OCR
Oxford Cambridge and RSA

A Level Biology A

H420/02 Biological diversity

Monday 11 June 2018 – Afternoon

Time allowed: 2 hours 15 minutes

You must have:
- the Insert (inserted)

You may use:
- a scientific or graphical calculator
- a ruler (cm/mm)

First name									
Last name									
Centre number						Candidate number				

INSTRUCTIONS
- The Insert will be found inside this document.
- Use black ink. You may use an HB pencil for graphs and diagrams.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Write your answer to each question in the space provided. If additional space is required, use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
- Do **not** write in the barcodes.

INFORMATION
- The total mark for this paper is **100**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended responses will be assessed in questions marked with an asterisk (*).
- This document consists of **36** pages.

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SECTION A

You should spend a maximum of 20 minutes on this section.

Write your answer for each question in the box provided.

Answer **all** the questions.

1 Which of the following best describes a microscope with *high resolution*?

A The microscope can distinguish structures that are very close together.

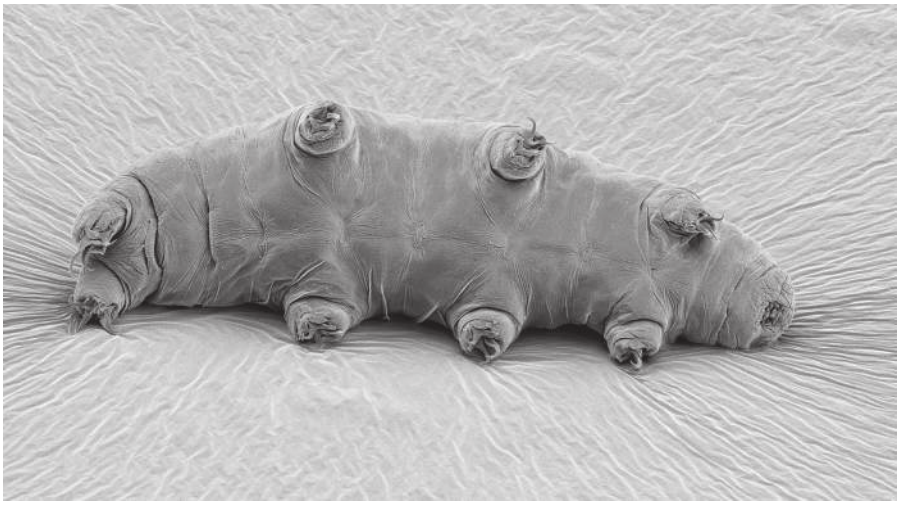
B The microscope can view structures that are very small.

C The microscope is capable of high magnification.

D The microscope has an in-built eyepiece graticule.

Your answer ☐ **[1]**

2 The image below shows a tardigrade, *Echiniscus granulatus*, viewed from the underneath. The magnification is × 110.



How long is the tardigrade in real life?

A 115 μm

B 1.14×10^{-5} m

C 8.64×10^{-4} m

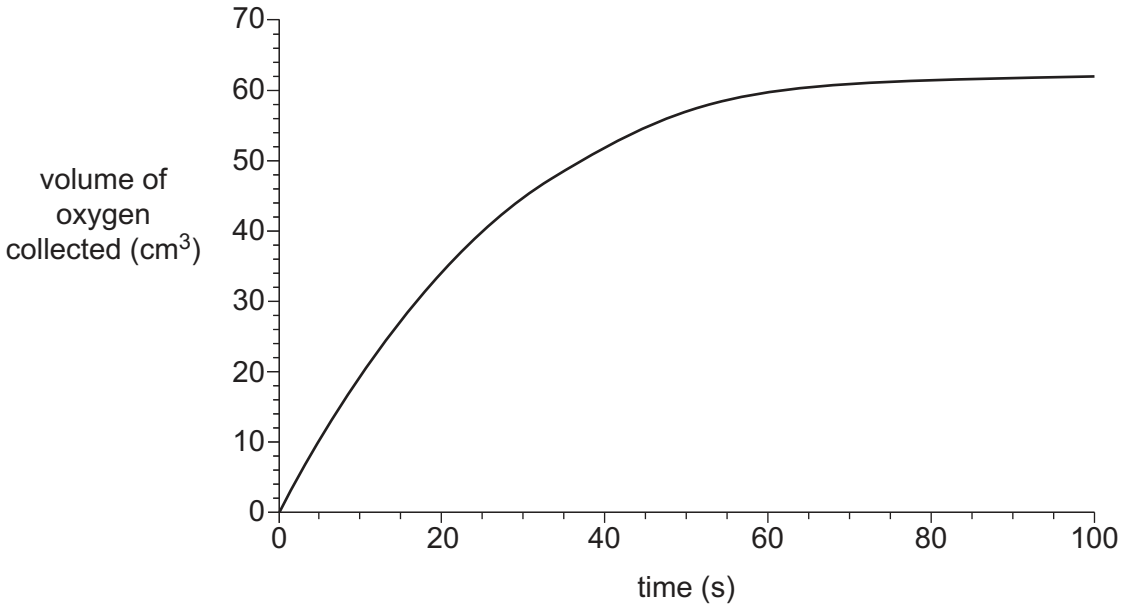
D 0.116 mm

Your answer ☐ **[1]**

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3 Celery contains the enzyme catalase, which breaks down hydrogen peroxide into oxygen and water.

