OCR
Oxford Cambridge and RSA

A Level Biology B (Advancing Biology)

H422/03 Practical skills in biology

Monday 26 June 2017 – Morning

Time allowed: 1 hour 30 minutes

You must have:
- the Insert (inserted)
- a ruler (cm/mm)

You may use:
- a scientific or graphical calculator

First name									
Last name									
Centre number						Candidate number				

INSTRUCTIONS
- The Insert will be found inside this document.
- Use black ink. You may use an HB pencil for graphs and diagrams.
- 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 **60**.
- 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 **16** pages.

Answer **all** the questions.

1 Fig. 1 is a fetal growth chart showing how biparietal diameter (BPD) increases during gestation.

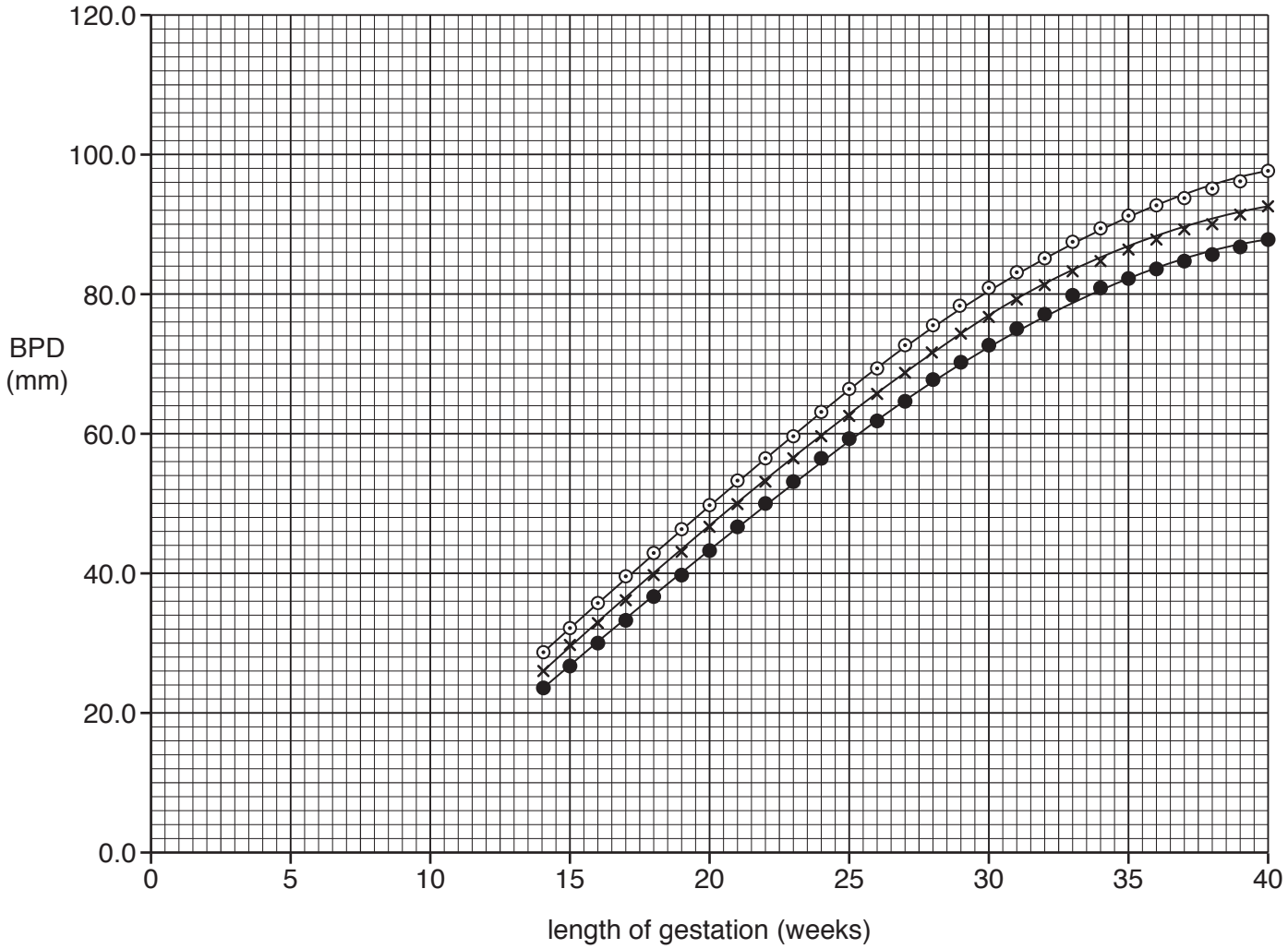

Fig. 1

(a) Calculate the rate of growth at 30 weeks' gestation for the data shown in the uppermost curve (95th percentile). Show your working.

