OCR
Oxford Cambridge and RSA

Friday 20 May 2022 – Afternoon

AS Level Biology B (Advancing Biology)

H022/01 Foundations of biology

Time allowed: 1 hour 30 minutes

You must have:
- the Insert (inside this document)

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

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

Centre number | | | | | | Candidate number | | | | |

First name(s) _____

Last name StemUp Model Solution

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 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 using 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 **[ ]**.
- This document has **24** pages.

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

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SECTION A

You should spend a maximum of 25 minutes on this section.

Write your answer for each question in the box provided.

Answer **all** the questions.

1 Which option is a short-term effect of a pollutant on the respiratory system?

A Asthma attack

B Chronic bronchitis

C Emphysema

D Lung cancer

Your answer A

[1]

2 Herceptin is a drug used in immunotherapy to treat breast cancer.

Which of the statements about treating cancer with Herceptin is correct?

A Chemicals bind to oestrogen to prevent transcription in cancer cells.

B Ionising radiation binds to cancer cells.

C Specialised antibodies are attracted to cancer cells.

D Toxic chemicals destroy cancer cells.

Your answer C

[1]

3 Which of the statements about a false-negative screening test for breast cancer is correct?

A A follow-up biopsy confirms that no cancer is present in the breast tissue.

B A mammogram looks abnormal even though no cancer is present.

C A mammogram looks normal even though cancer is present.

D The person looking at the mammograms records a positive result by mistake.

Your answer C

[1]

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4 When the number of people in a population that are immune to a disease reaches a herd immunity threshold (HIT) value then the disease is no longer present in that population.

The table shows data for four diseases, **A** to **D**, in a population of 50 000 people.

Disease	Number of people with immunity to the disease	Herd immunity threshold (%)
A	44 000	92–94
B	38 000	83–86
C	39 000	80–96
D	41 000	75–86

Which of the diseases is no longer present in this population?

Your answer D

[1]

5 The diphtheria vaccine contains a bacterial toxin that results in the production of antibodies when injected into the body.

Which type of immunity is provided by the diphtheria vaccine?

A Artificial active immunity

B Artificial passive immunity

C Natural active immunity

D Natural passive immunity

Your answer A

[1]

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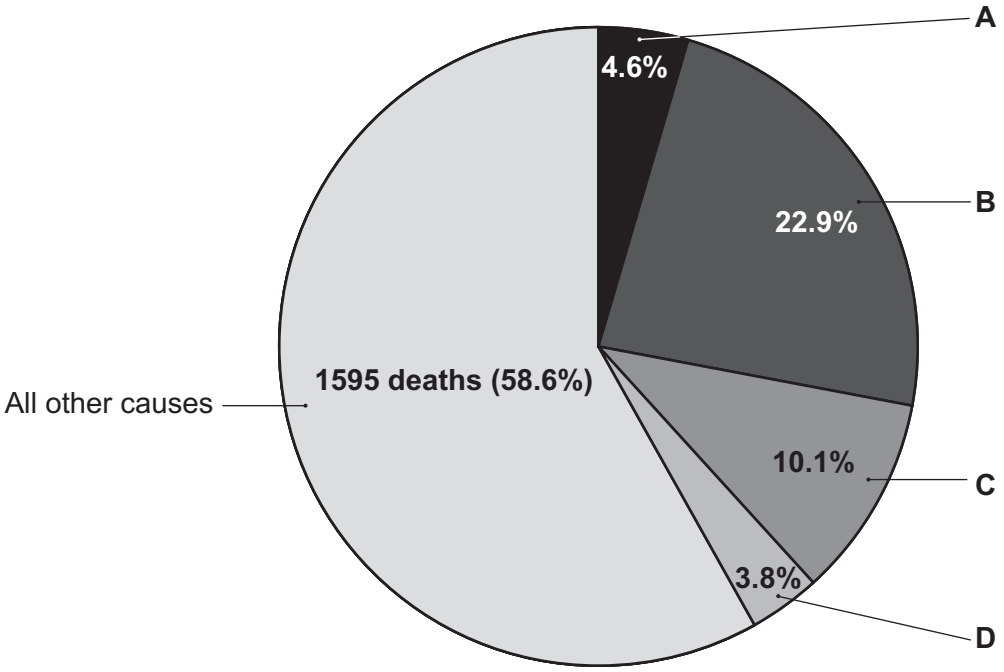
6 The pie chart shows the percentage number of deaths in a population from respiratory diseases and from all other causes during a flu epidemic.



The number of deaths caused by flu during the epidemic was 103.

