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SUBJECT

BIOLOGY – Paper 02

PROFICIENCY

GENERAL

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MAY/JUNE 2018

C A R I B B E A N E X A M I N A T I O N S C O U N C I L

**C A R I B B E A N S E C O N D A R Y E D U C A T I O N C E R T I F I C A T E[®]
E X A M I N A T I O N**

BIOLOGY

Paper 02 – General Proficiency

2 hours 30 minutes

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of SIX questions in TWO sections. Answer ALL questions.
2. Write your answers in the spaces provided in this booklet.
3. Do NOT write in the margins.
4. Where appropriate, answers should be illustrated with diagrams.
5. If you need to rewrite any answer and there is not enough space to do so on the original page, you must use the extra lined page(s) provided at the back of this booklet. **Remember to draw a line through your original answer.**
6. **If you use the extra page(s), you MUST write the question number clearly in the box provided at the top of the extra page(s) and, where relevant, include the question part beside the answer.**

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SECTION A

Answer ALL questions in this section.

1. (a) Scientists, interested in studying the survival of organisms living at high temperatures, identify some microorganisms living in a desert habitat where the average daily temperatures exceed 50 °C. They extract an enzyme, protease, that facilitates the digestion of proteins from these organisms, and investigate the effect of temperature on the action of this enzyme.

- (i) State TWO precautions that they should take in carrying out this experiment.

Ensure enzyme is viable/ not denatured. Ensure that it is living.

Accurate reading from thermometer to avoid parallax error.

(2 marks)

- (ii) The results of their experiment are presented in Table 1. On the grid provided in Figure 1 on **page 5**, draw a graph to represent the results presented in Table 1.

(4 marks)

**TABLE 1: RESULTS OF EXPERIMENT INVESTIGATING
THE EFFECT OF TEMPERATURE ON ENZYME ACTIVITY**

Temperature (°C)	5	10	30	45	50	55	60	65
Time Taken for Protein to Disappear (minutes)	60	60	45	25	18	15	60	60

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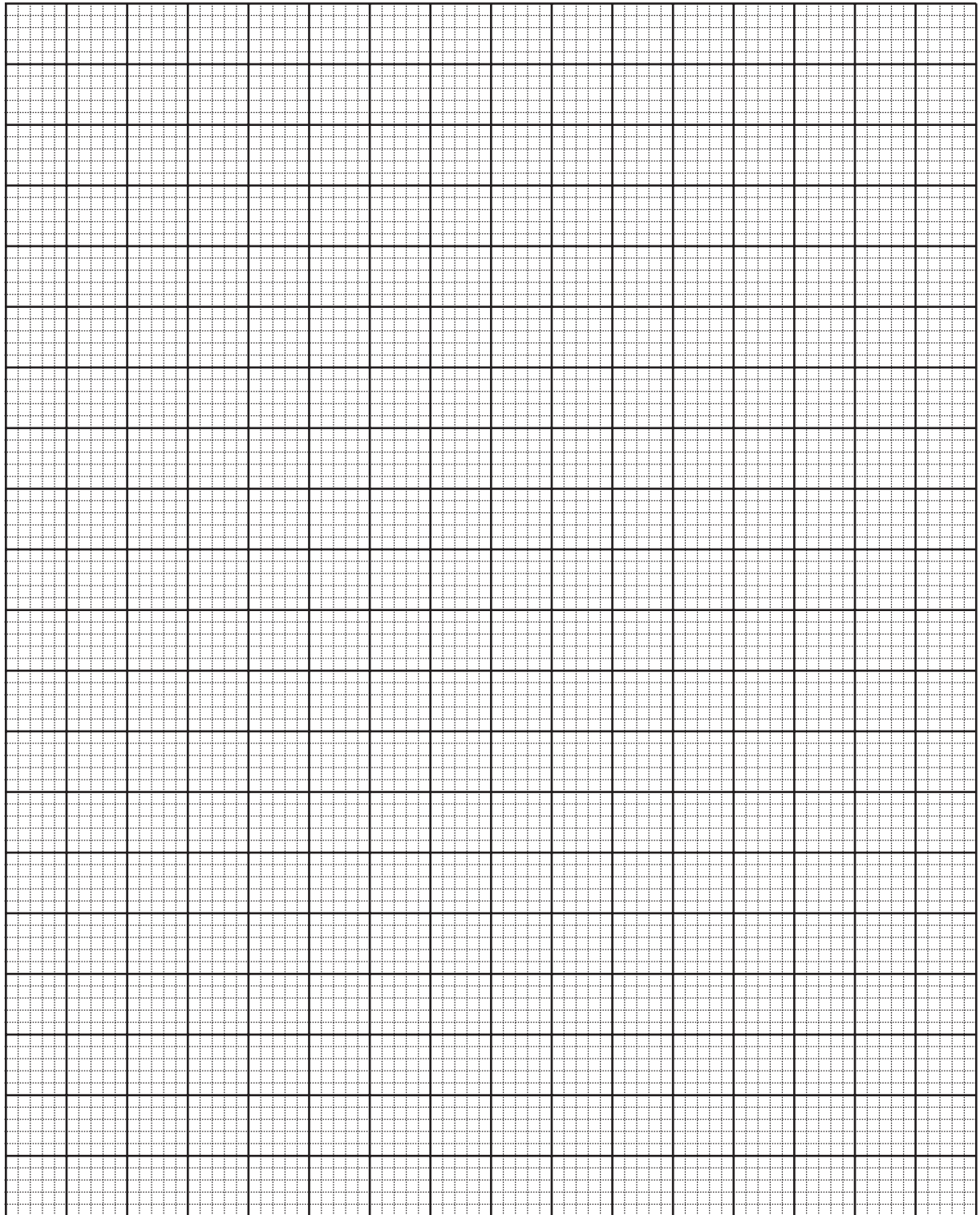