Answer = ... **[2]**

(b) Three sets of data are shown in Fig. 1.

How can the **three sets of data** be used together to monitor the health of a growing fetus?

.....

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

(c) The measurements for BPD in Fig. 1 were taken using ultrasound.

Evaluate the usefulness of ultrasound in measuring fetal growth.

.....

.....

.....

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

2 **(a)*** Lettuce seeds require a minimum day length to stimulate germination. Studies have shown that treatment with gibberellins can stimulate germination without the need for exposure to light.

Gibberellic acid is a type of gibberellin.

A gardener wishes to extend the growing season for lettuces and wants to find out the minimum concentration of gibberellic acid to use to achieve germination.

Outline a practical method to determine the minimum concentration of gibberellic acid required to stimulate germination of lettuce seeds.

Your method should be based on the assumption that you are provided with the following:

- school or college laboratory resources
- a solution of 100 mg dm^{-3} gibberellic acid.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... **[9]**

(b) A student is carrying out an experiment to determine the effect of a gibberellin, GA_1, on the length of radicles (embryonic roots) of germinating pea seeds.

Fig. 2, **on the insert**, is a photograph of the germinating pea seeds.

All the seeds were soaked on the same day and have been growing for 5 days. The seeds have been soaked in different concentrations of GA_1 as labelled in Fig. 2.

Using a ruler, measure the radicles in Fig. 2.

In the space below construct an appropriate table and record:

- the raw data to the most appropriate level of precision for this apparatus
- the mean values.

[4]

3 A researcher investigated the effect of water temperature on the metabolic rate of a fish species.

For this investigation, the researcher used a type of respirometer attached to data-logging equipment containing an electronic sensor.

The electronic sensor measured any changes in the oxygen concentration of the water, which were used to calculate the metabolic rate of the fish.

Each of the following was included in the procedure for this investigation:

- Ten individual fish of the same species were used.
- The rate of oxygen consumption of each fish was measured.
- The temperature of the water was changed and the measurements repeated.
- After each set of measurements, the respirometers were flushed (cleaned and rinsed with hot water).

The rate of oxygen consumption was also measured in clean, empty respirometers. These measurements of oxygen consumption were too small to affect the outcome of the experiment.

(a) (i) The oxygen concentration of water can be measured using a number of different methods.

Give **one** advantage of using an electronic sensor with a data-logger.

.....

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

(ii) State **two** of the control variables necessary in this experiment.

.....

.....

.....

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

(iii) Suggest why the respirometers were flushed after each experiment.

.....

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

(b) Table 3.1 shows some of the results from this investigation.

Temperature of water in respirometer (°C)	Mean metabolic rate (mg O_2 kg^{-1} $hour^{-1}$)
10	86.0
16	131.6

Table 3.1

The standard deviation, *s*, for both means is 8.3.

A Student *t*-test can be performed to compare the mean metabolic rate at each temperature and determine if the two are significantly different from each other.

(i) State the null hypothesis for this test.

.....

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

(ii) Calculate the variance (s^2) for these means.

Answer = ... **[1]**

(iii) Using the formula below, calculate the *t* value for the data in Table 3.1.

$$t = \frac{\overline{x}_A - \overline{x}_B}{\sqrt{\frac{s_A^2}{n_A} + \frac{s_B^2}{n_B}}}$$

Show your working. Give your answer to **three decimal places**.

t = ... **[3]**

(iv) Using Table 3.2 and your answer to **(b)(iii)**, comment on the mean metabolic rates for 10 °C and 16 °C.

Degrees of freedom	Level of probability		
	0.05	**0.01**	**0.001**
8	2.306	3.355	5.041
10	2.228	3.169	4.587
18	2.101	2.878	3.922
20	2.086	2.845	3.850

Table 3.2

.....

.....

.....

.....

.....

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

(c) The background research for this investigation into the effect of temperature on the metabolic rates of fish included information about increasing surface sea temperatures.

It has been predicted that surface sea temperatures will continue to increase throughout the 21st century.

Suggest **two** limitations of trying to link the results of this laboratory investigation with the likely consequences on marine fish as surface sea temperatures increase.

.....

.....

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

4 An investigation into the effects of ageing on reaction times was carried out using data from a longitudinal study of the same people over a period of time.

- A group of 25 people volunteered for a study in 1962.
- As part of the study, the mean reaction time for each person was measured and recorded.
- In 2012, ten of the same individuals were traced and volunteered to take part in a second study.
- The mean reaction time using the same method was, again, measured and recorded.