Which of the segments of the pie chart labelled **A** to **D** represents the percentage of deaths caused by flu?

Your answer D

[1]

7 The sentences below are about an immune response.

During a .....**1**..... immune response, clonal expansion is faster. More plasma cells are produced by .....**2**..... , which results in a greater concentration of .....**3**..... secreted into the blood.

	1	2	3
A	primary	memory B cells	antibodies
B	primary	memory T cells	antigens
C	secondary	memory B cells	antibodies
D	secondary	memory T cells	antibodies

Which row correctly identifies the missing words in the sentences?

Your answer C

[1]

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8 Which of the options would result in reduced oxygen supply and poorly developed lungs in a developing fetus?

A High intake of alcohol during pregnancy

B High intake of tobacco smoke during pregnancy

C Shortage of folic acid in the diet of a pregnant woman

D Shortage of vitamin C in the diet of a pregnant woman

Your answer B

[1]

9 The table shows some of the cells, tissues and organs found in the mammalian respiratory system.

	Cell	**Tissue**	**Organ**
A	cilia	ciliated epithelium	lung
B	cilia	trachea	lung
C	squamous epithelial	ciliated epithelium	trachea
D	squamous epithelial	trachea	lung

Which of the rows correctly identifies a cell, a tissue and an organ?

Your answer C

[1]

10 Which of the options would result in an increase in tissue fluid formation?

A Decrease in hydrostatic pressure and increase in osmotic pressure at arteriole end of capillaries

B Decrease in hydrostatic pressure and increase in osmotic pressure at venule end of capillaries

C Increase in both hydrostatic pressure and osmotic pressure at venule end of capillaries

D Increase in hydrostatic pressure and decrease in osmotic pressure at arteriole end of capillaries

Your answer D

[1]

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11 The blood pressure of patients is often monitored when admitted to hospital.

The table shows blood pressure measurements and diagnosis for four patients who had been admitted to hospital.

Patient	Diastolic pressure (mmHg)	Systolic pressure (mmHg)	Diagnosis
A	70	120	severe blood loss
B	100	170	hypertension
C	120	80	normal blood pressure
D	170	100	hypotension

Which patient has the correct diagnosis from the blood pressure measurements shown in the table?

Your answer B

[1]

12 Which statement about the transmission of electrical impulses through heart muscle is correct?

A Impulses are transmitted from Purkyne tissue to the AVN.

B Impulses are transmitted from Purkyne tissue to the SAN.

C Impulses are transmitted from the AVN to Purkyne tissue.

D Impulses are transmitted from the AVN to the SAN.

Your answer C

[1]

13 Acidified phloroglucinol is a differential stain that shows the presence of lignin in plant tissues by staining structures containing lignin red.

Which of the plant structures can be distinguished from others by using acidified phloroglucinol?

A Lenticels in the stem

B Palisade mesophyll cells in the leaf

C Waxy cuticle on the upper epidermis of the leaf

D Xylem vessels in the stem

Your answer D

[1]

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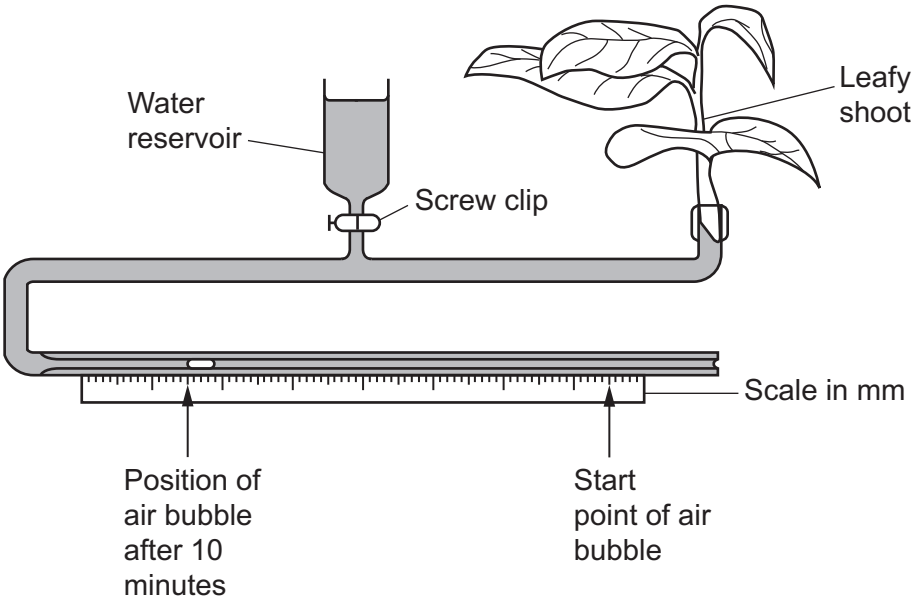
14 A group of students used the potometer below to estimate the rate of transpiration during an investigation.



