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Solved by Anubha Roberts

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BIOLOGY

0610/41

Paper 4 Theory (Extended)

October/November 2024

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [].

Note– The keywords of
answer are underlined.

This document has **16** pages. Any blank pages are indicated.



1 Fig. 1.1 is a photomicrograph of a cross-section of part of a leaf.

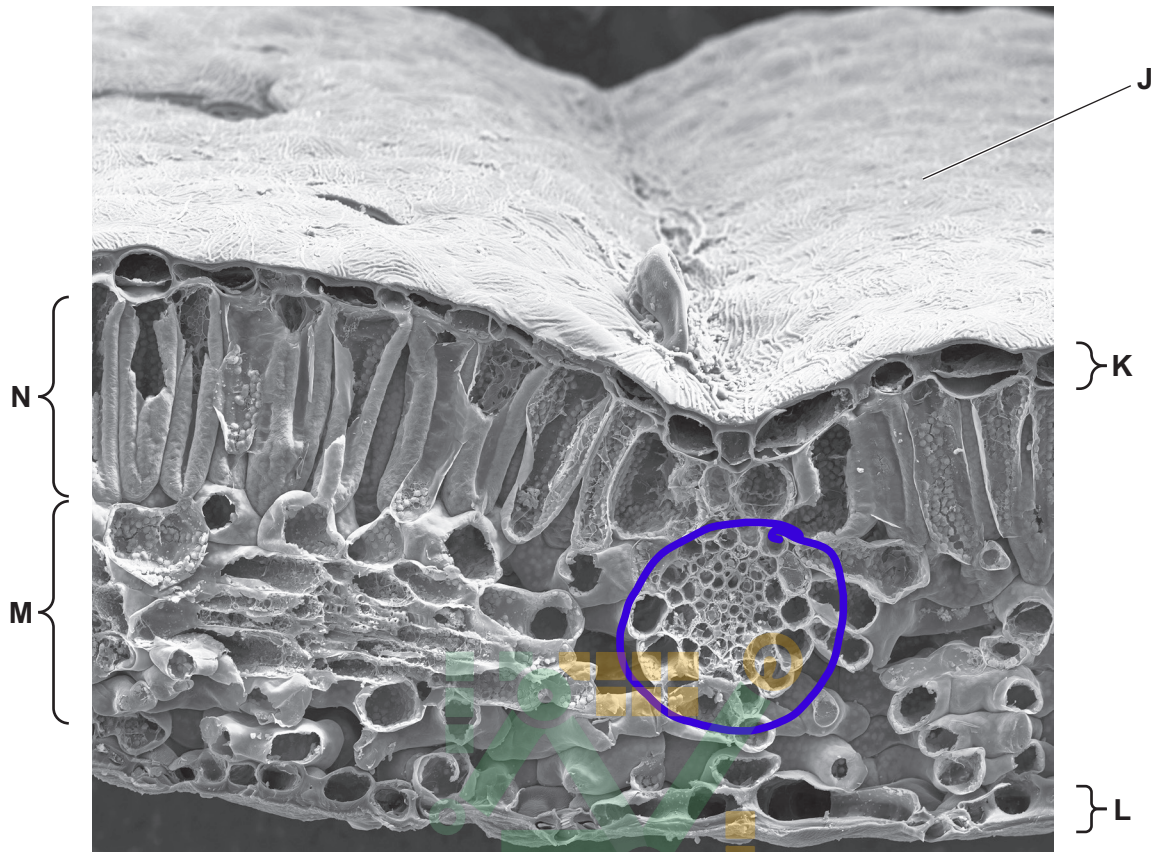


Fig. 1.1

(a) (i) State the letter in Fig. 1.1 that identifies where:

gas exchange is controlled

L (lower epidermis)

most photosynthesis occurs

N (Palisade cells)

spongy mesophyll cells are found.

M

[3]

(ii) Draw a circle on Fig. 1.1 to identify a vascular bundle.

[1]

(iii) Translocation occurs in the vascular bundle.

State the names of **two** substances that are only moved by translocation.

1 **Amino acids**

2 **Sucrose**

[2]



- (b) Explain how xylem vessels are adapted for their functions.

Xylem vessels have lignin in
cell walls to provide support.

