OCR
Oxford Cambridge and RSA

A Level Biology A
H420/03 Unified biology

Practice paper – Set 1
Time allowed: 1 hour 30 minutes

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

First name									
Last name									
Centre number						**Candidate number**				

INSTRUCTIONS
- Use black ink. HB pencil may be used for graphs and diagrams only.
- 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 **70**.
- 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 **20** pages.

Answer **all** the questions.

1 Banana plants, *Musa* spp., first underwent artificial selection thousands of years ago. Early human populations discovered mutant banana plants that produced seedless, soft fruit. This mutation prevented pollen and seeds from developing.

Early human populations planted cuttings of these mutant plants. The bananas that are eaten today are descended from these cultivations.

(a) Some scientists claim that banana crops will be extinct within a few years.

Use the information above to justify the scientists' claim.

.....

.....

.....

.....

.....

.....

.....

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

(b) The apple tree, *Malus domestica*, is another species that humans have selectively bred.

Circumference and seed production, listed in Table 1.1, are two features of apple tree fruit that vary between individuals.

Complete Table 1.1 by writing the correct **word or phrase** in each box to describe the type of variation shown by each feature.

Feature	**Cause of feature**	**Number of genes involved**	**Type of graph used to present data**
Circumference (mm)			
Seed-containing / seedless			

Table 1.1

[3]

(c)* The orange tree, *Citrus sinensis*, is another important crop plant.

Scientists applied the following treatments to commercial orange trees:

- Gibberellins were applied at various stages of development.
- Auxins were applied during development and to mature orange trees.

The treated orange trees were compared to untreated orange trees. Scientists observed that the treated trees:

- had slightly shorter roots
- grew taller
- all began to grow within two days of each other
- had fewer and shorter side branches
- retained their fruit and leaves for longer.

Suggest explanations for each of these observations.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

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

2 Excretion is important in both animals and plants.

(a) Table 2.1 describes some processes that occur in plants.

In Table 2.1, write **YES** or **NO** in each box in the right-hand column to indicate whether or not each statement is an example of excretion.

Process	**Is this an example of excretion?**
Flowering plants release chemicals that attract pollinators.	
Excess chlorine and heavy metals are transferred to cells in the leaves. These substances are lost when leaves are shed by abscission.	
The common reed, *Phragmites australis*, releases acid from its roots to destroy competing species.	
Auxins are produced in apical cells and diffuse to the zone of elongation.	
Carbon dioxide produced in respiration diffuses out of leaves via stomata.	

Table 2.1 **[2]**

(b) The kidney is one of the organs of excretion in vertebrate animals.

Fig. 2.1 shows a light micrograph of a section through a kidney cortex.

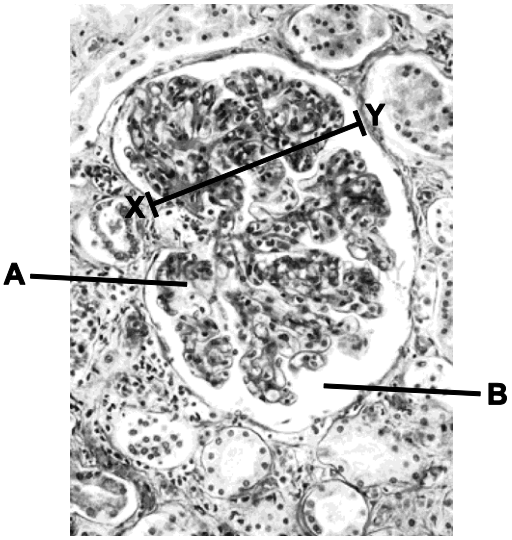

Fig. 2.1

(i) Name the parts of the kidney labelled **A** and **B**.

A .....

B .....

[2]

(ii) Calculate the length of the line labelled **X** to **Y**.

Give your answer in micrometres (µm) to **two** significant figures.

Answer = ... µm **[2]**

(c) Sodium ions and glucose are both reabsorbed into the blood from proximal convoluted tubules (PCTs) in the kidney.

(i) A student designed an experiment to investigate the effect of temperature on the rate of glucose diffusion through dialysis tubing.

