

Candidate Name	Centre Number				Candidate Number			
					0			



GCSE

SCIENCE (Double Award)

**UNIT 4: (Double Award) BIOLOGY 2
HIGHER TIER**

SAMPLE ASSESSMENT MATERIALS

(1 hour 15 minutes)

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	6	
2.	9	
3.	10	
4.	6	
5.	10	
6.	10	
7.	9	
Total	60	

ADDITIONAL MATERIALS

In addition to this paper you will require a calculator.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer all questions.

Write your answers in the spaces provided in this booklet.

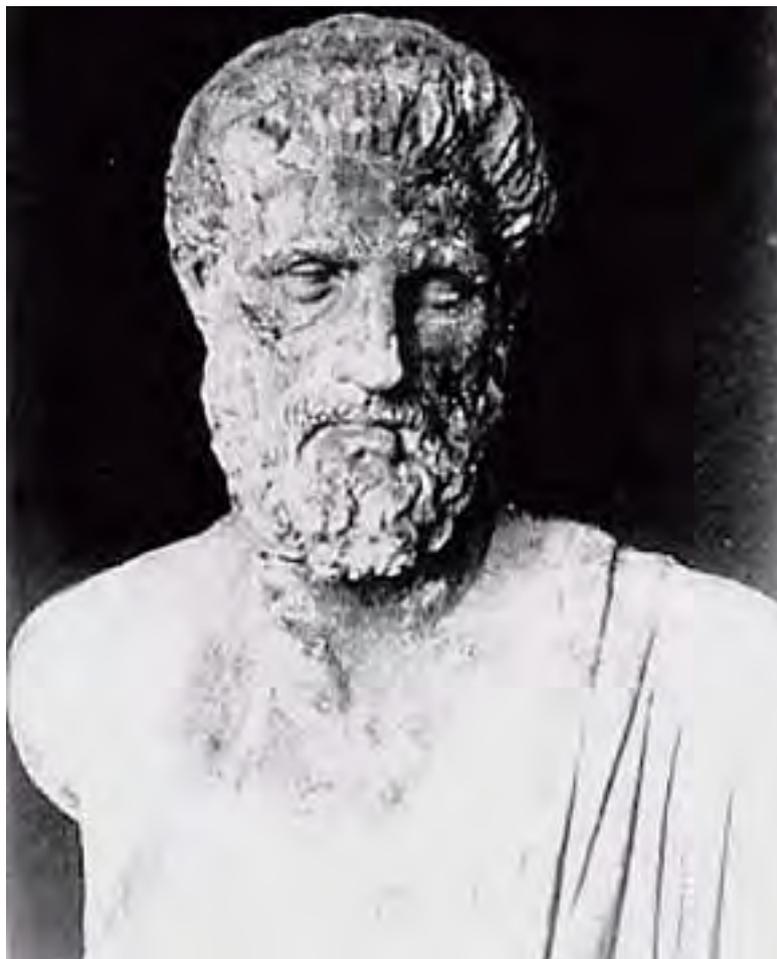
INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

Question 4 is a quality of extended response (QER) question where your writing skills will be assessed.

Answer **all** questions

1. The early history of diabetes.



Aretaeus of Cappadocia

Diabetes was given its name by the Greek physician Aretaeus of Cappadocia (30 – 90CE). He recorded a disease with the 3 symptoms of constant thirst (polydipsia), excessive urination (polyuria) and loss of weight. He named the condition 'diabetes', meaning 'a flowing through.'

In 1674, English physician Thomas Willis was the first in modern medical literature to observe the relationship between diabetes and a sweet taste to the patient's urine. He wrote in his notes that *'the pee was wonderfully sweet as if it were imbued with honey'*. This led him to add the term 'mellitus' to the name for this form of diabetes, from the Latin word for honey.

