Surname	Centre Number	Candidate Number
Other Names		0

GCSE

3400UB0-1

S19-3400UB0-1

BIOLOGY – Unit 2:
Variation, Homeostasis and Micro-organisms

HIGHER TIER

TUESDAY, 14 MAY 2019 – AFTERNOON

1 hour 45 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**10**	
2.	**10**	
3.	**6**	
4.	**9**	
5.	**10**	
6.	**8**	
7.	**6**	
8.	**13**	
9.	**8**	
Total	**80**	

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ADDITIONAL MATERIALS

In addition to this paper you may require a calculator and a ruler.

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. If you run out of space, use the additional pages at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

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

Question **6***(b)* is a quality of extended response (QER) question where your writing skills will be assessed.

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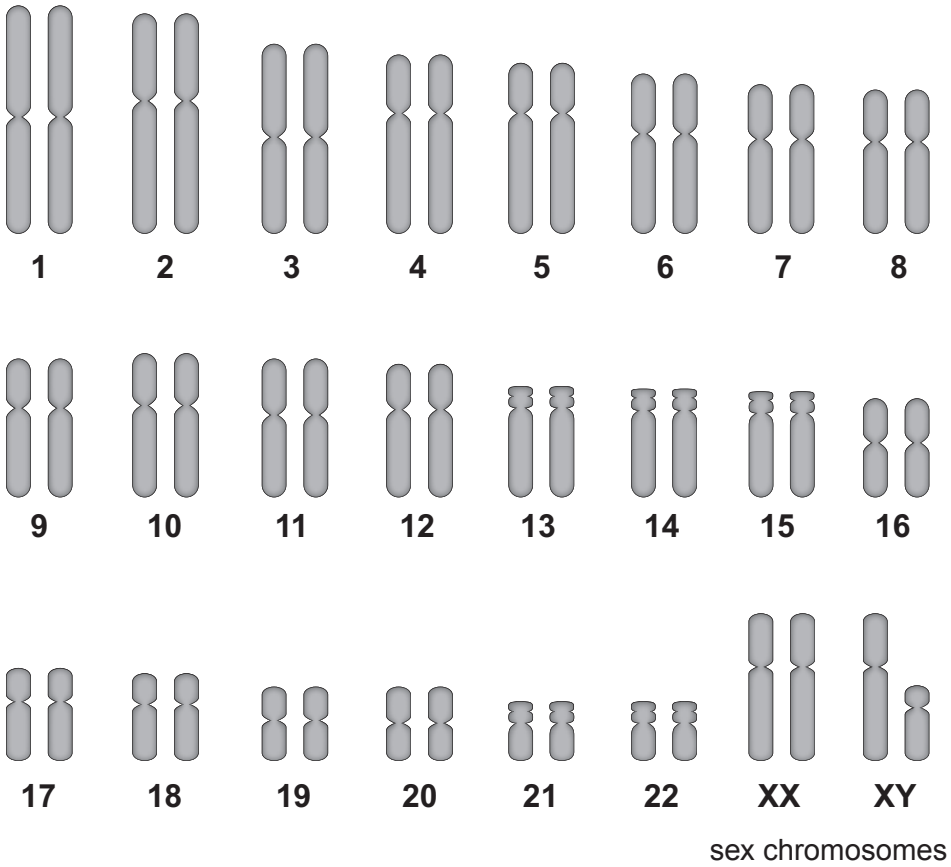
Answer **all** *questions.*

1. *(a)* The image shows human chromosomes.



(i) State the number of pairs of chromosomes present in a single body cell of a human. [1]

.....

(ii) State which sex chromosomes are present: [1]

in body cells of a man; .....

in body cells of a woman. .....

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(iii) Complete the Punnett square below to show the sex chromosomes in the gametes of a male and female parent and in their possible offspring. [2]

Male Parent

	Gametes		
Female Parent			

(b) Height in humans is controlled by many genes as well as by environmental factors. Females usually reach their full height by age 18 and males by 25.

Students investigated the heights of male and female airline cabin crew. All cabin crew must be between 1.58 m and 1.90 m in height and between 18 and 45 years of age.

The students said that they expected the males to be taller than the females.

They collected their data by selecting seven males and seven females at random and asking them to state their heights. They gave their heights in feet and inches and the students converted the data into metres.

