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GCSE (9-1)

Examiners' report

TWENTY FIRST CENTURY SCIENCE COMBINED SCIENCE B

J260
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Version 1

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Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates. The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report. A full copy of the question paper can be downloaded from OCR.

Paper 8 series overview

Candidates expression at times hindered their progress in open response questions. The use of key terminology was weak, and centres should look to improve this in future years.

Generally, the questions were well attempted, and few blank spaces were seen.

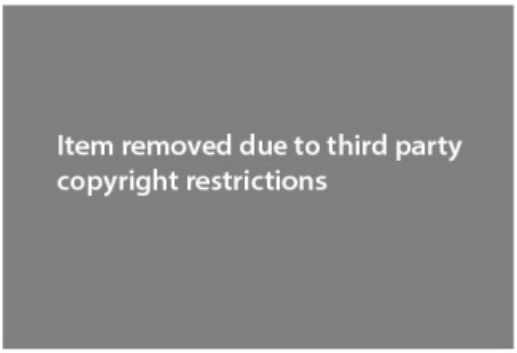
Questions involving practical aspects of the course were generally well answered and candidates seem to have had some exposure to practical activities.

Candidates seemed well prepared for calculations and data processing-based questions. They seemed more confident at attempting the more difficult questions and were much more tuned into the questions that required data processing to take place.

Question 1 (a) (i)

1 Oil tankers transport crude oil. Crude oil is a mixture of hydrocarbons.

Occasionally they may be involved in an accident and catch fire as shown.



(a) (i) Explain why the burning hydrocarbons in the oil produce thick black smoke.

.....

.....

..... [2]

Candidates often repeated the stem of the question and discussed black smoke rather than looking at explaining why the smoke was produced. Only high ability candidates were able to gain credit for both marking points. They seemed unfamiliar with the idea of incomplete combustion and the lack of oxygen that leads to this.

Question 1 (a) (ii)

(ii) The hydrocarbon fractions in crude oil are separated by fractional distillation.

Complete the sentences about fractional distillation.

Use the words from the list. Each word can be used once, more than once, or not at all.

dissolved **cooled** **crystallise**

evaporate **heated** **melt**

During fractional distillation the mixture is heated and the fractions ..... at different temperatures.

The separated fractions are then ..... so that they condense.

[2]

This question gained credit at all abilities, with the common misconception being the use of the word 'melt' rather than evaporate. The majority of candidates could identify the word 'cooled' to fit the second sentence.

Question 1 (a) (iii)

(iii) The hydrocarbons in crude oil are mostly alkanes.

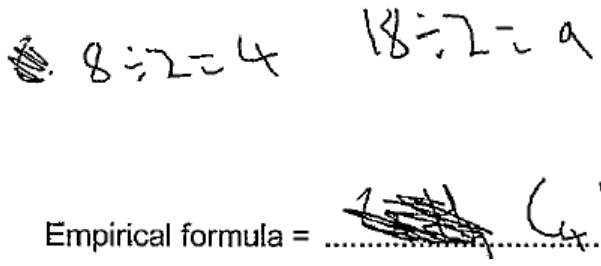
Octane is an alkane. Its molecular formula is C_8H_{18}.

Determine the empirical formula of octane.

Empirical formula = ... **[3]**

The quality of responses varied widely. Candidates rarely showed working that gained credit without then giving a fully credit worthy response. A number of candidates left this blank. A significant number of candidates simply drew a displayed formula of the compound, suggesting that they had little understanding of the requirements of an empirical formula. While they attempted to respond to the question, they had little understanding of the process to calculate such a formula. Multiples were also seen, which defeats the object of the formula and were not given credit.

Exemplar 1



This response gained 3 marks and shows an expected calculation to determine the empirical formula.

Question 1 (b)

(b) Some ships carry condensate oil, rather than crude oil.

Fig. 1.1 shows the composition of fractions in crude oil and condensate oil.

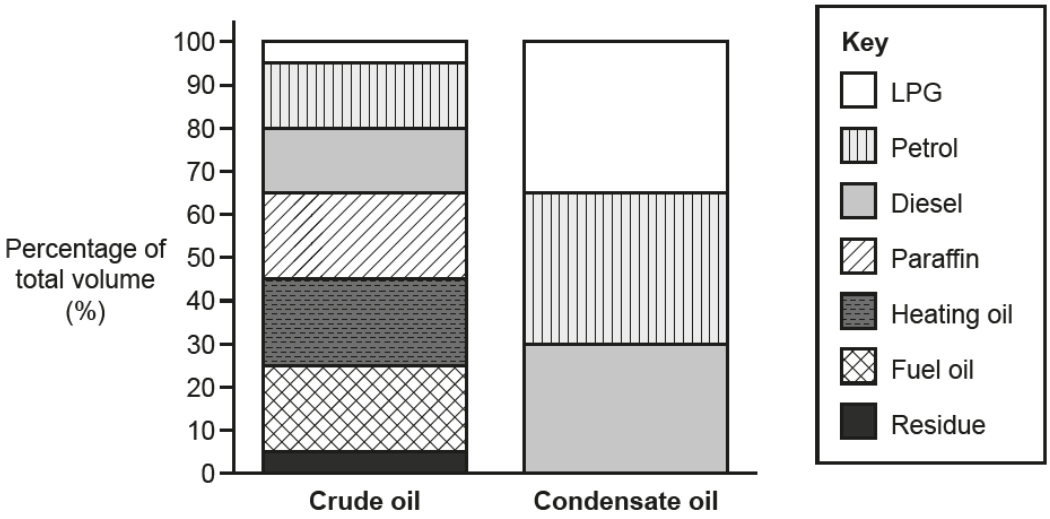


Fig. 1.1

Give **two** similarities and **two** differences between crude oil and condensate oil.