- (a) Explain any **two** of the three symptoms of diabetes, as recorded by Aretaeus. [2]

Symptom

Explanation

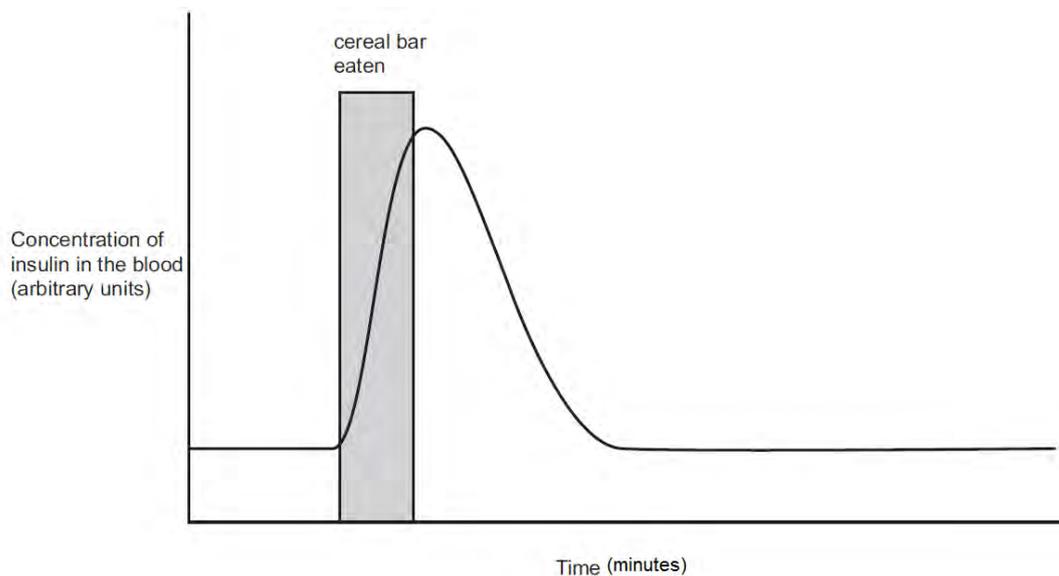
.....

Symptom

Explanation

.....

- (b) The graph shows the level of insulin in the blood of a person without diabetes before and after eating a breakfast cereal.



- (i) Explain what happens to the concentration of insulin in the blood as the breakfast cereal is being eaten. [3]

.....

- (ii) How would the graph above differ if the insulin levels of a person with untreated **Type 1** diabetes had been recorded? [1]

.....

2. PSSM1 is a muscle disease in horses. It results in muscle stiffness and a reluctance to move. One of the characteristics of PSSM1 is a very high level of glycogen stored in muscle tissue.

- (a) Suggest which class of food should be reduced in the diet of a horse suffering from PSSM1 and explain the reason for your answer. [2]

.....

- (b) The following table describes the number and percentage of randomly sampled horses that tested positive for the PSSM1.

Breed of horse	Number tested	Number with PSSM1	Prevalence (%)
Quarter horse	335	22	6.6
Paint	195	15	7.7
Appaloosa	152	9	5.9
Morgan	214	2
Percheron*	149	93	62.0
Belgian*	149	58	39.0
Shire*	200	0.5
Clydesdale*	48	0	0.0
Belgian draught*	37	34	92.0
Trekpaard*	23	17	74.0
Comtois*	88	70	80.0
Breton*	51	32	63.0

- (i) Explain what a prevalence of 62.0% amongst Percheron horses means. [1]

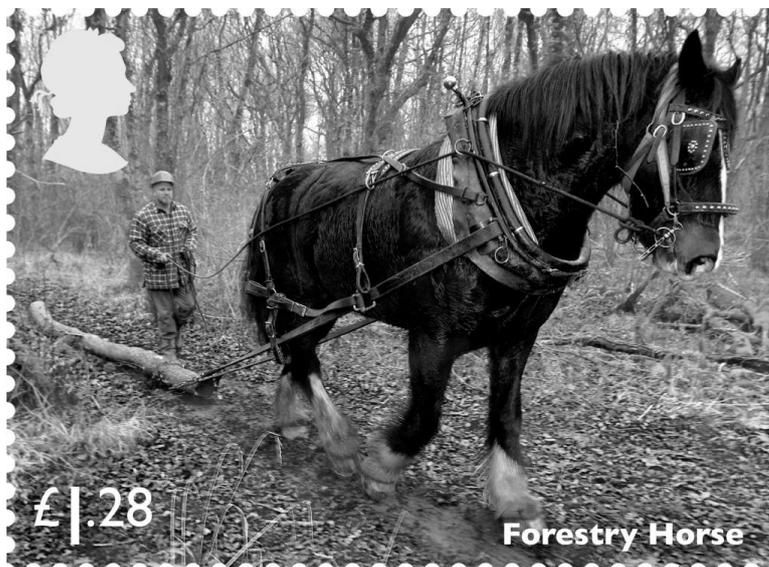
.....