The results, expressed to two decimal places, are shown in the table below.

Heights of females (m)	Heights of males (m)
1.80	1.84
1.78	1.80
1.83	1.72
1.68	1.70
1.75	1.61
1.82	1.81
1.69	1.73
mean height = ...	mean height = 1.74

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(i) **Complete the table** by calculating the mean height for females. [2]
Space for working.

(ii) I. State the hypothesis that the students were testing in their investigation. [1]

.....

.....

II. State whether the results of the investigation support their hypothesis, giving the reason for your answer. [1]

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III. Give **one** way in which the strength of the evidence could be improved. [1]

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(c) State **one** source of inaccuracy in the method. [1]

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2. Cystic Fibrosis (CF) is a serious medical condition which affects the lungs. It results from a mutation in the DNA of a single gene which gives rise to a recessive allele.

(a) Explain the meaning of the term *recessive allele*. [2]

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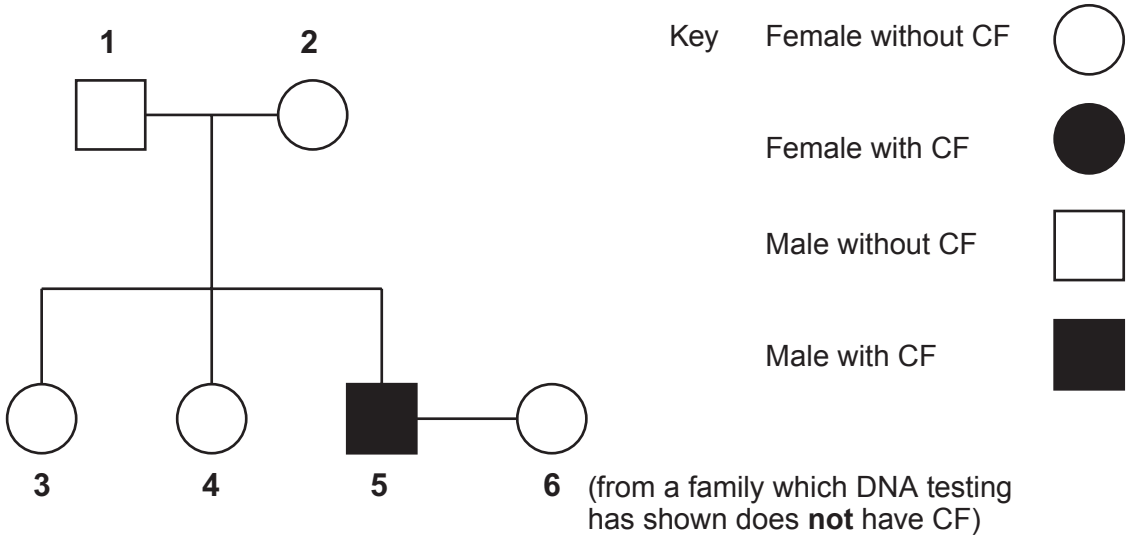
(b) The diagram below shows part of the family tree of a family which has one member who has CF.



(i) State the effect of a mutation on DNA. [1]

.....

.....

(ii) From the family tree:

I. State the numbers of **two** individuals who are known to be heterozygous for the allele which causes CF. [1]

.....

II. Suggest what advice a genetic counsellor would give individuals **5** and **6** about the chance of them having a child with CF. Explain your answer. [2]

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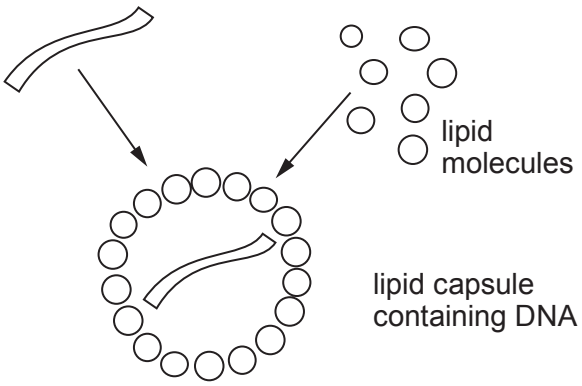
(c) CF is usually treated by intensive physiotherapy which can be very stressful. Medical scientists are now working to develop an alternative treatment called *gene therapy*. This process is summarised in the flow chart below.