Use **Fig. 1.1** to support your answers.

Similarity 1

.....

.....

Similarity 2

.....

.....

Difference 1

.....

.....

Difference 2

.....

.....

[4]

Almost all candidates gained some credit for their responses in this question, with a significant number achieving all the marks available. Candidates were able to interpret the information well. Common errors were where candidates didn't make a comparison for their differences.

Exemplar 2

Similarity 1

Both contain petrol

Similarity 2

Both contain diesel

Difference 1

Crude oil contains a lot more substances than condensate oil

Difference 2

Condensate oil contains more LPG than crude oil

[4]

This response shows clearly how 4 marks can be achieved.

Question 1 (c) (i)

(c) The table shows some other differences between crude oil and condensate oil.

	Crude oil	**Condensate oil**
Colour	black	dark brown
Physical state at 25 °C	thick liquid	liquid
Boiling point range (°C)	–48 to 593	–29 to 427
Flash point (°C) (the lowest temperature the vapour will catch fire)	–6	–46
Density (g / cm^3)	0.88	0.60

(i) Which statement best explains why there is a **range** of temperatures for the boiling point of crude oil and condensate oil?

Tick (✓) **one** box.

Crude oil and condensate oil are hydrocarbons. ☐

The oils contain different fractions. ☐

The density of a liquid changes its boiling point. ☐

The colour of the liquid causes the boiling point to change. ☐

[1]

A common incorrect response was to consider the density of the liquid and how it changes its boiling point.

Question 1 (c) (ii)

(ii) Some people conclude that condensate oil is more dangerous to carry than crude oil.

Evaluate this conclusion.

Use the data in the table to support your answer.

.....

.....

.....

.....

.....

..... **[3]**

The properties that were considered by candidates to be important for transportation were mainly the flash point and viscosity of the oils. The viscosity did not seem like a term the candidates were familiar with as they tended to discuss the thickness of the liquid rather than using the key terminology. Some candidates could link the properties to the dangers posed to the environment, but this was less common. For example, the candidates that discussed viscosity did not tend to link the runny nature of the condensate oil as something that could easily spread across the surface of the water and create wide ranging environmental issues. Some candidates incorrectly named crude oil as the more dangerous oil to carry and were confused about the flash point being the temperature at which the oil would catch fire. Some believing that -6 was lower than -46 degrees. Misconceptions also included quoting the trend in boiling point as a property that would affect the ability to transport the oil rather than the flash point.

Question 2 (a)

2 Scientists have used gene technology to transfer the anthocyanin gene into tomatoes to produce blue tomatoes.

Anthocyanin is the gene for the blue pigment in blackberries.

(a) The first stage of the gene transfer process is to locate and isolate the gene for anthocyanin in the nucleus of the blackberry cell.

Describe the next **four** stages in the genetic engineering process to produce blue tomatoes.

.....

.....

.....

.....

.....

..... **[2]**

Only higher ability candidates gained credit for their answers as there was a requirement to understand the process of genetic engineering stages. Even those that gained marks gave a lack of clarity in their understanding of the process. Of the seven marking points available candidates had to recall just two basic point of the process to gain one mark but this proved difficult and responses were very confused. The two main misconceptions surrounded the removal of the anthocyanin gene from the DNA using enzymes and use of a vector or plasmid to transfer the gene into the tomato cell. Candidates could recall the use of a vector or plasmid but not why or how they were used. Centres are encouraged to spend some time ensuring candidates have a basic understanding of the genetic engineering process and can apply the process to different situations or items.

Exemplar 3

Use enzymes to remove the gene.
Use enzymes to cut a hole in the tomato's cell nucleus.
Place the gene in the hole in the nucleus.
Place Grow tomatoes

This candidate has clearly understood the next stage in the process is to use an enzyme to cut out the gene before further stages can be carried out. Unfortunately, they did not go on to recognise the use of a vector to insert this gene into the tomato.

Exemplar 4

Next, the isolated ~~gene~~ gene needs to be cut ~~out~~ out of the nucleus using ~~enzymed~~ ~~enzyme~~ enzymes. After that, the desired gene needs to be ~~placed~~ placed into a vector that can ~~carry~~ hold it. Finally, ~~the~~ the plasmid in the tomato cell will be cut in half and then linked back together by placing the vector in the gap. [2]

This response is a little confused about where the gene is extracted from (nucleus rather than DNA) but the science given is not incorrect and is followed by sufficient points to gain the 2 marks available in this question.

Question 2 (b) (i)

(b) (i) Anthocyanins are antioxidants which may prevent cell damage. This means eating blue tomatoes may be beneficial to our health.

Suggest **two** possible benefits of using genetically modified (GM) crops.

1 .....

.....

2 .....

.....

[2]

This question highlighted the need to be careful with key word and phrases. The vague statement of 'making them healthier' did not gain credit. Some candidates described the modification as increasing a plant or person's immunity, which is not the same as making the plants resistant to diseases. Another misconception is that more plants equals a higher yield. This is not the case. Fewer plants can be used to produce a higher crop yield. The candidates who gave a response based on yield, often demonstrated this misconception. Some candidates could however give specific examples such as 'Golden rice' as those crops that would have additional benefits. There had obviously been some excellent class discussions about this topic and candidates could express their ideas about the use of GM crops for areas of drought, resistance to disease and herbicides.

Question 2 (b) (ii)

(ii) Blue tomatoes are still being tested and are not yet available for sale.

Suggest **two** possible risks of using genetically modified (GM) crops.

1 .....

.....

2 .....

.....