State **two** factors that would need to be controlled in this experiment.

1 .....

.....

2 .....

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

(ii) Describe the structural difference between alpha and beta glucose molecules.

.....

.....

.....

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

(iii) Sulthiame is a drug that inhibits the enzyme carbonic anhydrase.

Fig. 2.2 shows the role of carbonic anhydrase in the PCT of the kidney.

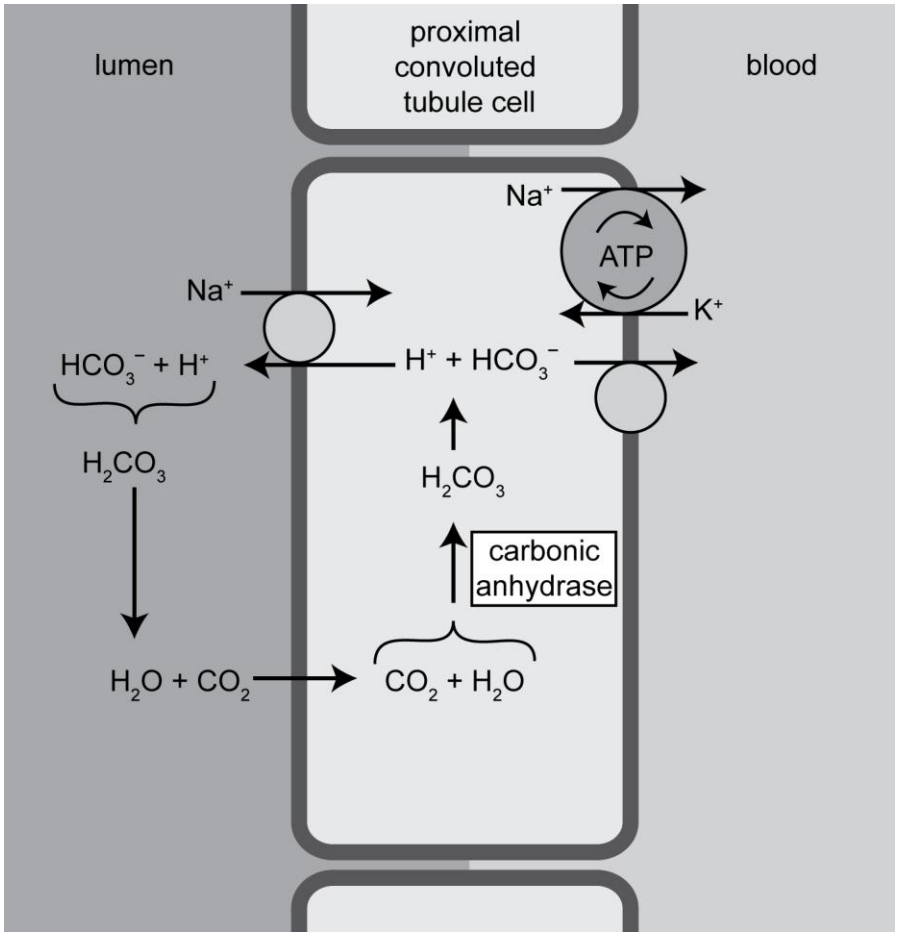

Fig. 2.2

Using the information in Fig. 2.2, what can you conclude about the likely effect of sulthiame on the reabsorption of sodium ions in the PCT?

.....

.....

.....

.....

.....

.....

.....

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

(d) The measurement of kidney filtration rate provides an indication of the health of the kidneys.

A filtration rate of below 60 cm^3 min^{-1} for three consecutive months or more is a sign of chronic kidney disease.

A patient was found to have the following kidney filtration rates:

Month 1: 54.00 cm^3 min^{-1}
Month 2: 4.85 x 10^{-5} m^3 min^{-1}
Month 3: 1.12 cm^3 s^{-1}
Month 4: 9.70 x 10^{-7} m^3 s^{-1}

Do these results suggest the patient has chronic kidney disease?

Explain your conclusion using the information given.

.....

.....

.....

.....

.....

