

Q1. (a) Use words from the list to complete the sentences.

**alleles chromosomes gametes genes mutations**

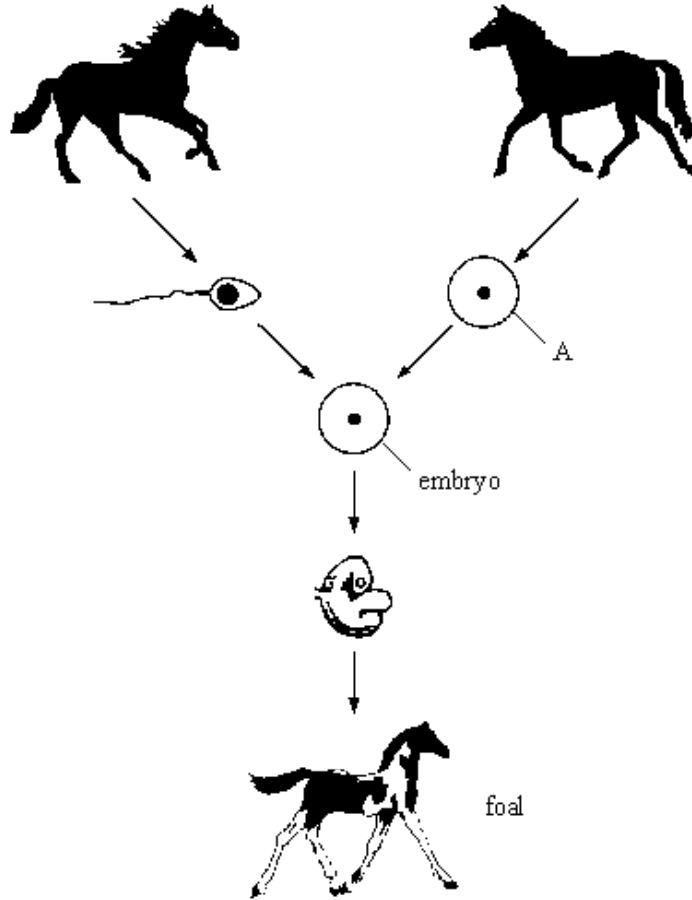
The nucleus of a cell contains thread-like structures called .....

The characteristics of a person are controlled by .....

which may exist in different forms called .....

(3)

(b) The drawing shows some of the stages of reproduction in horses.



(i) Name this type of reproduction .....

(1)

(ii) Name the type of cell labelled A .....

(1)

(c) When the foal grows up it will look similar to its parents but it will **not** be identical to either parent.

(i) Explain why it will look similar to its parents.

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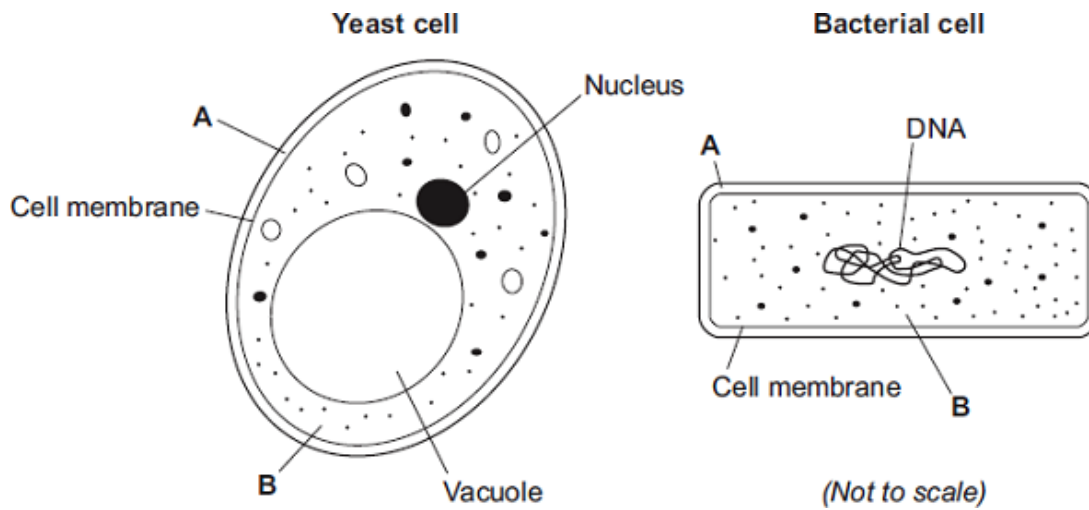
(1)

(ii) Explain why it will **not** be identical to either of its parents.