Physiotherapy for CF



Gene therapy for CF

(i) Lipid capsules are introduced into the lungs. State how this would be done. [1]

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(ii) In order for this therapy to be successful two further difficulties must be overcome. Describe these **two** difficulties and suggest why this therapy is **not** a permanent cure. [3]

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3. *(a)* (i) State what is meant by a sense organ. [1]

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(ii) Name the **two** components of the central nervous system. [1]

....

(iii) State **three** properties of a reflex action. [1]

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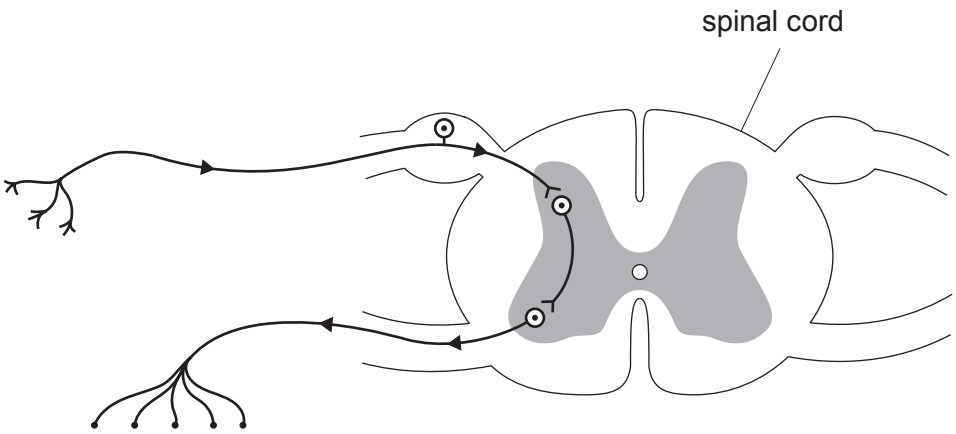
(b) The diagram below shows a reflex arc. **On the diagram label:** [2]

(i) the receptor

(ii) the motor neurone



(c) Motor neurone disease is a rare condition that is caused by the motor neurones not functioning correctly. Suggest the effect of motor neurone disease on a reflex action. [1]

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4. Chlamydia is the most common sexually transmitted disease (STD) diagnosed in Wales.

In 2013, there were 5 076 reported cases of chlamydia. By 2014 this number had risen to 5 452, of which 71.1% were 16 to 24-year-olds.

(a) (i) Give the scientific name of the pathogen that causes the disease chlamydia. [1]

.....

(ii) State the name of the group of micro-organisms to which this pathogen belongs. [1]

.....

(b) Describe how the spread of chlamydia can be prevented. [1]

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(c) (i) Calculate the number of 16 to 24-year-olds diagnosed with chlamydia in 2014. [2]

Number of young people = ...

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(ii) Calculate the percentage increase in new chlamydia diagnoses between 2013 and 2014. [2]

Percentage increase = ...

(d) Suggest why public health awareness campaigns targeting the spread of chlamydia are important. [2]

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5. There are many different species of snail. Students were asked to estimate the population density of the garden snail *(Cornu aspersum)* in a local park using the following method.

Method

- Use a tape measure to mark out an area of 30 m × 30 m.
- Search for snails in the marked area and pick them off any plants or the ground and place them in a bucket.
- Use an identification key to identify the garden snails.
- Count the number of garden snails caught and mark their shells with nail varnish.
- Allow the nail varnish to dry before releasing the garden snails.
- Search the marked area again for snails after 1 week.
- Count the total number of garden snails collected and the number of marked garden snails which you have found.
- Release the snails.
- Estimate the size of the population of garden snails for the area sampled using the formula:

$$P = \frac{a \times b}{c}$$

where P = size of population in sample area
a = number of garden snails collected, marked and released in the first sample
b = total number of garden snails collected in second sample
c = number of marked garden snails collected in second sample

Results

- Number of garden snails in first sample = 198
- Total number of garden snails in second sample = 152
- Number of marked garden snails in second sample = 8

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(a) (i) Garden snails are invertebrates. State what is meant by the term *invertebrate*. [1]

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(ii) Explain why it is important to use a scientific name to identify and classify organisms. [1]

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(b) (i) Use the formula given opposite to estimate the population of garden snails in the area sampled. [2]

Population of garden snails = ...

