

AQA – Energy transfers in and between organisms – A2 Biology

1. No.1

0 1 . 1

A student used chromatography to separate the different photosynthetic pigments in a chlorophyll solution. She had the following materials.

Chromatography paper

A ruler and pencil

Suitable glassware

A solvent (solvent **A**)

2 cm³ of the chlorophyll solution

Describe how she could use these materials to separate the photosynthetic pigments by chromatography.

[4 marks]

0 1 . 2

Using solvent **A**, the student separated five pigments. She then repeated her method using a different solvent, **B**. Using solvent **B**, she separated six pigments.

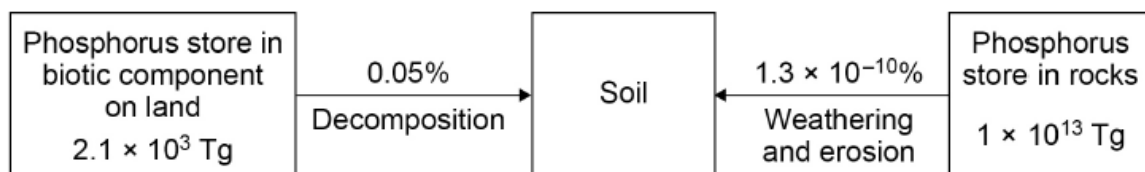
Explain the difference between these results.

[2 marks]

2. No.3

0 3

Figure 1 shows part of a phosphorus cycle, including the mass of phosphorus in two stores.

Figure 1

One teragram (Tg) is 1×10^{12} grams.

The supply of phosphorus to the soil is shown as a percentage of the total phosphorus mass of each store.

0 3 . 1

Calculate in teragrams the difference in the supply of phosphorus to the soil from the two stores shown in **Figure 1**.

Show your working.

[2 marks]

Answer _____ Tg

Water shortage can inhibit crop production. Scientists investigated the effect of the mycorrhizal species *Glomus intraradices* on the growth of tomato plants under conditions of water shortage and no water shortage.

- The scientists planted tomato seeds into a large number of pots containing sterilised soil.
- They added a culture of *G. intraradices* to 50% of the pots and 50% were left untreated.
- After the seeds had developed into seedlings (young plants), the seedlings from the untreated and treated pots were planted into four separate large greenhouses (glasshouses).
- A very limited supply of water (water shortage) was provided to two of the greenhouses. A sufficient supply of water (no water shortage) was provided to the other two greenhouses.
- After 60 days, the scientists determined the mean mass of tomatoes (kg m^{-2}) from each greenhouse.

Greenhouse **P** – untreated seedlings with water shortage

Greenhouse **Q** – treated seedlings with water shortage

Greenhouse **R** – untreated seedlings with no water shortage

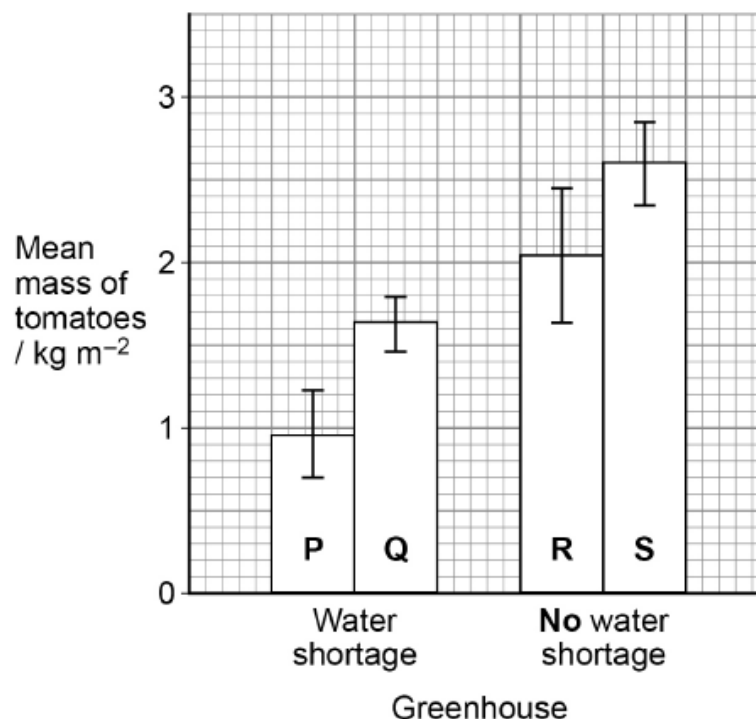
Greenhouse **S** – treated seedlings with no water shortage

Treated seedlings are plants grown with *G. intraradices*.