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(2)  
(Total 8 marks)

Q2. (a) The diagrams show the structures of a yeast cell and a bacterial cell.



(i) Both the yeast cell and the bacterial cell have structures **A** and **B**.

Name structures **A** and **B**.

**A** .....

**B** .....

(2)

(ii) The yeast cell and the bacterial cell have different shapes and sizes.

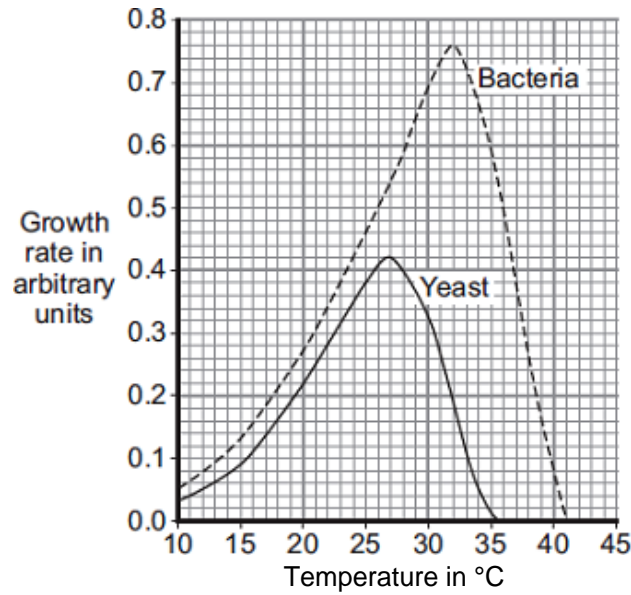
Give **one** other way in which the structure of the bacterial cell is different from the structure of the yeast cell.

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(1)

- (b) Sourdough bread is light in texture and tastes slightly sour. The bread is made using two types of microorganism, a yeast and a bacterium. The bacterium can make acids such as lactic acid. The acid makes the bread taste sour.

The graph shows how the growth rates of the yeast and the bacteria change with temperature.



- (i) Sourdough bread rises fastest at 27°C.  
Use information from the graph to explain why.

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(2)

- (ii) The bread tastes most sour if it rises at 32°C.  
Use information from the graph to explain why.

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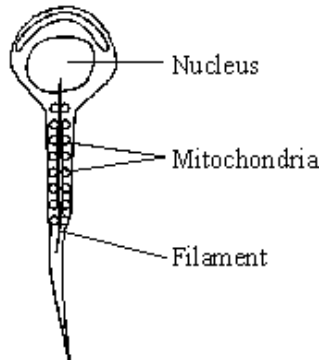
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(2)

(Total 7 marks)

**Q3.** The diagram shows a human sperm. Inside the tail of the sperm is a filament mechanism that causes the side to side movement of the tail, which moves the sperm.



(a) Describe the function of the mitochondria and suggest a reason why they are arranged around the filament near the tail of the sperm.

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(3)

(b) Explain the significance of the nucleus in determining the characteristics of the offspring.

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(2)

(Total 5 marks)

**Q4.** (a) How do fossils provide evidence that species alive today have evolved from simpler organisms?

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(3)

(b) The photographs show two species of gull.