A student added liquidised celery to a solution of hydrogen peroxide and collected the oxygen given off by the reaction. The results are shown in the graph below.



Which of the following shows the rate of reaction **at** 30s?

A $0.85\,cm^3\,s^{-1}$

B $1.00\,cm^3\,s^{-1}$

C $1.15\,cm^3\,s^{-1}$

D $1.50\,cm^3\,s^{-1}$

Your answer ☐ **[1]**

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4 Which of the following processes involves the formation of ester bonds?

1 synthesis of polynucleotides

2 synthesis of triglycerides

3 synthesis of polypeptides

A 1, 2 and 3

B Only 1 and 2

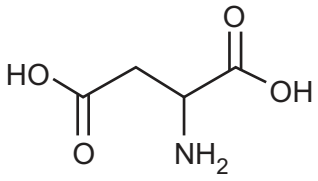
C Only 2 and 3

D Only 1

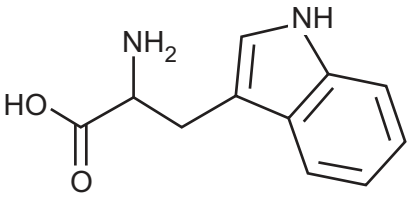
Your answer ☐ **[1]**

5 Which of the following could **not** be an amino acid?

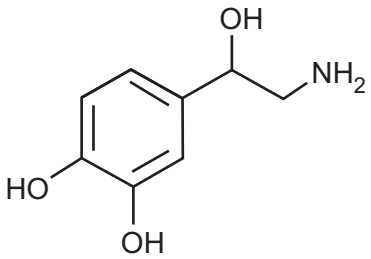
A



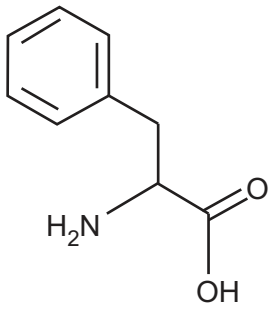
B



C



D



Your answer ☐ **[1]**

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6 Lipids are a diverse group of chemicals that are neither polar nor charged and hence are insoluble in water. The ___(1)___ nature of the heads of phospholipids allows them to form membranes. ___(2)___ also contain fatty acids and form part of the membrane. Lipids can be used for energy storage in the form of ___(3)___. Some hormones are also lipids and they are similar in structure to ___(4)___.

Which row shows the correct sequence of missing words?

	1	2	3	4
A	hydrophilic	glycolipids	triglycerides	cholesterol molecules
B	hydrophilic	triglycerides	cholesterol molecules	glycolipids
C	hydrophobic	cholesterol molecules	triglycerides	bile
D	hydrophilic	cholesterol molecules	triglycerides	glycolipids

Your answer ☐ **[1]**

7 Which of the following statements about antibiotic resistance is correct?

A All antibiotics cause mutations in bacterial DNA.

B Antibiotic resistance in bacteria is evidence to support Darwin's theory of evolution by natural selection.

C The development of antibiotic resistance in bacteria is an example of genetic drift.

D The development of antibiotic resistance in bacteria is an example of stabilising selection.

Your answer ☐ **[1]**

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8 Which of the following antibodies increase(s) the phagocytosis of pathogens?

1 opsonins

2 agglutinins

3 anti-toxins

A 1, 2 and 3

B Only 1 and 2

C Only 2 and 3

D Only 1

Your answer ☐ **[1]**

9 Which of the following describes an autoimmune disease?

A a disease in which an individual's own body cells are antigenic

B a disease in which a pathogen attacks cells of the immune system

C a disease that prevents production of antibodies

D a disease to which an individual has developed immunity

Your answer ☐ **[1]**

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10 During which stage of the cell cycle does semi-conservative DNA replication take place?

A first growth phase

B prophase

C second growth phase

D synthesis phase

Your answer ☐ **[1]**

11 The cell cycle includes a number of checkpoints.

Which of the following statements about the cell cycle is correct?

A If damaged DNA is detected at a checkpoint apoptosis is triggered.

B If damaged DNA is detected at the G_2 checkpoint the cell cycle is halted and the cell tries to repair the damage.

C If a mistake is detected at a checkpoint the cycle reverts to an earlier checkpoint and is repeated.

D The G_1 checkpoint checks for mistakes in DNA replication.

Your answer ☐ **[1]**

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12 Turtle doves, *Streptopelia turtur*, were once common in farmland in the UK but their numbers have recently been in decline.

Farmers can claim money from the UK government if they farm in ways that encourage the survival of species such as the turtle dove.

Which of the following agreements is/are relevant to the example described above?

1 The Convention on International Trade in Endangered Species (CITES)

2 The Rio Convention on Biological Diversity (CBD)

3 The Countryside Stewardship Scheme (CSS)

A 1, 2 and 3

B Only 1 and 2

C Only 2 and 3

D Only 1

Your answer ☐ **[1]**

13 Bacteria are used in many areas of biotechnology.

In which of the following processes, **A** to **D**, do bacteria **not** play an active role?

