Oxford Cambridge and RSA

Friday 16 October 2020 – Morning

AS Level Biology B (Advancing Biology)

H022/02 Biology in depth

Time allowed: 1 hour 30 minutes

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

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number						Candidate number				

First name(s) ________________________________

Last name ________________________________

INSTRUCTIONS
- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space you should use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for a correct method, even if your answer is wrong.

INFORMATION
- The total mark for this paper is **70**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended response will be assessed in questions marked with an asterisk (*).
- This document has **20** pages.

ADVICE
- Read each question carefully before you start your answer.

Answer **all** the questions.

1 DNA normally contains four different nucleotides. Scientists have managed to create cells with six different nucleotides in their DNA.
The two new nucleotides are known as nucleotides X and Y.

Fig. 1.1 shows a section of a DNA molecule containing all six nucleotides, including X and Y.

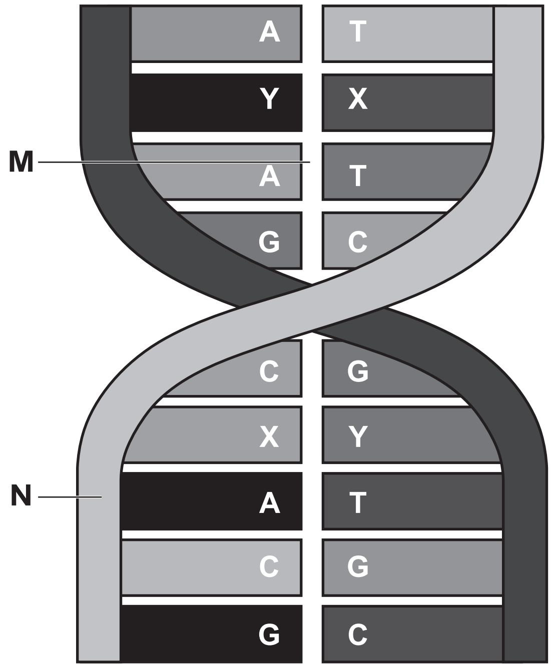

Fig. 1.1

(a) **(i)** Name the bonds found in the region labelled **M** on Fig. 1.1.

.... **[1]**

(ii) Name the **two** components of DNA found in the region labelled **N** on Fig. 1.1.

....

.... **[1]**

(b) Fig. 1.2 shows nucleotide X.

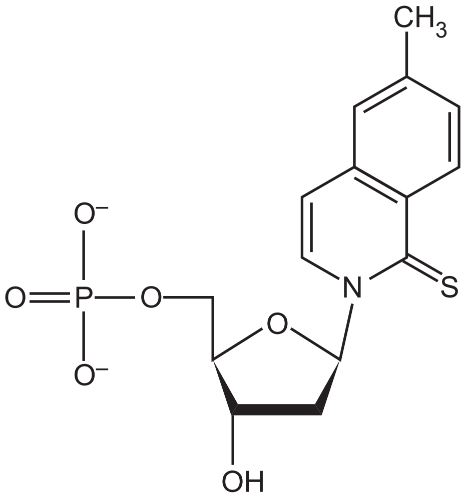

Fig. 1.2

Give **two** differences between the structures of nucleotide X and adenosine triphosphate (ATP).

1 ....

2 ....

[2]

(c) The percentage of each nucleotide base in a DNA sequence can be estimated.

Complete the table using Chargaff's rule of DNA replication.

Nucleotide base	Percentage of each base in DNA strand 1 (%)	Percentage of each base in DNA strand 2 (%)
A	21	26
C		15
G		11
T		
X		
Y	9	

[2]

(d) Scientists have also been trialling cancer treatment drugs that form strong 'crosslinks' between the DNA strands. This is shown in Fig. 1.3.

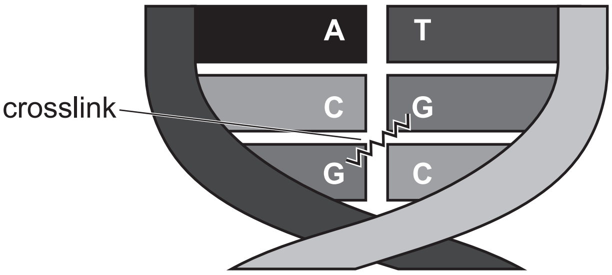

Fig. 1.3

Explain how the crosslinks would prevent DNA replication in the cancerous cell.