The students timed the movement of the air bubble for 10 minutes. The diameter of the capillary tubing used for the potometer was 1 mm.

The students used the formula:

Volume of a cylinder = $\pi r^2 l$

to calculate the volume of water taken up by the plant in 10 minutes.

Which of the estimated rates of transpiration is correct?

A 19 $mm^3 h^{-1}$

B 113 $mm^3 h^{-1}$

C 283 $mm^3 h^{-1}$

D 1130 $mm^3 h^{-1}$

Your answer C

[1]

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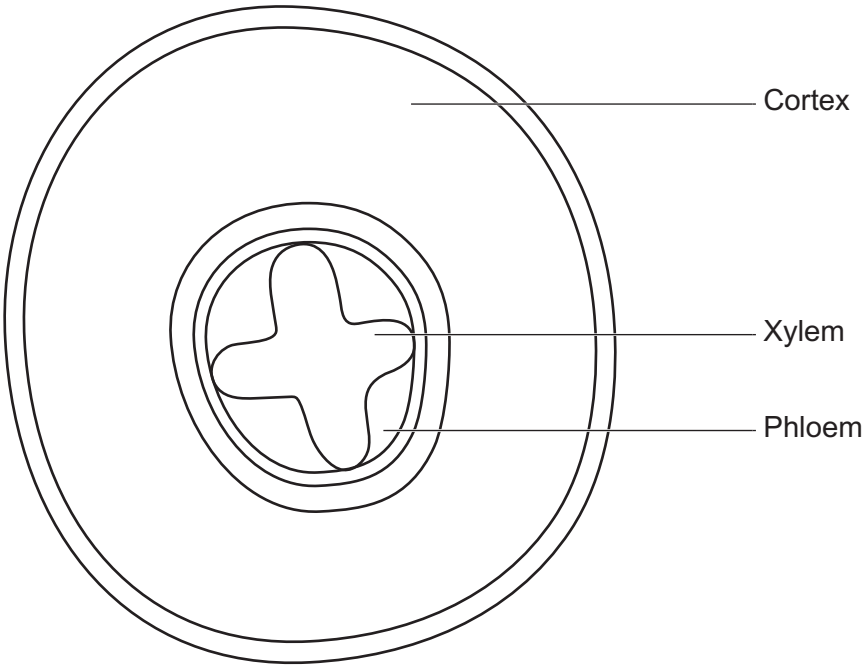
15 A student completed the plan drawing, shown below, of a section of plant organ they observed using a light microscope.



Which plant organ is drawn by the student?

A Dicotyledonous root

B Dicotyledonous stem

C Monocotyledonous root

D Monocotyledonous stem

Your answer A

[1]

16 Which of the reactions is catalysed by the enzyme thromboplastin?

A Fibrinogen ⟶ fibrin

B Fibrin ⟶ fibrinogen

C Prothrombin ⟶ thrombin

D Thrombin ⟶ prothrombin

Your answer C

[1]