A bioinformatics

B bioremediation

C cheese-making

D manufacturing human insulin

Your answer ☐ **[1]**

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14 Mycoprotein is a food produced using the fungus *Fusarium venenatum*.

Which statement about mycoprotein is correct?

A production of protein is slower than in animals and plants

B production is dependent on seasons

C waste products can be used as a substrate

D there are no ethical issues associated with production

Your answer ☐ **[1]**

15 Which of the following statements about ecosystems is **not** true?

A An ecosystem is affected by biotic and abiotic factors.

B An ecosystem is all of the organisms and habitats in a large area.

C An ecosystem is dynamic.

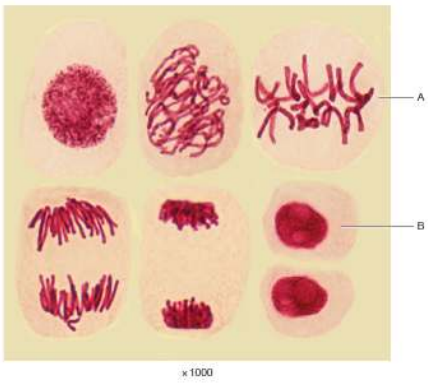
D There is a flow of biomass between trophic levels in an ecosystem.

Your answer ☐ **[1]**

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SECTION B

Answer **all** the questions.



16 Fig. 16, **on the insert**, shows 6 onion cells at various stages of mitosis.

(a) (i) Name the stage of mitosis shown in cell **A**.

metaphase ✓ ..... **[1]**

(ii) In the space provided below draw cell **A**. Label your drawing to show visible features.

single cell
and
≥ 60 mm horizontal diameter
and
some attempt to draw chromosomes as in Fig. 16 ✓
and
broadly circular

clear continuous lines (on chromosomes and membrane) ✓

ruled label lines (touching correct feature) ✓

chromosome(s)
and
cytoplasm labelled ✓

colour of any of above mentioned (as annotation) ✓

1 DO NOT CREDIT if all chromosomes represented as a single line or shaded

3 DO NOT CREDIT arrows

4 DO NOT CREDIT if any other structures are drawn or labelled

4 DO NOT CREDIT if labels written on part of diagram

[4]

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(b) (i) The volume of cell **A** is $5.4 \times 10^4\ \mu m^3$.

Assume that cell **B** is spherical.

Calculate the volume of cell **B**.

Use the formula: volume of sphere = $\frac{4}{3}\pi r^3$

Give your answer in standard form in μm^3.

If cell B is measured and formula applied…
1.7 (± 0.4)

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

(ii) State the type of microscope that was used to view these images. Justify your answer.

light (microscope) because
magnification , (only) 1000 / < 2000 / within LM range ✓ .....

colour visible ✓ .....

.....

(other) subcellular structures / (named) organelles , not visible ✓ .....

wide field of view ✓

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

(iii) Mitosis is involved in growth and repair of tissues.

State **two** other roles of mitosis in multicellular organisms.

1 ....*any **two** from*
asexual / vegetative , reproduction .....

2 ....
(development of) body plan .....
[1]

proliferation of white blood cells

producing gametes from haploid cells

production of new stem cells ✓

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17 Penguins are flightless birds that eat fish. Most species of penguin live near the coast of Antarctica or on the many islands that surround Antarctica.

Fig. 17 shows the populations of three penguin species on an island off the coast of Antarctica.

