

IGCSE Cambridge Topical Past Papers

BIOLOGY 9-1

0970 | Paper 4

2020 — 2025

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1 - (0970/42_Summer_2020_Q3)

Cheetahs, *Acinonyx jubatus*, are carnivores found in the dry grasslands and woodlands of southern Africa. Cheetahs hunt for food during the day. They eat deer and antelope.

The cheetah is the fastest mammal on land but can only run at high speed (sprint) over a short distance. Its hunting strategy is to creep up on prey and then sprint to catch them.

Fig. 3.1 is a photograph of a cheetah in its natural habitat.



Fig. 3.1

(a) Suggest how these adaptive features enable cheetahs to survive in their natural environment.

fur colouring

.....

.....

streamlined body shape

.....

.....

[2]

- (b) The king cheetah is a rare variety of *A. jubatus* that has inherited striped fur markings.

Fig. 3.2 shows a cheetah with spots and a king cheetah.



cheetah with spots



king cheetah

Fig. 3.2

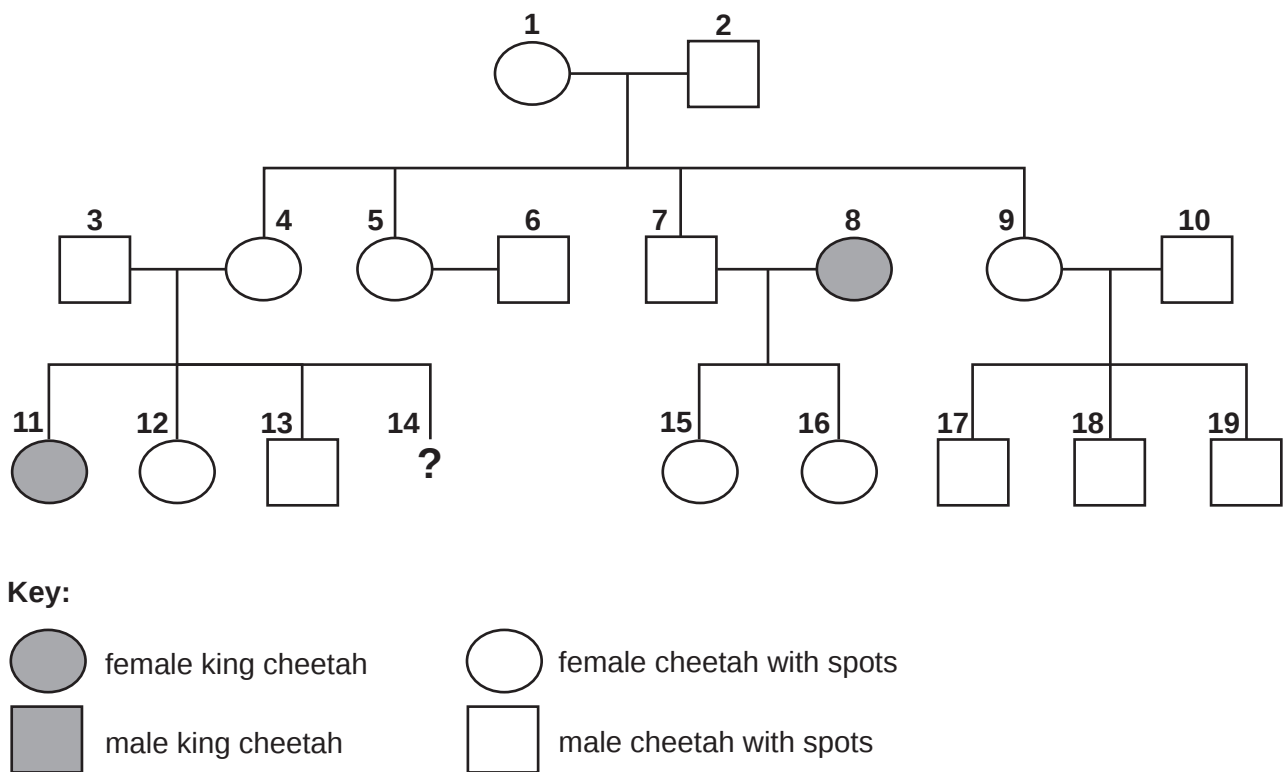
- (i) Define the term *inheritance*.

.....

.....

..... [1]

Fig. 3.3 shows a pedigree diagram of a population of cheetahs.

**Fig. 3.3**

(ii) Deduce the genotype of cheetah **11**.

..... [1]

(iii) Predict the probability of cheetah **14** being a king cheetah.

..... [1]

(iv) Describe how a breeder could determine the genotype of cheetah **17**.

.....

.....

.....

.....

..... [2]

- (v) When the king cheetah was first discovered it was thought that it was a new species.

Pedigree diagrams of cheetahs proved it was not a new species.

Suggest **one** type of evidence, other than pedigree diagrams, that can be used to determine how closely related organisms are.

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

- (c) Cheetahs are at risk of becoming endangered.

- (i) Suggest why the cheetah is at risk of becoming endangered.

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..... [3]

- (ii) Describe how species like the cheetah can be conserved.

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

[Total: 14]

2 - (0970/42_Summer_2020_Q5)

The Galápagos Islands are a group of small islands in the Pacific Ocean.

In 1839 Charles Darwin published a book that described differences in a family of birds called finches.

Each species of Galápagos finch had:

- a different diet
- a different beak shape, as shown in Fig. 5.1.