[2]

This question about risks proved to be more challenging than the benefits. Most correct responses considered the effects on the food chain or the idea that this is relatively new technology, so we are unsure of the long-term effects. Centres should make sure the candidates understand that side effects are tested for before a product can be used and are often immediate so prolonged testing may not be needed. Long-term effects may not appear until after the product is available for sale for some time. Perhaps discussions within centres about this technology with contextual information would help candidates improve their expression of their points here. The candidates often struggled to make their points clearly and concisely in this question.

Question 2 (c)

There are two pigments in red tomatoes, lycopene and beta-carotene. They are both soluble in water.

Chromatography can be used to determine if lycopene and beta carotene are present in blue tomatoes.

Fig. 2.1 shows a chromatogram that compares the pigments in a red tomato extract and a blue tomato extract.

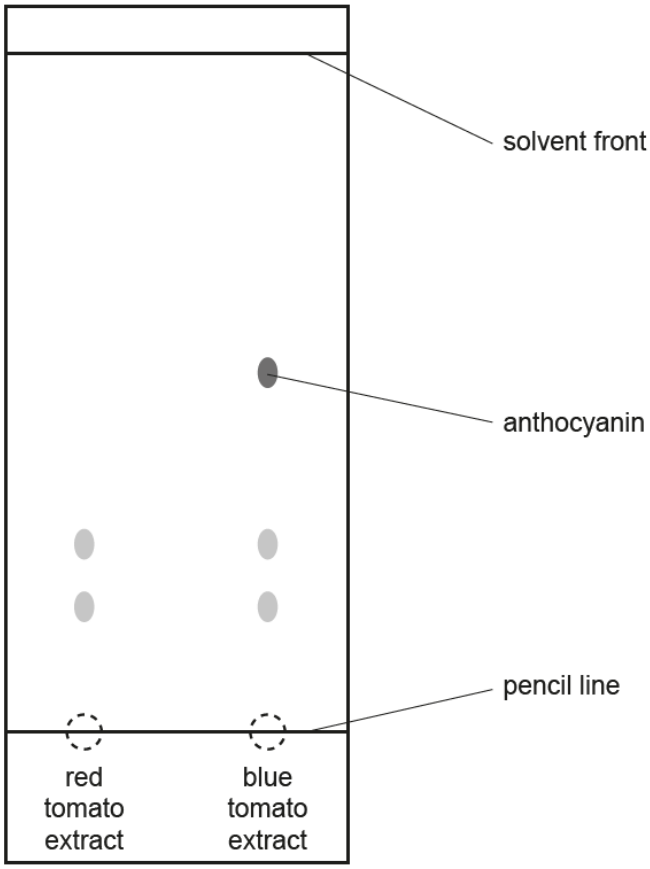


Fig. 2.1

(c) Outline the method to produce the chromatogram in **Fig. 2.1**.

.....

.....

.....

.....

.....

.....

..... **[3]**

This question was accessible to lower ability candidates. This is obviously an experiment that centres get candidates to carry out as many procedural differences were seen but, on the whole, the main points of the process could be seen within responses despite their lack of clarity. There were just a few misconceptions that centres could look to improve. Very few candidates discussed the extraction of the juice from tomatoes. While there is an appreciation that this is probably part of the process carried out by a technician to enable the practical to fit into a lesson, it is important that candidates know where the extract they are putting on the pencil line came from. Most candidates gained credit for saying the extract would be placed on the pencil line. Fewer could explain that the chromatogram would be placed in a beaker of solvent so it could travel up the paper. Misconceptions on this part of the method included 'dipping' the paper in the solvent rather than allowing the solvent time to move up the paper. A further misconception was that the solvent could be placed 'up to' the pencil baseline rather than just below the line. 'Up to' would suggest the spots would dissolve into the solvent and would not give any results on the chromatogram. Centres should also make sure simple points like putting the solvent in a suitable container such as a beaker are recognised as essential parts of a method to make sure the experiment can be carried out successfully.

Exemplar 5

To produce the chromatogram shown, chromatography needs to have taken place: firstly, a small beaker will be filled slightly with a solvent. Then, chromatonic ~~chromatography~~ paper is placed in the beaker. On the paper, a pencil line is drawn and the two extracts are placed on it. When dipped into the beaker, the solvent moves up the paper and carries any lycopene or beta carotene in the extract. [3]

(Spare space at back)

Question 2

(c) ... Eventually the solvent stops moving up the paper, the point where it does so is called the 'solvent front'.

This is a clear explanation of the method for carrying out chromatography. It does include the 'dipping' of the paper idea, but it also has a three clear marking points gained.

Question 2 (d) (i)

(d) (i) What do the results in **Fig. 2.1** show?

.....

.....

.....

..... **[2]**

Candidates tended to comment on just one aspect of the chromatogram such as the fact that blue tomatoes contain the anthocyanin pigment rather than comment on the pigments that were common to both tomatoes or vice versa.

Question 2 (d) (ii)

(ii) Calculate the **Rf** of **anthocyanin**, using **Fig. 2.1**.

Give your answer to **2** significant figures.

Rf of anthocyanin = ... **[3]**

It is expected that candidates have a ruler for the examination and that they use the ruler to measure in millimetres where appropriate. Candidates were expected to measure from the baseline to the centre of the spot. A tolerance was given for this measurement. The baseline to the solvent front was accurately measured by almost all that gave the measurement as part of their calculation.

Along with measurements, the biggest errors were seen in the recall of the formula to calculate the Rf value. There was an expectation that candidates could express their calculated value to 2 significant figures. This was considered when giving credit for the calculation. An incorrect value that was correctly rounded to the correct number of significant figures gained credit provided it was accompanied with a calculation relevant to the question.