Figure 2 shows the scientists' results.

The error bars represent ± 2 standard deviations from the mean, which includes over 95% of the data.

Figure 2



0	3	.	2
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Using all the information, evaluate the effectiveness of using mycorrhizae to increase crop production under conditions of water shortage and no water shortage.

[5 marks]

[illegible]

0 3 . 3

The tomato seeds were planted into sterilised soil.

Suggest **two** reasons why the soil was sterilised.**[2 marks]**

1 _____

2 _____

0 3 . 4

The soil used in this investigation had the recommended concentration of fertiliser.

Suggest **two** reasons why the soil contained the recommended concentration of fertiliser.**[2 marks]**

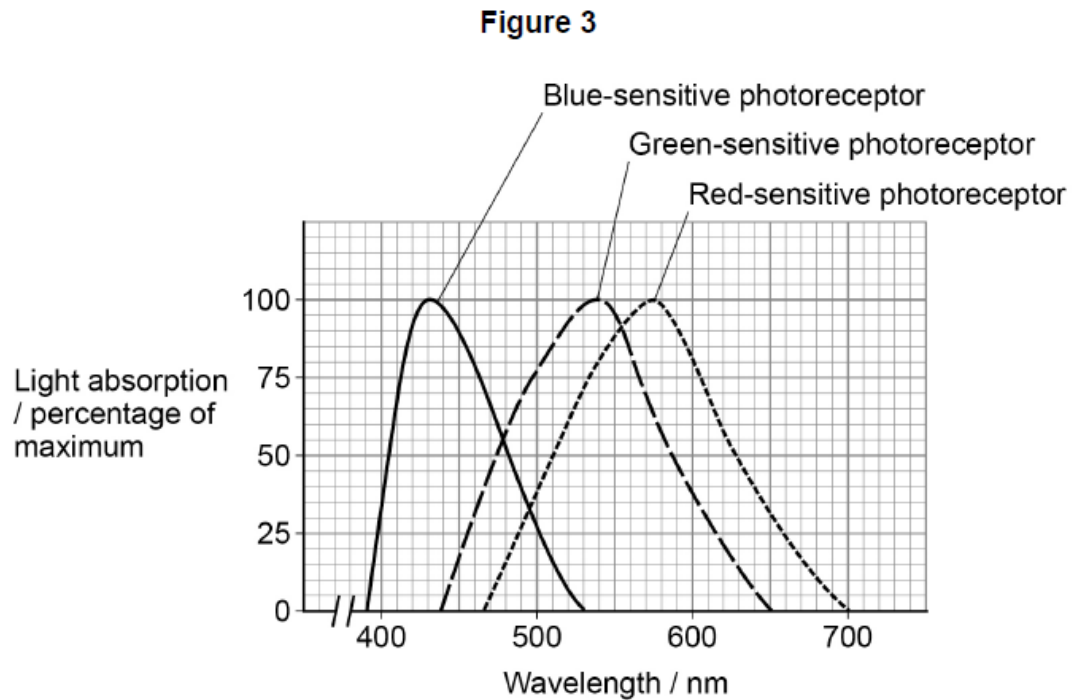
1 _____

2 _____

3. No.5

0 5 . 1

Figure 3 shows the wavelengths of light absorbed by three types of photoreceptor found in the human retina.



Use **Figure 3** and your knowledge of colour vision to explain how an orange colour is seen at 600 nm

[3 marks]

05.2

Which of the following statements is associated with high sensitivity to light in the retina?

Tick (✓) **one** box.

[1 mark]

A single photoreceptor connecting to one neurone and spatial summation

☐

A single photoreceptor connecting to one neurone and temporal summation

☐

Several photoreceptors connecting to one neurone and spatial summation

☐

Several photoreceptors connecting to one neurone and temporal summation

☐

- *Erythranthe lewisii* (Great Purple Monkeyflower), which has pink flowers, is mostly found at higher altitudes (1600 to 3000 metres) and attracts bumblebees.
- *Erythranthe cardinalis* (Scarlet Monkeyflower), which has red flowers, is mostly found at lower altitudes (up to 2000 metres) and attracts hummingbirds.

Explain the different processes that may have been involved in the evolution of these two species of monkeyflower. Use the information provided to justify your answer.