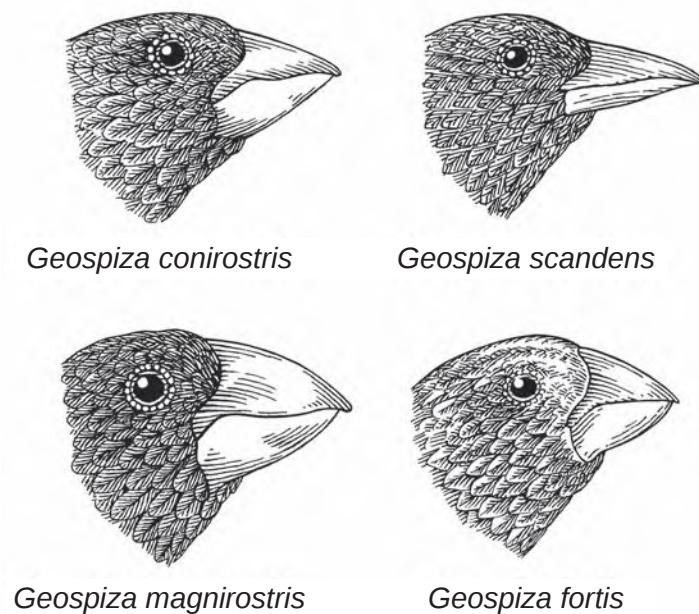


Fig. 5.1

(a) State the genus name for the Galápagos finches shown in Fig. 5.1.

..... [1]

(b) Galápagos finches share a common ancestor.

Suggest how Galápagos finches have evolved different shaped beaks.

.....

.....

.....

.....

..... [5]

[Total: 6]

3 - (0970/42_Winter_2020_Q1)

- (a)** Sensitivity is one of the characteristics of life. The eye is one of the major sense organs of vertebrates.

(i) Define the term *sensitivity*.

.....

.....

.....

..... [2]

(ii) Define the term *sense organ*.

.....

.....

.....

..... [2]

- (b)** Accommodation (focusing) is one of the functions of the eye.

Fig. 1.1 is a diagram of an eye that is focusing on a distant object.

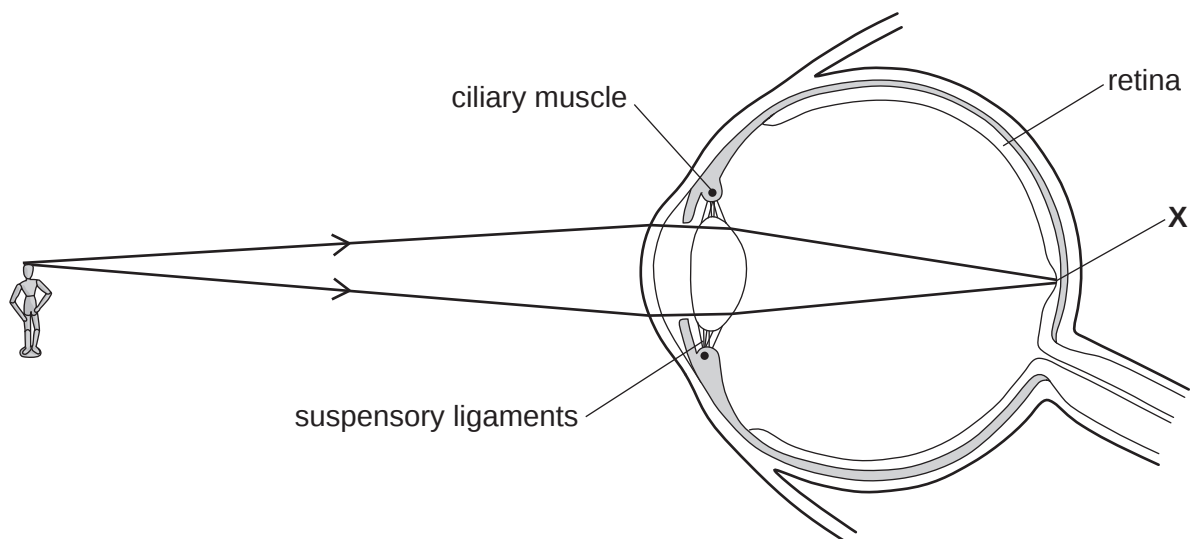


Fig. 1.1

(i) State the name of the part of the retina labelled **X**.

..... [1]

Fig. 1.2 is an incomplete diagram of an eye that is focusing on a near object.