Question 3 (a)

3 Nina and Kareem plan to investigate sunscreens (sun creams) with different sun protection factors (SPFs) to see how well they block UV radiation. They set up the apparatus in **Fig. 3.1**.

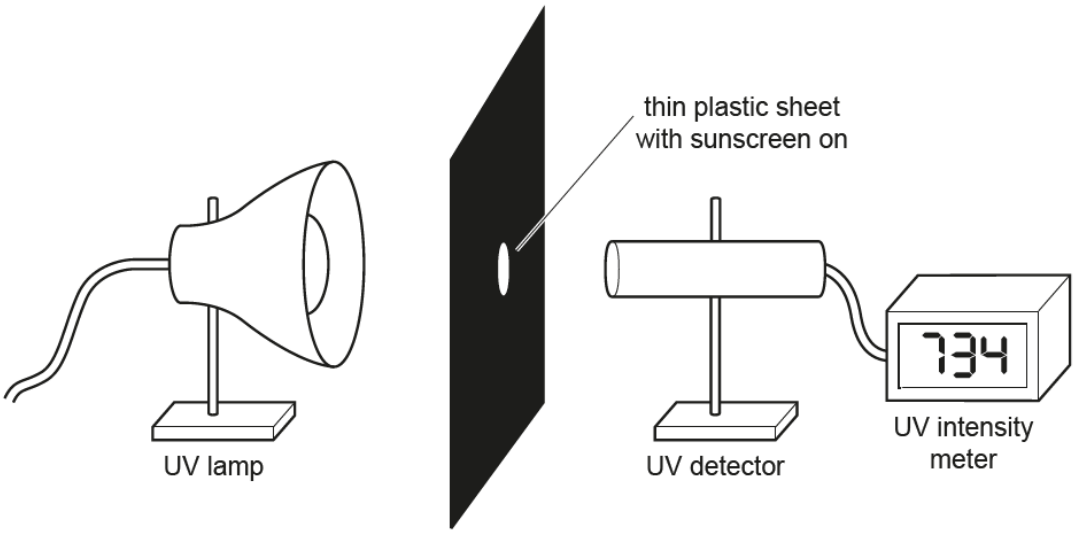


Fig. 3.1

This is a plan for their investigation:

- Set up equipment as shown in diagram.
- Put sunscreen on the plastic sheet.
- Record UV intensity.
- Repeat for sunscreens with different SPFs.

(a) Suggest **two** ways in which Nina and Kareem's plan for this investigation could be improved to ensure they collect valid data.

1 .....

.....

.....

2 .....

.....

..... **[2]**

Candidates struggled to identify two control variables in this experiment despite being given information in the diagram and a method to critique. A variety of responses were seen that highlighted a control variable but then went on to say that it should be changed rather than kept constant so the data would be more valid. Common errors included repeating the experiment and taking a mean. These would not affect the validity of the results and centres should tackle this for future examinations.

Question 3 (b) (i)

(b) Nina and Kareem collected data for sunscreens (sun creams) with different SPFs.

The mean UV intensities are shown in the table.

Sun protection factor (SPF)	**0**	**10**	**15**	**30**	**50**
Mean UV intensity (mW/cm^2)	748.0	76.2	37.2	23.6	14.2
Percentage of UV blocked (%)	0.0	89.8	95.0	96.8	98.1

(i) Suggest why there is no blockage of UV for SPF 0 sunscreen.

.....

.....

..... **[1]**

Only lower ability candidates could not make the link between SPF 0 and there being no protection from the UV radiation.

Question 3 (b) (ii)

(ii) The manufacturer claims SPF 10 sunscreen blocks out at least 95% of UV radiation.

Nina and Kareem's investigation gives a different value for the percentage of UV blocked.

Suggest **two** reasons why the value from Nina and Kareem's investigation is different.

1 .....

.....

2 .....

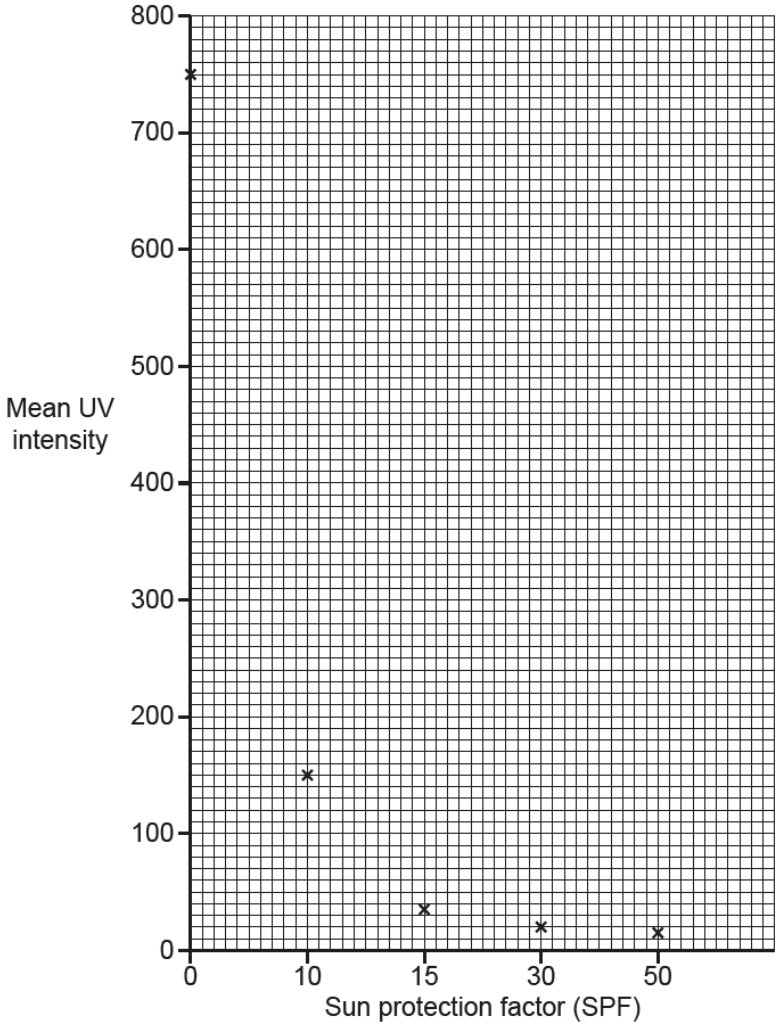
.....