**Herring gull (*Larus argentatus*)**



By Ken Billington (Own work) [CC-BY-SA-3.0],  
via Wikimedia Commons

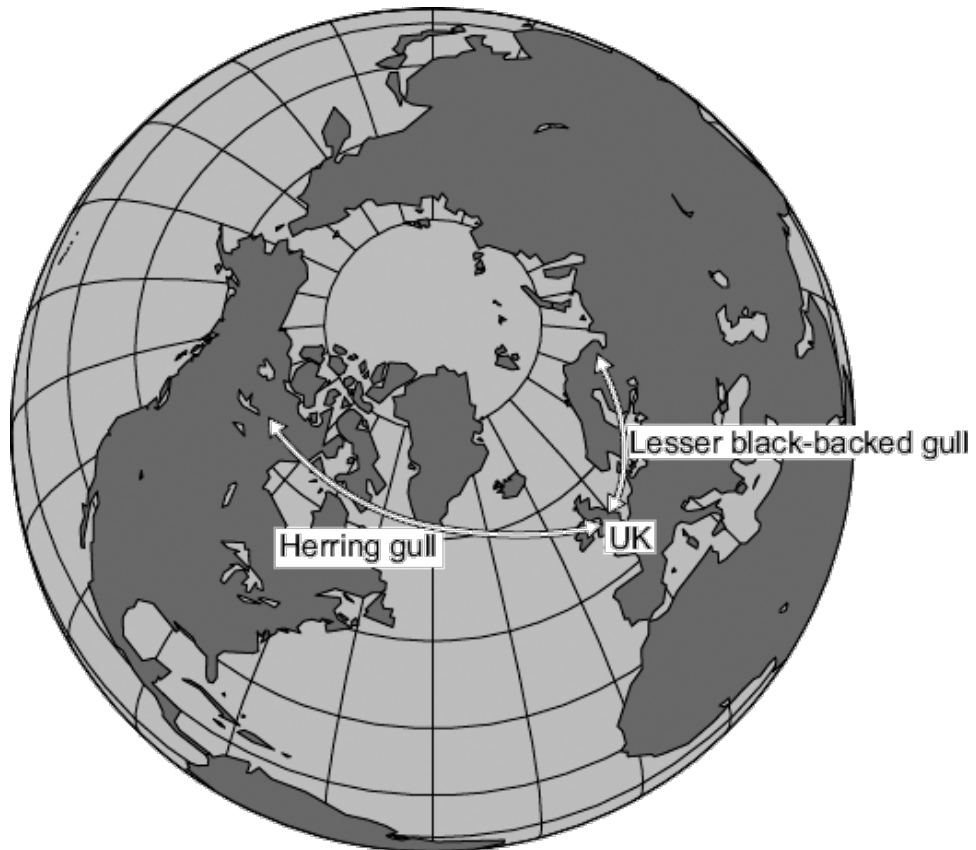
**Lesser black-backed gull (*Larus fuscus*)**



By Andreas Trepte (Own work) [CC-BY-SA-2.5],  
via Wikimedia Commons

Both species are now found in the UK but the two species cannot interbreed with each other. Scientists believe that these two species have evolved from a common ancestor.

The map on the next page shows a view of the Earth from above the North Pole. The map also shows where these two species are found.



Suggest an explanation for the development of these different species.

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(6)  
(Total 9 marks)

**Q5.** The photographs show the flowers of two closely-related species of plant.

**Species A**



**Species B**



Images: © iStock/Thinkstock

The drawings show chromosomes from one cell in the root of each plant during cell division.

**Species A**



**One  
chromosome**

**Species B**



**One  
chromosome**

(a) The drawings show that each chromosome has two strands of genetic material.

(i) How does a chromosome become two strands?

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.....

(1)

(ii) Explain why each chromosome must become two strands before the cell divides.

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(2)

(b) For sexual reproduction, the plants produce gametes.

(i) Name the type of cell division that produces gametes.

.....

(1)

(ii) How many chromosomes would there be in a gamete from each of these two plant species?

**Species A**

**Species B**

(1)

(iii) It is possible for gametes from **Species A** to combine with gametes from **Species B** to produce healthy offspring plants.

How many chromosomes would there be in each cell of one of the offspring

plants?

(1)

(c) (i) Look back at the information at the start of the question and the information from part (b).

What evidence from these two pieces of information supports the belief that **Species A** and **Species B** evolved from a common ancestor?

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(2)

- (ii) For successful gamete production to take place, chromosomes that contain the same genes must pair up.

The drawings showing the chromosomes of **Species A** and of **Species B** are repeated below.



The offspring plants cannot reproduce sexually.

Suggest an explanation for this.

