energy much more difficult.

A common error was to calculate the useful energy and then to put it into the equation again to gain a figure of 0.9.

Learners who made this error but showed their working still gained 1 mark for calculating the 2430.

(ii) The efficiency of Charlotte's model is 90%.

Calculate the useful energy supplied by the water in ten minutes.

$$\text{efficiency} = \frac{\text{useful energy}}{\text{total energy supplied}} \times 100\%$$

(2)

$$90\% \times 2700 = 2430$$

$$\frac{2430}{2700} \times 100\%$$

$$.9$$



In other cases, an incorrect answer was given but as no working was given no credit for any partial answers could be awarded.

(ii) The efficiency of Charlotte's model is 90%.

Calculate the useful energy supplied by the water in ten minutes.

$$\text{efficiency} = \frac{\text{useful energy}}{\text{total energy supplied}} \times 100\%$$

(2)

11.1

Although learners did not always calculate the value in the expected way, full marks were gained for the correct answer on the answer line.

(ii) The efficiency of Charlotte's model is 90%.

Calculate the useful energy supplied by the water in ten minutes.

$$\text{efficiency} = \frac{\text{useful energy}}{\text{total energy supplied}} \times 100\%$$

$$2700 \div 10 = 270$$

$$2700 - 270 = 2430$$

$$\text{efficiency} = \frac{2430}{2700} \times 100\% = 90$$

(2)

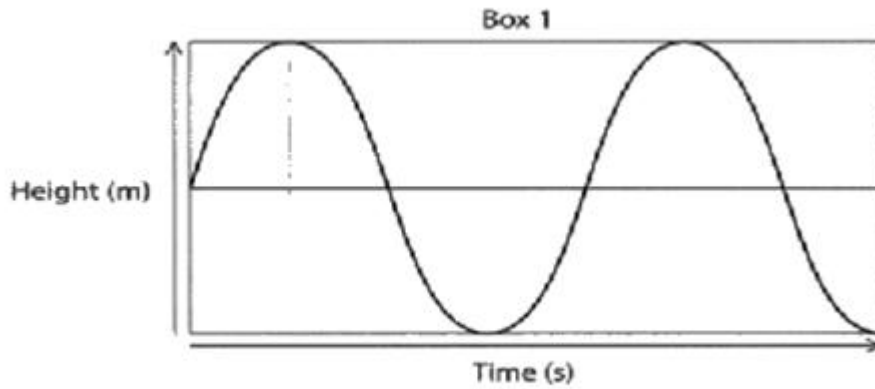
2430

### Q03c

Learners seemed to find drawing a wave of equal amplitude but higher frequency quite difficult.

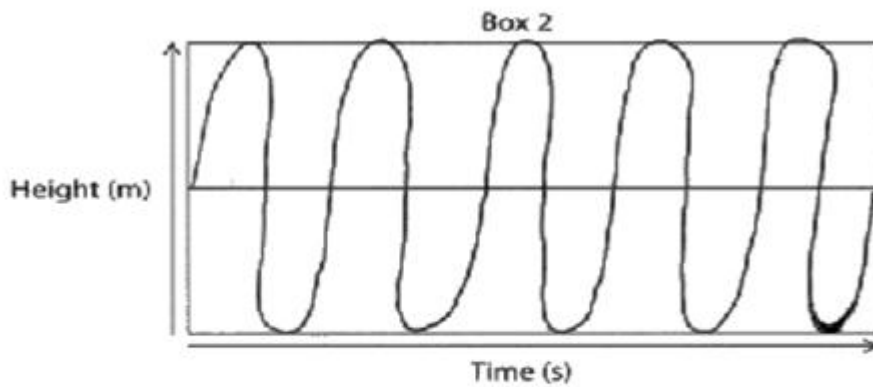
The better candidates were able to draw a wave that showed both of these characteristics.

(c) The diagram in box 1 shows a wave.