Figure 1. Results of experiment

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- (iii) From the graph in Figure 1, identify the optimum temperature for the protease activity.

55 degrees Celsius

(1 mark)

- (iv) Suggest ONE reason for the shape of the graph at less than 10 °C, TWO reasons for the shape of the graph between 10 and 55 °C, and ONE reason for the shape of the graph at more than 55 °C.

Less than 10 °C

Little enzyme activity, no kinetic energy

Little or no energy to react for the enzyme to meet the substrate.

10–55 °C

Enzyme activity increases, this means that the protein/substrate is broken down faster.

It has a lot of kinetic energy as molecules collide faster

Enzymes work the fastest at 55 degrees Celsius.

More than 55 °C

Enzyme will denature

Active site is destroyed and can no longer bind to the substrate.

(4 marks)

GO ON TO THE NEXT PAGE

- (v) Describe a suitable procedure that the scientists could use to investigate the effect of pH on the activity of the protease enzyme.

Investigating effect of pH

- The same volumes of enzyme and the same volume of substrate at each pH
- Enzyme/substrate mixture added to reagents/buffer with a range of pH (acid, alkaline, neutral)
- Keep temperature constant for all samples
- Replicate experiment at each pH
- Use protein test to determine that protein is no longer present (end point)
- Results of Rate/time of disappearance of substrate at each pH recorded/plotted/used to draw a graph

(3 marks)

Note: Acid and base to produce salt and water

- (b) The human skin shown in Figure 2 is an organ which helps humans to regulate their body temperature.

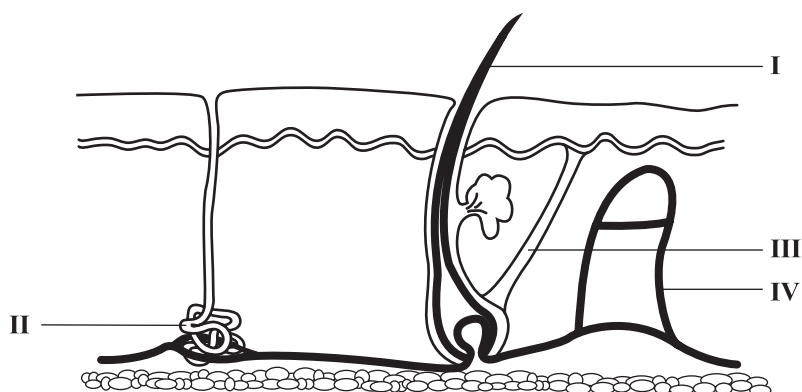


Figure 2. Vertical section through human skin

- (i) Name the parts labelled I, II, III and IV in Figure 2.