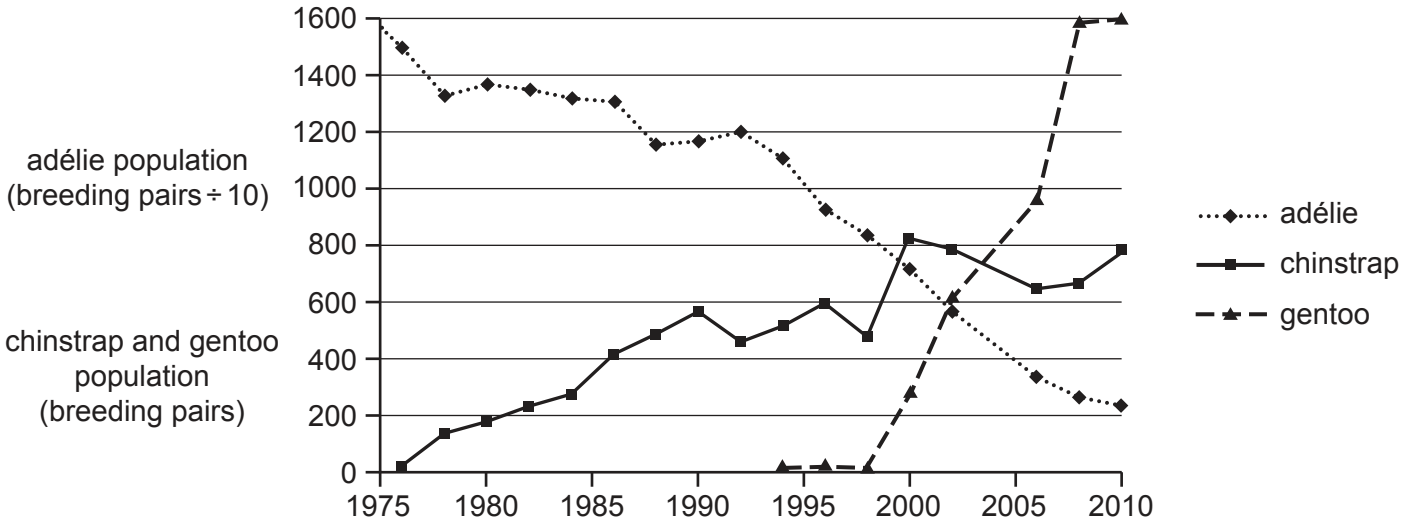


Fig. 17

(a) (i) Before 1975 the only penguin species on the island was the adélie penguin. Chinstrap penguins were first recorded on the island in 1976.

The changes in the chinstrap penguin population are not directly related to abiotic factors.

Suggest explanations for the changes in the population of **chinstrap** penguins between 1976 and 2010.

1 penguin species have overlapping / AW , niches ✓ .....

2 competitive exclusion ✓ .....

3 increase as , food / nesting sites / resources (available) ✓ .....

4 increase as , no / little , competition / limiting factors ✓ .....

5 plateau / drop, because of (increased) competition ✓ .....

6 drop / plateau , due to , arrival of / competition from , gentoo ✓ ..... **[3]**

(ii) Calculate the mean annual decrease in the **adélie** penguin population between **1988** and **2010**.

Show your working. Give your answer to **three significant figures**.

836 (± 40) / 8.36 (± 0.4) x 10^2 , (individuals) y^{-1}

or

418 (± 20) / 4.18 (± 0.2) x 10^2 , per year / y^{-1} ✓✓

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

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(b) Adélie penguins need a habitat that contains sea-ice. Gentoo and chinstrap penguins can survive without access to sea ice.

Scientists have claimed that the population changes in the three penguin species on the island suggests that the Antarctic temperature is increasing.

(i) Discuss whether the information in Fig. 17 supports the scientists' claim.

You should refer to the data in Fig. 17 in your answer.

supports because…

1 Adélie / ice-reliant / AW , penguin (population) decreased .....
OR
gentoo / chinstrap / non-ice-reliant , penguin (population) increased ✓ .....

figs that support either point given above ✓ .....

2 .....

does not support because…

idea that changes could be explained by (chance) arrival of , gentoo / .....
3 chinstrap (and subsequent competition) ✓ .....

change in another described factor could explain changes (in a single .....
4 species) ✓

correlation does not mean causation ✓ .....
5 .....

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

(ii) Scientists working in the local area monitored water temperatures and populations of other water animals around the island between 1976 and 2010.

Suggest **two** further pieces of evidence that the scientists might have found to support their claim.

1 reduction in extent of ice ✓ — **1 IGNORE** sea level changes

change in ocean current ✓

2 change in (penguin) food (species or population) ✓ — **3 IGNORE** fish or other named aquatic animal

[2]

new , disease / parasite ✓

change in predator (species or population) ✓

new animal (species) present on land ✓

change in population of (aquatic) plants ✓

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18* For centuries, artificial selection has been used to improve the quality of crop plants used for human consumption.

Explain, with reference to selective breeding, why it is important to maintain viable wild populations of crop plant species.

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Level 3 (5–6 marks)
Provides a detailed explanation of the benefits to selective breeding of maintaining a viable wild population.
The answer contains well-developed lines of reasoning which are clear and logically structured and uses scientific terminology at an appropriate level. All the information presented is broadly relevant.

Level 2 (3–4 marks)
Provides an explanation of the benefits to selective breeding of maintaining a viable wild population.
The answer contains some reasoning, structure and use of appropriate scientific language. The information presented is mostly relevant.

Level 1 (1–2 marks)
Lists at least one benefit to selective breeding of maintaining a viable wild population.
The information is communicated with only a little structure. Communication is hampered by the inappropriate use of technical terms or substantial irrelevant material.

Indicative points
These could be described in terms of problems associated with selective breeding and solutions offered by maintaining a wild population

- genetic variation
- genetic resource / gene bank
- source of useful alleles
- can be cross bred with crop varieties
- allows introduction of different traits
- unknown future requirements
- potentially useful in changing climate
- prevention of inbreeding depression
- promotion of hybrid vigour
- prevent dwindling gene pool
- source of replacement if cultivated population is in danger
- plausible example(s) of any of the above

[6]

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19 Two students investigated the growth of bacteria at different temperatures.

Three flasks containing identical solutions of nutrient broth were used.

- Flask 1: inoculated with 1 cm^3 of broth containing the bacterium *Bacillus subtilis* and incubated at 20 °C.
- Flask 2: inoculated with 1 cm^3 of broth containing *B. subtilis* and incubated at 30 °C.
- Flask 3: inoculated with 1 cm^3 of broth containing no bacteria and incubated at 30 °C.