Table 4 shows the results of the investigation.

Volunteer	Reaction time (10^{-3} s)	
	aged 18–25	aged 68–75
1	262	310
2	261	305
3	262	298
4	263	298
5	262	297
6	262	303
7	258	311
8	288	298
9	290	300
10	295	298
Mean	270	302
Median		
Range		

Table 4

(a) (i) Complete Table 4 by calculating the median **and** the range for both data sets. **[2]**

(ii) Evaluate the usefulness of the mean **and** the median when carrying out statistical analyses.

.....

.....

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

(iii) Suggest **one** limitation of using the **range** in a statistical analysis.

.....

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

(b) The investigators decided to perform a paired *t*-test on the data in Table 4.

Explain why a paired *t*-test is more appropriate than an unpaired (Student's) *t*-test for these data.

.....

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

(c)* Laboratory experiments are often carried out to determine the effect of drugs on reaction times.

These experiments may be:

- longitudinal studies of the same animal species over time
- carried out using human subjects
- carried out using different animal species.

Discuss the ethical considerations of using humans **and** other animal species in laboratory experiments to determine the effect of drugs on reaction times.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

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

5 Researchers were studying the possible association between smoking and the respiratory tract infections, pneumonia and bronchitis.

The study included an analysis of the infection figures for **all** admissions to a hospital.

- Data from 5018 patients were collected.
- 4022 of these patients were **non-smokers**.
- Each patient had only **one** infection.

Some of the data from this study are shown in Table 5.1.

	Number of patients admitted with a respiratory tract infection		**Number of patients admitted with other type of infection**
	Pneumonia	**Bronchitis**	
Smokers	335	230	431
Non-smokers	1166	526	2330

Table 5.1

(a) Calculate the percentage of patients who were **smokers**.

Give your answer to **two** decimal places.

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

(b) The researchers stated the following null hypothesis:

Smoking does not affect the incidence of respiratory tract infections.

(i) Analyse the data in this study **and** comment on the researchers' hypothesis.

In your answer you should use data to support your analysis.

.....

.....

.....

.....

.....

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

(ii) Suggest **one** statistical test that could be used to analyse the data further.

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

(iii) Why would this statistical test be the most useful?

.....

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

(c) Fig. 5.1, **on the insert**, is a photomicrograph showing tissues in the respiratory tract from one of the patients in the study.

Name **one** structure, visible in Fig. 5.1, involved in the **primary** defence system.

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

(d) A sample of bacteria from a patient with pneumonia was collected and a pure culture was prepared.

A Kirby-Bauer test was carried out to allow the doctor treating the patient to decide on the correct concentration of antibiotic to use.

Six different concentrations of the antibiotic were used, as shown in Table 5.2.

Kirby-Bauer disc	Concentration of antibiotic (a.u.)
A	0.0001
B	0.0010
C	0.0100
D	0.1000
E	1.0000
F	10.0000

Table 5.2

Describe the apparatus and method necessary to produce the six different concentrations.

You are supplied with an antibiotic solution of 10.0000 a.u. concentration and distilled water.

.....

.....

.....

.....

.....

.....

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

(e) Fig. 5.2 shows the result of the Kirby-Bauer test.

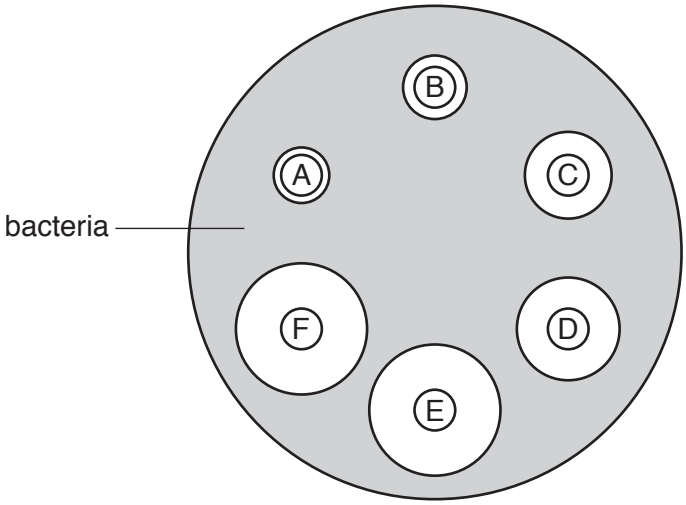

Fig. 5.2

Use the information in Fig. 5.2 to advise the doctor on the most appropriate concentration of antibiotic to use. Explain your choice.

.....

.....

.....

.....

.....

..... **[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).