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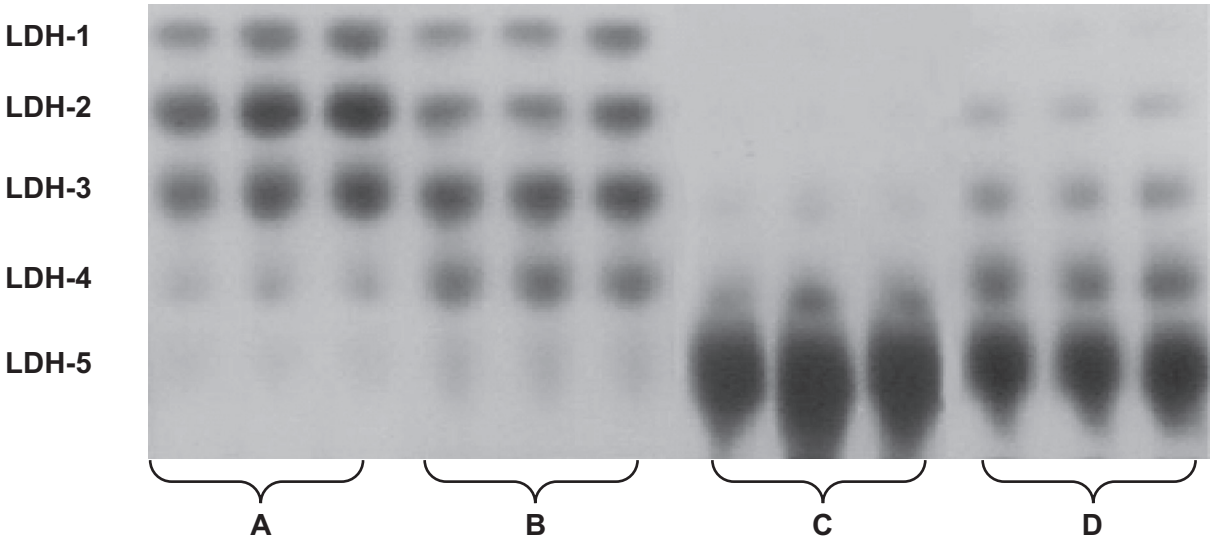
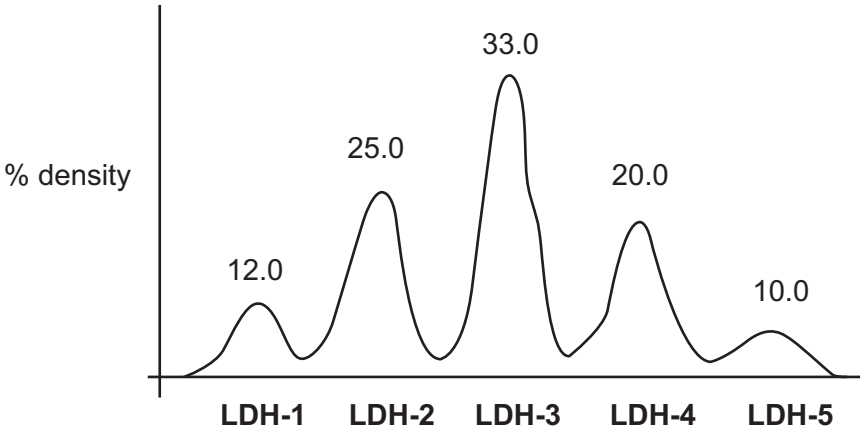
17 The relative amounts of the lactic acid dehydrogenase (LDH) isoenzymes in four different mouse tissues were measured using gel electrophoresis.

Results for three samples from each tissue are shown below and the relative amount of the five LDH isoenzymes was determined as a percentage by measuring the density of the spots.



The graph below shows values for LDH isoenzymes in brain tissue calculated using this technique.



Which of the tissues, **A** to **D**, can be identified as brain tissue from the gel electrophoresis results?

Your answer B

[1]

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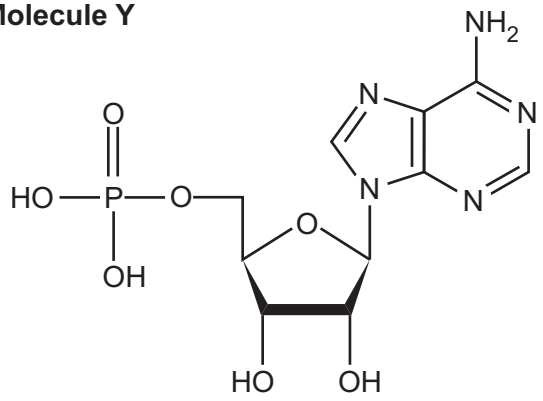
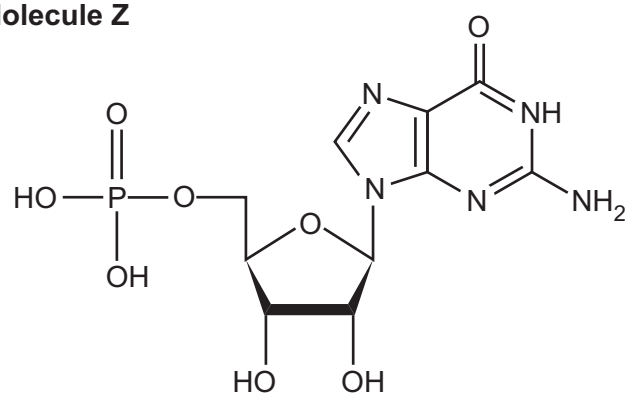
18 Molecules **Y** and **Z** are monomers that can be joined by a condensation reaction.

Molecule Y



Molecule Z



Which of the bonds would be formed between molecules **Y** and **Z** during a condensation reaction?