In box 2 draw a wave that has the **same amplitude** but a **higher frequency** than the wave shown in box 1.

{2}



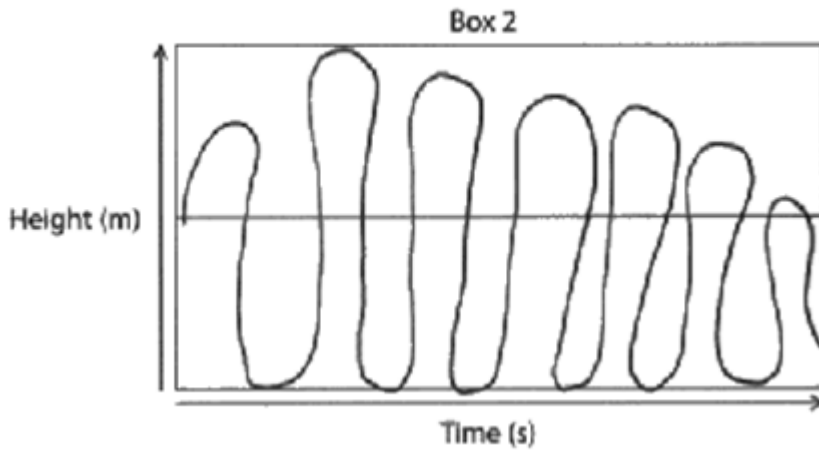
**(Total for Question 2 = 6 marks)**

However, many learners found this hard.

Out of the two characteristics that had to be shown, learners were better at understanding how to show a wave that had a higher frequency.

In box 2 draw a wave that has the **same amplitude** but a **higher frequency** than the wave shown in box 1.

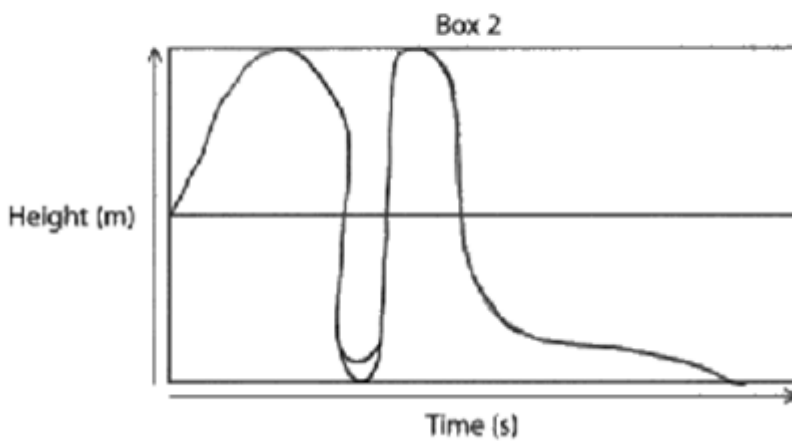
(2)



In some cases, learners had drawn more than one line, so it was unclear which they thought was the amplitude and which not. Learners should be encouraged to rub or cross out errors such as this to avoid a situation such as this.

In box 2 draw a wave that has the **same amplitude** but a **higher frequency** than the wave shown in box 1.

(2)



### Q03d

Learners tried hard at this question which was looking for a comparison between the properties and uses of radio waves and gamma rays.

In this example, the learner scored 3 marks. The learner states that the radio waves are the longest, due to the comparative word 'longest' this gained a mark for the comparison of the wavelength. Later in the response, the learner has stated that 'gamma rays..... are most dangerous', which also scored 1 mark. Finally the learner has given a use for radio waves, if they had just stated for radios this would not be creditworthy, however they have also stated mobile phones, which is acceptable. They give the comparison that gamma rays are used in cancer treatment. Together these two comparative uses gained a mark. Unfortunately the learner did not make reference to the frequency of the waves for the final marking point.

(d) The diagram shows different parts of the electromagnetic spectrum.