Aseptic techniques were used throughout.

At set times over the next 3 days the students removed samples from each flask and measured the number of viable bacteria present.

(a) State one further variable the students should have controlled in their investigation in order to produce **valid** results.

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

(b) The students used the following procedure to determine the number of viable bacteria in each flask at a given time.

From each flask, 0.1 cm^3 was removed and mixed with 9.9 cm^3 of sterile water in a test tube. This was labelled **Tube A**. A serial dilution then proceeded, as shown in Table 19.1.

Tube	**Contents**	
B	1 cm^3 of Tube A mixture	9 cm^3 of sterile water
C	1 cm^3 of Tube B mixture	9 cm^3 of sterile water
D	1 cm^3 of Tube C mixture	9 cm^3 of sterile water
E	1 cm^3 of Tube D mixture	9 cm^3 of sterile water
F	1 cm^3 of Tube E mixture	9 cm^3 of sterile water

Table 19.1

From each tube, A–F, 0.1 cm^3 of mixture was cultured on nutrient agar for 24 hours at 30 °C.

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The results from Flask 2 after 7 hours of incubation are shown in Fig. 19.

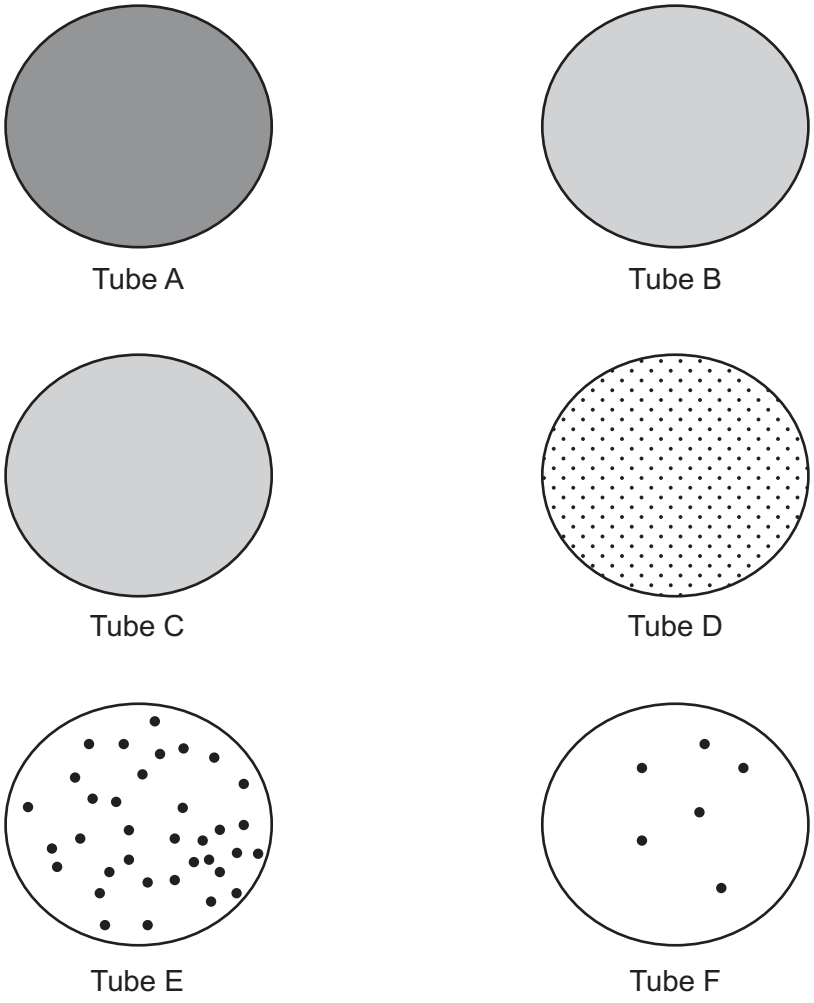


Fig. 19

The students used Tube F to calculate the number of viable bacteria present in the original sample.

(i) Use Tube F to calculate the number of viable bacteria present in the original 0.1 cm^3 sample from Flask 2 after 7 hours of incubation.

Give your answer in standard form.

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

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(ii) The students disagreed about which tube's result to use as a starting point for their calculation.

Discuss whether the petri dish resulting from Tube F was the most appropriate for them to use.

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

(c) The processed results from the students' investigation are shown in Table 19.2.

Time after incubation started (hours)	**Number of viable bacteria present in Flask 1 at 20 °C**	**Number of viable bacteria present in Flask 2 at 30 °C**
0	7.0×10^2	7.1×10^2
2	6.8×10^2	7.4×10^2
4	4.7×10^4	2.5×10^6
8	6.5×10^7	9.2×10^{10}
12	2.4×10^9	1.8×10^{11}
18	7.8×10^{10}	1.8×10^{11}
24	9.2×10^{10}	5.5×10^8
36	8.6×10^{10}	4.2×10^4
48	6.0×10^9	6.7×10^2
60	5.7×10^7	5.2×10^2
72	1.3×10^5	3.1×10^2

Table 19.2

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(i)* Using the information in Table 19.2, compare and explain the patterns of growth seen at 20 °C and at 30 °C.