[2]

After the majority of candidates correctly suggesting a control variable in Q3a, some struggled to then explain that if any of these variables were different in the two sets of experiments, then the results would be different. A number of candidates described human error or errors in the equipment rather that experimental procedures. Many candidates also thought the company would lie or that they would test with the sun rather than with a UV lamp.

Question 3 (b) (iii)

(iii) Kareem plotted a graph of sun protection factor (SPF) against mean UV intensity.



Kareem's teacher identifies **three** errors in Kareem's graph.

Identify these **three** errors.

1 .....

.....

2 .....

.....

3 .....

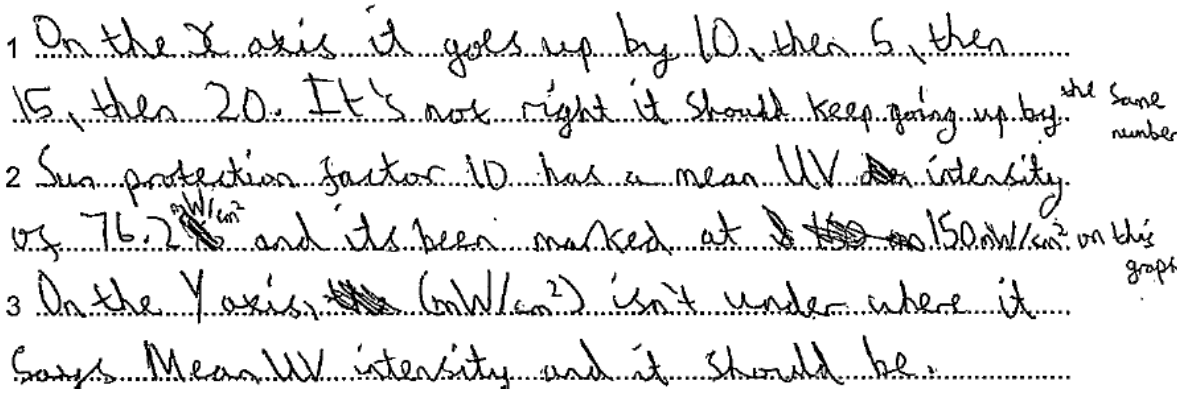
.....

[3]

Candidates struggled to express their ideas clearly in this question. Many described how the x axis didn't go up by the same number each time with numerical examples given rather than just explaining the scale wasn't linear. A large number of candidates incorrectly discussed the need for a title or the lack of a line of best fit. While the lack of a line of best fit was not incorrect, it is not an error of the graph. Points incorrectly plotted was the most common correct response.

	AfL	Graph drawing skills are an area for centres to work with candidates to improve for future examinations, particularly the terminology associated with graphs.

Exemplar 6



This candidate has just about expressed their ideas clearly enough to gain credit in all 3 marking points but without the use of key terminology that would be expected when discussing graphs. They have the idea of there not being a linear scale in point 1, points plotted incorrectly in point 2 and missing units on the y axis in point 3. Clearer use of such terms would benefit candidates in future examinations.

Question 3 (c) (i)

(c) Kareem reads the labels on the bottles of SPF 30 and SPF 50 sunscreens (sun creams).

Fig. 3.2

Nina says her skin usually gets burnt after **5 minutes** in the sun.

(i) Nina cannot decide whether she should use SPF 30 or SPF 50 sunscreen.

Calculate how much longer Nina could remain in the sun without being burnt if she uses SPF 50 sunscreen rather than SPF 30 sunscreen.

Give your answer in **hours and minutes**.

Number of hours and minutes longer = ...hour(s).....minutes **[3]**

This was very well answered with a significant number of candidates gaining all 3 marks for a correct calculation with conversions of time. Those candidates that didn't score full marks did not understand time and its conversion from minutes to hours or from a decimal to hours. 4 hours and 16 minutes was a common incorrect response for the protection time of the SPF 50.

Exemplar 7

30 x 5 = 150 mins
2·05 hours

50 x 5 = 250 mins
4·16 hours

4·16
- 2·05
2:11

Number of hours and minutes longer = ..2.....hour(s)..11.....minutes **[3]**

This response showed the candidates inability to convert the calculated value into hours and minutes. While they have correctly calculated the value in minutes the conversion from a decimal to hours and minutes is incorrect.

Question 3 (c) (ii)

(ii) Nina thinks that either sunscreen (sun cream), if used correctly, will prevent her skin from burning.

Is Nina correct?

Yes ☐

No ☐

Use your answer from **(c)(i)** and the information in **Fig. 3.2** to justify your decision.

.....

.....

.....

.....

..... **[2]**

Where candidates selected 'Yes', they generally gained both marks available. Where candidates selected 'No', they tended to gain only one of the 2 marks available as they didn't recognise that her skin will burn after the time exposed to the sun exceeds the time given by the protecting SPF value.

Question 3 (c) (iii)

(iii) Give **one** benefit **or** use of UV radiation.