Radio waves	Microwaves	Infrared	Visible	Ultraviolet	X-rays	Gamma rays
-------------	------------	----------	---------	-------------	--------	------------

Describe how radio waves and gamma rays differ in their properties and uses. (4)

radio waves differ to gamma rays because radio waves are the longest but not dangerous at all and some ~~uses~~ uses of a radio wave are radio and mobile phones. Gamma rays differ to radio waves because they are the shortest but they are the most dangerous. Some uses of this are radiation and cancer treatment, and radio therapy

(Total for Question 3 = 8 marks)

Learners who did not do so well in this question lost marks as they did not give a comparison of the properties or uses, or because their answer was too vague. This following example gained 0 marks. Whilst the learner has made several attempts to answer the question the uses given for radio and gamma rays were too vague. Learners should be encouraged to be more scientifically specific with their responses to questions. Simply stating that radio waves are used in radio, is not specific enough. Similarly simply stating that gamma rays are used in medical equipment is just too vague. In the same manner, the learner has stated the frequencies of radio waves and gamma rays are different, but they have not stated in which way they are different.

(d) The diagram shows different parts of the electromagnetic spectrum.

Radio waves	Microwaves	Infrared	Visible	Ultraviolet	X-rays	Gamma rays
-------------	------------	----------	---------	-------------	--------	------------

Describe how radio waves and gamma rays differ in their properties and uses.

(4)

Radio waves are transmitted <sup>differently</sup> from gamma rays. They are also at different ends of the spectrum. Radio waves are also used in different devices such as a radio. Whereas gamma rays are used in different appliances such as medical equipment. Also radio waves and gamma rays have different frequencies.

(Total for Question 3 = 8 marks)

TOTAL FOR SECTION A = 18 MARKS

The better learners generally gave a concise and to the point answer that scored 4 marks.

(d) The diagram shows different parts of the electromagnetic spectrum.

Radio waves	Microwaves	Infrared	Visible	Ultraviolet	X-rays	Gamma rays
-------------	------------	----------	---------	-------------	--------	------------

Describe how radio waves and gamma rays differ in their properties and uses.

(4)

Radio waves have a lower frequency and longer wavelengths, ~~and~~ this means that they are at no risk to humans and they are used to transfer satellite signals. Compared to the radio waves, gamma rays have a higher frequency and shorter wavelengths, they are used to sterilise foods to keep them fresh for longer and they can kill bacteria, they are also used to sterilise hospital equipment. Gamma rays can be harmful as they can cause cancer.

(Total for Question 3 = 8 marks)

TOTAL FOR SECTION A = 18 MARKS

### Q04ai

Learners found stating what Edward would have observed during the reaction of hydrochloric acid and sodium carbonate, quite difficult.

Better learners used the information in the question to help inform their answer. As in this example. Learners who just wrote bubbles or fizzing gained the mark.

4 Edward added hydrochloric acid to sodium carbonate.  
The reaction produced a gas.

(a) (i) State what Edward would have **seen** during the reaction.

(1)

~~A sudden~~ bubbles, to show Gas is being created

However, many learners tried to answer a question that was not there. In this example the learner has tried to give the products of the reaction, not what would be seen during the reaction, there therefore no credit could be awarded.

4 Edward added hydrochloric acid to sodium carbonate.  
The reaction produced a gas.

(a) (i) State what Edward would have **seen** during the reaction.

(1)

water + Carbon dioxide and sodium chloride.

### Q04aiii

It was disappointing to see that many learners were unable to correctly give the formula for a molecule of carbon dioxide.

Whilst it appeared that the majority of learners knew the formula, only the better learners were able to write it down using the correct scientific conventions.

(iii) Give the formula for a molecule of carbon dioxide.

(1)

CO<sub>2</sub>

The majority of learners lost marks as they thought that the '2' should be superscript rather than subscript, as in this example.

(iii) Give the formula for a molecule of carbon dioxide.