A Ester

B Glycosidic

C Hydrogen

D Phosphodiester

Your answer D

[1]

19 Which of the methods is **not** used to study the evolution of language?

A Comparisons with other species

B Computer simulations

C DNA bar coding

D Mathematical modelling

Your answer C

[1]

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20 The table shows genetic data from four species of dormouse.

Dormouse species	Number of polymorphic gene loci	Total number of gene loci
A	3	19
B	5	27
C	2	19
D	4	23

Which of the dormouse species, **A** to **D**, has the highest genetic diversity?

Your answer B

[1]

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SECTION B

Answer **all** the questions.

21 Sugarcane is one of the largest crop productions in the world. Over 75% of commercial sucrose (sugar) is extracted from the stems of sugarcane plants of the genus *Saccharum*.

(a) Explain why most of the sucrose extracted from sugarcane plants is found in their stems.

The stems contain phloem (sieve tubes), and translocation of sucrose occurs in the phloem. Glucose made by photosynthesis in the leaves is converted to sucrose and transported through the stem from the source (leaves) to the sinks (roots and rest of plant). **[2]**

(b) Starch is also found in sugarcane stems. Starch reduces the efficiency of the extraction process and results in loss of sucrose.

Researchers investigated the starch content in samples taken from the stems of three different species of sugarcane during the harvesting season, May to November.

The presence of starch in each sample was confirmed using a qualitative test and then colorimetry was used to determine the concentration of starch.

(i) Name the reagent in the qualitative test that could have been used by the researchers to confirm the presence of starch.

Iodine (iodine in potassium iodide solution) **[1]**

(ii) Give **one** reason why the researchers chose a red filter when using colorimetry in this investigation.

Red light is absorbed by the blue-black solution of a positive result, so the filter allows the intensity of the blue-black colour to be measured. **[1]**

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(iii) To determine the concentration of starch in each sample from the colorimetry readings, the researchers needed a calibration curve.

Outline how a calibration curve could have been produced for this investigation.

Make up a series of starch solutions (suspensions) of known concentrations, e.g. by serial dilution, and add iodine solution to each.

Measure the absorbance (or transmission) of each known concentration in the colorimeter using the red filter.

Plot a graph of absorbance against starch concentration, with concentration on the x-axis and absorbance on the y-axis, and draw a line or curve of best fit.

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

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(c) Some of the data from this investigation are shown in **Fig. 21.1** and **Fig. 21.2**.