(ii) Use your answer from part *(b)*(i) to calculate the population density per m^2 of the garden snails. [2]

Population density = ... snails per m^2

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(c) State **two** assumptions made when using the method given on page 12 to estimate the population density of garden snails. [2]

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(d) Suggest how the students could improve the strength of evidence in their survey. [1]

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(e) Suggest **two** precautions that the students should take during this survey to reduce the risk of harm to individual snails or their habitat. [1]

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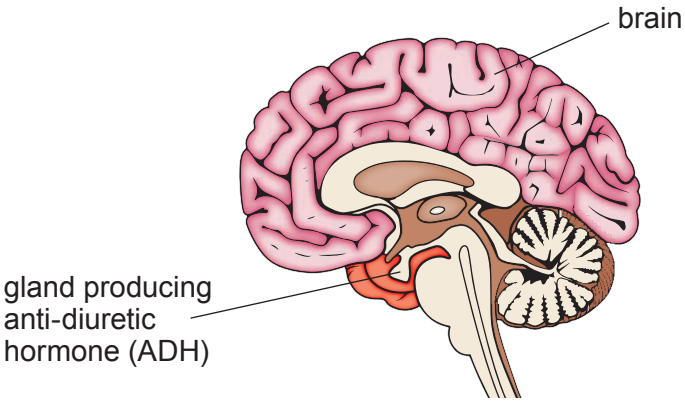
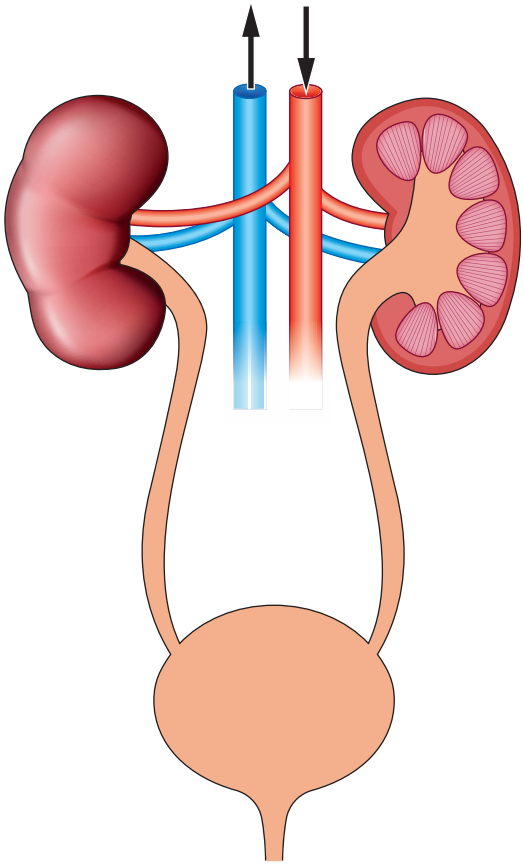
6. The diagrams below show a section through the human brain and also the excretory system.

The brain



The excretory system



(a) **On the diagram of the excretory system, label:** [2]

(i) the aorta;

(ii) the medulla of a kidney.

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(b) Explain the link between the quantity of anti-diuretic hormone (ADH) produced by the brain and the volume and concentration of urine produced in a person who is dehydrated.
[6 QER]

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7. The article below was taken from a newspaper in early 2017.

"DNA profiling snares Welsh sheep rustler after investigation."