(1)

CO<sup>2</sup>

Other learners seemed to be lazy in the way in which they wrote the formula such as in this case.

(iii) Give the formula for a molecule of carbon dioxide.

(1)



### Q04avi

In a similar manner to question 4aiii, only the best learners could correctly give the formula for a molecule of hydrogen. As in this example.

(iv) Give the formula for a molecule of hydrogen.

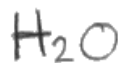
(1)



Some learners were confused and wrote the correct formula but for water rather than for hydrogen.

(iv) Give the formula for a molecule of hydrogen.

(1)



Some learners knew the formula but as the hydrogen was represented by a lower case 'h' rather than a capital, could not score.

(iv) Give the formula for a molecule of hydrogen.

(1)



The place in which most learners lost marks on this question, however, was because they did not read the question and gave the formula for an atom, rather than a molecule, of hydrogen.

(iv) Give the formula for a molecule of hydrogen.

(1)



### Q04b

Learners found question 4b, quite difficult. Some learners understood that as sodium carbonate is a base, a solution of sodium carbonate would have a pH of more than 7. Some gave this as a range and some gave a specific number, either of which were acceptable.

(b) Sodium carbonate is a base.

Suggest a value for the pH of a sodium carbonate solution.

(1)

8 to 14

---

(Total for Question 4 = 6 marks)

(b) Sodium carbonate is a base.

Suggest a value for the pH of a sodium carbonate solution.

(1)

8

---

(Total for Question 4 = 6 marks)

A common misconception seen was that the solution would be neutral and a value of pH7 was suggested.

(b) Sodium carbonate is a base.

Suggest a value for the pH of a sodium carbonate solution.

(1)

7

---

(Total for Question 4 = 6 marks)

### Q05bii

Learners still find writing word equations difficult.

Only the better learners were able to correctly write the word equation.

(ii) Write a word equation for the reaction.

(2)



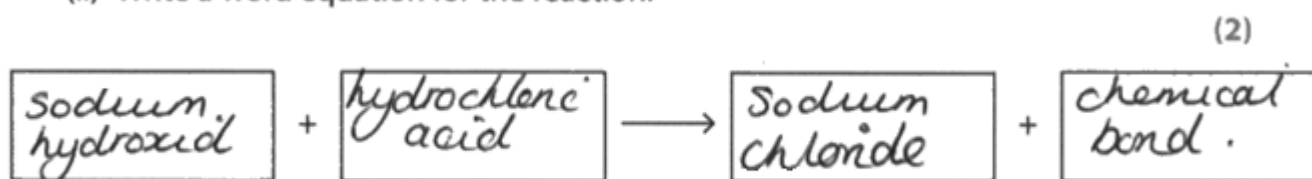
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(Total for Question 5 = 6 marks)



In some cases the learners were able to correctly write the reactants for the equation but then were unable to give both of the correct products.

(ii) Write a word equation for the reaction.



(Total for Question 5 = 6 marks)

A common error was that learners did not use the information in the stem correctly and gave the sodium chloride as one of the reactants instead of one of the products.

(ii) Write a word equation for the reaction.



(Total for Question 5 = 6 marks)

## Q06

Question 6 was the first of the two extended answer, six mark questions, with a points based mark scheme. Learners found this question hard. Many learners did not gain full credit as they did not explain their answers. Centres need to prepare their learners for the exam by practising past papers and exemplifying questions that require explanations. These questions will require the learners to give a point or fact and then explain that idea.

In this example the learner scored 4 of the 6 available marks. The learner starts by stating that fluorine's configuration is 2.7, which scored one mark, unfortunately there is no explanation to go with this in terms of how this explained the position of fluorine in the Periodic Table.

The learner then goes on to state that chlorine's configuration is 2.8.7 which is worthy of another mark. Again, there is no explanation to go with this point.

Lastly the learner states that 'they both have seven in their outer shell' and then gives the explanation, 'this means that they are in group 7'. The learner then gives some information regarding the reactivity of the elements, however this is incorrect.