[illegible]

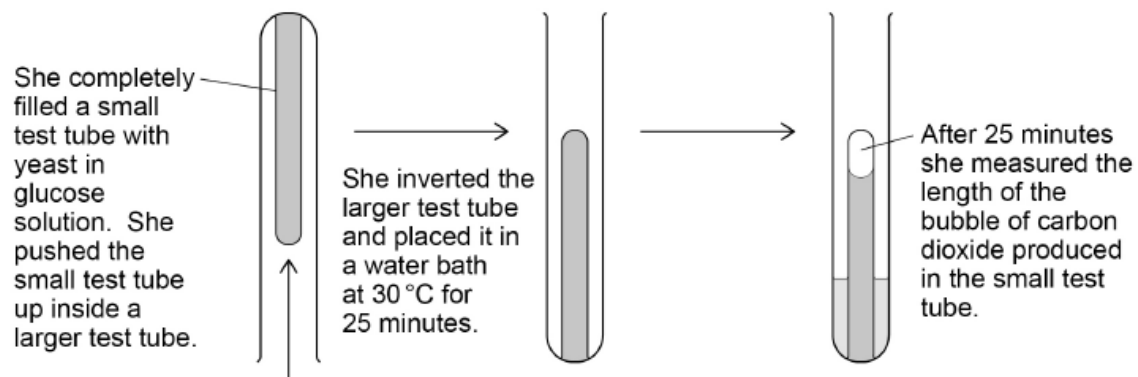
4. No.2

0 2

A student investigated the effect of different sugars on the rate of respiration in yeast. Yeast normally respire glucose.

Figure 2 shows the method she used for her first experiment.

Figure 2



0 2 . 1

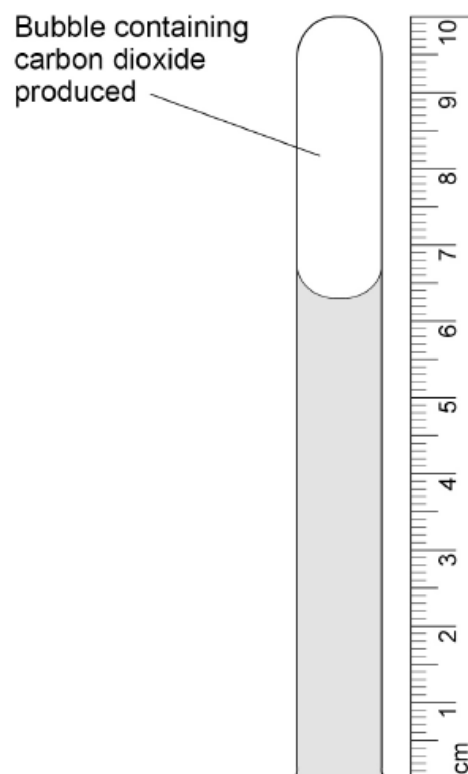
Other than those stated, suggest **two** variables the student needed to keep constant in her investigation.

[1 mark]

- 1 _____
- 2 _____

Figure 3 shows the result she obtained for yeast in glucose solution.

Figure 3



0 2 . 2

Use **Figure 2** and **Figure 3** to calculate the rate of carbon dioxide production in mm s^{-1} for yeast in glucose solution.

Give your answer in standard form **and** to **2** significant figures.

Show your working.

[2 marks]

Answer _____ mm s^{-1}

0 2 . 3

The student repeated the experiment using yeast in maltose solution. She found the rate of carbon dioxide production was slower than with yeast in glucose solution. Suggest why.

[2 marks]

0 2 . 4

A second student used a different method to investigate the effect of different sugars on the rate of respiration in yeast.

He set up a tube with yeast in glucose solution and added bromothymol blue. Bromothymol blue changes from blue to yellow when carbon dioxide is produced.

To determine the rate of respiration, he timed how long it took for the solution to change from blue to yellow.

Suggest:

- why the method the second student used would be less accurate than the method the first student used
- how the accuracy of the method the second student used could be improved.