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

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(ii) No bacteria were detected at any time in the flask that was inoculated with nutrient broth that did not contain bacteria.

Explain the purpose of this flask.

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

(iii) The teacher told the students they should not investigate the growth of bacteria at 35 °C.

Suggest why the teacher told them not to grow bacteria at 35 °C.

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

(iv) The teacher also suggested that the students should have carried out the investigation using three flasks at each temperature.

Explain how this suggestion would have improved the students' investigation.

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

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20 The cheetah, *Acinonyx jubatus*, is a member of the cat family, Felidae.

Cheetahs display less intraspecific variation than other members of the family Felidae.

Fig. 20.1 shows the mean body length of a population of cheetahs from southern Africa.

The error bars on Fig. 20.1 show the standard deviation of mean body length.

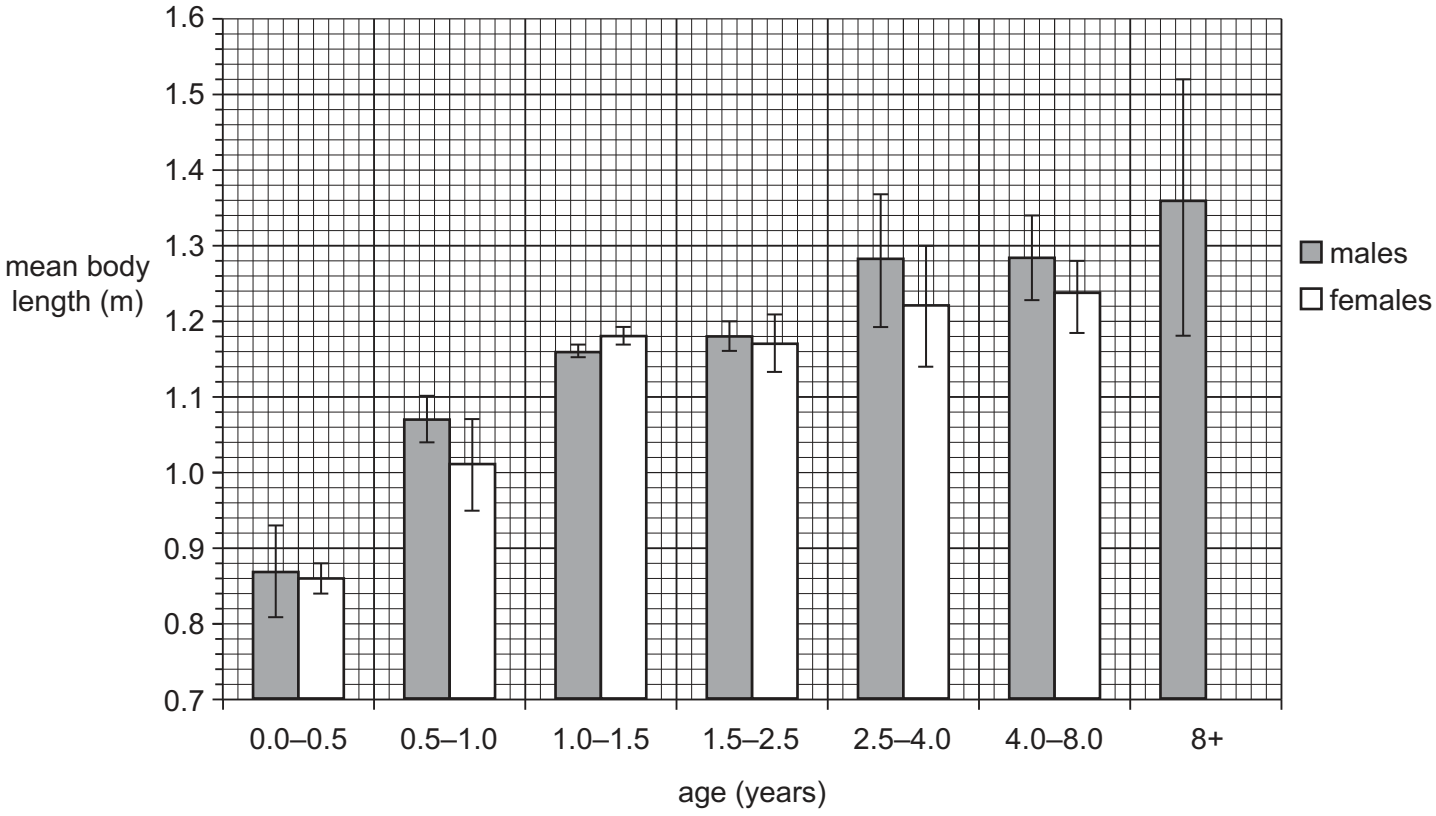


Fig. 20.1

(a) (i) At between 2.5 and 4 years old, the mean length of female cheetahs is less than that of males.

Calculate how much shorter than males female cheetahs are.

Show your working. Express your answer as a percentage to **two significant figures**.