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.... **[4]**

(e) A student wanted to investigate the DNA content of two samples of plant tissue using the ethanol precipitation method in a school laboratory.

They used the following method:

1. Use an electric blender to blend 5 g of the plant tissue with table salt and cold water.
2. Filter this mixture and collect the filtrate in a beaker.
3. Add 30 cm^3 of washing-up liquid and swirl to mix.
4. Let the resulting mixture settle for 5–10 minutes and then pour into a test tube.
5. Add protease enzyme to the test tube.
6. Pour cold ethanol into the test tube.
7. Use a glass rod to collect the precipitated DNA.
8. Dry the precipitated DNA on a paper towel and measure the mass.
9. Repeat for the second plant tissue sample.

State **two** precautions that should be taken to produce valid results **and** explain why these two precautions are taken.

precaution 1 ....

explanation ....

....

precaution 2 ....

explanation ....

....

[4]

2 Human Papilloma Virus (HPV) has been linked to the development of cervical cancer.

A study was carried out involving 1000 women from five hospital trusts.

The table shows the number of cases of each strain of HPV found in women diagnosed with cervical cancer from the five hospital trusts between 2014 and 2015.

Hospital trust	**Number of cases of cervical cancer for HPV strain**					
	HPV 16	**HPV 18**	**HPV 31**	**HPV 33**	**HPV 45**	**HPV 52**
1	112	28	3	7	11	14
2	136	32	4	9	14	17
3	121	45	7	5	13	19
4	101	43	5	11	14	10
5	142	34	5	14	12	12
Total	612	182	24	46	64	72
Mean number of cases	122.4	36.4	4.8	9.2	12.8	14.4

(a) **(i)** Using only the data in the table, what conclusions can be made about the link between HPV and the development of cervical cancer?

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.... **[2]**

(ii) During the study the researchers wanted to use a statistical test to compare two of the strains of HPV and the associated risk of developing cervical cancer.

Name an appropriate statistical test that could be used **and** justify your choice.

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.... **[2]**

(b)* In 2008, the UK introduced the HPV vaccination into the national vaccination programme.

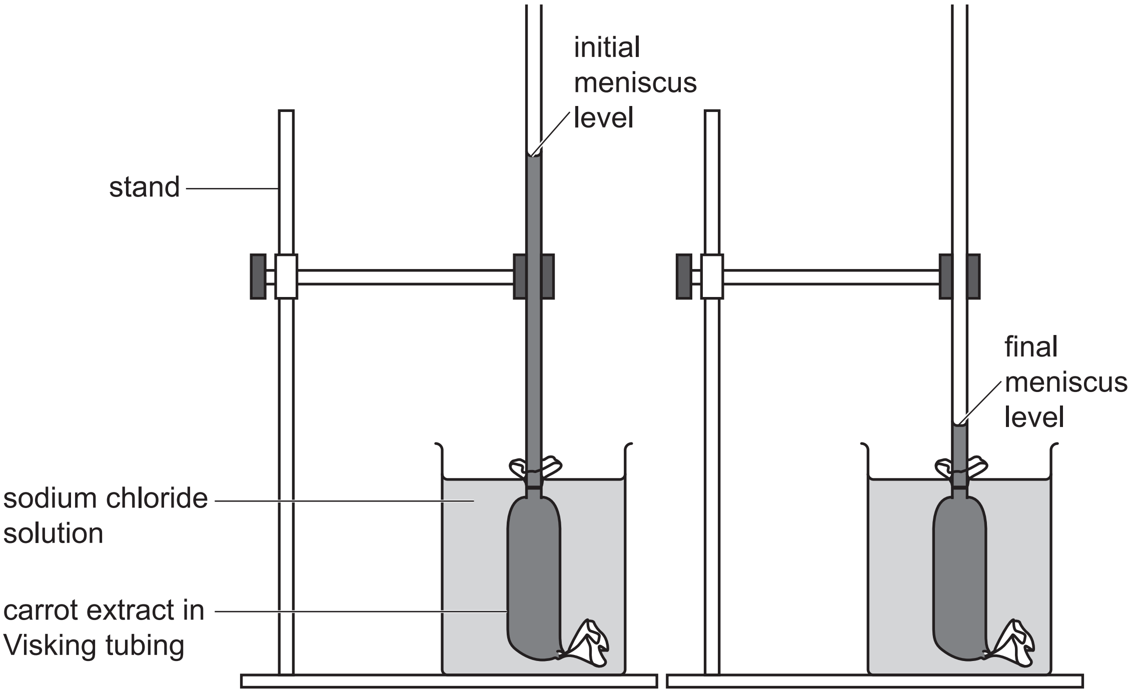
Outline the different types of vaccine available **and** the biological problems in developing these vaccines.