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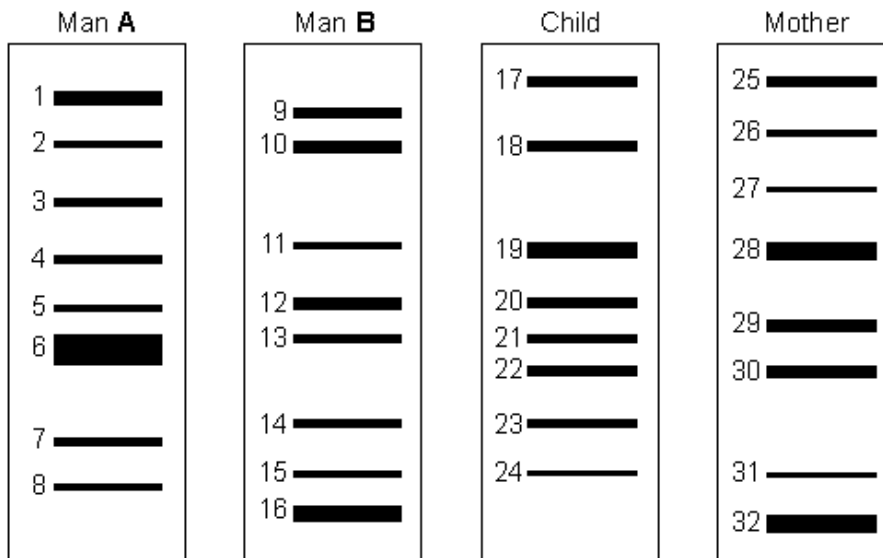
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(2)  
(Total 10 marks)

- Q6.** DNA fingerprinting can be used to identify people. One example of the use of DNA fingerprinting is to find out which man is the father of a child. The diagram shows the DNA fingerprints of a child, the child's mother and two men who claim to be the child's father. The numbers refer to the bars on the DNA fingerprints.



- (a) Only half the bars of the child's DNA fingerprint match the mother's DNA fingerprint. Explain why.

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(2)

- (b) Which man, **A** or **B**, is more likely to be the father of the child?

Use the numbers on the DNA fingerprints to explain your choice.  
In your answer you should refer to all four people.

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(3)

(Total 5 marks)

- Q7.** (a) Mr and Mrs Smith both have a history of cystic fibrosis in their families. Neither of them has cystic fibrosis. Mr and Mrs Smith are concerned that they may have a child with cystic fibrosis. Use a genetic diagram to show how they could have a child with cystic fibrosis. Use the symbol **A** for the dominant allele and the symbol **a** for the recessive allele.

(3)

(b) Mr and Mrs Smith decided to visit a genetic counsellor who discussed embryo screening.

Read the information which they received from the genetic counsellor.

- Five eggs will be removed from Mrs Smith's ovary while she is under an anaesthetic.
- The eggs will be fertilised in a dish using Mr Smith's sperm cells.
- The embryos will be grown in the dish until each embryo has about thirty cells.
- One cell will be removed from each embryo and tested for cystic fibrosis.
- A suitable embryo will be placed into Mrs Smith's uterus and she may become pregnant.
- Any unsuitable embryos will be destroyed.

(i) Suggest why it is helpful to take five eggs from the ovary and not just one egg.

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.....

(1)

(ii) Evaluate the use of embryo screening in this case.

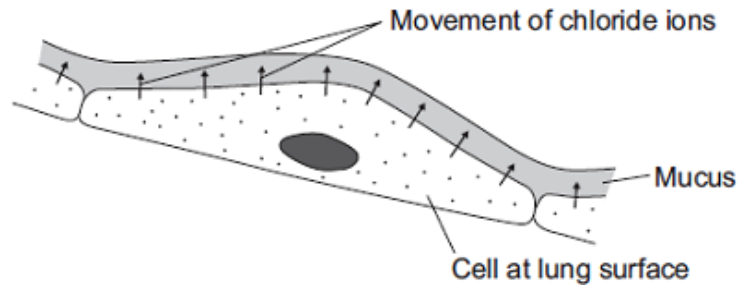
Remember to give a conclusion to your evaluation.

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(4)

(c) In someone who has cystic fibrosis the person's mucus becomes thick.

The diagram shows how, in a healthy person, cells at the lung surface move chloride ions into the mucus surrounding the air passages.



The movement of chloride ions causes water to pass out of the cells into the mucus.

Explain why.