..... **[1]**

A wide variety of responses were seen. Unfortunately, some candidates believed that UV radiation would 'prevent cancer'. UV radiation has an increasingly wide range of uses and all responses were carefully considered including recent technology on treating cancer. This is a very different concept to 'preventing cancer'. This is a clear misconception that needs addressing by centres.

?	**Misconception**	UV radiation prevents cancer. Candidates confuse prevention of cancer with treating of cancer.

Question 4 (a)

4 Galagos, or bush babies, are mammals which live in tropical forests.

Amaya and Kai see a galago (**Fig. 4.1**) at their local zoo.

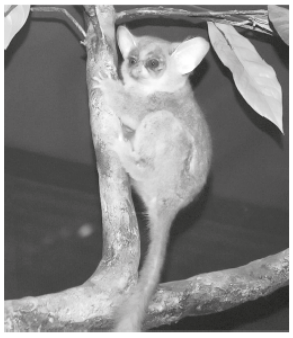


Fig. 4.1

(a) Kai says that galagos regulate their body temperature by a process called homeostasis.

Explain **why** it is important that a galago maintains a body temperature of around 37 °C.

.....

.....

.....

.....

.....

..... **[3]**

Candidates found this question challenging. They could not explain the link between body temperature and the role of enzymes. If they did describe their link, their expression of their ideas were weak with the use of unclear statements rather than key terminology. Misconceptions included that enzymes would denature in the cold. Very few discussions about the active site were seen along with the role of the enzyme in reactions in the body. The role of enzymes in the body is an essential contextual teaching point. Enzymes should not be simply taught in isolation but related to their role in the body and why homeostasis is essential for the body maintaining enzyme activity. Candidates should understand and apply key phrases such as active site, substrate, complex and denature.

Exemplar 8

The enzymes in their body will denature if it doesn't remain at the same 37° C. Meaning that it's immune system will be weakend.

This response recognises the role of enzymes and that they can be denatured but this candidate has not said that this happens at temperatures that are high (in comparison to the optimum temperature).

Question 4 (b) (i)

(b) The galago lives in a heated enclosure, making it easier for it to regulate its body temperature. An electric heater keeps the enclosure warmer than the outside.

Answer the questions below.

Use words from the list. Each word can be used once, more than once, or not at all.

absorption	**cooling**	**dissipation**
evaporation	**insulation**	**radiation**

(i) Which word best describes how the heater warms the enclosure?

..... **[1]**

The only method of heat transfer in the list was radiation. Insulation was the most seen incorrect response.

Question 4 (b) (ii)

(ii) Which word best describes the galago's fur reducing its heat loss?

..... **[1]**

The majority of candidates gained credit on this question with absorption being the most common incorrect response.

Question 4 (b) (iii)

(iii) Which words best describe how energy is transferred from the galago, as heat, to the surroundings?

..... **and** ..... **[2]**

Dissipation was usually correctly identified but a variety of other responses were seen for the second of the 2 marks available This again highlights that candidates need to understand and apply key terminology.

Question 4 (c) (i)

(c) **Fig. 4.2** shows the temperature change in the galago's enclosure and the change in the galago's body temperature over 24 hours.

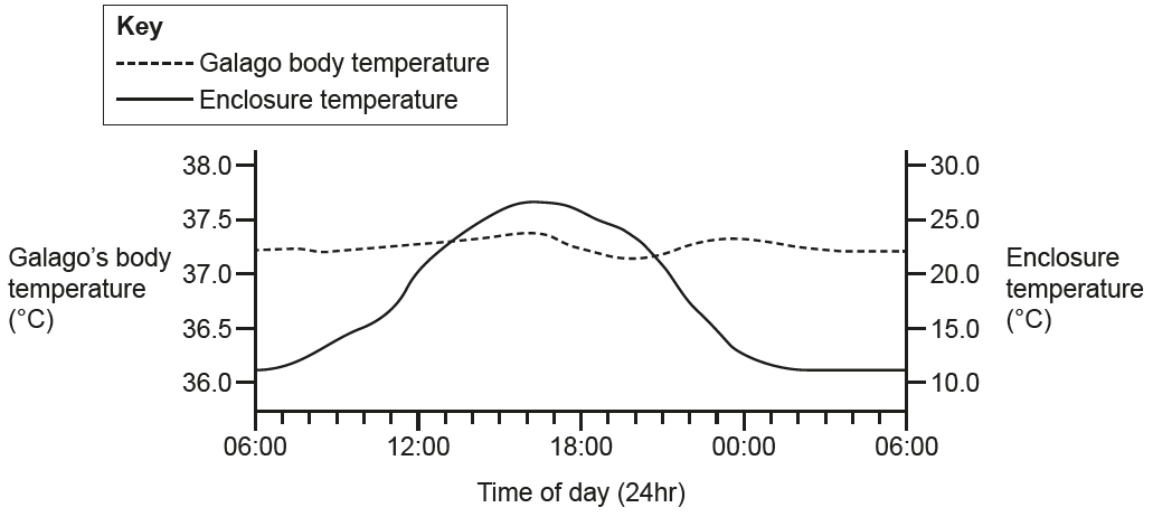


Fig. 4.2

(i) Shivering is a response to being cold.

Use **Fig. 4.2** to suggest **when** and **why** the galago is most likely to shiver.

.....

.....

.....

..... **[2]**

The key information the candidates needed to obtain from the graph was the change in enclosure temperature. This dropped between midnight and 6am. Few candidates that gave a time that actually fitted into this range. Often the link between an enclosure temperature leading to a fall in body temperature and therefore the need to shiver was missed. Where is was seen the link to the activity of shivering happening to make sure the body temperature remaining constant was not clearly expressed.