No cell cytoplasm or hollow
tube to transport water
without resistance.

[3]

- (c) Describe how water moves through a plant from the soil to the air spaces in a leaf.

Water moves inside the root
hair cells by osmosis
Water moves inside the roots
to root xylem.

Inside the xylem, water molecules
move in continuous column due
to evaporation of water from
surface of mesophyll cells followed
by diffusion out of stomata.

[4]

- (d) Explain why plants need nitrate ions.

Nitrate ions combine with glucose
to form amino acids which further
form proteins used in growth
and to form enzymes.

[2]

[Total: 15]





- 2 (a) Chlamydia is a sexually transmitted infection (STI) that is caused by a bacterium.

Fig. 2.1 shows the number of chlamydia cases in a country in 2018.

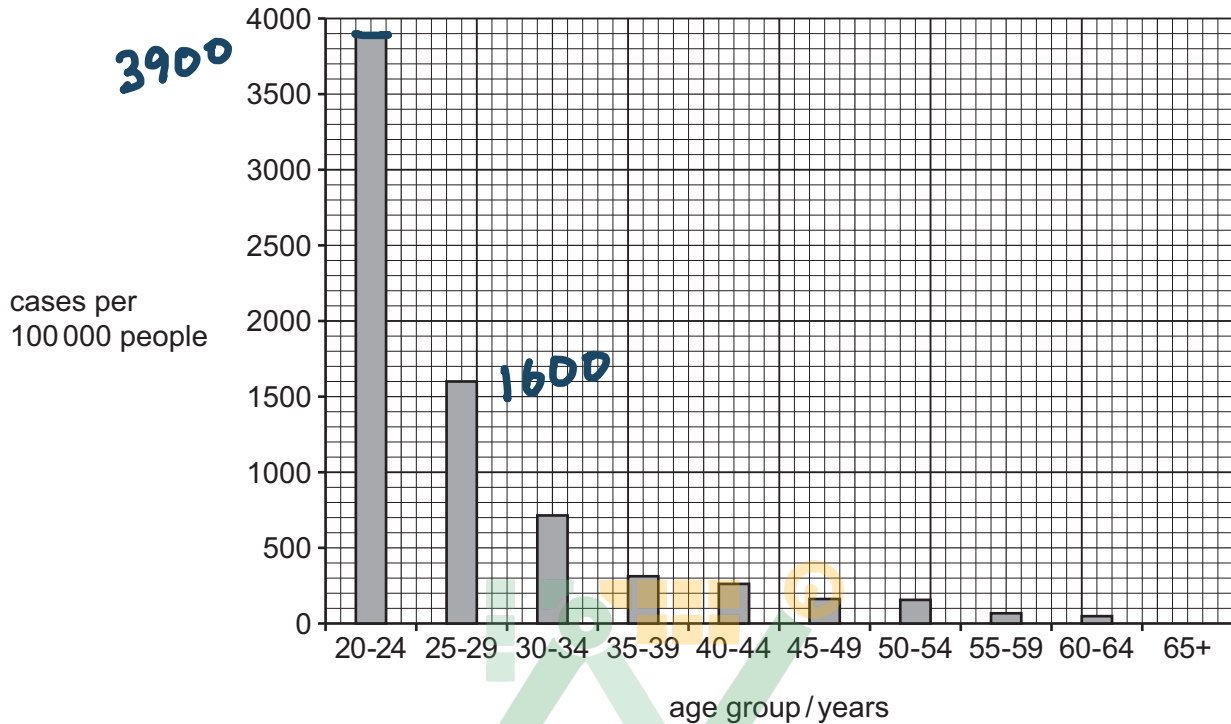


Fig. 2.1

- (i) Calculate the percentage decrease in the number of chlamydia cases between the age groups 20–24 and 25–29.

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

Space for working.

Percentage change formula

$$\frac{\text{Final} - \text{Initial}}{\text{Initial}} \times 100$$

$$\frac{1600 - 3900}{3900} \times 100 = -58.97\% \quad \text{[3]}$$

-59

↑

$$\frac{2300}{3900} \times 100 = -58.97$$



- (ii) Describe how the spread of STIs, such as chlamydia, can be controlled.

STI spread by sexual contact.
so by avoiding sexual contact
or by using condoms.

