OCR
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Friday 7 June 2019 – Afternoon

GCSE (9–1) Combined Science B (Twenty First Century Science)

J260/08 Combined Science (Higher Tier)

Time allowed: 1 hour 45 minutes

You must have:
- the Data Sheet (for GCSE Combined Science B (inserted))
- a ruler (cm/mm)

You may use:
- a scientific or graphical calculator
- an HB pencil

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number ☐☐☐☐☐ Candidate number ☐☐☐☐

First name(s) ______________________

Last name ______________________

INSTRUCTIONS
- The Data Sheet will be found inside this document.
- Use black ink. You may use an HB pencil for graphs and diagrams.
- Answer **all** the questions.
- Where appropriate, your answers should be supported with working. Marks may be given for a correct method even if the answer is incorrect.
- Write your answer to each question in the space provided. If additional space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.

INFORMATION
- The total mark for this paper is **75**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended response will be assessed in the question marked with an asterisk (*).
- This document consists of **24** pages.

Answer **all** the questions.

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.

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

(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]

(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]**

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

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

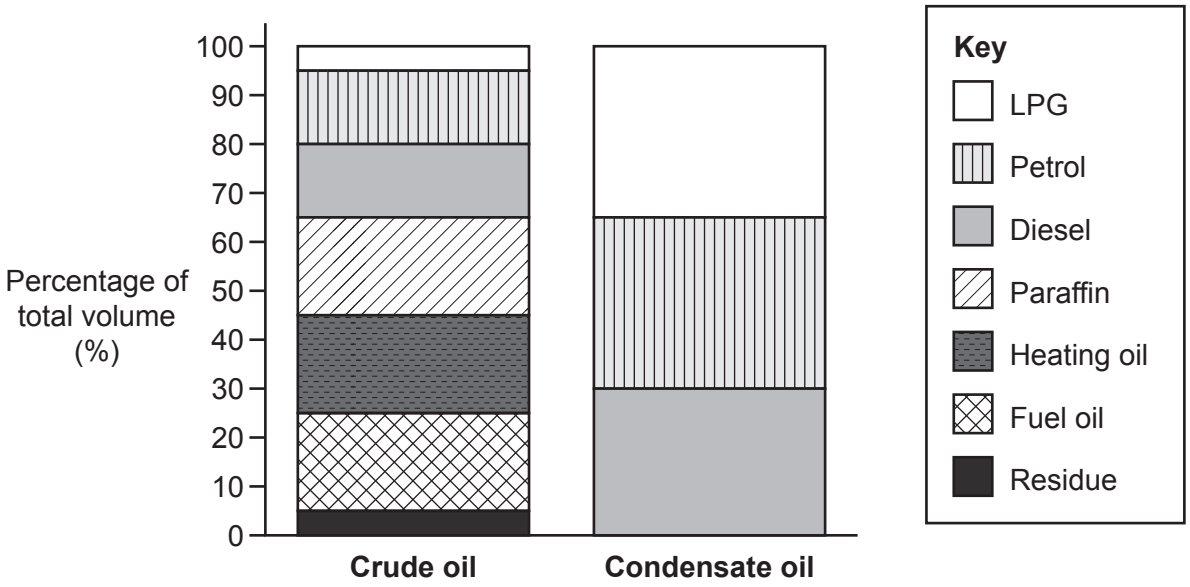

Fig. 1.1

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

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

Similarity 1

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Similarity 2

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Difference 1

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Difference 2

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.....

[4]

(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]

(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.

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

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.

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

(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]

(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]

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.