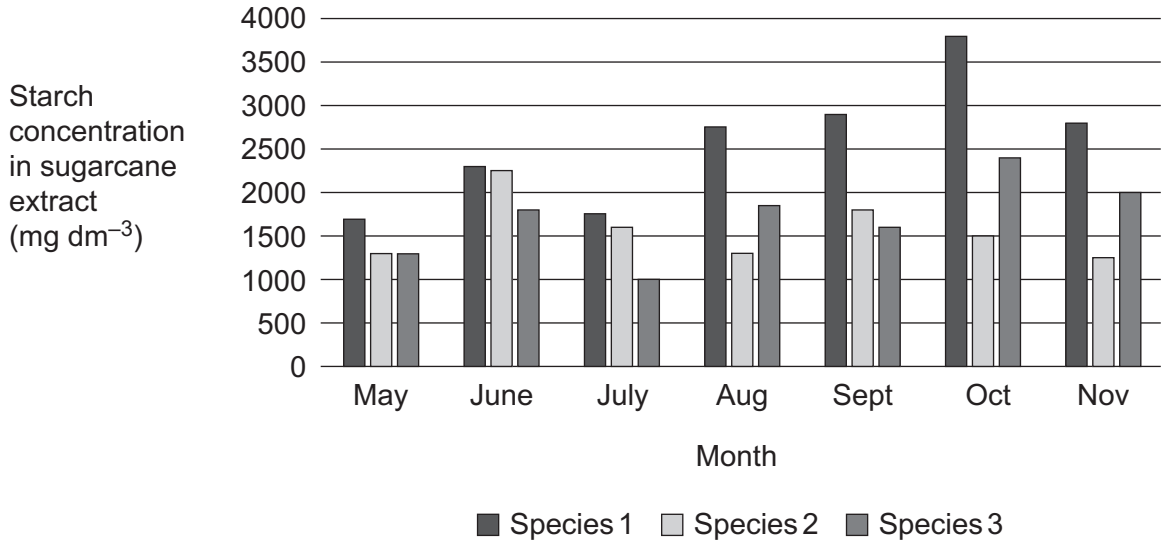

Fig. 21.1

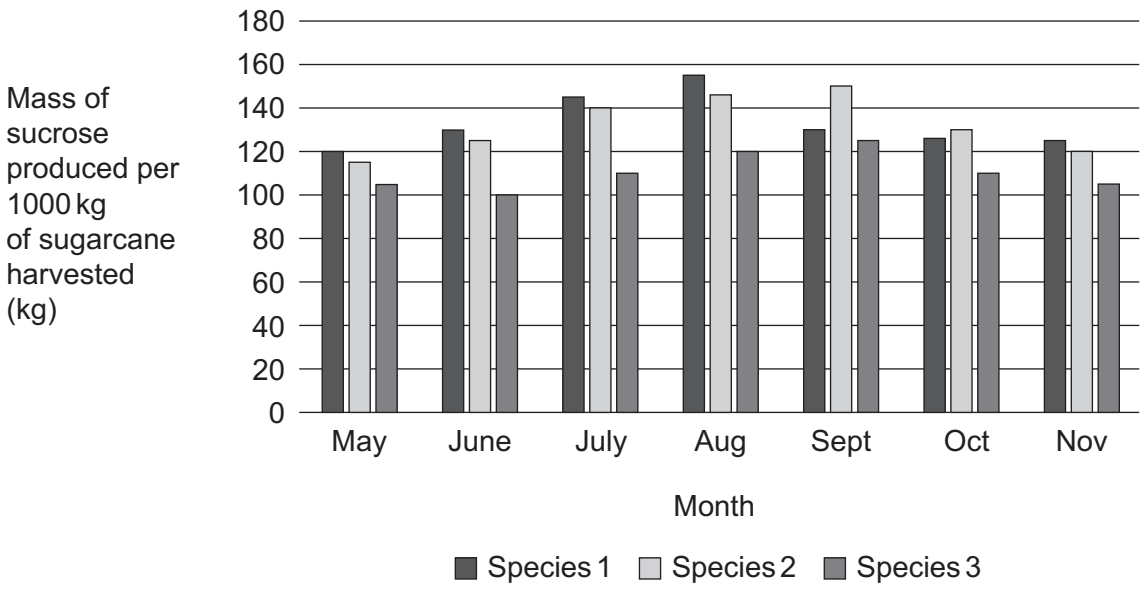

Fig. 21.2

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Using the data in **Fig. 21.1** and **Fig. 21.2**, suggest which of the sugarcane species would be the best for sucrose production and give reasons for your choice.

Species 2 would be the best.

It has a high yield of sucrose throughout the season, e.g. up to 150 kg per 1000 kg in September, and a mean of about 132 kg per 1000 kg, similar to species 1.

It has the lowest overall concentration of starch in the extract, e.g. only 1250 to 2250 mg dm^{-3} (mean about 1570 mg dm^{-3}) compared with up to 3800 mg dm^{-3} for species 1.

So less sucrose is lost and extraction of the sucrose is more efficient.

[4]

(d) Two microbial enzymes can be used to break down starch found in sugarcane samples.

- α-amylase produced by the bacterium, *Bacillus subtilis*, breaks down α-1,4 glycosidic bonds.
- Pullulanase is a fungal enzyme that breaks down α-1,6 glycosidic bonds.

(i) Name the type of reaction catalysed by these enzymes.

Hydrolysis **[1]**

(ii) Name **one** possible product of the reaction catalysed by α-amylase.

Maltose (or α-glucose) **[1]**

(iii) Suggest why pullulanase is used to increase the solubility of starch suspensions.

It hydrolyses the α-1,6 bonds at the branches, so the starch becomes less branched. **[1]**

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22 A study was carried out into the heart rates of young Southern elephant seals, *Mirounga leonina*.

- Ten young seals aged between 4 and 6 weeks were selected from a single population of *M. leonina*.
- The seals were captured and fitted with a logging device to record their heart rates in beats per minute (bpm).
- Heart rates were recorded continuously for 7 days.

(a) The table shows data from part of the study.

Seal	Mean heart rate during daylight (bpm)	Mean heart rate during darkness (bpm)	Difference (d)	$(d - \bar{d})$	$(d - \bar{d})^2$
1	86	73	13	0.5	0.25
2	77	62	15	2.5	6.25
3	80	66	14	1.5	2.25
4	79	68	11	–1.5	2.25
5	76	65	11	–1.5	2.25
6	85	70	15	2.5	6.25
7	78	67	11	–1.5	2.25
8	80	71	9	–3.5	12.25
9	79	69	10	–2.5	6.25
10	76	60	16	3.5	12.25

(i) Complete the calculations for **Seal 10**.

Write your answers in the table. **[1]**

(ii) Explain why a paired Student's *t*-test is an appropriate statistical test to analyse the data in the table.