Can be treated by antibiotics.
and by getting vaccinated
to get active immunity.

[4]

- (b) Chlamydia can damage the reproductive system.

- (i) State the name of the part of the female reproductive system that produces oestrogen.

Ovaries.

[1]

- (ii) Describe the role of oestrogen at puberty.

It is responsible for high pitch
voice, growth of hips and
pubic hairs and other
secondary sexual characteristics.

[3]



- (c) Complete the sentences about drug resistance and genetic variation by writing a suitable word or phrase in the spaces provided.

Bacteria can be killed by drugs called antibiotics. The development of strains of bacteria that are resistant to these drugs is an example of natural selection.

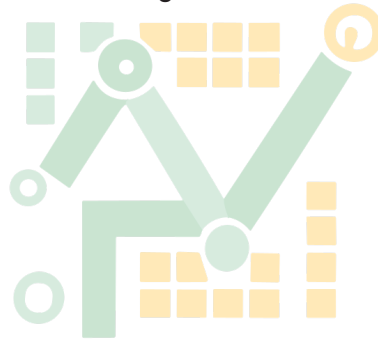
Resistant strains of bacteria have gene mutations that enable them to survive drug treatment.

Gene mutations are caused by random changes in the sequence of bases in DNA and result in the formation of new alleles in the bacteria. Mutation rates can be increased by ionising radiation and some chemicals.

In animals and plants, another source of genetic variation is a type of nuclear division called meiosis.

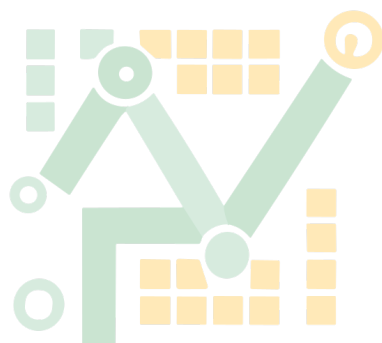
[6]

[Total: 17]



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3 (a) Fig. 3.1 shows the structure of the pathogen that causes cholera.

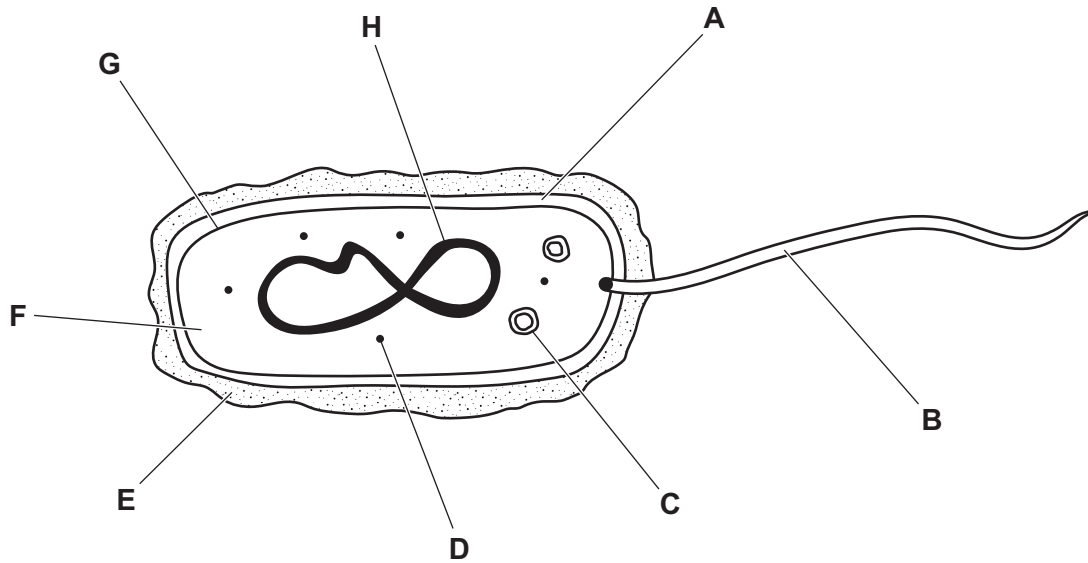


Fig. 3.1

- (i) State the name of the kingdom that includes the pathogen shown in Fig. 3.1.

Prokaryotes.