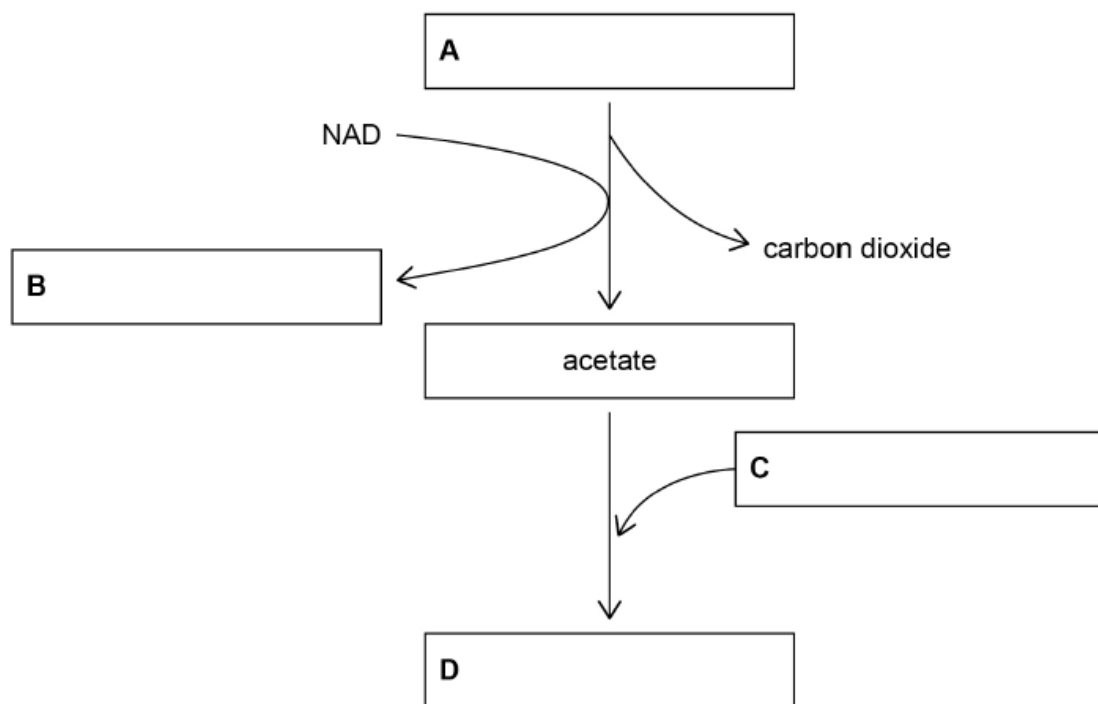
[2 marks]

This method would be less accurate because

The accuracy of this method could be improved by

0 2 . 5 Complete the boxes **A** to **D** in **Figure 4** to show the link reaction.

Figure 4



[2 marks]

5. No.3

0 3 1

Below are **four** statements about the structure of prokaryotic cells.

1. No prokaryotic cell has DNA that is associated with proteins.
2. No prokaryotic cell has membrane-bound organelles.
3. All prokaryotic cells have one or more flagella.
4. All prokaryotic cells have smaller ribosomes than eukaryotic cells.

Which statements about the structure of prokaryotic cells are correct?

Tick (✓) **one** box.**[1 mark]**

A statements 1, 2 and 3

☐

B statements 1, 2 and 4

☐

C statements 2, 3 and 4

☐

D statements 1, 2, 3 and 4

☐

A student investigated the effect of **two** antibiotics on the growth of the bacterium *Micrococcus luteus*.

During the investigation, the student:

- transferred 9 cm^3 of a liquid culture of *M. luteus* into each of **three** bottles
- added the antibiotic chloramphenicol to the first bottle
- added the antibiotic novobiocin to the second bottle
- added no antibiotic to the third bottle.

After 24 hours, he diluted the contents of each bottle by 1 in 100 000 (10^{-5}). He then transferred 0.25 cm^3 samples from the first bottle onto each of 3 separate agar plates. He repeated this with 0.25 cm^3 samples from the second bottle and the third bottle, resulting in 9 agar plates in total.

He incubated the plates for 48 hours.

Table 1 shows the number of colonies of bacteria he counted on each plate after 48 hours' incubation.

Table 1

Plate	Number of colonies of bacteria		
	with chloramphenicol	with novobiocin	with no antibiotic
1	2	238	276
2	4	263	258
3	6	261	324

03.2

Calculate the mean number of bacteria in the **undiluted** bottle of liquid culture containing novobiocin.

Give your answer in standard form. Show your working.

[2 marks]

Answer _____ bacteria

03.3

Starting with a single bacterium, calculate how many generations it would take to produce at least the number of bacteria you have calculated for your answer in Question 03.2

You can assume no bacteria die.

You could use the ln or log button on your calculator to calculate your answer.

[1 mark]

Answer _____ generations

0 3 . 4 *M. luteus* is not resistant to chloramphenicol.

Suggest **two** reasons why the bacteria were able to grow in the culture containing chloramphenicol.