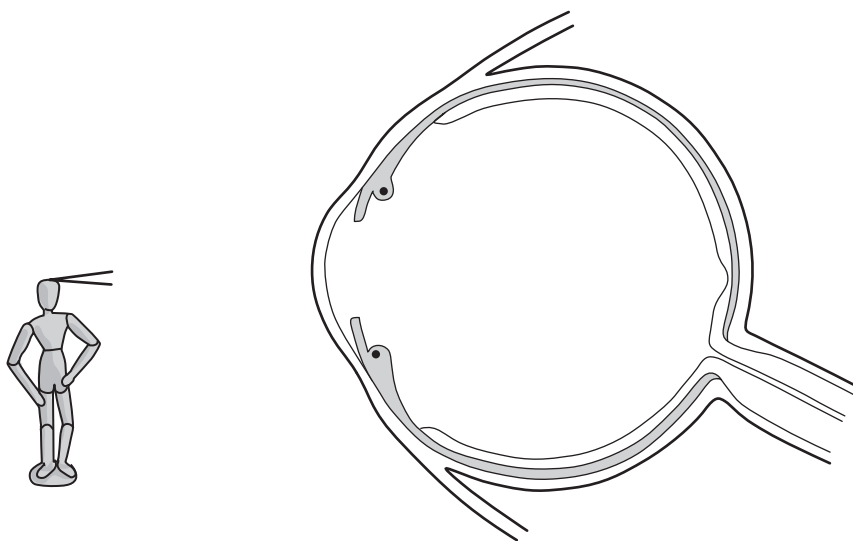


Fig. 1.2

- (ii) Complete Fig. 1.2 by **drawing** the shape of the lens and the light rays from the object to the retina. [3]
- (iii) Describe the roles of the ciliary muscles and suspensory ligaments in focusing on a **distant object**, as shown in Fig. 1.1.

.....

.....

.....

.....

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.....

.....

..... [3]

- (c) The eye also controls the amount of light that enters the pupil.

Fig. 1.3 shows an eye in low light and in bright light.



eye in low light



eye in bright light

Fig. 1.3

Describe the changes that occur in the eye when the light becomes bright, as shown in Fig. 1.3.

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.....

.....

.....

.....

.....

.....

..... [3]

- (d) The change shown in Fig. 1.3 occurs automatically without thought.

State the name given to this type of action.

..... [1]

[Total: 15]

4 - (0970/41_Summer_2021_Q1)

- (a) Baker's yeast, *Saccharomyces cerevisiae*, is a single-celled organism that is classified in the kingdom Fungi.

Fig. 1.1 is a drawing of a section through a yeast cell.

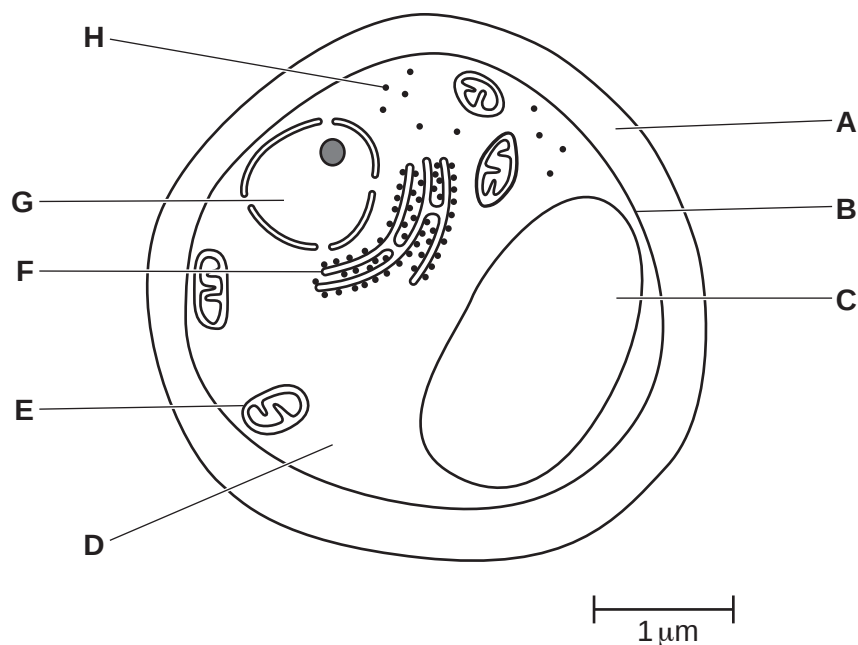


Fig. 1.1

- (i) State **one other** kingdom that contains organisms that all have structure **A**.

..... [1]

- (ii) Table 1.1 shows some cell functions.

Complete Table 1.1 by naming the cell structure responsible for each cell function and give the letter that identifies each cell structure in Fig. 1.1.

Table 1.1

cell function	cell structure	letter from Fig. 1.1
storage of genes		
aerobic respiration		
amino acids are assembled to make protein		

[3]

- (b) A student made a drawing of one *Escherichia coli* bacterium. Fig. 1.2 shows the student's drawing.

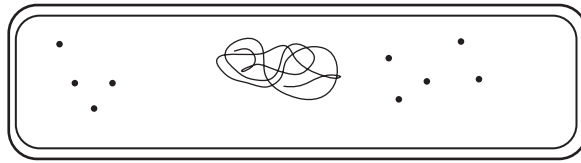


Fig. 1.2

The actual length of the bacterial cell is $2\mu\text{m}$.

- (i) Convert the actual length of the cell to millimetres.

..... mm [1]

- (ii) State the other information that the student needs in order to calculate the magnification of the drawing in Fig. 1.2.

..... [1]

- (c) Describe the similarities **and** differences between the structure of the yeast cell and the structure of the bacterial cell.

Use the information in Fig. 1.1 and Fig. 1.2 in your answer.

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..... [6]

(d) Some bacteria are involved in the nitrogen cycle.

Fig. 1.3 shows part of the nitrogen cycle.