I Hair follicle
II Sweat gland
III Erector muscle
IV Blood capillary

(4 marks)

- (ii) Describe how the structures named in (b) (i) help humans to regulate their body temperature.

Cooling:

- Erector muscles relax
- Hairs lie flat on skin
- Arterioles/blood capillaries/blood vessels dilate to supply more blood to skin
- Sweat gland produces more sweat/sweat evaporates

Heat conservation/Warming up:

- Erector muscles contract.
- Hair stands up
- Layer of heat/warm air trapped at surface.
- Arterioles constrict to reduce blood flow to the skin/retain heat in blood vessels.
- Sweat glands stop producing sweat.

(4 marks)

- (c) Explain how changes in the epidermal cells of leaves help plants to conserve water during high temperatures.

Conservation of water

- Epidermal cells consist of guard cells which surround openings called stomata
- Many/more stomata are in the lower epidermis
- Few stomata on upper surface/epidermis
- Guard cells are bean shaped with thin outer cell walls and thickened inner walls to permit opening/closing of stoma/opening
- At high temperatures guard cells lose water causing them to get flaccid
- Stomata close when guard cells are flaccid
- Stomata close during the day when temperatures/transpiration rates are high
- Epidermal cells develop a waxy cuticle which prevents water loss

(3 marks)

Total 25 marks

Transpiration is the process where plant cells loses water.

2. (a) Figure 3 shows three different types of cells, A, B and C.

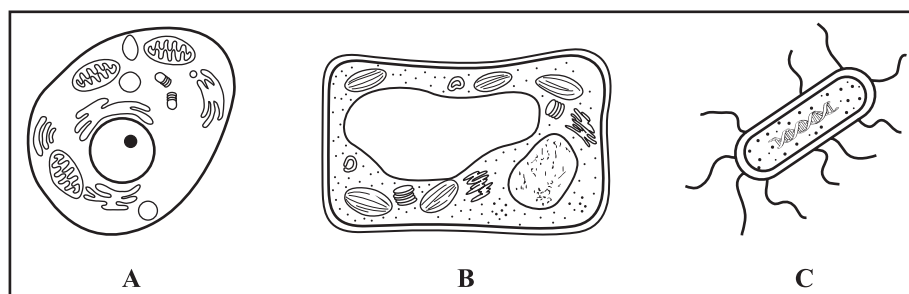


Figure 3. Diagram showing three different types of cells

- (i) Name the types of cell labelled A, B and C in Figure 3.

A animal/eukaryotic

B plant/eukaryotic

C bacterial/prokaryote/prokaryotic

(3 marks)

- (ii) Name TWO structures that are common to the three types of cell.

cell membrane, cytoplasm, vacuoles

(2 marks)

- (iii) State TWO differences between the type of cell labelled A and the type of cell labelled C.

Prokaryotes (C) lack nucleus membrane-bound organelles

• A/B belongs to multicellular while C belongs to a unicellular organisms

• A has a nucleus while C has a Nucleoid with DNA (no proteins)

• C Small(70S) ribosomes; A has 80s ribosomes

• C has No membrane-bound organelles

• C has flagellum

• Accept: No vacuole in C

• A has no cell wall while C has a cell wall

(2 marks)

GO ON TO THE NEXT PAGE

- (b) Tissues made up of Type B cells are placed in a container of concentrated salt solution and left for one hour.

Describe THREE changes in the appearance of the cells after one hour in the concentrated salt solution, and give an explanation to account for these changes.