6 The diagram shows part of the periodic table.

1	2	3	4	5	6	7	0
						19 F	
						35.5 Cl	

Explain why fluorine and chlorine are in the positions shown.

Your answer should include ideas about ~~2,8,8,1~~ 2,7

- the electronic configuration of the atoms 2,8,7.
- periods and groups
- properties of the elements.

~~Fluorine~~ Fluorine is in group 7, as (6)  
its configuration is 2,7 and  
in Chlorine, the configuration is  
2,8,7. They both have 7 in  
outer shell and this makes them go  
into group 7. Fluorine is a higher  
period than Chlorine, as it is  
less reactive and safer to the  
user.

In the example below, the learner starts by stating that they are both non-metals so are both on the right of the table, this point explained is worthy of 2 marks. They go on to say that they both have one electron in their outer shell which is incorrect, they say that this means that they are in group 7 which is incorrect and so no credit can be scored for this part.

Although they have stated that they are in group 7, as they have not linked this to having 7 electrons in the outer shell, this mark is not scored.

In the last section the learner states that both elements react with the same things, which is an acceptable alternative for react in similar ways, but as this is not linked to both requiring one electron to get a full outer shell, this mark cannot be scored.

						19	
						F	
						9	
						35.5	
						Cl	
						17	

Explain why fluorine and chlorine are in the positions shown.

Your answer should include ideas about

- the electronic configuration of the atoms
- periods and groups
- properties of the elements.

• They both in the non metal <sup>(6)</sup> section on the right of the periodic table.

• They both a one electron in their outer shells putting them in groups 7

• Both the elements will react with the same things but ~~fluorine~~ fluorine reacts quick than chlorine.

In this next example however, the learner has stated that they are both non-metals which scored 1 mark, as there is no explanation of this the second marking point is not scored.

'They are both harmless to the human body and they don't react with many things' is wrong and also insufficient for reacting in similar ways.


Explain why fluorine and chlorine are in the positions shown.

Your answer should include ideas about

- the electronic configuration of the atoms
- periods and groups
- properties of the elements.

one reason is because they are non-metals. they are both harmless to the human body and they don't react with many things. (6)

As in previous questions, learners who scored well, tended to write concise answers that were to the point.

6 The diagram shows part of the periodic table.


Explain why fluorine and chlorine are in the positions shown.

Your answer should include ideas about

- the electronic configuration of the atoms
- periods and groups
- properties of the elements.

The electronic configuration for fluorine is 2.7, the electronic configuration for chlorine is 2.8.7. Both atoms have 7 electrons in their outer shell that's why they are in group 7. fluorine has 2 shells that's why it's in period two. chlorine has 3 shells that's why chlorine is in period 3. Chlorine and fluorine both have low melting and boiling point. (6)

### Q07a

Question 7a was generally well attempted by learners, with many being able to give a correct example of a voluntary response.

7 (a) Human responses can be voluntary or involuntary.

Give **one** example of a voluntary response.

(1)

Walking

Those that did not score on this question generally did so because they misread the question and gave an involuntary response, such as blinking, instead of a voluntary responses.

7 (a) Human responses can be voluntary or involuntary.

Give **one** example of a voluntary response.

(1)

blinking

### Q07bi

The majority of learners were able to give a correct response of the human body to being cold. The majority of learners either correctly stated that the body would shiver or that goose bumps would appear.

(b) The human body maintains its temperature of  $37^{\circ}\text{C}$  by homeostasis.

(i) Give **one** way in which the human body will respond to being too cold.

(1)

Shivering

Learners who did not score, generally did so because they did not use the science they had learnt to answer the question but tried to apply general ideas, often incorrectly, as in this example:

(b) The human body maintains its temperature of  $37^{\circ}\text{C}$  by homeostasis.

(i) Give **one** way in which the human body will respond to being too cold.

(1)

The human will get a cold.