.... **[6]**

Additional answer space if required.

3 A student carried out an investigation into osmosis using the equipment shown. Carrot extract was placed into Visking tubing and the Visking tubing was then placed into a beaker filled with sodium chloride solution.

The initial level of the meniscus was recorded at the start and the final level of the meniscus was recorded after 24 hours.



The student repeated the investigation at a range of sodium chloride concentrations measuring the distance moved by the meniscus after 24 hours. The results are shown in the table.

Concentration of sodium chloride solution (mol dm^{-3})	**Distance moved by meniscus (mm)**
0.4	–17
0.6	–23
0.8	–29
1.0	–29

(a) **(i)** Calculate the percentage increase in the distance moved by the meniscus between 0.4 mol dm^{-3} and 0.6 mol dm^{-3} sodium chloride.

percentage increase = ... % **[2]**

(ii) Explain why the Visking tubing containing carrot extract was left for 24 hours in the sodium chloride solution.

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.... **[1]**

(iii) What conclusions can be made about the movement of water from the results given in the table?

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.... **[2]**

(iv) Explain how the investigation could be modified to find the concentration of sodium chloride solution that has the same water potential as the carrot extract.

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.... **[3]**

(v) Explain how the student could have calculated the initial rate of osmosis in the different concentrations of sodium chloride.

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.... **[2]**

(b) (i) It is important to use carrots of a similar age when preparing extracts for this investigation.

Explain how using carrots of different ages could affect the results shown in the table.

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.... **[2]**

(ii) Give **one** reason why using a Benedict's test to compare the sugar content of carrot extracts may **not** give valid results.

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.... **[1]**

4 Pneumoconiosis is a respiratory disease often found in coal miners and is caused by the inhalation of coal dust.

Lung function tests can be used to help diagnose a patient with pneumoconiosis. The results from the tests can be used to show the volume of air remaining inside the patient's lungs as the patient forcefully exhales.

The table shows the results for a patient with pneumoconiosis.

Time (s)	**Volume of air inside the lungs (dm^3)**	
	Pneumoconiosis patient	**Mean for healthy individuals**
0	4.8	5.7
1	3.4	4.1
2	2.6	3.0
3	2.0	2.0
4	1.7	1.3
5	1.5	1.2
6	1.4	1.2
7	1.3	1.2
8	1.2	1.2
9	1.1	1.2
10	1.1	1.2

(a) (i) Calculate the rate at which air can be exhaled by the patient suffering from pneumoconiosis between 0 and 5 seconds.

rate = ... unit = ... **[2]**

(ii) Suggest why the mean lung volume for healthy individuals was included in the table.

....

.... **[1]**

(b) What conclusions about the effect of pneumoconiosis can be made from the results in the table?

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.... **[2]**

(c) State **two** pieces of additional information that the doctor would need to consider when comparing the pneumoconiosis patient to a healthy person.

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2...

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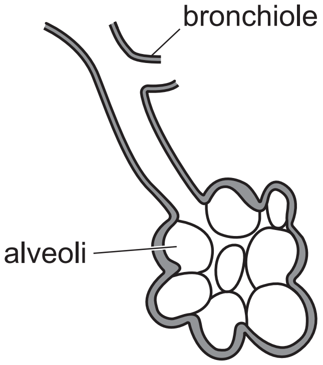
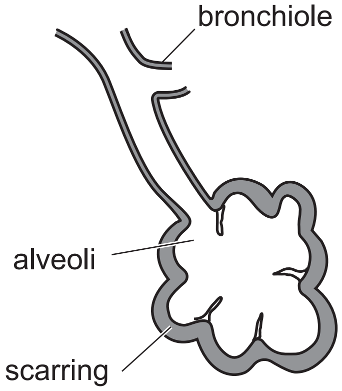
[2]

(d) The diagrams show the alveoli of a healthy person and a patient suffering from pneumoconiosis.

healthy person



pneumoconiosis patient



(i) Using the diagrams, explain why there would be a decrease in the oxygen concentration of the pneumoconiosis patient's blood.