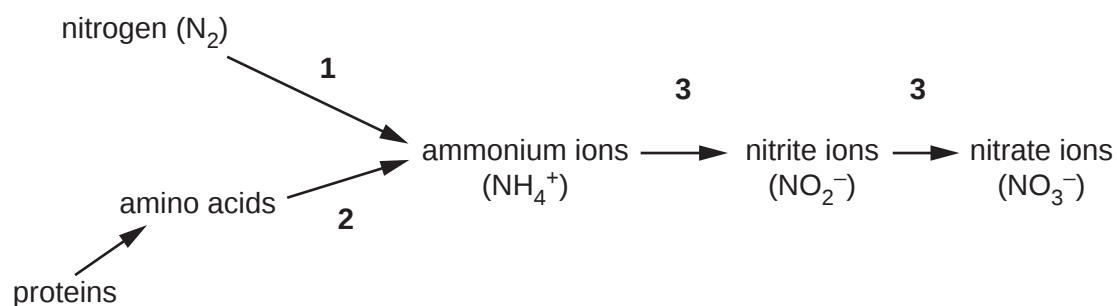


Fig. 1.3

State the processes that are represented by **1**, **2** and **3** on Fig. 1.3.

1

2

3

[3]

[Total: 15]

5 - (0970/41_Summer_2021_Q2)

Large quantities of plastic waste are polluting the oceans.

- (a) A survey published in March 2018 showed the increase in plastic waste in the Pacific Ocean. One area of the Pacific Ocean is known as the Great Pacific Garbage Patch (GPGP).

Data were collected from areas inside and outside the GPGP between 1965 and 2015 to estimate the quantity of plastic waste.

The results are shown in Fig. 2.1.

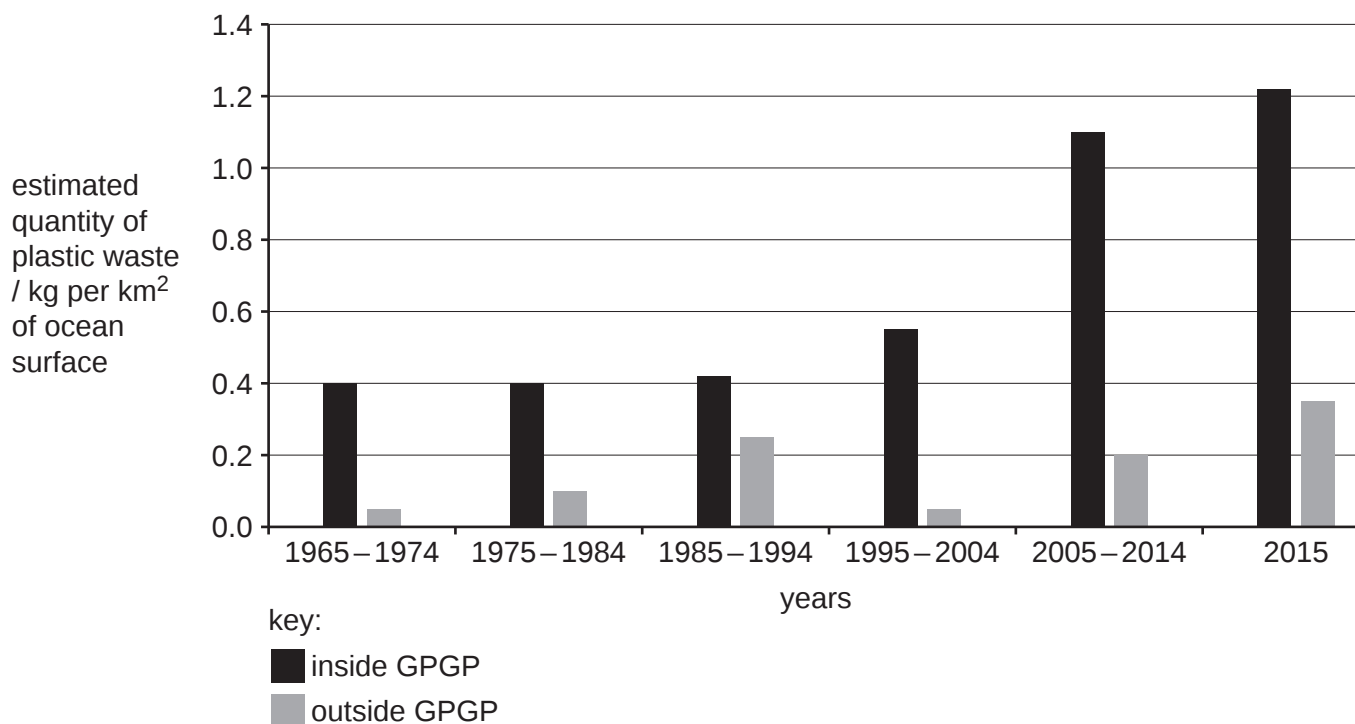


Fig. 2.1

Describe the results of the survey shown in Fig. 2.1.

[4]

- (b) The green turtle, *Chelonia mydas*, is a species of marine animal that is harmed by plastic waste.

Fig. 2.2 shows a green turtle swimming past a plastic bag in the Pacific Ocean.



Fig. 2.2

- (i) Turtles are classified as reptiles.

State **one** feature shown by all reptiles that is **not** found in amphibians.

..... [1]

- (ii) Outline the dangers of non-biodegradable plastic waste to marine animals, such as green turtles.

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

(iii) Suggest ways to reduce the quantity of plastic waste.

.....

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.....

.....

..... [2]

[Total: 11]

6 - (0970/42_Summer_2021_Q2)

The classification of giant pandas, *Ailuropoda melanoleuca*, is debated by many scientists.

Fig. 2.1 shows a giant panda eating bamboo plants.



Fig. 2.1

Fig. 2.2 shows a red panda, *Ailurus fulgens*, and a polar bear, *Ursus maritimus*.



red panda eating bamboo plants



polar bear eating fish

Fig. 2.2

(a) State **one** dietary component that is more likely to be found in bamboo plants than in fish.