[1]

- (ii) Table 3.1 shows some of the names, functions or uses, and identifying letters of the parts labelled in Fig. 3.1.

Complete Table 3.1.

Table 3.1

name	function or use	letter from Fig. 3.1
flagellum	<i>to move</i>	<i>B</i>
<i>Cell membrane</i>	<i>Control movement of molecules in and out of cell.</i>	<i>G</i>
<i>Ribosomes</i>	protein synthesis	<i>D</i>
cell wall	<i>Prevents the cell from bursting</i>	<i>A</i>
<i>Plasmid DNA</i>	used by humans in genetic modification	<i>C</i>

[5]



- (b) Describe how a person becomes infected with cholera.

Consuming contaminated water.

[1]

- (c) People with cholera can become very dehydrated.

Explain how cholera causes dehydration.

Cholera bacteria produces toxin
toxin causes Chloride ions to move
in lumen and reduce water potential
water from the cells now move
in lumen by osmosis resulting
Diarrhoea loss of water in faeces
and dehydration.

[4]

- (d) Vaccination can help to prevent the spread of diseases such as cholera.

Outline the process of vaccination and explain how it can prevent the spread of diseases.

Weak form of pathogen is
injected.
Pathogen has antigens over its surface.
Lymphocytes produce antibodies
complementary to antigens.
Antibodies bind to antigens
and mark them for destruction
by phagocytes.
Memory cells are produced to
provide long-term immunity.
Less chances of transmission of
disease as most of people are
vaccinated.

[6]

[Total: 17]

[Turn over]



- 4 (a) Complete the sentence about the mammalian nervous system.

The central nervous system consists of the brain and spinal cord and the peripheral nervous system consists of the nerves outside the brain and spinal cord.

[1]

- (b) Fig. 4.1 shows the parts of a reflex arc.

M	effector
N	motor neurone
P	receptor cell
Q	relay neurone
R	response
S	sensory neurone
T	stimulus

Fig. 4.1

- (i) Put the parts listed in Fig. 4.1 into the correct sequence, and write the letters in the boxes.

Two have been done for you.

T	P	S	Q	N	M	R
---	---	---	---	---	---	---

[2]

- (ii) State **two** stimuli that are detected by the skin.

1 Pain
2 Temperature

[2]

- (iii) The pupil reflex controls the amount of light that enters the eye.

State the name of an effector in the pupil reflex.

circular muscles

[1]



- (c) Describe and explain how impulses are **only** passed in one direction from one neurone to the next.

Neurotransmitters are produced in pre synaptic neurone membrane which are released in synaptic gap. They diffuse in the gap to the post synaptic neurone membrane and bind to receptors impulse is generated in the next neurone.

Neurotransmitters are produced by previous neurone and receptors are present on second neurone only [5]

[Total: 11]

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- 5 The gene for red-green colour vision is on the **X** chromosome.

There are two alleles for this gene:

- The allele for normal colour vision is represented by the letter **B**.
- The allele for red-green colour blindness is represented by the letter **b**.

Fig. 5.1 shows a pedigree chart for a family in which some of the members are red-green colour-blind.

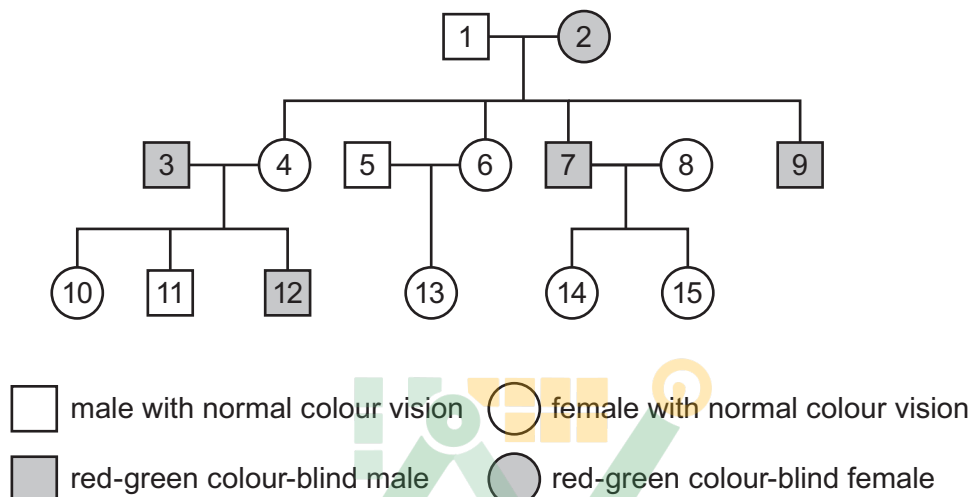


Fig. 5.1

- (a) Explain why all of the male children of parent 1 and parent 2 are red-green colour-blind.