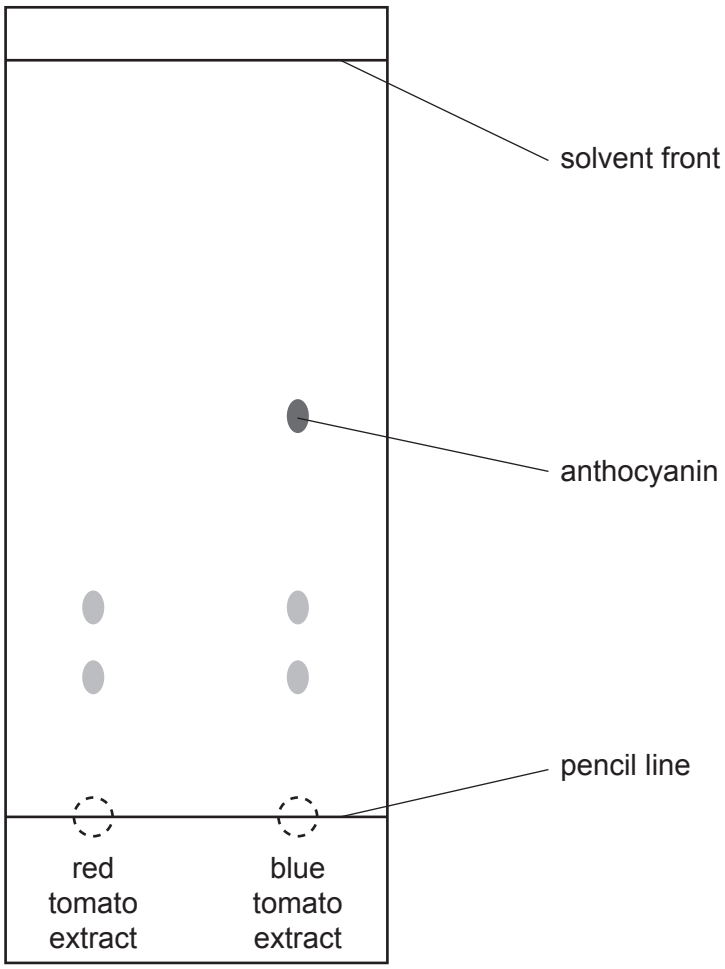

Fig. 2.1

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

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

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

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

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

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

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

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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**.

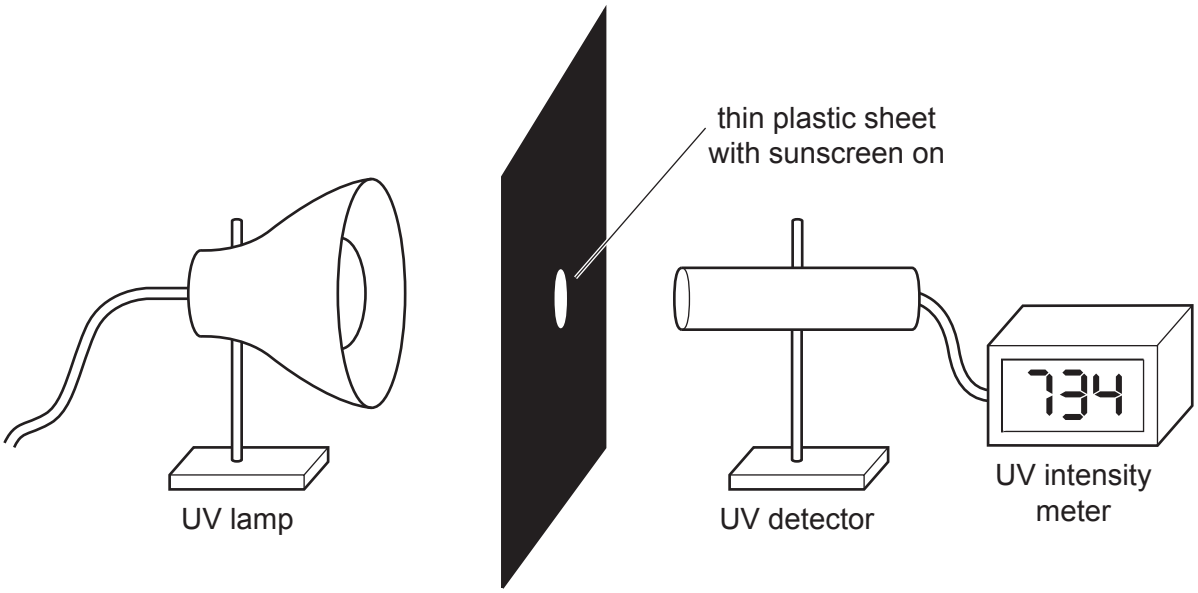

Fig. 3.1

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 .....