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.... **[2]**

(ii) Explain how the damage shown in the diagram could affect the physical activity of the patient.

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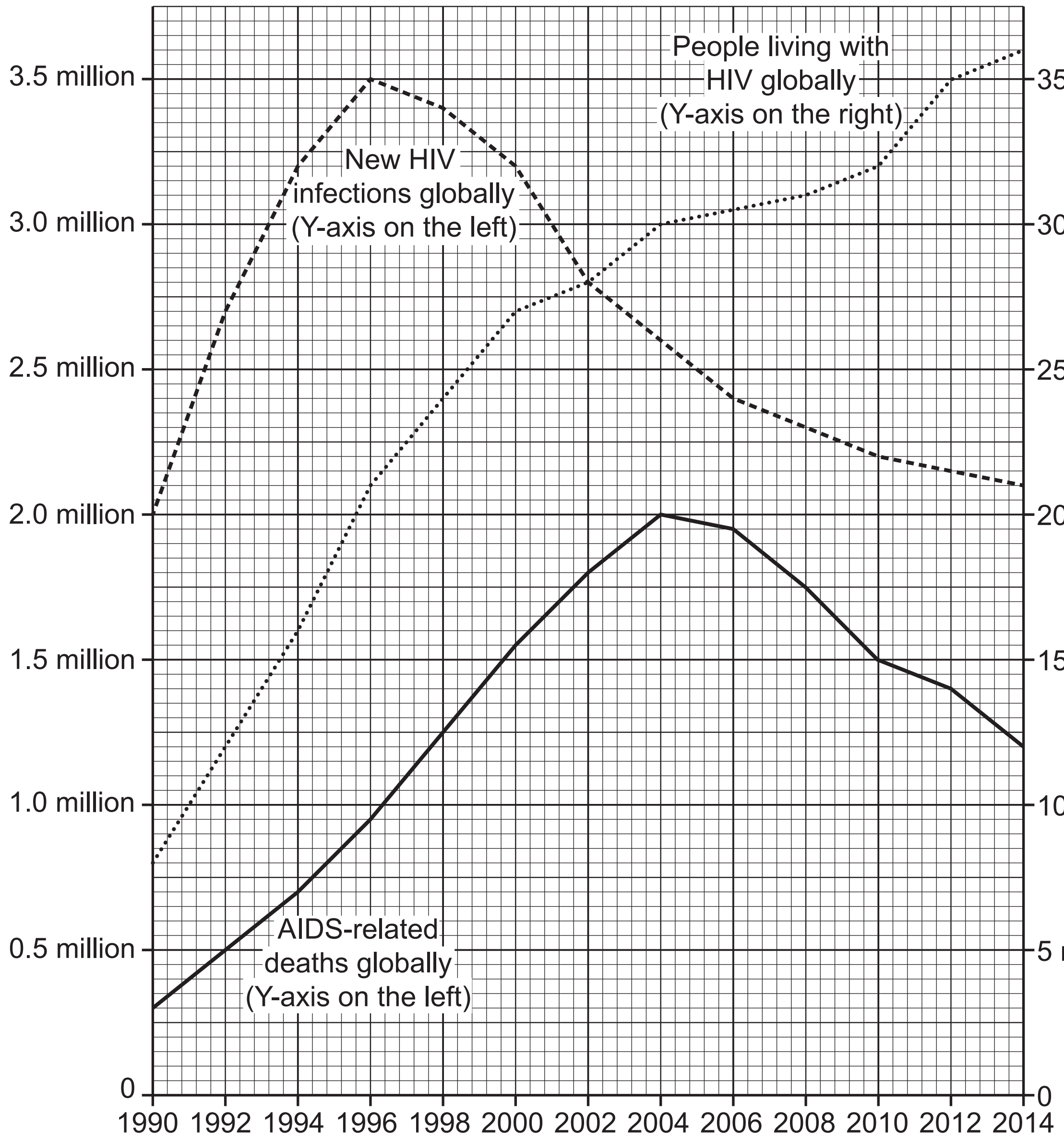
.... **[2]**

Turn over for the next question

5 Acquired immune deficiency syndrome (AIDS) is caused by the Human Immunodeficiency Virus (HIV).

The graph shows the estimated global number of AIDS-related deaths, new HIV infections and the number of people living with HIV between 1990 and 2014.