..... [1]

(b) (i) State **two** features, visible in Fig. 2.1 and Fig. 2.2, that identify the three animals as all belonging to the same vertebrate group.

1

2

[2]

(ii) DNA can also be used to classify species.

Molecular biologists compared the DNA base sequences of eight species from the same vertebrate group. They used the differences to draw a classification diagram.

Fig. 2.3 shows the classification diagram for these eight species. The shorter the horizontal distance from two species to the branching point that they share, the more similar their DNA sequences are and the more closely the two species are related.

The scale on Fig. 2.3 shows the time at which the molecular biologists estimate that each branching point occurred.

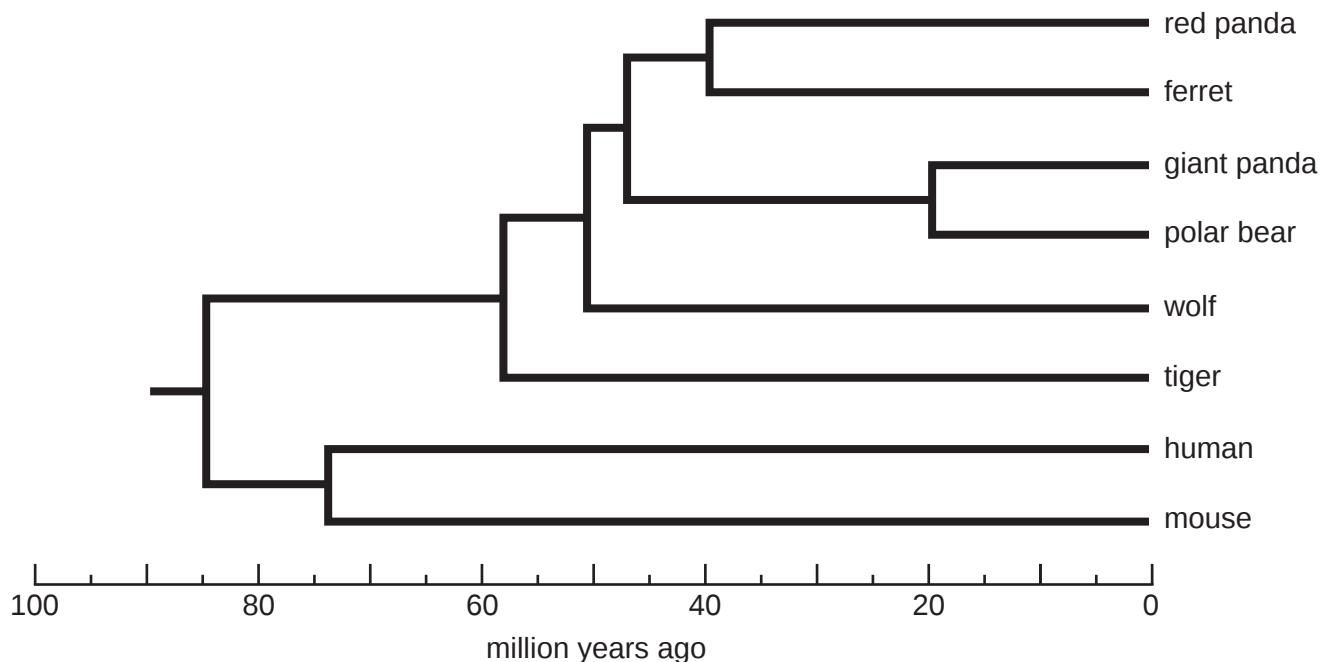


Fig. 2.3

Morphology can also be used to classify species. Some scientists think that morphology suggests that the giant panda is more closely related to the red panda than it is to the polar bear.

Discuss the evidence for **and** against the giant panda being more closely related to the red panda than it is to the polar bear. Use the information in Fig. 2.1, Fig. 2.2 and Fig. 2.3 in your answer.

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..... [5]

(iii) State one **other** type of evidence that is used to classify species.

..... [1]

[Total: 9]

7 - (0970/41_Summer_2022_Q1)

(a) Some students were studying the activity of yeast. They made a fact file, as shown in Fig. 1.1.

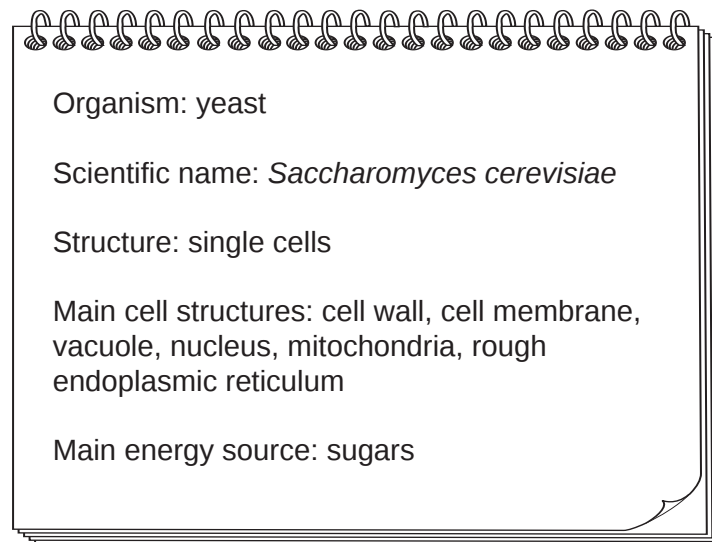


Fig. 1.1

(i) State the kingdom in which yeast is classified.