- (ii) **Complete the table** by calculating:

I the prevalence of PSSM1 amongst the Morgan horses tested;. [1]

II the number of Shire horses that had the PSSM1 gene. [1]

- (iii) In the table opposite the horses marked with an asterisk (*) are heavy working or draught horses.
 For environmental reasons a commercial forestry owner wants to replace some of his heavy tracked vehicles with draught horses.



Which **three** breeds of horse would you recommend to the forestry owner so that the horses have an active working life? [1]

- I
 II
 III

- (c) PSSM1 is caused by a mutation and is inherited as a dominant allele, **(B)**.
 A horse, heterozygous for PSSM1, is mated with a horse that does not suffer from the condition.

- (i) Complete the Punnett square below to show this mating. [2]

Gametes		

- (ii) State the ratio of PSSM1 horses to non-PSSM1 horses in the offspring. [1]

PSSM1 : non-PSSM1

3. The adder (*Vipera berus*) is a protected species in the UK under the Wildlife and Countryside Act and is classified as a Priority Species in the UK Biodiversity Action Plan.



© Alan Gravell

Scientists are concerned that the numbers of adders in an area of west Wales is decreasing. The scientists decided to estimate the population size, in the area, using capture/recapture techniques.

In 2015, 47 adders were captured in one day and some scales on the body were marked with a harmless biodegradable paint. This first sample of adders was then released. Two days later a second sample of 51 adders were captured, in the same area, and of these 36 were found to be marked with the paint.

The population of adders in the area can be estimated using the formula

$$\text{population size} = \frac{\text{number in first sample} \times \text{number in second sample}}{\text{number in second sample marked with paint}}$$

- (a) Using the above formula calculate the population size **to the nearest whole number**. Show your working. [2]

Population of adders =

- (b) State **three** assumptions that the scientists have to make when using capture recapture data. [3]

I

II

III

- (c) 2015 was the fourth time that the population of adders in the area had been estimated using capture/recapture techniques. The table below shows the data for three previous sampling years.

	Year of capture/recapture exercise			
	2009	2011	2013	2015
population of adders	86	82	73

Complete the table with the data you calculated for 2015.

State how the contribution the adder makes to the biodiversity of the sample area has changed since 2009. [1]

.....

- (d) Explain why it is important that the harmless paint used to mark the adders is biodegradable and in your answer suggest a minimum time for the paint to last before it biodegrades. [2]

.....

.....

.....

.....

The following chart shows the adder's year.

Month	Activity
January February	Adders in hibernation deep underground
March	Adders emerge from hibernation with the males appearing first
April May	Mating takes place
June	
July	
August September	Females give birth to between 3 – 18 live young. Young are vulnerable to predation
October	
November	Adders return to hibernation
December	Adders in hibernation

GCSE SCIENCE (Double Award) Sample Assessment Materials 202

- (e) Between which months would it be best to carry out a capture/recapture investigation in order to gain a true picture of the population of adders in the sample area? Justify your answer. [2]

.....

.....

.....

.....

10

5. (a) What are stem cells? [2]

.....
.....

- (b) Stem cell transplants are classified differently depending on the individual providing the stem cells.

- Stem cells which come from the patient are called autologous stem cells.
- Stem cells which come from a donor are called allogenic stem cells.