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2 .....

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

(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.

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

(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 .....

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2 .....

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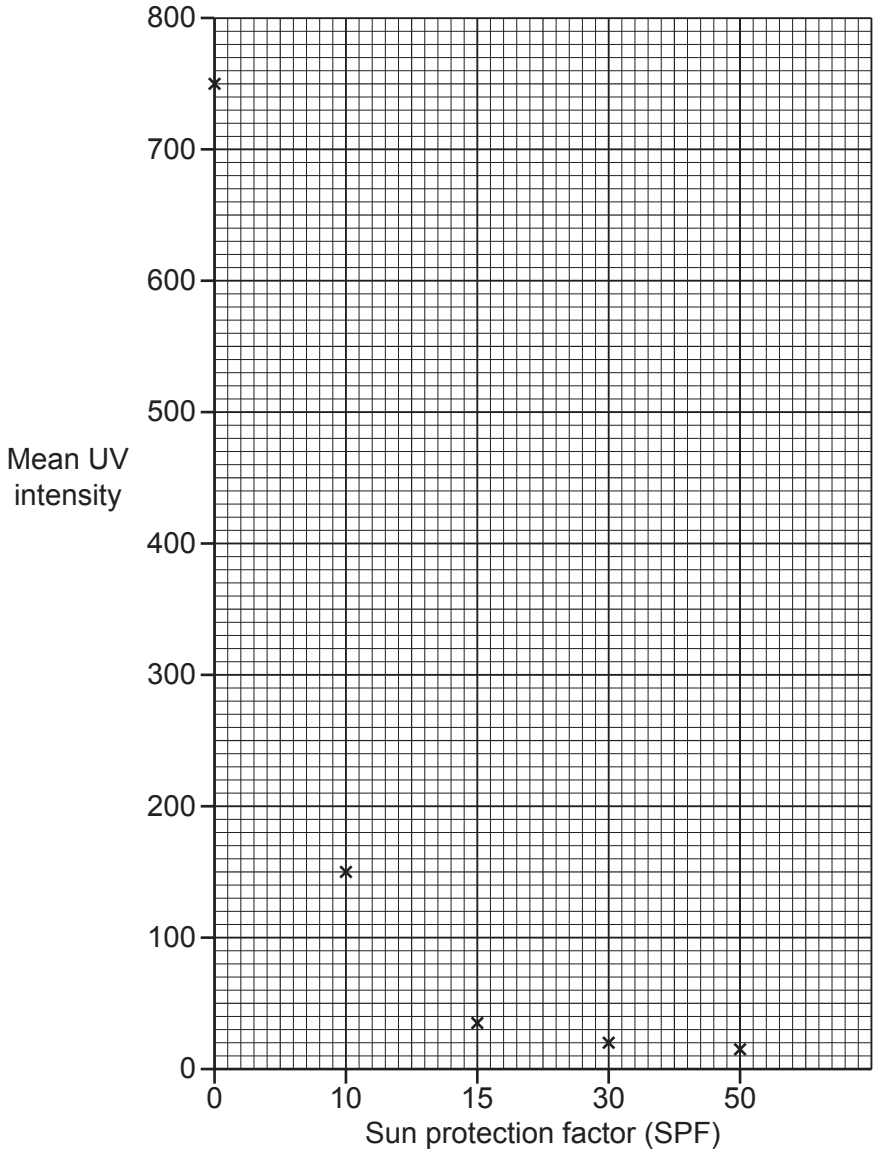
[2]

(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 .....

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2 .....

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3 .....