### Q07bii

Again in question 7bii, learners could generally give a correct way that the body would respond to being too hot, many stated that the body would sweat or that vasodilation would occur.

(ii) Give **one** way in which the human body will respond to being too hot.

(1)

Vasodilation = When your blood vessels get wider.

In a similar manner to question 7bi, learners who did not score in 7bii, generally did so as they did not use the science they had learnt to answer the question but tried to apply general ideas often incorrectly. As in this example.

(ii) Give **one** way in which the human body will respond to being too hot.

(1)

Go outside and cool down.

### Q07c

Learners found this question difficult. Those that scored generally done so for giving a correct comparative statement as in this example.

(c) Give **one** difference between the endocrine system and the nervous system.

(1)

The nervous system responds quicker.

(Total for Question 7 = 4 marks)

Those who did not score tended to make vague, generally incorrect comments on either the endocrine or nervous system.

(c) Give **one** difference between the endocrine system and the nervous system.

(1)

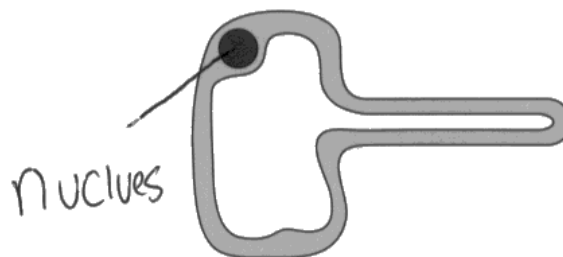
The Nervous System passes information to the brain whereas the endocrine system does not.

(Total for Question 7 = 4 marks)

### Q08bi

The majority of learners were able to label the nucleus correctly to gain the mark.

The diagram shows a root hair cell.



(b) (i) Draw a line to label the nucleus.

In some cases, the learner looked like they might have known which part the nucleus was but unfortunately, as they have rushed their work, the label did not stretch far enough to the nucleus and no credit could be awarded.

### Q08c

In question 8c, learners found it difficult to recall a way that the root hair cell is adapted to its function. Only the better learners were able to state that the root hair cell had a large surface area.

(c) State **one** way that the root hair cell is adapted to absorb water and minerals from the soil.

(1)

large surface area

In many cases, the learners had misread the question and stated how the root is adapted to its function giving the fact that it had root hairs as their answer.

(c) State **one** way that the root hair cell is adapted to absorb water and minerals from the soil.

(1)

The roots on the plant have little tiny hairs on which allows the root cell to absorb water and minerals from the soil.




## Q08d

In question 8d, some learners were able to score 2 out of the 4 marks available for giving a function of both the xylem and phloem. However only the very best learners were able to explain how the the xylem and function are adpated.

In the following example, the learner has correctly give the functions of both the xylem and phloem and has correctly discussed how they are both adapted for their functions.

(d) The xylem and phloem are present in the stem of the plant.  
Explain how the xylem and phloem are adapted for their functions.



(4)

Xylem The xylem is hollow/empty for the transport of water and minerals from the roots to other parts of the plants. The xylem also has valves to keep the water/minerals flowing one way. The xylem has a thick cell wall to transport water/minerals.

Phloem The Phloem has a sieve plate and sieve tube which transports dissolved sugars produced during photosynthesis in the leaves to other parts of the plant. The Phloem has a slightly thinner cell wall than the xylem.

Some learners gave the function of the xylem and phloem but did not explain how they were adapted to this function to gain the second mark for each.

(d) The xylem and phloem are present in the stem of the plant.

Explain how the xylem and phloem are adapted for their functions.

(4)

Xylem xylem carries minerals and water around the stem it <sup>pushes</sup> stretches out the inner stem which allows the substances (water and minerals) to be transported around the stem.

Phloem phloem has adapted to its functions as it contains glucose and also chlorophyll. ~~carries~~ The phloem is a cell that takes these substances \* to the leaves which helps with ~~photo synthesis~~ photosynthesis.