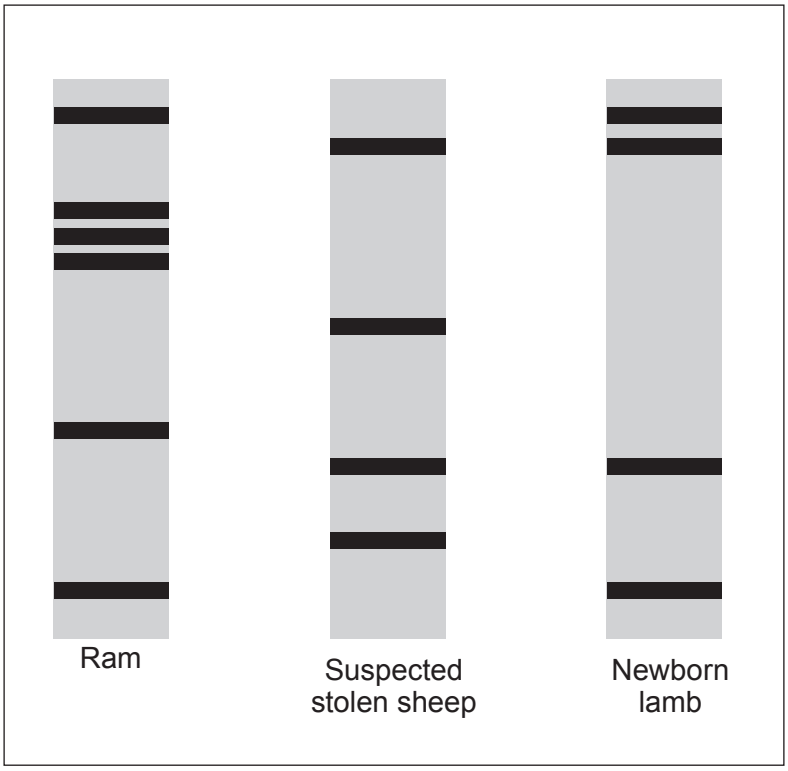
Daily Post 4/4/2017

In January 2015, a number of pregnant sheep were stolen from a farm. Enquiries within the local farming community revealed a pregnant sheep, which was suspected of having been stolen, had been sold at a livestock market.

The Animal Plant Health Agency (APHA) wanted to carry out DNA analysis on the sheep and its lamb. They had to wait two months for the sheep to give birth before taking a sample of blood from the lamb.

The diagram below shows a genetic profile of:

- the ram (known to be the father of the lamb in the suspected stolen sheep)
- the suspected stolen sheep
- the newborn lamb.



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(a) Describe the process of genetic profiling. [2]

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(b) Explain how the genetic profile provides evidence that the sheep had been stolen. [2]

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(c) State **one** possible health benefit and suggest **one** ethical concern linked to DNA profiling in humans. [2]

Possible health benefit

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Ethical concern

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8. *Staphylococcus aureus* is a bacterium which is a common cause of infection in human wounds.

S. aureus has become resistant to antibiotics.

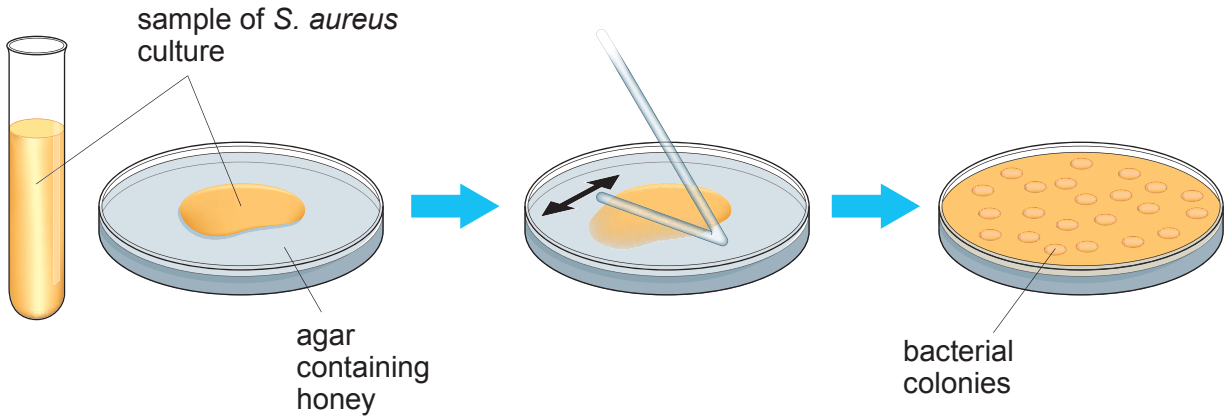
Honey has been used as a wound dressing for thousands of years. Scientists carried out a laboratory investigation to study the effect of honey on the growth of *S. aureus*.

A series of agar plates containing different honey concentrations was prepared.
A culture containing *S. aureus* was transferred to each of the agar plates.

1 0.3 mm^3 of *S. aureus* culture poured onto honey agar

2 Spread sample evenly over the surface

3 Agar containing honey at 3% concentration at 24 hours.



The plates were incubated for 24 hours and then inspected for the presence of bacterial colonies.
The results are shown below.

