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Other names

Pearson Edexcel
Level 3 GCE

Centre Number

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Candidate Number

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Biology B

Advanced

**Paper 3: General and Practical Principles
in Biology**

Specimen Paper for first teaching September 2015

Time: 2 hours 30 minutes

Paper Reference

9BI0/03

You may need a ruler, a pencil and a calculator.

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Show your working in any calculation questions and include units in your answer where appropriate.
- Answer the questions in the spaces provided
– *there may be more space than you need.*
- You may use a scientific calculator.
- In question(s) marked with an **asterisk** (*), marks will be awarded for your ability to structure your answer logically showing how the points that you make are related or follow on from each other where appropriate.

Information

- The total mark for this paper is 120.
- The marks for **each** question are shown in brackets
– *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

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PEARSON

Answer ALL questions.

Write your answers in the spaces provided.

1 Fungi break down dead plant and animal material in ecosystems.

Some types of fungi produce cellulase enzymes. These enzymes break down cellulose.

The breakdown of cellulose can be detected using Benedict's solution.

This solution turns red if monomers from the breakdown of cellulose are present.

(a) Give a reason why more cellulose is found in dead plant material than in dead animal material.

(1)

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(b) State the type of reaction catalysed by cellulase to break down cellulose.

(1)

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(c) Describe the structure of the monomer produced when cellulose is broken down.

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2 Chester Zoo has 12 000 animals from 400 different species.

Chester Zoo aims “to be a major force in conserving biodiversity worldwide”.

(a) State **one** ethical reason and **one** economic reason for the conservation of biodiversity.

(2)

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(b) Chester Zoo has 10 black rhinoceros. The black rhinoceros is critically endangered due to being hunted for its horns.

One kilogram of rhinoceros horn can sell for more than £50 000.

The photograph shows a black rhinoceros.



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The number of black rhinoceros fell from 70 000 in 1960 to 15 000 in the late 1970s.

All trade in black rhinoceros horn was prohibited under CITES in 1977.

However, hunting continued and fewer than 2 500 black rhinoceros were left by the year 2000.

- (i) Explain why hunting continued after the black rhinoceros was listed in CITES. (2)

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- (ii) Explain how the genetic diversity of the black rhinoceros is likely to have changed between 1960 and 2000. (2)

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(ii) DNA from dung indicated that 14 rhinoceros were present in the park.

Explain why 14 could be an underestimate of the population.

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(Total for Question 2 = 13 marks)

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3 Poliomyelitis is a serious disease that can lead to muscle weakness, paralysis and death. There is no cure.

Poliomyelitis is caused by poliovirus.

(a) The first poliovirus vaccine was tested in a study using 1.8 million children.

These children were divided into three groups.

Children in group 1 were injected with the vaccine.

(i) Devise suitable treatments for the children in group 2 and group 3.

(2)

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(ii) There are three types of poliovirus: PV1, PV2 and PV3. Each type causes poliomyelitis.

The table shows the results of the study for each type of poliovirus.

Type of poliovirus	Effectiveness of vaccine (%)
PV1	60–70
PV2	>90
PV3	>90

A few children had a severe allergic reaction to the vaccine.

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Comment on the extent to which this study supports the widespread use of this vaccine.

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(b) Newer vaccines against poliovirus are now widely used.

In 1980, there were an estimated 400 000 cases of poliomyelitis worldwide.

In 2012, there were 291 recorded cases in a few countries.

Calculate the percentage decrease in cases from 1980 to 2012.

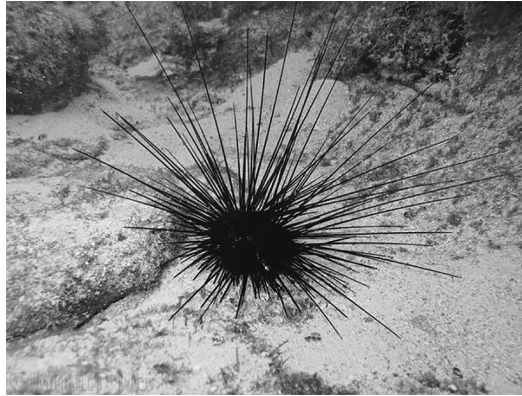
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Answer%



4 A sea urchin is an invertebrate animal that lives on the seabed.

The photograph shows a sea urchin.



Sea urchin embryos are often used to study embryonic development. In the early stages of embryonic development, a sea urchin embryo is similar to a mammalian embryo.

(a) A scientist observed a fertilised sea urchin egg during the first day after fertilisation.

Explain how this fertilised egg became a hollow structure.