..... [1]

(ii) State the process that occurs in mitochondria to provide energy for yeast cells.

..... [1]

(b) Yeast cells make the enzyme sucrase. Sucrase catalyses the breakdown of sucrose to glucose and fructose.

Enzymes are made of protein.

Explain how the shape of a sucrase molecule is related to its function.

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

(c) The students made an extract of sucrase from yeast cells.

They investigated the activity of the sucrase extract at different pH values. They determined the rate of reaction at each pH.

They then calculated the rate of each reaction as a percentage of the fastest reaction, to give the percentage activity of sucrase.

The results of this investigation are shown in Fig. 1.2.

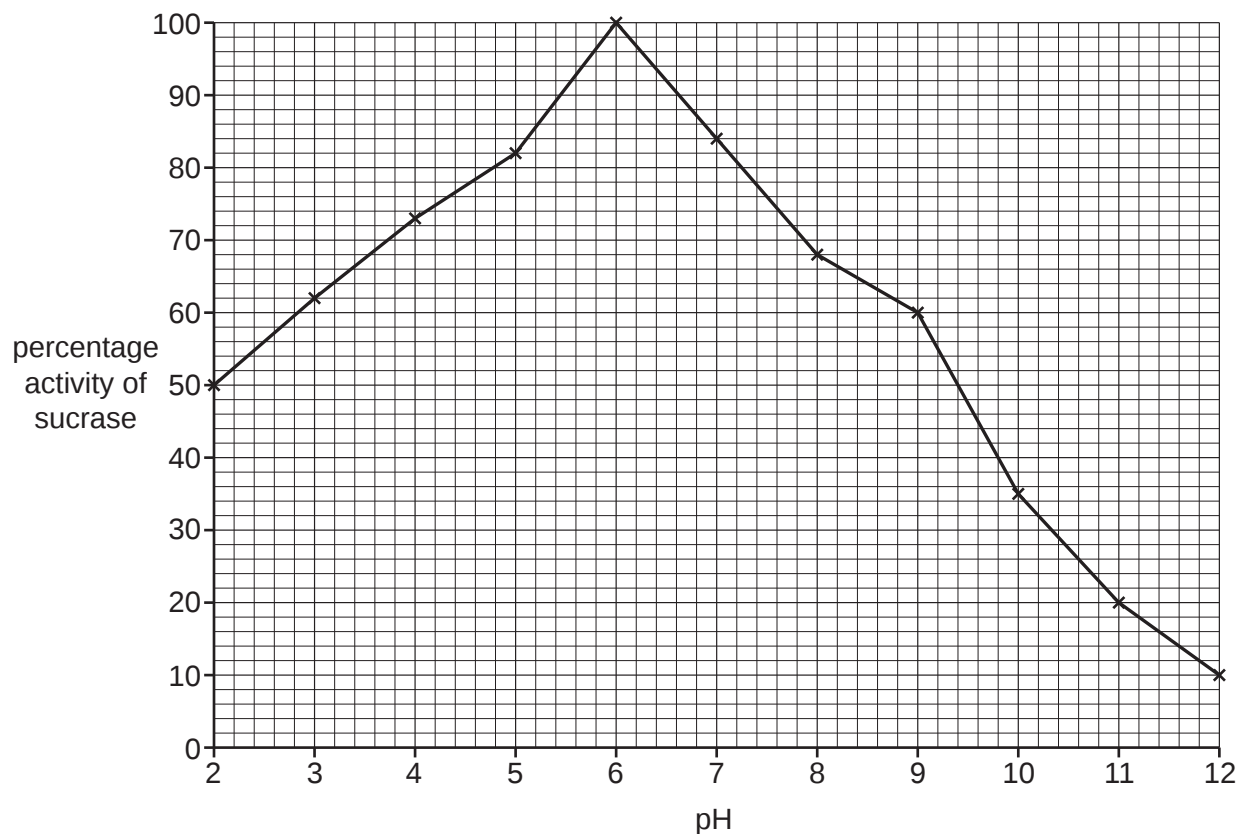


Fig. 1.2

Describe **and** explain the effect of pH on the activity of sucrase shown in Fig. 1.2.

.....

.....

.....

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.....

.....

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..... [6]

8 - (0970/41_Summer_2022_Q5)

The Mulanje cedar, *Widdringtonia whytei*, is the national tree of Malawi. This species of tree grows naturally only on Mount Mulanje in Malawi. Many of the trees have been overharvested or destroyed by wildfires, resulting in deforestation, as shown in Fig. 5.1.



Fig. 5.1

(a) State the genus name of the Mulanje cedar tree.

..... [1]

(b) Explain the undesirable effects of deforestation on habitats that are on mountains, such as Mount Mulanje.

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

- (c) Scientists in Malawi are working to prevent the extinction of the Mulanje cedar tree in its natural habitat.

Explain the benefits to other organisms on Mount Mulanje of conserving the Mulanje cedar tree in its natural habitat.

.....

.....

.....

.....

..... [2]

- (d) The seeds of many endangered tree species are kept in seed banks.

Suggest why it is important to collect seeds from many individual trees of each species rather than just one tree.

.....

.....

.....

.....