(a) **(i)** Calculate the rate of increase in people living with HIV globally between 1990 and 1998.

rate of increase = ...yr^{-1} **[2]**

(ii) Some scientists believe the rise in people living with HIV globally is proof that HIV has become a bigger problem since 1990.

Using only the information in the graph, explain why this may **not** be the case.

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.... **[2]**

(iii) Suggest why the data given in the graph is an estimate of the number of deaths and not the actual value.

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.... **[1]**

(b) Discuss the effectiveness of antibiotics in the treatment of AIDS.

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.... **[2]**

(c)* Methods to control the spread of HIV in developing parts of the world have proved less successful than in developed countries.

Outline the biological, ethical and economic factors involved in the attempt to control the spread of HIV **and** how these factors may differ between developed and developing countries.

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.... **[6]**

Additional answer space if required.

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6 It is believed that the common ancestor of chimpanzees, gorillas and humans dates back around seven million years ago to a forest-dwelling ape.

Fig. 6.1 shows part of the phylogenetic tree for classifying these primates.

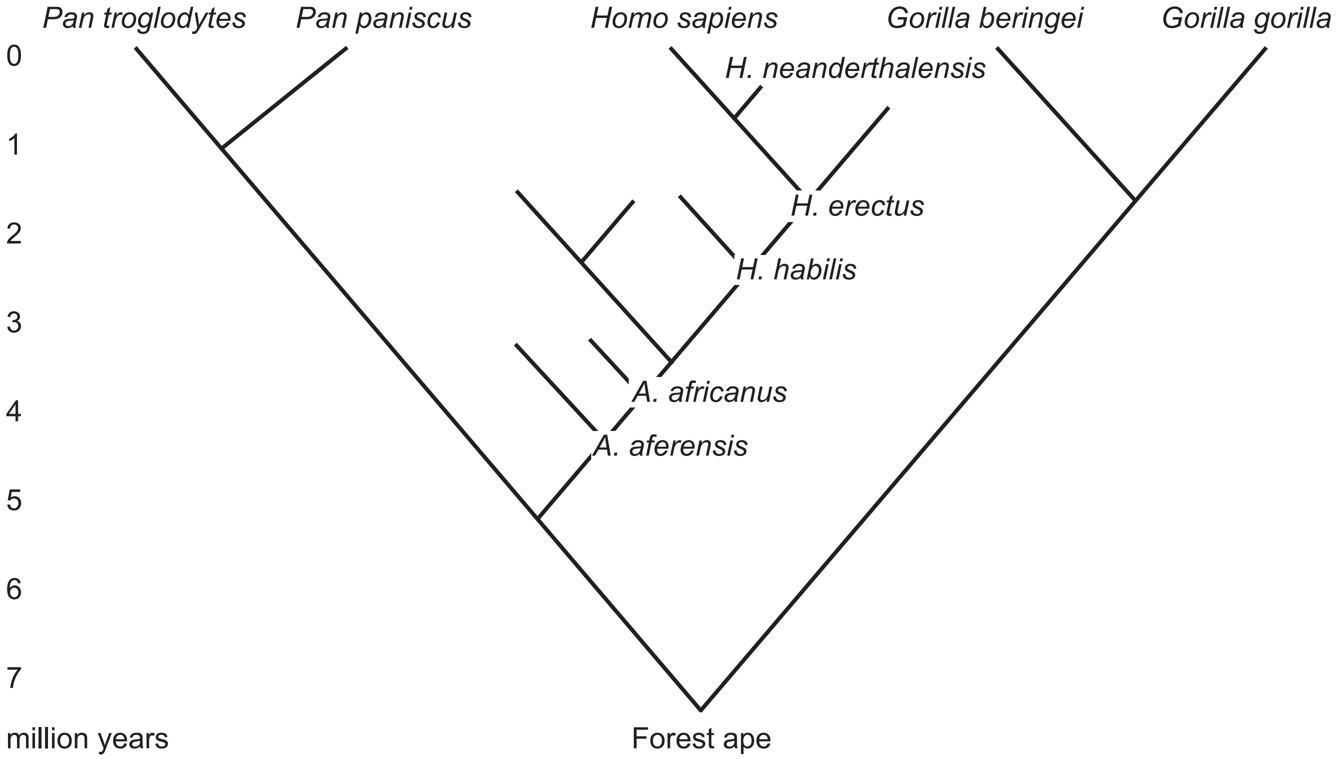

Fig. 6.1

(a) **(i)** Using Fig. 6.1, state how many species of primates that descended from forest apes are still alive today.