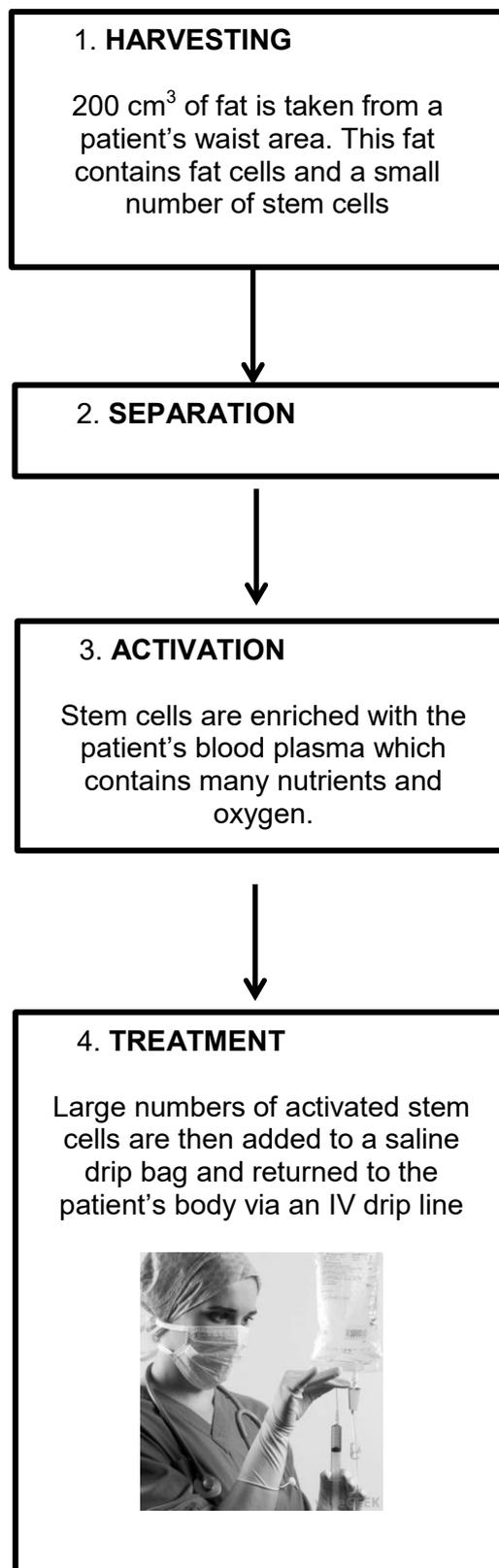
- (i) Explain the advantage to the patient of treating them with autologous stem cells rather than allogenic stem cells. [2]

.....
.....

- (ii) Name the source of allogenic (donor) stem cells whose use, for some people, raises a serious ethical issue and give reasons for your answer. [2]

.....
.....
.....

- (c) Injuries can be treated with stem cells. One method of treatment involves the following processes and stages.



- (i) What happens in the **separation** stage of the process? [1]

.....

- (ii) Suggest what happens to the stem cells in the activation stage after they have been enriched with patient's blood plasma. [2]

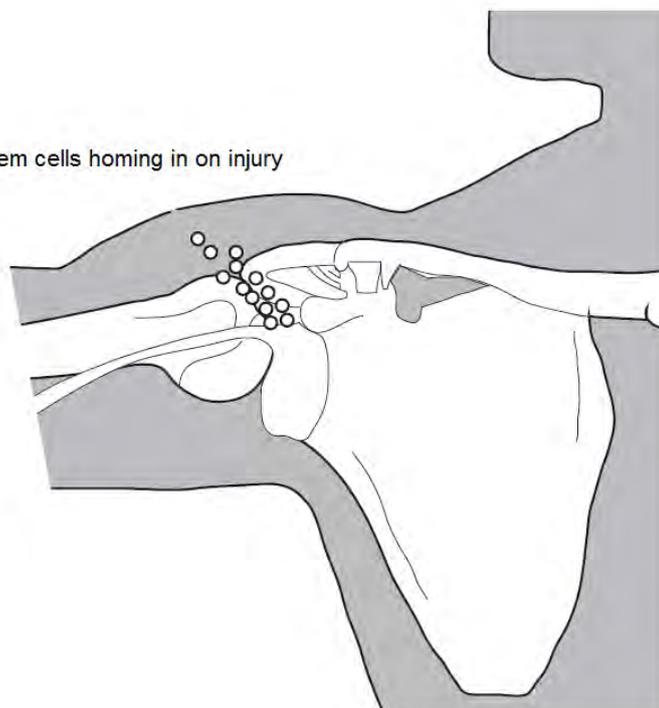
.....

.....

- (iii) A patient was treated for a shoulder injury with autologous stem cells. The stem cells were introduced into the patient via a drip connected to the back of the hand. All injured tissues in the body secrete a chemical called chemokine.



Stem cells homing in on injury



GCSE SCIENCE (Double Award) Sample Assessment Materials 207

Using the information provided explain how the stem cells are able to 'home in' on the area of the injury in the patient's shoulder. [1]

.....