..... [2]

[Total: 8]

1 - (0970/42_Summer_2020_Q3)

(a)	<i>fur colouring</i> camouflaged so that not seen by prey (when stalking) / reflecting heat / AW ; <i>streamlined body shape</i> improved ability to run fast / reduced air resistance / AW / AVP ;	2
(b)(i)	transmission of genetic information from generation to generation ;	1
(b)(ii)	two of the same letter both lower case ;	1
(b)(iii)	0.25 / 25% / $\frac{1}{4}$;	1
(b)(iv)	<i>any two from:</i> perform a test cross ; by breeding with, homozygous recessive / king cheetah ; if any of the offspring of the test cross are king cheetahs it confirms 17 is heterozygous ; DNA testing ;	2
(b)(v)	<i>any one from:</i> compare, morphology / anatomy ; compare, DNA / amino acid, sequences ;	1
(c)(i)	<i>any three from:</i> hunting / poaching ; disease ; lack of, food / prey ; loss of (natural) habitat / urbanization ; pollution / poisoned carcasses ; inbreeding / AW ; climate change ; AVP ;	3

(c)(ii)	<i>any three from:</i> captive breeding programmes ; local cooperation / education (of farmer / land users) ; national parks / conservation areas / protect habitats ; legislation / public pressure, against hunting ; monitor numbers ; AVP ;	3
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2 - (0970/42_Summer_2020_Q5)

(a)(i)	<i>Geospiza</i> ;	1
(a)(ii)	<i>any five from:</i> natural selection ; variation (in beak shapes) ; mutation / description ; those birds with, selective advantage / unique beak shape, more likely to find food and survive ; the birds that survive reproduce ; pass on their alleles ; continues over many generations ; AVP ;	5

3 - (0970/42_Winter_2020_Q1)

(a)(i)	(the ability to) detect <u>stimuli</u> (in the internal / external environment) ; to make (appropriate) responses ;	2	
(a)(ii)	groups of receptor cells ; responding to specific stimuli ;	2	
(b)(i)	fovea ;	1	
(b)(ii)	lens drawn with correct shape and position ; light rays are shown refracted in, cornea / lens ; light rays focused on fovea ;	3	
(b)(iii)	(ciliary) muscles relax ; suspensory ligaments are, taut / tight / tense / are pulled / AW ; so ligaments pull <u>on lens</u> ; lens is, thin(ner) / flatter / less convex / elliptical shape / stretched ; light is <u>refracted</u> less ;	3	
(c)	<i>idea that</i> size of pupil, decreases / constricts / gets smaller ; <u>iris</u> in the correct context ; <u>circular muscles</u> (of iris) contract ; <u>radial muscles</u> (of iris) relax ; ref to antagonistic muscles ;	3	
(d)	reflex / involuntary ;	1	

4 - (0970/41_Summer_2021_Q1)

(a)(i)	prokaryote / plant ;			1	
(a)(ii)				3	one mark per row
	cell function	cell structure	letter from Fig. 1.1		
	storage of genes	nucleus	G ;		
	aerobic respiration	mitochondria	E ;		
	amino acids are assembled to make protein	ribosome(s) OR (rough) endoplasmic reticulum / (R)ER	H / F ; F		
(b)(i)	0.002 (mm) ;			1	
(b)(ii)	length of, drawing / image / Fig. 1.2 (in mm) ;			1	

(c)	<i>total of six from:</i> <i>similarities, max four from:</i> single cell / unicellular / AW ; (cell) wall / A ; cytoplasm / D ; ribosomes / H ; cell membrane / B ; DNA / genetic material ; <i>differences, max four from: ;;;</i> <table><tr><th>(bacteria have)</th><th>(yeast have)</th></tr><tr><td>no nucleus / no G / has nucleoid</td><td>nucleus / G</td></tr><tr><td>loop / coil / AW, of DNA</td><td>linear DNA / chromosome</td></tr><tr><td>no, (rough) endoplasmic reticulum / ER</td><td>(rough) endoplasmic reticulum</td></tr><tr><td>no mitochondria / no E</td><td>mitochondria / E</td></tr><tr><td>no (large / permanent) vacuole / no C</td><td>(large / permanent) vacuole / C</td></tr><tr><td>plasmid(s)</td><td>no plasmids</td></tr><tr><td>no membrane-bound, cell structures / organelles</td><td>membrane-bound, cell structures / organelles</td></tr></table>	(bacteria have)	(yeast have)	no nucleus / no G / has nucleoid	nucleus / G	loop / coil / AW, of DNA	linear DNA / chromosome	no, (rough) endoplasmic reticulum / ER	(rough) endoplasmic reticulum	no mitochondria / no E	mitochondria / E	no (large / permanent) vacuole / no C	(large / permanent) vacuole / C	plasmid(s)	no plasmids	no membrane-bound, cell structures / organelles	membrane-bound, cell structures / organelles	6
(bacteria have)	(yeast have)																	
no nucleus / no G / has nucleoid	nucleus / G																	
loop / coil / AW, of DNA	linear DNA / chromosome																	
no, (rough) endoplasmic reticulum / ER	(rough) endoplasmic reticulum																	
no mitochondria / no E	mitochondria / E																	
no (large / permanent) vacuole / no C	(large / permanent) vacuole / C																	
plasmid(s)	no plasmids																	
no membrane-bound, cell structures / organelles	membrane-bound, cell structures / organelles																	

(d)	1 = nitrogen fixation ; 2 = deamination ; 3 = nitrification ;	3	
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5 - (0970/41_Summer_2021_Q2)