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[3]

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

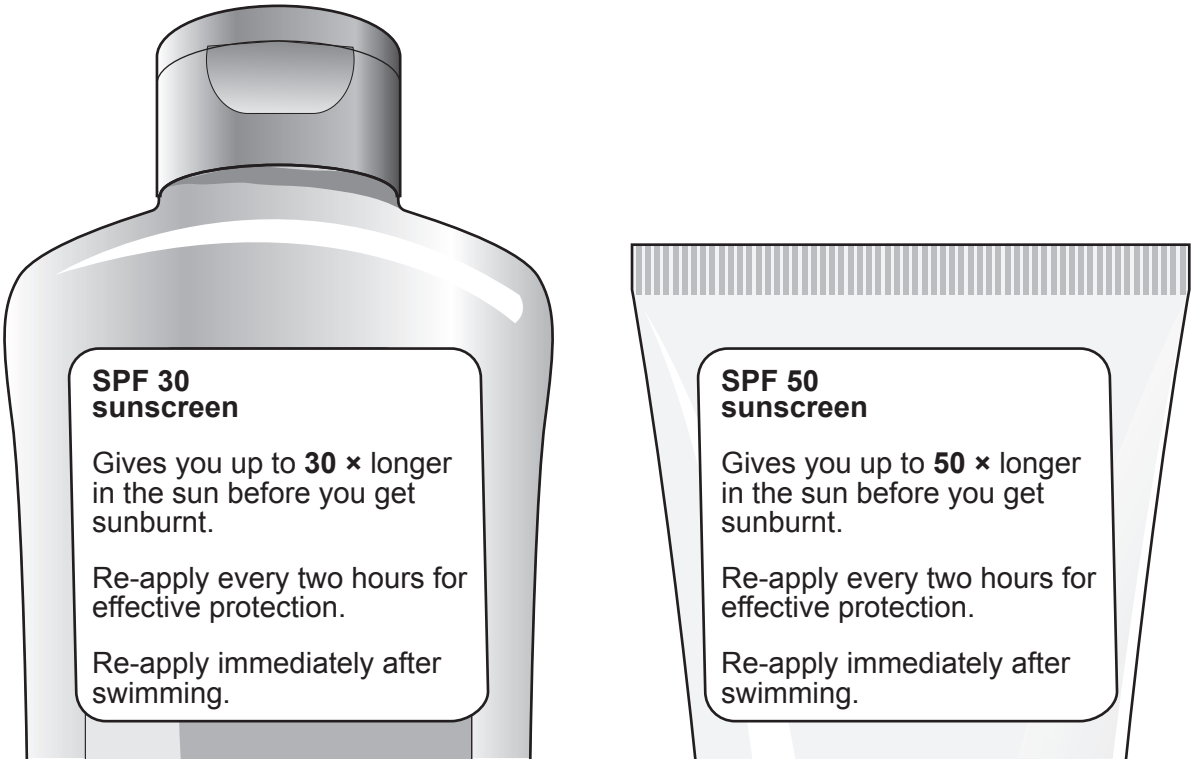

Fig. 3.2

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]**

(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.

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

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

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

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.

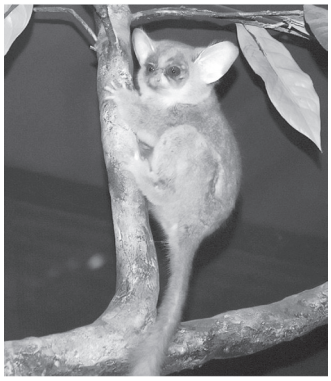

Fig. 4.1

(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.

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

(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]**

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

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

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

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

(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.