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(3)  
(Total 11 marks)

**Q8.** The dodo is an extinct bird. The drawing shows an artist's impression of the bird.



The dodo lived on a small island in the middle of the Indian Ocean. Its ancestors were pigeon-like birds which flew to the island millions of years ago. There were no predators on the island. There was a lot of fruit on the ground. This fruit became the main diet of the birds. Gradually, the birds became much heavier, lost their ability to fly and evolved into the dodo.

(a) Suggest an explanation for the evolution of the pigeon-like ancestor into the flightless dodo.

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**(4)**

- (b) The dodo became extinct about 80 years after Dutch sailors first discovered the island in the eighteenth century.

Scientists are uncertain about the reasons for the dodo's extinction.

Suggest an explanation for this uncertainty.

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(1)  
(Total 5 marks)

<b>M1.</b>	(a) chromosomes genes (reject alleles) alleles  <i>for 1 mark each</i>	3
	(b) (i) sexual / sex <i>for one mark</i>	1
	(ii) egg / gamete / sex cell / ovum (reject ovule) <i>for one mark</i>	1
	(c) (i) information / genes / DNA passed from parents (reject chromosomes) <i>for one mark</i>	1
	(ii) genes / genetic information / chromosomes from <u>two</u> parents alleles may be different environmental effect / named may have been mutation <i>any two for 1 mark each</i>	2
		<b>[8]</b>

<b>M2.</b>	(a) (i) A = (cell) wall <i>ignore cellulose</i>	1
	B = cytoplasm	1
	(ii) any <b>one</b> from: <i>accept has DNA instead of a nucleus, but not just has DNA</i>	
	• bacterial cell / it has no nucleus <i>allow no mitochondria</i>	
	• DNA free in cytoplasm <i>ignore size</i>	
	• has no vacuole / no vesicles <i>ignore strands of DNA</i>	1
	(b) (i) <u>yeast</u> grows best / better / well <b>or</b> optimum temperature for <u>yeast</u> / more <u>yeast</u> present <i>allow <u>yeast</u> works best / better / well</i>	1

(yeast) makes CO<sub>2</sub> **or** respire / respiration

*allow fermentation*

1

(ii) bacterium grows best / better / well / more bacteria present **or** optimum temperature for bacterium

*ignore microorganisms / microbes*

*allow works / respire best / better / well*

1

(bacterium) makes (lactic) acid

*do **not** allow wrong acid*

1

[7]

**M3.** (a) **award one mark for each key idea**

energy released **or** energy transferred **or** respiration

*allow provides **or** gives*

*do **not** allow produces **or** makes*

3

near to the site of movement **or**  
energy available quickly **or** more  
energy

*accept allows more mitochondria to fit in*

(mitochondria) packed (around  
filament) **or** efficient arrangement **or**  
spiral arrangement

(b) contains chromosomes **or** genes **or**  
DNA

***not** genetic material*

1

(which) contribute half (the genes) to  
the fetus **or** offspring

*23 chromosomes **or** half the genes*

***or** reference to X,Y chromosome determining sex (if the notion of  
halfness is there)*

*nucleus contains half genes for the offspring = 2 marks*

1

[5]

**M4.** (a) fossil is (remains / impression of) organism that lived a long time ago

*if numbers, ≥ 1000s years*

1

fossils show changes over time **or** older fossils simpler **or** fossils simpler than present-day species

1

fossils have similar features to present-day species

*allow fossils allow us to compare old species with present-day species*

1

(b) isolation / separation / splitting

1

by geographical barrier / sea

*ignore other examples*

1

there was variation (in these isolated populations) / different alleles

*accept mutation*

1

different environmental conditions **or** example eg climate / predators / food

1

natural selection acted on the isolated populations

*accept became adapted in each area*

1

**OR**

only certain allele(s) passed on to offspring / different alleles passed on in different environments

*allow genes*

so differences lead to inability to interbreed

*allow differences described – eg mismatch of genitalia / different courtship displays / different breeding seasons*

1

[9]