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

3 DNA replication and transcription are two processes that occur in the nucleus of eukaryotic cells.

(a)* Compare DNA replication and transcription by describing the similarities and differences between the two processes.

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....**[6]**

(b) DNA fragments can be separated using electrophoresis.

Fig. 3.1 shows the result of electrophoresis of several DNA samples.

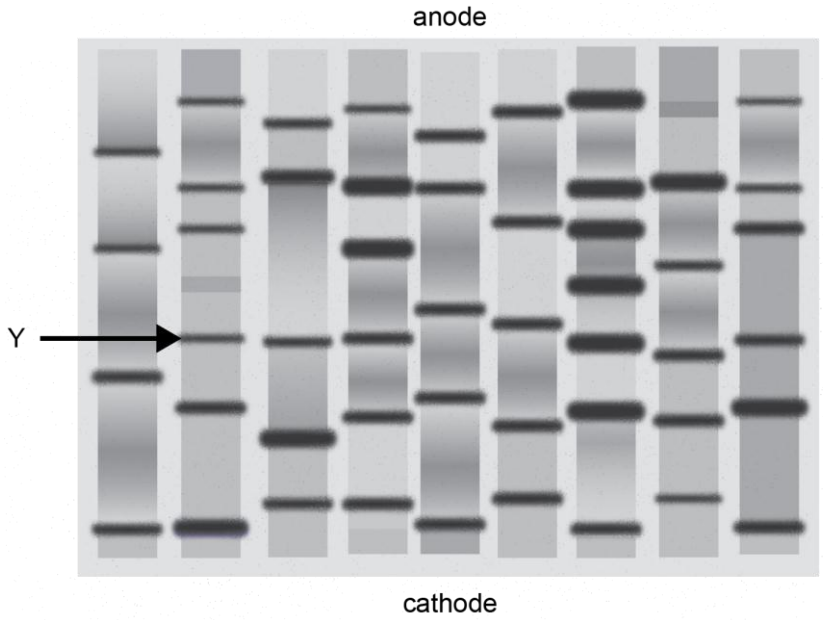

Fig. 3.1

(i) Describe how DNA can be visualised after electrophoresis has been completed.

.....

.....

.....

.....

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

(ii) Place a cross (X) **on Fig. 3.1** to indicate the position of a fragment of DNA with a mass greater than the DNA band labelled Y.

[1]

(c) (i) Mixtures of proteins can also be separated by electrophoresis.

- Proteins are heated before being placed in the electrophoresis gel.
- The gel contains a substance called SDS, which has a negative charge.
- SDS binds to proteins.

Suggest why proteins are heated before being placed in the electrophoresis gel.

.....

.....

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

(ii) Suggest why the binding of SDS to proteins is necessary for protein electrophoresis.

.....

.....

.....

.....

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

4 Peat bogs are ecosystems that contain unique communities of invertebrates, bird species, and wetland plants.

Sphagnum mosses represent a vital part of peat bog ecosystems. These species of moss require a high soil moisture content.

Almost all of the peat bogs in the UK have been affected by human activity.

The following management activities were planned in a peat bog ecosystem:

- the planting of a small area of conifer trees at the edge of the peatland
- a ban on the extraction of peat for use as compost
- reintroduction of natural sphagnum mosses
- the construction of a ditch as a flood prevention measure
- extended grazing by cattle and a large flock of sheep
- managed burning to create new growth for livestock grazing
- the construction of a boardwalk to replace several sets of footpaths

(a) (i) Suggest improvements that could be made to these plans.

Explain why your improvements would help conservation of the peat bog ecosystem.

.....

.....

.....

.....

.....

.....

.....

.....

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

(ii) Explain why the **preservation** of peat bog ecosystems is **not** a strategy that can be used in most cases.

.....

.....

.....

.....

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

(b) The invertebrate biodiversity of two different peat bog ecosystems was sampled. Values of Simpson's Diversity Index were calculated for both ecosystems. The results are shown in Table 4.1.