Concentration of Honey (%)	Bacterial colonies present (✓) or absent (×)
0	✓
1	✓
2	✓
3	✓
4	×
5	×
6	×
7	×
8	×
9	×
10	×

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(a) State the link between the number of bacterial colonies present on the agar in diagram **3** at 24 hours and the number of bacteria in the original sample. [1]

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(b) (i) Suggest the temperature at which the agar plates would have to be incubated in this investigation. Give a reason for your answer. [2]

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(ii) State **two** basic aseptic techniques that should have been followed in preparing the plates shown in the diagram. [2]

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(c) Using the diagrams, calculate the number of bacteria present in **1 cm^3** of the original *S. aureus* culture. **Present your answer in standard form**.
(Note 1 cm^3 = 1000 mm^3) [3]

Number of bacteria present = ... bacteria / cm^3

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(d) (i) Using the table on page 20, state the minimum concentration of honey required to stop the growth of bacteria for 24 hours. [1]

Minimum concentration = ... %

(ii) Suggest how scientists could develop their investigation to get a more accurate value for the minimum concentration of honey required to stop the growth of bacteria for 24 hours. [1]

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(e) State the **three** pre-clinical stages that would have to be carried out in order to develop honey as a new medicine for the treatment of wounds. [3]

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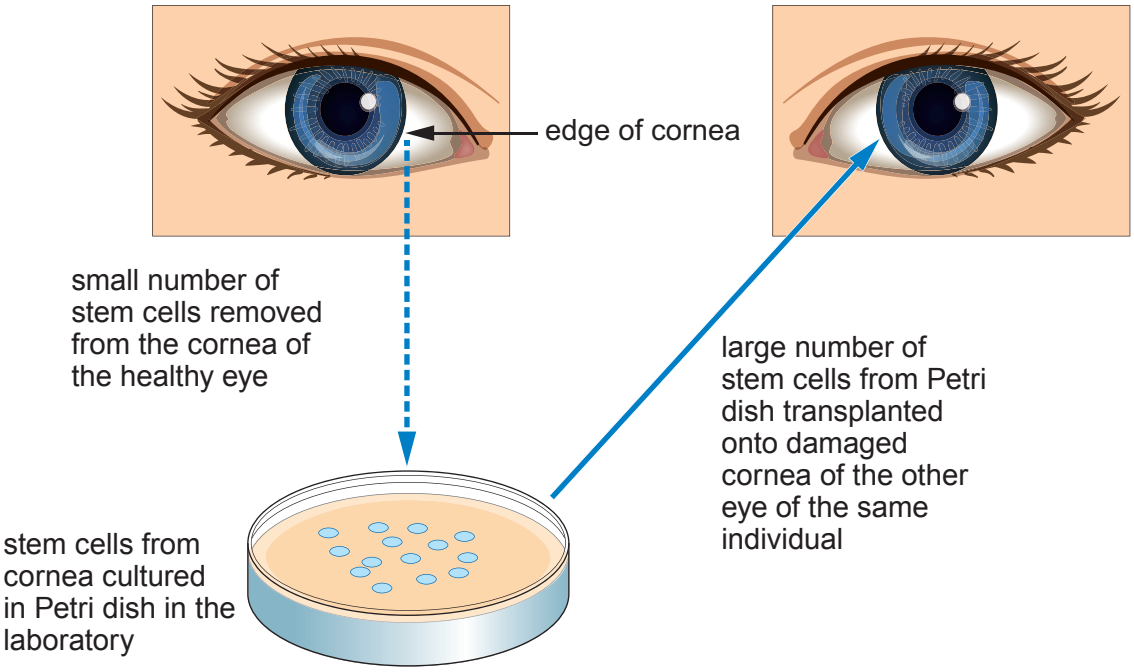
9. The eye is a complex organ made up of many tissues.
Diseases of the eye occur when one or more of these tissues are damaged or stop functioning.
Stem cell treatments are now being developed and used to treat many eye diseases.

Example 1 – Repairing the cornea (This treatment is now licensed for use.)

Stem cells at the edge of the cornea replace cells that are constantly being worn away. These stem cells may also be damaged by burns, radiation, genetic disorders, infection and drug use.