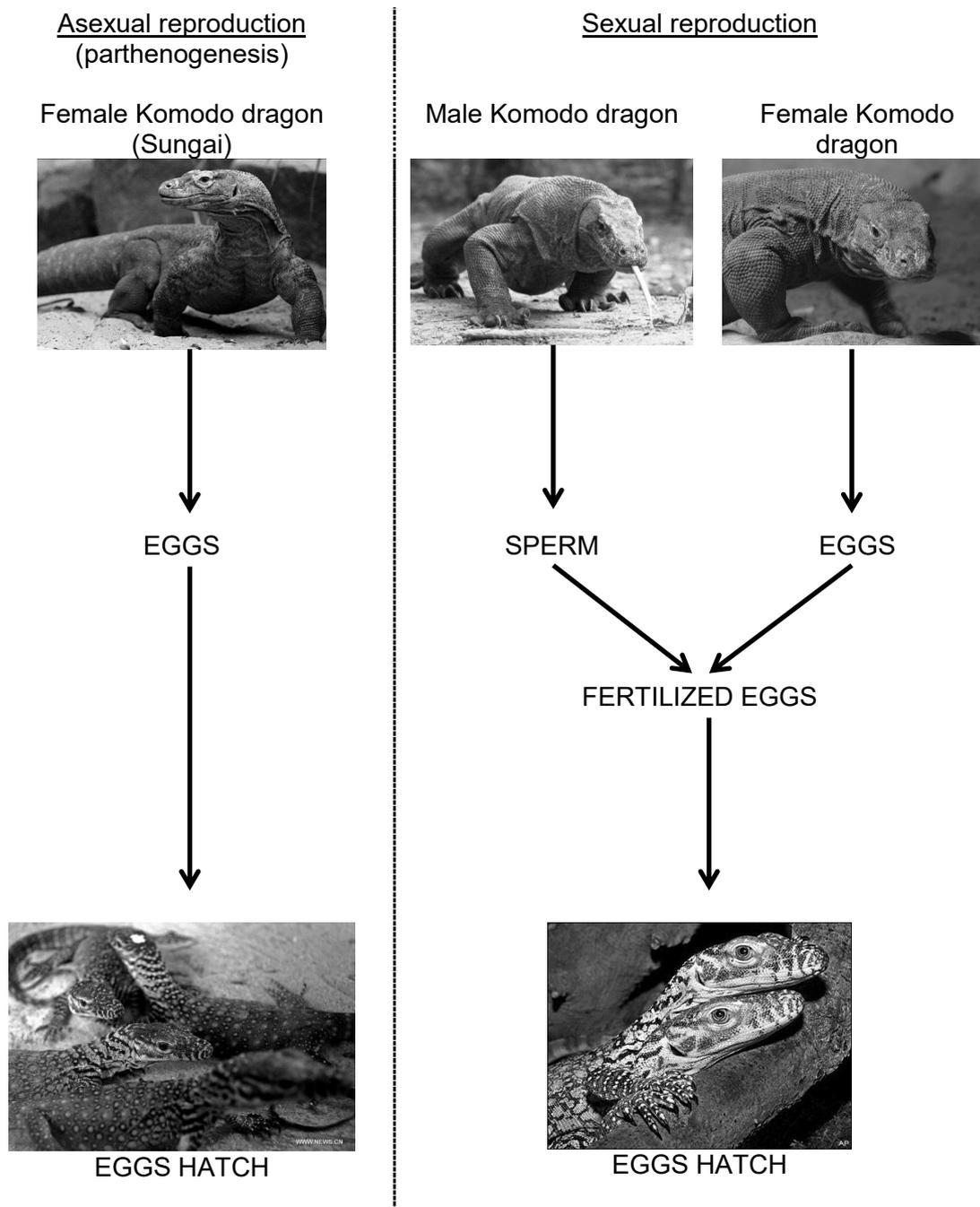
.....

10

6. Parthenogenesis happens when an unfertilized egg produces offspring. This means that the organism has reproduced asexually. Parthenogenesis occurs in many animal species which normally reproduce sexually. It occurs either for a lack of males, for population sex control, or in some cases because of an abundance of resources. Parthenogenesis occurs in about 0.1% of vertebrate species.