(a)	<i>any four from:</i> quantity of plastic waste always higher inside GPGP than outside it ; ora quantity inside GPGP constant (from 1965) to, any year 1975 to 1994 ; quantity increases in GPGP, steeply ; smaller (overall) increase outside the GPGP ; ora quantity of plastic waste outside the GPGP, fluctuates / AW ; comparative data quote with years and unit ;	4	
(b)(i)	<i>any one from:</i> leathery / hard / scaly, skin ; hard(er) / rubbery / leathery / AW, eggs ; lay eggs on land (not in water) ; internal fertilisation ;	1	

(b)(ii)	<i>any four from:</i> <i>direct effects</i> (non-biodegradable plastic) does not break down ; <i>idea that</i> ability to breathe affected ; <i>idea that</i> ability to move affected ; <i>idea that</i> ability to gain nutrition affected ; damage / injury / infection / death ; toxic / poisonous ; <i>indirect effects</i> blocks (sun)light, so algae / plants / producers, cannot photosynthesise ; (so) less, food / energy, enters, food chains / food webs ; loss of (named), habitat / feeding / breeding area ; more likely to be predated ; <i>idea that</i> (plastic) accumulates up the food chain / bioaccumulation ; AVP ;	4	
(b)(iii)	<i>any two from:</i> use (named) alternatives for plastic ; reduce, use of / manufacture, single-use plastic ; use biodegradable plastics instead of non-biodegradable plastics ; reduce unnecessary packaging ; reuse plastic product(s) ; recycle / described ; education / awareness campaigns ; AVP ; e.g. idea of fines / punishment, for unregulated disposal of plastic waste / legislation / taxation / charging for using plastic / money-back schemes / quotas or limits for production / international treaties	2	

6 - (0970/42_Summer_2021_Q2)

(a)	(dietary) fibre / carbohydrate / starch / (named) sugar / vitamin C ;	1	
(b)(i)	external ears / pinnae ; fur ;	2	
(b)(ii)	<i>any five from:</i> <i>for (giant panda closer to red panda):</i> same diet / herbivores / AW ; terrestrial / similar, ecosystems / habitats ; fur markings described ; ear position ; <i>against:</i> shorter (branch) distance between giant panda and polar bear (than to red panda) ; fewer, DNA (base sequence) / gene, differences between giant panda and polar bear (than to red panda) ; (red panda) first appeared, 40±3 <u>million</u> rather than 20±3 <u>million, years</u> ago (giant and polar) ; more time for, mutations / evolution (for red panda) ; common, ancestor / branch / relationship, 20±3 <u>million</u>, (giant and polar), than 47±3 <u>million years</u> ago (red) ; DNA data is likely to be more, accurate / quantitative / not subjective ;	5	
(b)(iii)	anatomy / ability to produce fertile offspring / AVP ;	1	

7 - (0970/41_Summer_2022_Q1)

(a)(i)	Fungus / Fungi	1	
(a)(ii)	<u>aerobic respiration</u> ;	1	
(b)	<i>any two from:</i> ref. to specificity (of enzyme) ; shape of <u>active site</u> is <u>complementary</u> to, substrate / sucrose ; for, substrate / sucrose, to bind / fit, enzyme / sucrase / active site ;	2	
(c)	<i>total of six from:</i> <i>max. four for description:</i> 1 sucrase / enzyme, is active between pH2 and pH12 ; 2 activity, increases and decreases / reaches a peak ; 3 peak / maximum or 100% activity, at pH 6 ; 4 steeper increase between pH 5–6 / steeper decrease in activity between pH 9–10 ; 5 minimum / 10%, activity at pH 12 ; 6 more activity in, acidic conditions / low pH, than, alkaline conditions / high pH ; <i>explanation:</i> 7 (change in) pH affects the shape of, sucrase / active site / enzyme ; 8 at pH 6, most enzyme-substrate complexes form / AW ; 9 at, low / high / extremes of, pH, enzyme is (partially) <u>denatured</u> ; 10 ref to substrate molecules can no longer bind with enzyme (at low / high / extreme pH, so activity decreases) ; 11 AVP ;	6	

8 - (0970/41_Summer_2022_Q5)

(a)	<i>Widdringtonia</i>	1	
(b)	<i>any three from:</i> 1 no roots, to absorb water / bind soil / hold soil together ; 2 <i>idea of:</i> no canopy / AW, to protect (soil) from rainfall ; 3 increase in run off / AW ; 4 ref. to soil erosion ; 5 loss of, mineral content / ions / nutrients / AW, in the soil ; 6 flooding (in the valleys) ; 7 landslides / mudslides ; 8 ref. to visual pollution / dead tree stumps / bare ground / AW ; 9 loss of biodiversity / disruption of food chains / disruption of food webs / (species) extinction ; 10 AVP ;	3	
(c)	food source(s) ; nesting / breeding, sites ; shelter / shade / protection from predators ; leaf litter for decomposers ; ref. to nutrient cycling ; (named) resources for humans ; AVP ;	2	
(d)	<i>any two from:</i> ref. to genetic, diversity / variation ; <i>importance of genetic diversity:</i> plants (grown from seeds) may be adapted to changes in the environment ; plants (grown from seeds) may be resistant to, diseases / pests ; (seeds collected) may not, be viable / germinate ; (seeds collected) may, be diseased / have parasites / AW ; (seeds collected) may have harmful, alleles / mutations ; AVP ; e.g., increase in fitness	2	

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