Two measurements (daylight and darkness) are collected from the same individual seal, so the data are paired.

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

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(iii) The standard deviation (S_d) for this data = 2.42.

Calculate the value for t.

Use the formula: $t = \frac{\overline{d}\sqrt{n}}{s_d}$

mean difference = 125 ÷ 10 = 12.5

t = (12.5 × √10) ÷ 2.42 = 39.53 ÷ 2.42

t = 16.33

t = ...16.3..... **[2]**

(iv) The null hypothesis for this part of the study stated:

There is no difference between the heart rates of the young seals in daylight and darkness.

The critical value of t for a significance level of 5% is 2.26.

Using this information and your calculated value for t in **(a)(iii)**, evaluate the null hypothesis.

The calculated value of t (16.3) is much greater than the critical value of 2.26 at p = 0.05. So the null hypothesis can be rejected: there is a significant difference between the heart rates in daylight and darkness, and the difference is not due to chance. **[2]**

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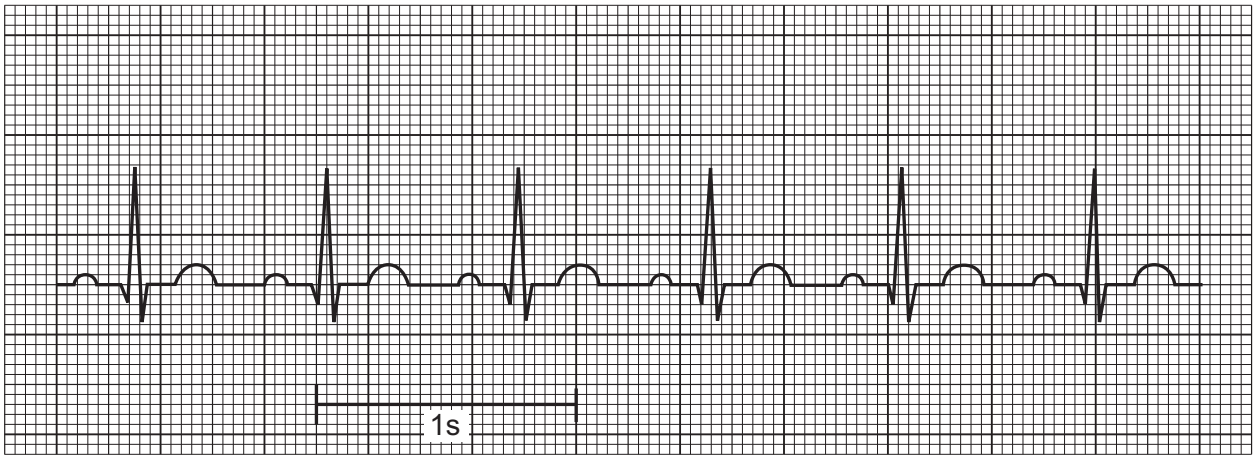
(b) *M. leonina* have physiological adaptations for deep sea diving. One of these adaptations includes the ability to alter their heart rates resulting in bradycardia.

This electrocardiogram (ECG) trace of a heart shows normal rhythm.



Describe how an ECG trace of a heart showing bradycardia would compare to the trace showing normal rhythm.

There would be a greater distance (gap) between the QRS complexes, so there would be fewer peaks in the same time interval. The P waves and the height of the QRS complexes would be the same (similar) in shape and size.

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

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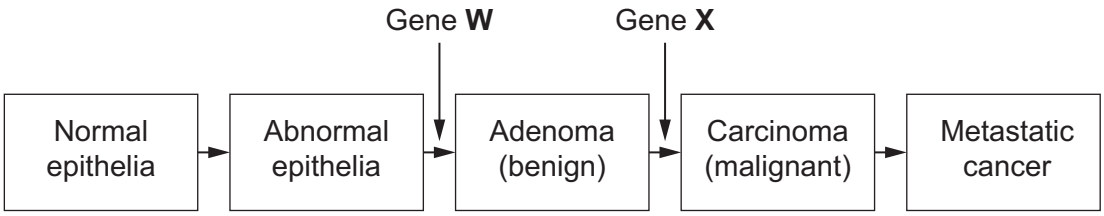
23 Bowel (colorectal) cancer is one of the major causes of cancer deaths.

The diagram shows some of the stages in carcinogenesis of bowel cancer.



(a) Gene **W** is the same type of gene as the *Ras* gene.

(i) Suggest how a mutation in gene **W** may result in the formation of an adenoma in the lining of the bowel.