[2 marks]

1 _____

2 _____

6. No.5

0 5

Scientists investigated the effect that the release of heated water into a river from a power station had on the biodiversity of a local fish community over 29 years.

They measured the species richness and the number of fish of each species at the same site in October every year. The scientists used this information to calculate an index of diversity (d) of fish for each year.

Figure 7 and **Figure 8** show their results.

Figure 7

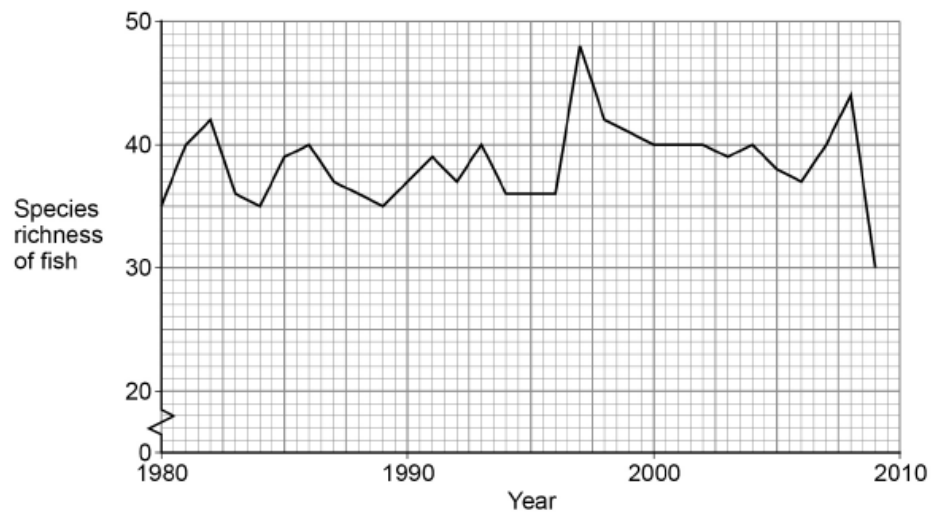
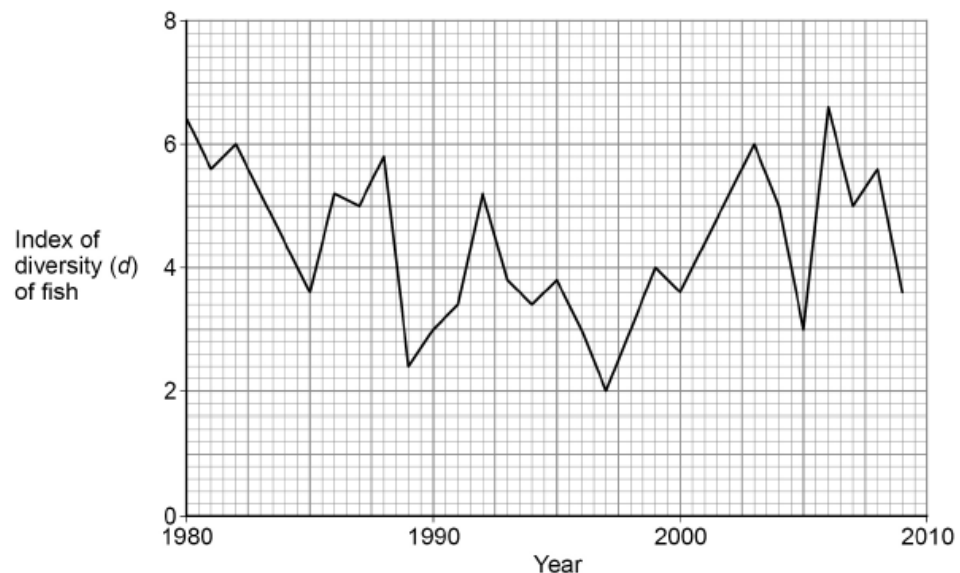


Figure 8



- 0 5 . 1 The scientists used the following formula to calculate the index of diversity (d) of fish.

$$d = \frac{N(N-1)}{\sum n(n-1)}$$

where N = total number of fish of all species
and n = total number of fish of each species

In some years, the values were $N = 624$ and $\sum n(n-1) = 64\,792$

Which years had these values?

Use **Figure 8** and the formula above to work out your answer.

[1 mark]

Answer _____

- 0 5 . 2 In 1997, the scientists recorded the highest species richness, but the lowest value of d over the 29 years.

Describe and explain how these results for 1997 were possible.

[2 marks]

[4 marks]

[illegible]

Write an essay on one of the topics below.

The importance of membranes in the functioning of cells.

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