Exemplar 9

the galago is more likely to shiver at 06:00 because that is when the enclosure temperature drops significantly. [2]

This candidate has given a clear range of times when the enclosure temperature has dropped significantly. This candidate has also linked the change in enclosure temperature to the reasons for shivering.

Question 4 (c) (ii)

(ii) The galago enclosure is heated by a 3000 W electric heater for 12 hours every day.

Calculate the energy transferred to heat the galago enclosure for **7 days**.

Energy transferred for 7 days = ... J **[4]**

The fully correct calculation was rarely seen. Often candidates gained 3 of the 4 marks available as they missed a step of the conversion of time. For example, 252,000 was a common response that gained 3 marks. This missed the conversion from hours to seconds.

Exemplar 10

24 hours in a day to work out 7 days you do ~~24x7=168~~

24x7=168 hours

168÷2=84 hours how long the heater was on for

84x3000=252000

Energy transferred for 7 days = 252000 J **[4]**

This calculation shows clearly the conversion of time into hours, but they have not completed the conversion into seconds. This therefore gives an incorrect final value. There is essentially only a conversion error in the calculation as they have used the correct formula and the correct value for power in the calculation. Three marks out of the possible 4 were gained by the candidate.

Question 5 (a) (i)

5 HIV is an infection caused by a virus. People with this virus are HIV+. HIV weakens the immune system.

Tuberculosis (TB) is a disease caused by bacteria. It may be fatal in people with a weak immune system.

The table shows information on cases of TB and HIV for three African countries.

Country	Estimated TB cases (per 100,000)	TB cases that are also HIV+ (per 100,000)	Percentage of TB cases that are also HIV+ (%)	Mortality from TB (per 100,000)
Cameroon	204.8	68.3	33.3	55.5
South Africa	781.9	460.6	58.9	221.4
Zambia		217.1	58.1	102.5

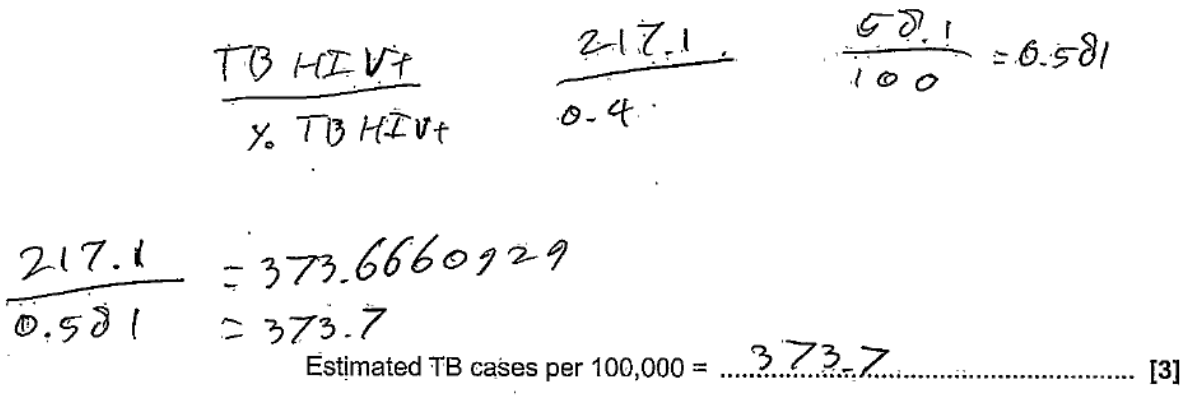
(a) (i) Calculate the estimated TB cases per 100,000 for Zambia.

Give your answer to **1** decimal place.

Estimated TB cases per 100,000 = ... **[3]**

Candidates found this calculate difficult but good attempts were made by a number of candidates. The most common errors were in not recognising the number quoted for TB that were also HIV was a percentage (58.1). Candidates also neglected to correctly round their value to one decimal place. Evidence of an incorrect calculation but a correctly rounded value to one decimal place did gain credit.

Exemplar 11



This candidate has calculated the correct value and has converted their calculator value to one decimal place as the question requires so gained all 3 marks. The working shown is very clear and easy to follow.

Question 5 (a) (ii)

(ii) The data shows a weak positive correlation between the percentage of TB cases that are also HIV+, and the mortality (death) rate due to TB, in the three countries investigated.

Suggest **three** ways the investigation could be improved, to see if a stronger correlation exists.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

Very few candidates could give three ways to improve the investigation. Most gave just one sensible way to improve. Most commonly candidates identified the sampling of more countries or increasing the sample size. Misconceptions were that smaller sample sizes would make the investigation data more accurate or that scientists could look at why the TB or HIV caused death.

Question 5 (b)

(b) The death rate due to TB increased when people were HIV+.

Which two statements could explain this?

Tick (✓) **two** boxes.

Having HIV makes it harder for your body to kill pathogens.	☐
HIV can remain undetected for many years.	☐
HIV is a sexually transmitted infection.	☐
HIV reduces the number of white blood cells.	☐
TB can remain undetected for many years.	☐

[2]

The majority of candidates gained 2 marks here. Where only one mark was gained, there seemed to be no common errors.

Question 6 (a)

6 Jack would like to buy a house. He is comparing the energy efficiency of two houses, House **A** and House **B**.

Fig. 6.1 shows a comparison of energy use and energy dissipated for House **A** and House **B**.

Fig. 6.2 shows the potential energy efficiency ratings of House **A** and House **B**.