Gene W is a proto-oncogene; the mutation turns it into an oncogene, so abnormally high quantities of growth factors are produced, triggering increased DNA replication. This leads to uncontrolled cell division, forming the adenoma. **[2]**

(ii) Gene **X** is an example of a gene that can initiate apoptosis.

Name gene **X**.

p53 (a tumour-suppressor gene) **[1]**

(b) Suggest **one** similarity and **one** difference between an adenoma and a carcinoma.

Similarity Both contain cells undergoing uncontrolled cell division.

Difference An adenoma is slow growing and not metastatic, whereas a carcinoma is metastatic and spreads to other tissues. **[2]**

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24 In the UK, pre-conceptual and post-conceptual care programmes are available for women.

(a) For each of these care programmes, state **one** test offered to women **and** give a reason why the test is offered.

Pre-conceptual test Blood test for immunity to rubella (German measles)

Reason If rubella is contracted in pregnancy the virus can cross the placenta and cause deafness or brain damage in the baby.

Post-conceptual test Urine test for glucose

Reason To check for gestational diabetes.

[4]

(b) During pregnancy, women need to eat more protein.

A pregnant woman was advised to increase her normal daily intake of protein by 11% to 58 g.

(i) Calculate how many additional grams of protein she was advised to eat.

Give your answer to **2** significant figures.

Normal intake = 58 ÷ 1.11 = 52.25 g

Additional = 58 − 52.25 = 5.748 g

Additional protein = 5.7 g **[2]**

(ii) Apart from protein, name **one** other nutrient that the pregnant woman would be advised to increase in her daily intake.

Folic acid **[1]**

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(c) During pregnancy, measurements of the fetus are taken using an ultrasound scan. These measurements can be plotted on a growth chart and compared with expected values to monitor fetal development.

Fig. 24, in the **Insert,** shows fetal growth charts with plotted values for weight, length and head circumference (HC) for two fetuses, **G** and **H**.

(i) Use the information in **Fig. 24** to comment on the development of fetus **G**.

At 34 weeks fetus G is on the 10th percentile for weight, the 50th percentile for length and the 90th percentile for head circumference. So G is underweight for its gestational age, as 90% of fetuses weigh more; its length is average; and its head circumference is above average, as only 10% of fetuses have a larger HC. This means the fetal development of G is a concern.

[3]

(ii) Calculate the weight to length ratio for fetus **H** at 40 weeks gestation.

Weight = 3950 g, length = 51.5 cm

3950 ÷ 51.5 = 76.7

Ratio = 77 : 1 **[1]**

(d) Biparietal diameter (BPD) measurements are also used to monitor fetal development.

Describe what is meant by a BPD measurement.

The width of the fetal head at its widest point (side to side across the skull).

[1]

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25 **Fig. 25**, in the **Insert**, is a blood sample viewed using a light microscope.

(a) Identify the blood cells in **Fig. 25** and complete the table below.

Name	Letter
Erythrocyte	P
Monocyte	Q
Lymphocyte	R

[2]

(b) The sample of blood in **Fig. 25** was prepared for viewing by making a blood smear (film) on a microscope slide which was then stained using Leishman's stain.

(i) Give **one** reason why it was important to make a correct smear (film) of the blood sample.

So individual cells can be seen clearly, without the cells overlapping, and the sample is representative. **[1]**

(ii) Give **one** reason why Leishman's stain was used.

It stains the nuclei so that the different types of white blood cells (leucocytes) can be distinguished. **[1]**

(iii) Suggest why macrophages were **not** present in this blood sample.

Macrophages develop from monocytes only after they have left the bloodstream; they are found in the tissues, e.g. liver and lungs. **[1]**

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(c) Neutrophils are blood cells that have a role in the non-specific immune response.

Outline the mode of action of neutrophils.

..Neutrophils..are..phagocytes..They..are..attracted..to..pathogens..by..cytokines.....

..and..opsonins,..and..engulf..the..pathogen..into..a..vesicle..(phagosome)..by.....

.phagocytosis.....

..Lysosomes..fuse..with..the..phagosome..and..release..hydrolytic..(digestive).....

.enzymes,..so..the..pathogen..is..digested.....

.....

.....

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

(d) Different products can be made from donated blood and then stored.

Complete the sentences about stored blood products using the most appropriate word or words.

A transfusion of ..clotting..factors..... can be used to treat people with a genetic disorder that causes their blood to clot slowly.

..Erythrocytes..... are separated from the rest of the blood to produce a concentrated blood cell product that can be used to treat people with anaemia.

People with leukaemia or bone marrow failure can be given a transfusion of

...platelets..... .

[3]

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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