The diagram below shows a stem cell treatment to repair the cornea. This treatment uses stem cells from a healthy part of the cornea of an affected individual.

Diagram 1



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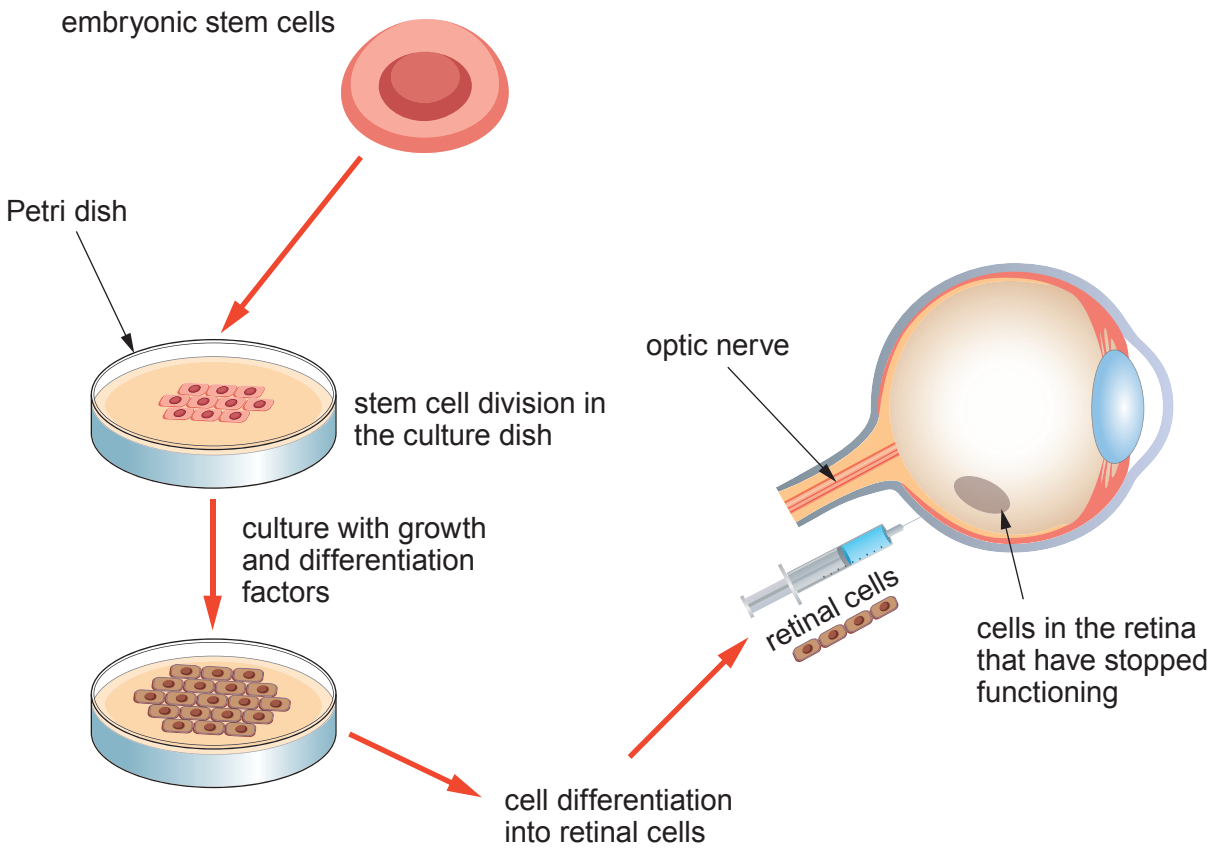
Example 2 – Repairing the Retina (This treatment is currently being researched and tested.)

In age-related macular degeneration (ARMD), cells in the retina stop functioning.

The diagram below shows a stem cell treatment for ARMD that uses embryonic stem cells to replace non-functioning cells in the retina.

Diagram 2



(a) State the function of the cornea. [1]

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.....

(b) Explain the meaning of the term *stem cell*. [1]

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(c) State the name of the type of cell division that occurs in the Petri dishes in diagrams **1** and **2** and explain its significance in the treatments. [3]

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(d) Suggest why example **1** does not work if both eyes are badly damaged. [1]

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(e) State **two** advantages of using stem cells as a treatment in example **1** compared to their use in example **2**. [2]

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END OF PAPER

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