.... **[1]**

(ii) Using Fig. 6.1, explain why *Homo sapiens* are more closely related to *Pan paniscus* than *Gorilla gorilla*.

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.... **[1]**

(b) Fig. 6.2 shows three primate skulls and the position of the foramen magnum.

The foramen magnum is the hole at the base of the skull that the spinal cord passes through.

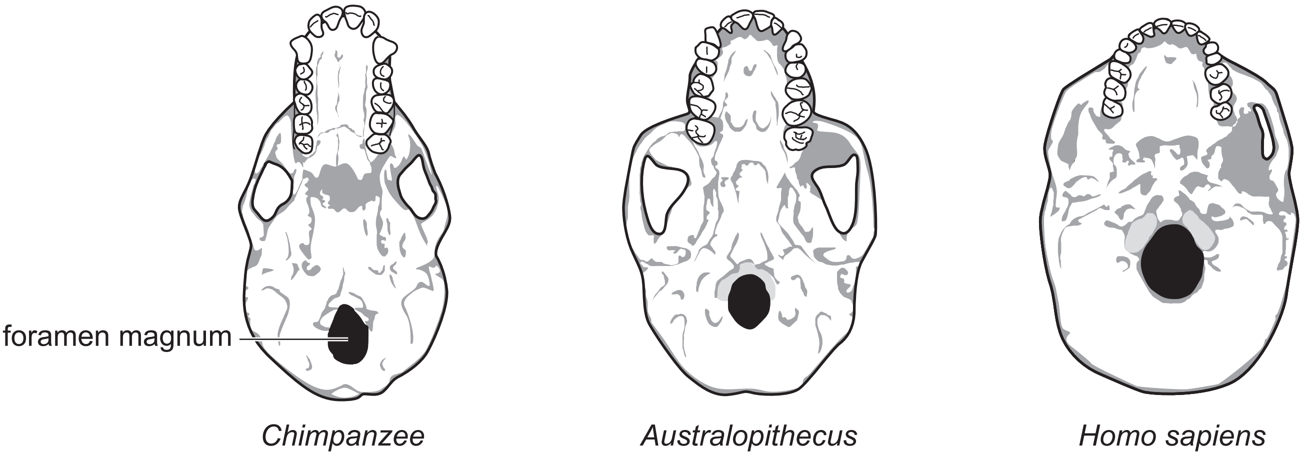

Fig. 6.2

(i) Describe the change in the position of the foramen magnum **and** explain how this could have affected the behaviour of the primates.

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.... **[2]**

(ii) Scientists claim that *Australopithecus* species may have been able to use smaller tools and understand a wider range of vocal sounds than a chimpanzee.

What evidence in Fig. 6.2 supports this claim?

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.... **[1]**

(iii) A number of *Australopithecus* species have been discovered but it has been difficult for scientists to classify them as distinct species due to a lack of genetic material found.

One example is that specimens of *Australopithecus prometheus* have been grouped with the more well-known *Australopithecus africanus* species.

Suggest **one** reason, other than a lack of genetic material found, why it may be difficult to classify them as two distinct species.

....

.... **[1]**

(c) State the name of **three** types of monomers or molecules that can be used in the genetic classification of a species.

1 ....

2 ....

3 ....

[3]

END OF QUESTION PAPER

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).