**M5.** (a) (i) DNA replication / copies of genetic material were made

*'it' = a chromosome*

*allow chromosomes replicate / duplicate / are copied*

*ignore chromosomes divide / split / double*

1

(ii) one copy of each (chromosome / chromatid / strand) to each offspring cell

*ignore ref. to gametes and fertilisation*

1

each offspring cell receives a complete set of / the same genetic material

*allow 'so offspring (cells) are identical'*

1

- (b) (i) meiosis  
*allow mieosis as the only alternative spelling* 1
- (ii) Species A = 4 **and** Species B = 8 1
- (iii) sum of A + B from (b)(ii) e.g. 12 1
- (c) (i) similarities between chromosomes  
**or**  
similarities between flowers described  
*e.g. shape of petals / pattern on petals / colour / stamens* 1
- can breed / can sexually reproduce  
*allow can reproduce with each other / they can produce offspring* 1
- (ii) any **two** from:
- offspring contain 3 copies of each gene / of each chromosome / odd number of each of the chromosomes
  - some chromosomes unable to pair (in meiosis)
  - (viable) gametes not formed / some gametes with extra / too many genes / chromosomes
- or**  
some gametes with missing genes / chromosomes 2
- [10]**
- M6.** (a) eggs produced by meiosis 1
- therefore contain only half of mother's DNA 1

(b) (man B)

*no marks*

(child has) mother's 25 / 28 / 30 / 31

**or**

child gets 17 / 19 / 22 / 24 from mother

1

(child has) man B's 10 / 12 / 13 / 14

**or**

child gets 18 / 20 / 21 / 23 from **B**

1

no bars / DNA / lines from man **A** correspond to child

1

[5]

**M7.** (a) both parents **Aa**

*accept other upper and lower case letter without key **or** symbols  
with a key*

*allow as gametes shown in Punnett square*

1

**aa** in offspring correctly derived from parents

**or**

**aa** correctly derived from the parents given

*ignore other offspring / gametes*

*for this mark parents do not have to be correct*

1

offspring **aa** identified as having cystic fibrosis

*may be the only offspring shown **or** circled / highlighted / described*

1

(b) (i) any **one** from:

*accept converse if clear, eg if you (only) took one it might have  
cystic fibrosis / might not be fertilised*

- (more) sure / greater chance of healthy / non-cystic fibrosis egg /  
embryo / child

*accept some may have the allele*

*reference to 'suitable / good embryo' is insufficient*

- greater chance of fertilisation

1

(ii) **advantages**

*to gain 3 marks both advantage(s) and disadvantage(s) must  
be given*

max 3

any **two** from:

*ignore references to abortion unless qualified by later screening*

- greater / certain chance of having child / embryo without cystic fibrosis / healthy
- child with cystic fibrosis difficult / expensive to bring up
- cystic fibrosis (gene / allele) not passed on to future generations

### **disadvantages**

any **two** from:

- operation dangers / named eg infection  
*ignore risk unqualified*
- ethical or religious issues linked with killing embryos  
*accept wrong / cruel to embryos accept right to life argument*  
*ignore embryos are destroyed*
- (high) cost of procedure
- possible damage to embryo (during testing for cystic fibrosis / operation)

### **plus**

### **conclusion**

a statement that implies a qualified value judgement

eg it is right because the child will (probably) not have cystic fibrosis even though it is expensive

**or**

eg it is wrong because embryos are killed despite a greater chance of having a healthy baby

**note:** *the conclusion mark cannot be given unless a reasonable attempt to give both an advantage and a disadvantage is made*  
*do **not** award the mark if the conclusion only states that advantages outweigh the disadvantages*

(c) any **three** from:

- osmosis / diffusion  
*do **not** accept movement of ions / solution by osmosis / diffusion*
- more concentrated solution outside cell / in mucus  
*assume concentration is concentration of solute unless answer indicates otherwise or accept correct description of 'water concentration'*
- water moves from dilute to more concentrated solution  
*allow correct references to movement of water in relation to concentration gradient*
- partially permeable membrane (of cell)  
*allow semi / selectively permeable*

3

[11]

**M8.** (a) any **four** from:

- mutation / variation
- produces smaller wings / fatter body  
*must be linked to mutation / variation*
- wings no longer an advantage since no predators  
*allow wings / flight not needed as no predators*
- wings no longer an advantage since food on ground  
*allow wings / flight not needed as food on ground*
- fatter body can store more energy when fruit scarce
- successful birds breed / pass on genes

4

(b) any **one** from:

- evidence has all gone
- no scientists on island at time to record evidence
- no records (from sailors)

1

[5]