\* (glucose and chlorophyll).

(Total for Question 8 = 8 marks)

Other learners did not understand the difference between the xylem and phloem and got the functions mixed.

(d) The xylem and phloem are present in the stem of the plant.

Explain how the xylem and phloem are adapted for their functions.

Xylem <sup>(4)</sup> this is the storage at  
the bottom of the plant stem

Phloem the function of the phloem  
is to help move the water up  
the plant stem.

## Q09

Question 9 was the second of the two six mark questions, with a leveled mark scheme.

In this example, the learner shows an understanding that Hannah has inherited one allele from each parent. This learner explains that Hannah has brown eyes because she has one dominant allele from Mrs Williams and a recessive blue allele from Mr Williams and that she will have brown eyes as this allele is dominant and so this colour will be seen.

The learner then goes on to explain how Sam has had two blue alleles passed down one from Mrs Williams who was heterozygous and Mr Williams who is homozygous. They state that as there is no dominant allele, Sam would have blue eyes.

This is a distinction-level answer, that discussed dominant and recessive alleles and explained why Hannah has brown eyes and why Sam has blue eyes.

Female	B	Bb	Bb
	b	bb	bb

Use the Punnett square and your knowledge of genetics to explain why Hannah has brown eyes and Sam has blue eyes.

(6)

Hannah has brown eyes because of the dominant allele that Mrs Williams had. They <sup>parents</sup> would have passed on one of their alleles. Mr Williams could only pass on the recessive blue eye allele and Mrs Williams would have passed on the dominant brown eye allele. Since the brown eye allele ~~would be the~~ is dominant, that would be the one to show. Sam, however, would have received two recessive blue eye alleles - one from his homozygous father, and one from his heterozygous mother. So there would be no dominant allele so he'd have blue eyes.

In this merit level example, the learner has shown an understanding that Mr Williams has two recessive 'genes' so he is homozygous for the trait of blue eyes.

The learner also shows an understanding that Mrs Williams has a recessive and a dominant 'gene' so the dominant 'gene' is for the trait of brown eyes.

The learner has not referred to Hannah or Sam by name but they have understood that the children have a 50% chance of having blue or brown eyes.

Overall the learner has shown a good understanding of dominant and recessive alleles and that the children have a 50:50 chance of having blue or brown eyes.

Female	B	Bb	Bb
	b	bb	bb

Use the Punnett square and your knowledge of genetics to explain why Hannah has brown eyes and Sam has blue eyes.

(6)

Mr Williams has two recessive genes so he would be homozygous so the recessive gene must be blue, whereas Mrs Williams has a recessive gene and a dominant gene so the dominant gene must be for brown eyes. So their children have a 50% chance of being blue or brown eyed so the same as their parents so its most likely that one child would have brown eyes and the other would have blue.

In this pass level example, the learner has made reference to the brown eye gene being dominant. They also state that there is a 50:50 chance of getting blue/brown eyes.

Sam has blue eyes.

		Male	
		b	b
Female	B	Bb	Bb
	b	bb	bb

Use the Punnett square and your knowledge of genetics to explain why Hannah has brown eyes and Sam has blue eyes.

(6)

They Brown eye gene was the dominant gene so it overrode the blue eyes. But there is a 50/50 chance of getting Blue or Brown eyes

Unfortunately the most common response seen was similar to the following example, learners assumed that Sam was a boy and so took after the dad and Hannah took after her mum.

		Male	
		b	b
Female	B	Bb	Bb
	b	bb	bb

Use the Punnett square and your knowledge of genetics to explain why Hannah has brown eyes and Sam has blue eyes.

(6)

this has worked from genes the  
son Sam has gotten his dad's  
blue eyes and the daughter Hannah  
has got her mums eyes. So when  
they get older this will be passed  
down through to their children. because  
we are like our parents that is  
from the genes from our parent and their  
parents.

0 Marks

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