Answer ..... % **[2]**

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(ii) Using only Fig. 20.1 and your answer to **(i)**, what can be concluded about the **significance** of the difference between the length of male and female cheetahs aged between 2.5 and 4 years?

Explain your answer.

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

(iii) A student looked at Fig. 20.1 and wrote:

"The longest male cheetah that was measured was 1.52 m long".

Explain whether the information in Fig. 20.1 supports the student's answer.

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.....

.....

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

(iv) State the likely causes of variation in body length in cheetahs.

.....

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

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(b) The population of cheetahs has been declining for the past 100 years and is estimated to be between 6000 and 7000.

Within the remaining cheetah population, intraspecific genetic diversity is very low.

One isolated population of cheetahs in Iran has fewer than 100 individuals.

(i) State one way in which genetic diversity can be measured.

.....

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

(ii) It is thought that the modern cheetah population has low genetic diversity because the population, relatively recently, experienced a genetic bottleneck.

Explain why a genetic bottleneck can lead to low genetic diversity.

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

(iii) Scientists are concerned about genetic drift in the remaining cheetah populations.

Explain why genetic drift is likely to be of particular concern in the population of 100 cheetahs in Iran.

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

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(c) Madagascar is a large island off the coast of Africa that once formed part of the mainland.

The fossa, *Cryptoprocta ferox* is the top predator on Madagascar.

The fossa shares many physical similarities with cats but it is not a member of the family Felidae. It is related to the mongoose.

The mongoose is a much smaller mammal that lives on the African mainland.

Fig. 20.2 shows a fossa and a mongoose.

fossa



mongoose



Fig. 20.2

(i) The mongoose is a smaller mammal and also has proportionally longer fur. State **one** other difference, **visible in Fig. 20.2**, between a fossa and a mongoose.

.....

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

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(ii) When the island of Madagascar became separated from the African continent, there were no members of the cat family, Felidae, on the island.

Outline how a fossa could have evolved from a much smaller, mongoose-like ancestor.

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..... **[4]**

(iii) Islands, such as Madagascar, often have species that are different from those on the nearest land mass because they are reproductively isolated.

State **three** other conditions that must be present in order for speciation to occur.

1 .....

2 .....

3 .....

[3]

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21 Fred Sanger developed an effective DNA sequencing technique in 1977.

(a) Define the term *DNA sequencing*.

.....

.....

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

(b) The speed at which DNA can be sequenced has been increasing rapidly since the introduction of DNA sequencing.

The length of DNA that can be sequenced in a given time is measured in base pairs or kilobase pairs.

In 1980, the speed at which DNA could be sequenced by a single machine was approximately 500 **base pairs** per hour. In 2016 that speed had increased to approximately 50 million **kilobase pairs** per hour.

Calculate how many times faster the speed of DNA sequencing is in 2016 compared with 1980.

Answer ..... times faster **[2]**

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(c) One technique that has allowed the speed of DNA sequencing to increase has been the development of nanopores.

Fig. 21 shows how nanopores can be used to sequence DNA.