Female (2) has color blindness $x^b x^b$ is homozygous recessive. She passes her x^b chromosome to her male children who have $x^b y$ and only one x^b chromosome for being recessive color blind male. [2]





- (b) Parent 4 is a female who has normal colour vision and is heterozygous for red-green colour blindness.

Complete the genetic diagram to determine the probability that the offspring of parent 3 and parent 4 would be red-green colour-blind.

parents

3

x

4

parental phenotypes

red-green colour-blind male

x

female with normal colour vision

parental genotypes

$x^b y$

x

$x^B x^b$

gametes

x^b

y

x

x^B

x^b

	x^B	x^b
x^b	$x^B x^b$	$x^b x^b$
y	$x^B y$	$x^b y$

offspring genotypes	$x^B x^b$	$x^b x^b$	$x^B y$	$x^b y$
offspring phenotypes	Carrier female	Color-blind female	Normal male	Color-blind male

probability of offspring having red-green colour blindness 50%

[5]

[Total: 7]

[Turn over]





6 Penicillin can be produced in fermenters.

(a) State the name of the type of organism that produces penicillin.

Fungus

[1]

(b) Fig. 6.1 shows the change in biomass of the organism that produces penicillin, when grown in a fermenter under controlled conditions.

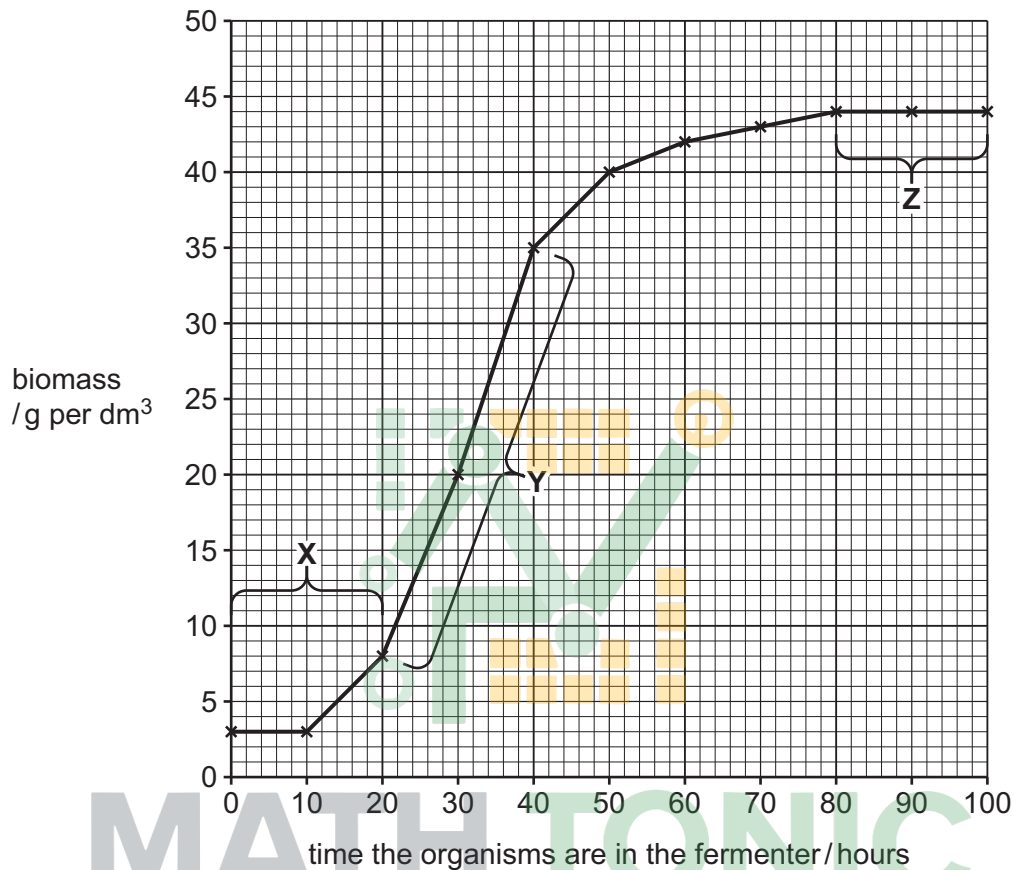


Fig. 6.1

State the name of the growth stages of the organism, shown by the letters X, Y and Z in Fig. 6.1.

X *Lag*

Y *Exponential*

Z *Stationary*

[3]



(c) Fig. 6.2 is a diagram of a fermenter containing the organisms that produce penicillin.

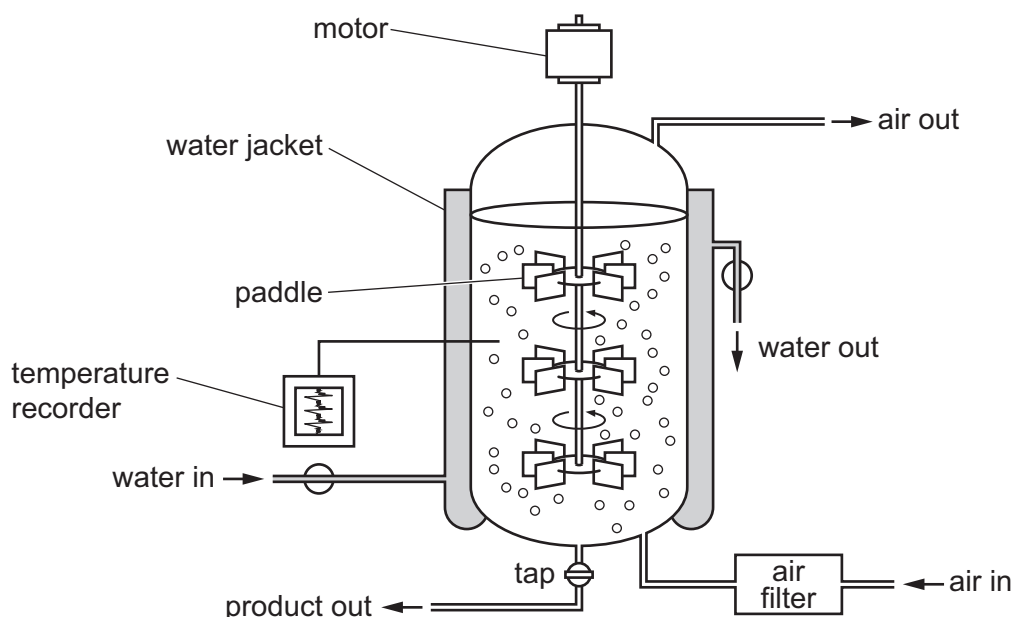


Fig. 6.2

- (i) Explain why air is supplied to the fermenter shown in Fig. 6.2.

Supplies Oxygen to the fungus
to release energy by
aerobic respiration for
growth

[2]

- (ii) Explain why the temperature in the fermenter must be controlled.

Enzymes require optimum
temperature
Excess of heat due to
respiration can denature
enzymes
to increase the production of
product by enzyme activity.

[3]



- (iii) State the role of the paddles in the fermenter.

Paddles distribute Oxygen and nutrients uniformly. Paddles also allow uniform temperature in the fermenter.

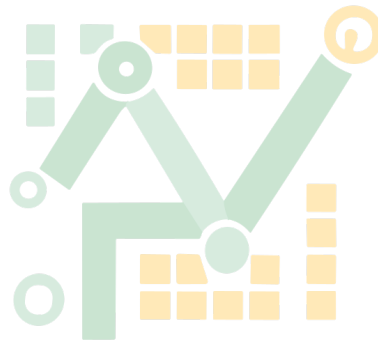
[2]

- (iv) Other than penicillin, state the names of **two** commercial products that can be made using fermenters.

1 Insulin
2 Antibodies

[2]

[Total: 13]



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