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(b) The scientist found that 128 cells were present after 24 hours.

Calculate the number of rounds of cleavage that had taken place.

(1)

Answer

(c) The scientist carefully removed one of the 128 cells and injected fluorescent dye into its cytoplasm.

She replaced this cell in a new position on the opposite side of the embryo.

The embryo developed normally. The repositioned cell formed healthy tissue, appropriate to its new position.

The tissue formed by an embryonic cell is called the 'fate' of the cell.

(i) Explain how the scientist could identify the fate of the repositioned cell.

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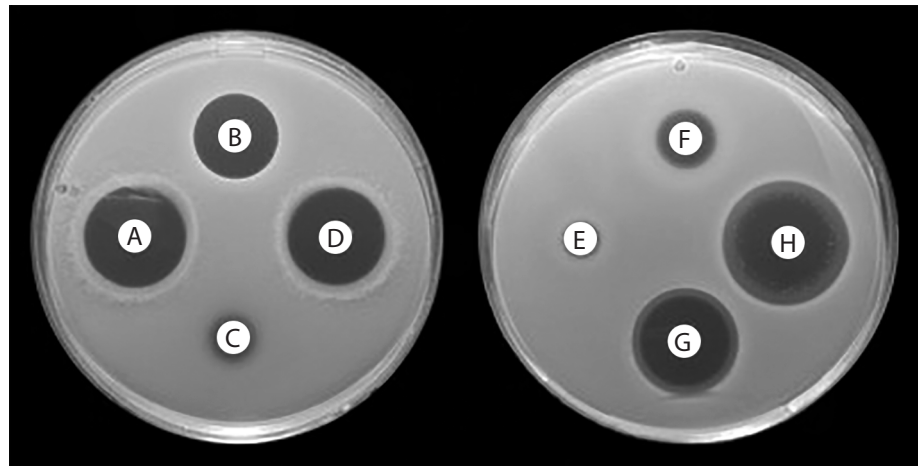


- 5 A student read that more than half of raw chickens on sale in supermarkets are contaminated with bacteria from the genus *Campylobacter*.

Some species of *Campylobacter* cause food poisoning in humans.

The student carried out an experiment to test the effectiveness of various antibiotics against *Campylobacter*.

The photograph shows the student's agar plates at the end of the experiment.



The white circles labelled A–H are filter paper discs. These discs were soaked in different antibiotics then placed on the surface of the agar.

- (a) Explain how the student's method could ensure that the results from the two agar plates can be compared.

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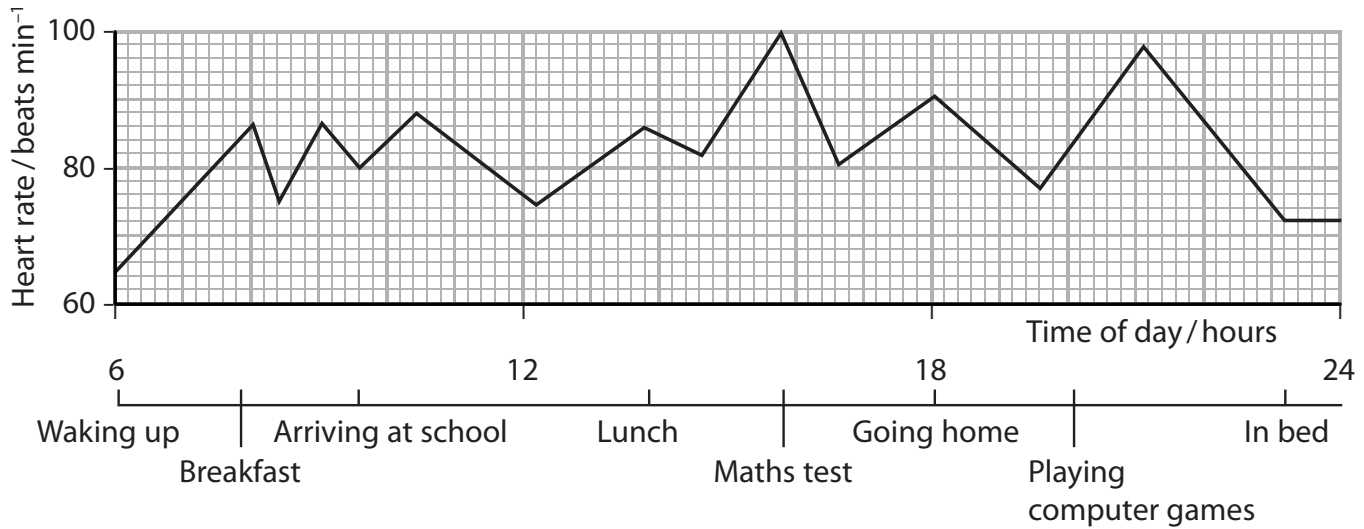
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7 A student was interested to find out how his heart rate would vary throughout the day. He wore a heart rate monitor from the time he woke up until the time he went to bed. The graph shows the data collected and some of the student's activities during the day.