	House A	House B
Average daily energy use (MJ)	72.3	57.9
Energy dissipated to surroundings (MJ)	31.7	18.6

Fig. 6.1

House A **House B**

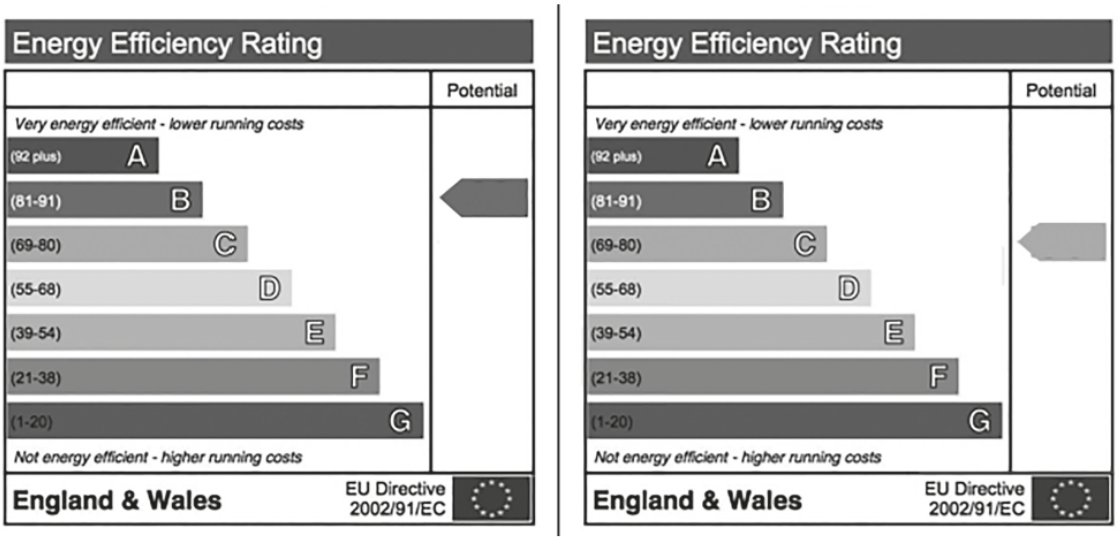


Fig. 6.2

(a)* Jack has decided to buy House B.

Use the information in **Fig. 6.1** and **Fig. 6.2** to evaluate whether Jack has made the right decision.

.....

.....

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.....

.....

..... **[6]**

This was a high demand question that required some processing of data as well as an evaluation of the conclusion that had been given. Most candidates attempted to process the data in fig 6.1 to evaluate the conclusion in terms of energy dissipated by the house, but did not express their ideas in terms of the efficiency. Few candidates attempted to express their ideas about fig 6.2. When they did discuss fig 6.2, they were often confused about what the data showed. Candidates discussed the house 'running costs' but had not been given any data eluding to this so any argument along those lines were invalid. Only the higher ability candidates who understood fig 6.2 to be the potential energy efficiency of a house after improvements were made could express their ideas about the conclusion made and correctly evaluate that house A would be a better choice to purchase.

Exemplar 12

Figure 6.1 shows that less energy used by house B is lost to its surroundings, compared to its surroundings. House B is 67.9% efficient. On the other hand, House A loses more energy to its surroundings and is only 56.2% efficient. However, figure 6.2 shows that house B has a lower potential of being energy efficient whereas house A has higher potential, overall I think that Jack made the right decision As figure 6.1 is more specific based on the household energy usages, showing that B is more efficient. [6]

This is a Level 3 response where the candidate has engaged fully with bot figure 6.1 and figure 6.2. They have evaluated the conclusion to buy house B using the information provided. They haven't fully understood figure 6.2 and the idea of potential energy efficiency if improvements to the house were made but they have correctly processed the data to be able to compare the current efficiency of the houses in the question.

Exemplar 13

In House B, the average daily energy use is 57.9 MJ, Whereas In House A, the average daily energy use was 72.3 MJ, a 14.4 MJ increase, it depends on how much energy he wants to use whether it was good decision. The good thing about house B is that it dissipates less energy to Surroundings, 18.6. In House A, 31.7MJ is dissipated, a 13.1 MJ difference. The energy efficiency rating was A more efficient in House A, due to its lower running costs. House A was in the B category (81-91 MJ) and House B was in the C category (69-80 MJ) Overall, House A was the much better decision to choose, due to it being more efficient in energy, and a higher daily energy use. [6]

This candidate has only partly processed the data to discuss the efficiency of the houses and has not fully understood the idea of the potential energy efficiency of the houses shown in figure 6.2. There is no indication that they understand that potentially house A could be more efficient than house B, so their evaluation is not complete. This is a good Level 2 response and is credited with 4 marks.

Question 6 (b) (i)

(b) Eve has a house and is thinking about replacing the gas boiler.

Her current boiler uses 18 000 kWh per year and her gas bill is £900 a year.

She is considering buying one of three boilers, **A**, **B** or **C**.

Boiler	Annual gas use (kWh)	Installation cost (£)
A	8000	1050
B	12 500	595
C	2000	8250

(i) Calculate how much money, in £, each boiler, **A**, **B** and **C**, will save in **running costs** for Eve when compared to her current boiler.

Cost of gas = 5p / kWh

Boiler **A** saving = £ .....

Boiler **B** saving = £ .....

Boiler **C** saving = £ .....

[2]

Most candidates could calculate the savings for each boiler in £. Where full marks were not gained; it was due to a slip in the calculation or perhaps pressing the wrong button on the calculator.

Question 6 (b) (ii)

(ii) Suggest which boiler Eve should buy, **and** give reasons for your choice.

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.....

..... **[3]**

Candidates found expressing their ideas and reasons for choosing a particular boiler challenging. The reason for choosing a particular boiler had to make sense. Common errors were to say that boiler B was the best to choose because it used the most gas rather than the fact that it was the cheapest to install or that boiler C was chosen because it was the most expensive to install rather than that it uses less gas. Candidates often quoted calculated values from the savings in the previous question rather than commenting on what the data actually meant.

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