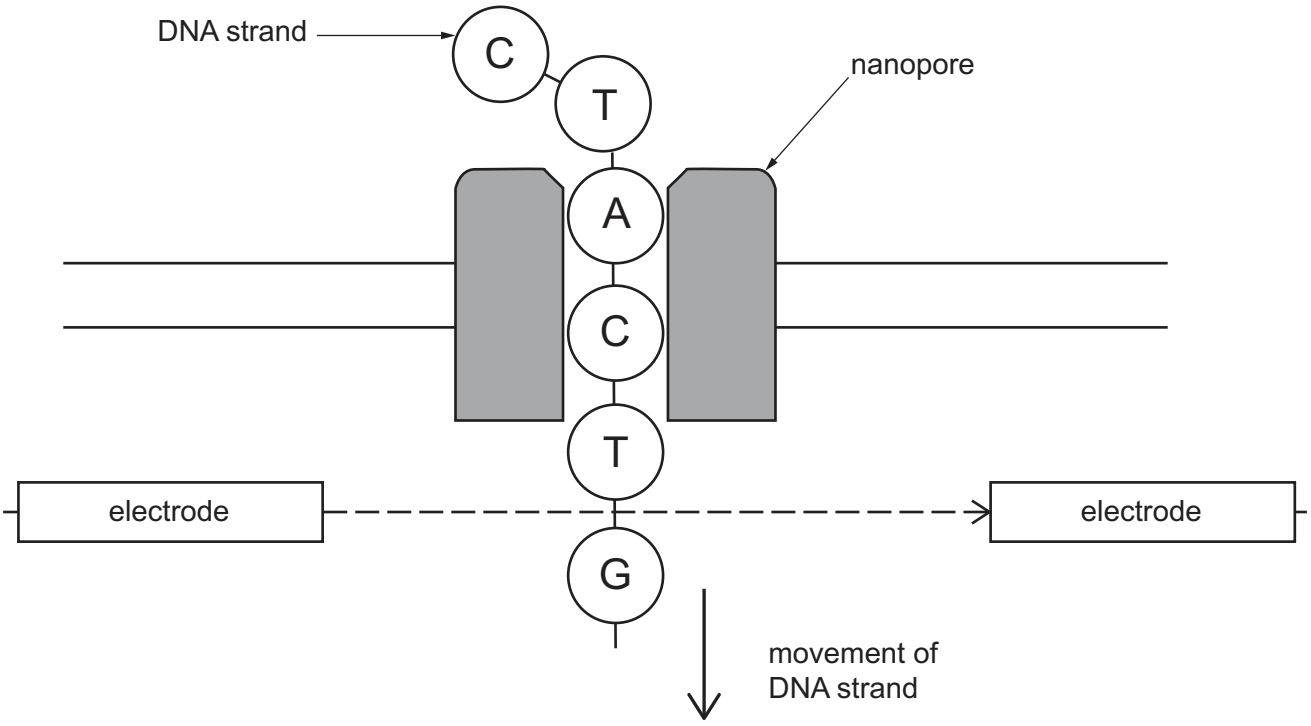


Fig. 21

(i) State one development, other than nanopore technology, that has led to an increase in the speed at which DNA can be sequenced.

.....

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

(ii) Part of Fig. 21 is labelled **G**.

Use the table below to identify two differences between the part labelled **G** and the structure of a molecule of ATP.

	G	**Molecule of ATP**
Difference 1	....	....
Difference 2	....	....

[2]

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(iii) Explain how DNA sequencing allows the sequence of amino acids in a polypeptide to be predicted.

.....

.....

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

(d) DNA sequencing can be used to determine the genome of an entire organism.

The first organism to have its entire genome sequenced was a virus.

Ebola is a virus that caused the death of over 11 000 people in West Africa between 2014 and 2016. The DNA of ebola virus has a rapid rate of mutation.

Since the first outbreak in 2014 scientists have been working to develop an effective vaccination against ebola.

Other scientists have developed a portable nanopore sequencing technique that could be used to sequence rapidly the entire ebola genome.

Outline how DNA sequencing and bioinformatics could be used to increase the effectiveness of a vaccination programme against ebola.

sequencing .....

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bioinformatics .....

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.....

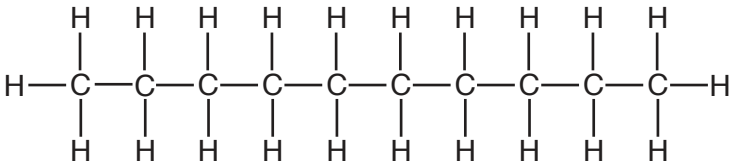
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[4]

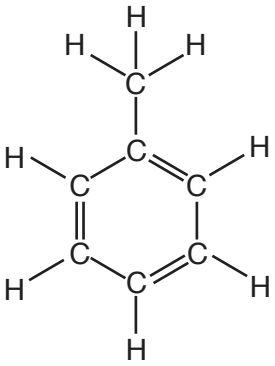
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22 Crude oil contains hydrocarbons. Three hydrocarbons commonly present in crude oil are shown in Fig. 22.

W



X



Y

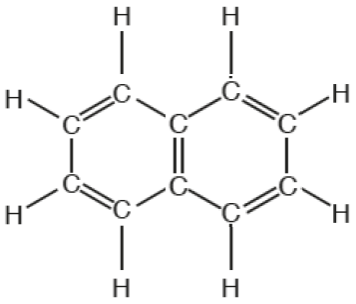


Fig. 22

(a) Compound **W** shows some structural similarities with fatty acids.

State one structural difference between compound **W** and a saturated fatty acid.

.....

.....

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

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(b) Crude oil is often spilled from ships into the sea causing great damage to wildlife. The chemicals in crude oil are harmful to many species and do not break down quickly in the environment.

Some bacteria can break down the hydrocarbons in crude oil. These bacteria have been used by conservationists at sites where oil has been spilled.

(i) The rate of hydrocarbon breakdown by bacteria can be increased by spraying the oil with detergent. Detergents break up oil into droplets, thereby increasing their surface area.

- Student A concluded that the detergent speeded up the rate of hydrocarbon breakdown **only** because it increased the surface area of hydrocarbon upon which the bacteria could grow.

- Student B concluded that the detergents **also** increased the growth of the bacterial population by an alternative mechanism.

Use the information in Fig. 22 and your knowledge of bacterial growth requirements to provide support for student B's conclusion.

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

(ii) Suggest **one** piece of evidence that would further support student B's conclusion.

.....

.....

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

(c) Bacteria that are able to digest and metabolise the hydrocarbons in crude oil are more common in areas, such as around the coast of Alaska and the Gulf of Mexico, where oil spillages are common.

Suggest an explanation for this observation.

.....

.....

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

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(d) Listed below are three approaches, A, B and C, that can be taken to maintain biodiversity:

A	*ex situ* conservation
B	*in situ* conservation
C	preservation

For each of the statements below, indicate whether it could be consistent with *in situ* conservation, *ex situ* conservation or preservation by inserting the correct **letter or letters** in the table.

	Approach
organisms are **not** removed from their natural habitat	
human intervention is happening	

[2]

END OF QUESTION PAPER

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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).

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