Species	**Ecosystem A**			**Ecosystem B**		
	n	*n*/*N*	$(n/N)^2$	*n*	*n*/*N*	$(n/N)^2$
G. cottonae	3	0.0361	0.0013	14	0.15	0.0227
G. servulus	1	0.0120	0.0001	12	0.13	0.0166
C. cocksi	4	0.0482	0.0023	20	0.22	0.0462
L. nigrifrons	24	0.2892	0.0836	25	0.27	0.0723
E. cryptarum	33	0.3976	0.1581	22	0.24	0.0560
T. limbata	5	0.0602	0.0036			
S. litorea						
T. rivularis	1	0.0120	0.0001			
S. argus	4	0.0482	0.0023			
Σ =			0.2607			0.2138
1-Σ =			0.7393			0.7862

Table 4.1

(i) Complete the missing row **in Table 4.1** by adding the correct values for *S. litorea*.

[3]

(ii) What can you conclude about the species evenness and richness of **Ecosystem A** in comparison to **Ecosystem B**?

.....

.....

.....

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

(iii) Scientists planned to sample the biodiversity in another peat bog ecosystem. They identified three different areas within the ecosystem:

- an area of conifer trees (800 m^2)
- a marshy area with a high water table (2400 m^2)
- a heavily grazed area (3200 m^2)

Suggest the sampling strategy that the scientists should use and comment on the number of samples they should collect.

.....

.....

.....

.....

.....

.....

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

(c) The genetic diversity of the moss *Polytrichum commune* was analysed in two peat bog ecosystems.

Scientists measured genetic diversity by studying three gene loci. For each gene locus, they calculated the proportion of heterozygotes in each population. These values were used as a measure of genetic diversity.

The scientists sampled 72 individuals from Population A and 48 individuals from Population B.

The results of the genetic analysis are shown in Table 4.2.

	Number of heterozygous individuals		
	Locus 1	Locus 2	Locus 3
Population A	65	69	60
Population B	42	41	40

Table 4.2

Using the data in Table 4.2, suggest which of the two populations of *P. commune* has the greater genetic diversity.

Explain your conclusion **and** show your working.

.....

.....

.....

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

5 The rhythm and rate at which a human's heart beats can be determined by several factors.

Fig. 5.1 shows electrocardiogram traces (ECGs) from two different individuals, **X** and **Y**.

Fig. 5.1

(a) (i) Describe and explain the differences between the two ECGs.

.....

.....

.....

.....

.....

.....

.....

.....

.....

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

(ii) An individual's cardiac output is calculated using the following equation:

Cardiac output = stroke volume x heart rate

The individual who produced ECG **Y** on Fig. 5.1 had a stroke volume of 80 cm^3.

Calculate the cardiac output of the individual responsible for ECG **Y**.

Include appropriate units in your answer.

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

(b) Draw an ECG trace **on Fig. 5.1** (next to **Z**) to represent a recording from a patient with an ectopic heartbeat.

Show at least three cardiac cycles.

[2]

(c) Heart rate can be increased by the hormone adrenaline, which binds to cardiac cells.

Describe how adrenaline binds to cardiac cells.

.....

.....

.....

.....

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

6 Plants have evolved response mechanisms to a variety of abiotic and biotic stimuli.

(a) Flowering plants respond to changes in the length of day. The advantage of this response is that these plants begin to flower only when environmental conditions are favourable.

Karl Hamner studied the effect of exposure to light and darkness on flowering in cocklebur plants. He placed cocklebur plants in darkness for different periods of time. Some of his results are shown in Table 6.1.

Period of darkness (h)	Flash of light during the period of darkness?	Flower production
8.5	No	Yes
6.5	No	No
12.5	Red light after 6 hours	No
12.5	Red light after 6 hours, followed by a flash of far red light	Yes
6.5	Several flashes of far red light	Yes

Table 6.1

Suggest what conclusions can be drawn from the results in Table 6.1 about the effect of exposure to light and darkness on flowering in cockleburs.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

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

(b) Flowering plants often produce fruit.

State **one** hormone that promotes the ripening of fruit.

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

(c) State **two responses** that some plants use to defend themselves from herbivory.

.....

.....

.....

.....

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

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional answer space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).