(a) Calculate the rate of increase in the student's heart rate between 6 am and 8 am. (2)

Answer

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(b) Explain why the student's heart rate changed at the time of his maths test.

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(ii) Sketch a suitable graph that the student could use to present the results of his investigation.

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(Total for Question 7 = 13 marks)





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8 ATP is involved in a wide variety of biological processes such as active transport and muscle contraction.

A typical adult human body has a mass of 62 kg.

It contains approximately 250 g of ATP and comprises approximately 3.7×10^{13} cells.

(a) (i) Calculate the mean mass of ATP in one cell of a typical human.

Express your answer in standard form.

(2)

Answer

(ii) Explain why this calculation does **not** give an accurate estimate of the mass of ATP in a nerve cell.

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(b) Scientists have calculated that a typical person synthesises their own body mass in ATP every 24 hours.

(i) Calculate the mean rate of ATP production in grams per second in a person with a body mass of 62 kg.

(2)

Answer

(ii) Explain why people do not double their body mass in 24 hours due to ATP production.

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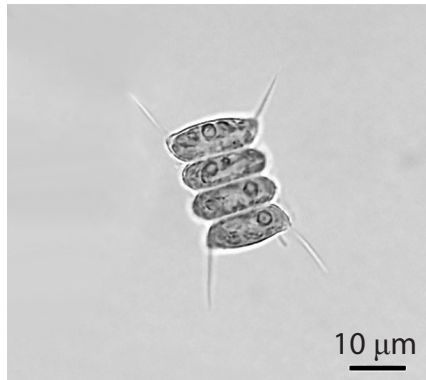
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- 9 The green alga, *Scenedesmus quadricauda*, lives in fresh water. Each cell has a single chloroplast. The photograph shows some *Scenedesmus* cells.



Photosynthesis can be measured if these algae are placed in a solution containing bicarbonate indicator.

When the carbon dioxide concentration is the same as that of atmospheric air, the bicarbonate indicator is red.

As the carbon dioxide concentration decreases, the bicarbonate indicator changes colour from red to pink and then to purple.

- (a) Explain why the carbon dioxide concentration of the solution decreases when the algae carry out photosynthesis.

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(b) A student investigated the effect of light on the rate of photosynthesis in *S. quadricauda*.

He used different coloured filters to vary the wavelength of the light.

The algae were added to a solution of bicarbonate indicator in a test tube.

The test tube was sealed and placed under a lamp with a red filter.

After 30 minutes, the student noted the colour of the bicarbonate indicator.

He then shook the open test tube until the indicator returned to its original colour.

He repeated this procedure with yellow, green and blue filters, using the same algae and the same indicator solution.

The student's results are shown in the table.

colour of filter	wavelength of light / nm	colour of indicator after 30 minutes
red	640	reddish pink
yellow	580	pink
green	520	pinky purple
blue	460	dark purple

(i) Analyse the data to explain what conclusion may be drawn from these results.

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(Total for Question 9 = 13 marks)



(b) The allele that leads to sickle cell anaemia is known as HbS.

From 1990 to 1996, all newborn infants in California were screened for the presence of the HbS allele.

The data in the table show the ratio of individuals with and without the HbS allele, in various ethnic groups.

Ethnic group	HbS allele : no HbS allele
African American	1:14
Asian	1:1336
Caucasian	1:625
Hispanic	1:183
Middle Eastern	1:360
Native American	1:176

A chi squared test was used to analyse the raw data.

The null hypothesis was: "There is no significant difference between the frequency of the HbS allele in African Americans and in all other ethnic groups combined."

The calculated value of chi squared was 450 615.

The table shows some critical values for the chi squared distribution, with one degree of freedom.

probability, p	0.005	0.010	0.025	0.050	0.100
critical value	7.879	6.635	5.024	3.841	2.706



Explain the conclusion that can be drawn from this chi squared test.

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(c) People who are homozygous for the HbS allele develop sickle cell anaemia.

People who are heterozygous for HbS produce both forms of haemoglobin.
These individuals have some sickled red blood cells.

People with the HbS allele are less likely to get malaria.

(i) You are provided with a blood sample from a patient with malaria and a blood sample from a healthy individual.

Devise a method that would allow you to distinguish between the two blood samples.

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