In 2006 two different cases of parthenogenesis occurred in two female Komodo dragons (*Varanus komodoensis*) in London Zoo. Komodo dragons are large lizards. One of the females was called Sungai.

The diagram below shows some of the stages in asexual reproduction (parthenogenesis) and sexual reproduction in Komodo dragons.



- (a) Using the **information in the diagrams only**, complete the table below by giving **three** differences between asexual and sexual reproduction. [3]

Asexual reproduction	Sexual reproduction

- (b) When Komodo dragons reproduce sexually, the male introduces sperm into the female's body. Some female reptiles, including some lizards, are able to store sperm in their bodies for years after mating. Sungai had not been with a male Komodo dragon for over 12 months and therefore some scientists thought that she had stored sperm from a previous mating. Other scientists disagreed with this because they thought that the offspring were too similar to one another and they were all male. They thought Sungai's offspring were a clone.

- (i) Describe the test the scientists could carry out on Sungai's offspring in order to find out whether they were a clone. Include the possible results of the test in your answer. [3]

.....

.....

.....

.....

.....

.....

- (ii) Komodo dragons live on many small and large islands in Indonesia. What advantage would the species gain by being able to reproduce by parthenogenesis? [1]

.....

.....

- (iii) Suggest a possible advantage to a species of the female being able to store sperm in her body for many years. [1]

.....

- (c) In many species the main advantage of parthenogenesis is that large numbers of offspring can be produced very quickly. However this could be a 'risky strategy'. Suggest why this could be a 'risky strategy' compared to the production of offspring by sexual reproduction. [2]

.....

.....

.....

.....

10

7. (a) What is meant by antibiotic resistance? In your answer give an example of a pathogen which is resistant to antibiotics. [2]

.....

.....

- (b) In 1928 Sir Alexander Fleming was working on ways to destroy bacteria. He grew colonies of bacteria on agar jelly in Petri dishes. One of his dishes became infected with a mould.

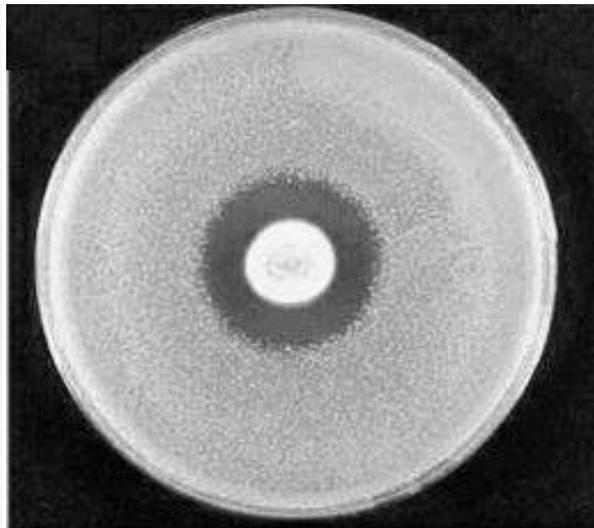
Study the photographs below.

Plate A



1928 Alexander Fleming's photograph of bacterial colonies growing on agar jelly. The agar has become contaminated at the bottom of the dish with a mould.

Plate B



Recent photograph of 1000s of bacterial colonies growing on agar jelly. A drop of crocodile blood has been placed in the centre of the colonies.

- (i) Describe and explain the similarities you can see between Plates **A** and **B**. [2]

.....

.....

- (ii) Name the chemical which was developed as a result of Sir Alexander Fleming's work on bacteria. [1]

.....

- (c) The increased incidence of antibiotic resistance has led many pharmaceutical companies to carry out research into the development of new antimicrobial drugs. One of the sources of new antibiotics which scientists are very interested in is crocodile blood.

Scientists exposed human blood and crocodile blood to 23 different strains of bacteria, including antibiotic resistant strains. The results are shown in the table below.

	Crocodile blood	Human blood
Number of strains of bacteria destroyed	23	8

Unfortunately, it is not possible to inject crocodile blood into human patients suffering from life-threatening bacterial infections because it would be identified as a foreign tissue and be destroyed. It may also have harmful effects on the body.

What would the pharmaceutical companies have to do before crocodile blood could be used to make new drug treatments for bacterial infections? [4]

.....

.....

.....

.....

.....

.....

.....