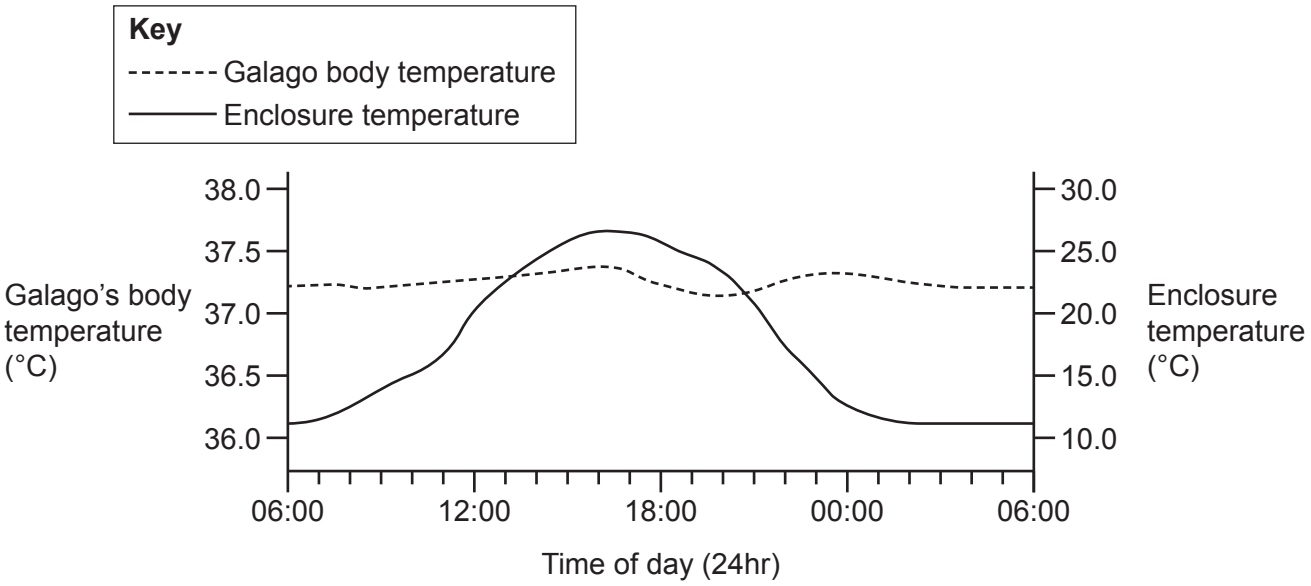

Fig. 4.2

(i) Shivering is a response to being cold.

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

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

(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]**

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]**

(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 .....

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2 .....

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3 .....

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[3]

(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]

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**

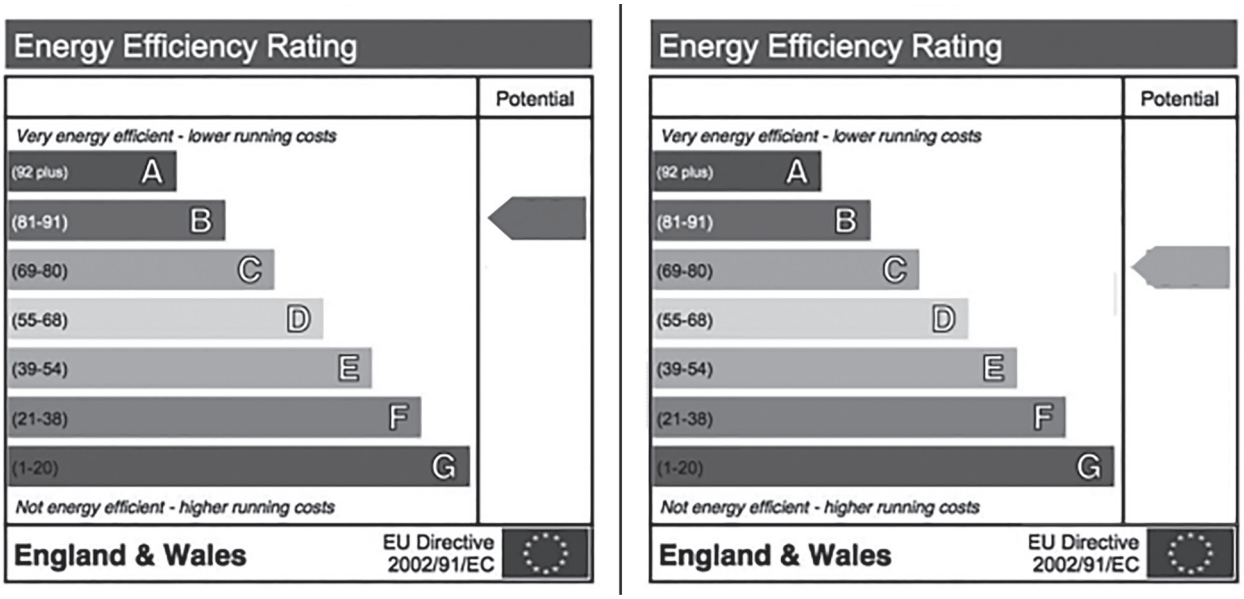

Fig. 6.2

(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]**

(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]

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

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

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).