Cell B in conc. salt solution

Changes

- Cell becomes plasmolyzed/ Cell membrane shrinks away from the cell wall/ Cytoplasm/Protoplasm/Protoplast pulls away from cell wall (1)
- Cell wall becomes more visible/slightly shrunken
- Cell becomes flaccid
- Shape and size of cell are retained (Accept the cell shrinks)
- Vacuole/organelles/nucleus gets smaller in size.

Explanation

Cell loses water through osmosis/salt unable to cross the membrane but enters the cell wall

(4 marks)

- (c) Tissues made up of Type A cells and Type B cells are placed in a container of distilled water and left for one hour.

Describe how the appearance of Type A cells is expected to differ from that of Type B cells and give an explanation for this difference.

Cells in distilled water

- For cell A, the cell will expand/gets swollen and the cell membrane will rupture, releasing its content
- For cell B, the cell will become turgid, the cell wall retain its shape/slight increase in size

Explanation

- Water enters both cells by osmosis, the pressure in both cells increases, but cell A has no cell wall to handle the increased pressure and burst
- Cell B remains intact/does not burst; has a cell wall and a large vacuole which allows it to handle the increased pressure.

(4 marks)

Total 15 marks

3. (a) Figure 4 shows a section through the human eye.

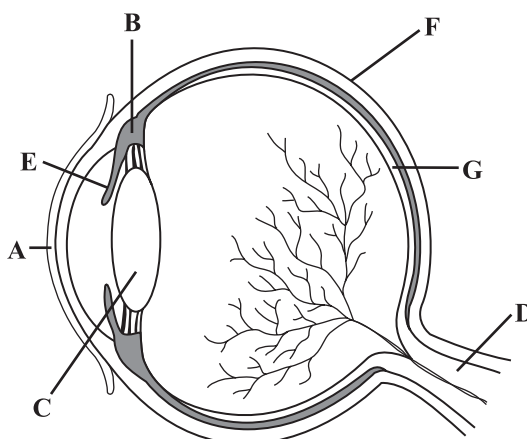


Figure 4. Section through the human eye

Table 2, which is incomplete, shows structures in the human eye labelled in Figure 4 and their related functions.

Complete the table by matching EACH labelled part of the eye to its function. Write the letter and the name of the part. The first row has been completed for you.

TABLE 2: FUNCTIONS OF THE PARTS OF THE EYE

Letter	Structure	Function
A	Conjunctiva	The membrane that protects the cornea
D	Optic nerve	Transmits nerve impulses to the brain
C	Lens	Becomes more or less convex to focus light on the retina
E	Iris	Controls the amount of light passing through the pupil
B	Ciliary Muscle	Contracts and relaxes to alter the shape of the lens
F	sclerotic coat	Protects and keeps the shape of the eye
G	Retina	Converts light energy to nerve impulses

(6 marks)

GO ON TO THE NEXT PAGE

- (b) Name ONE type of light sensitive cell found in the retina.

rods or cones

(1 mark)

- (c) Explain why colours are seen less clearly in dim light than in bright light.

Cone is responsible for colour/vision. It is sensitive to colour.

Cones work best in bright light.

Rods are responsible for vision in dim light.

(2 marks)

- (d) A colour-blind woman mates with a man who has normal colour vision. Determine the probability of this couple having a colour-blind daughter by completing the genetic diagram below.

Parents' phenotypes: Normal colour vision man × colour-blind woman

Parents' genotypes: $X^C Y$ × $X^c X^c$

Gametes: X^c Y X^c X^c

Fertilization cross:

Gametes →	male		
↓ female		X^c	Y
X^c	$X^c X^c$	$X^c Y$	
X^c	$X^c X^c$	$X^c Y$	

Probability of colour-blind daughter zero

(6 marks)

Total 15 marks

SECTION B

Answer ALL questions.

4. (a) Figure 5 is a diagram of the human respiratory system. Name the parts labelled A, B, C, D, E and F in the space provided.

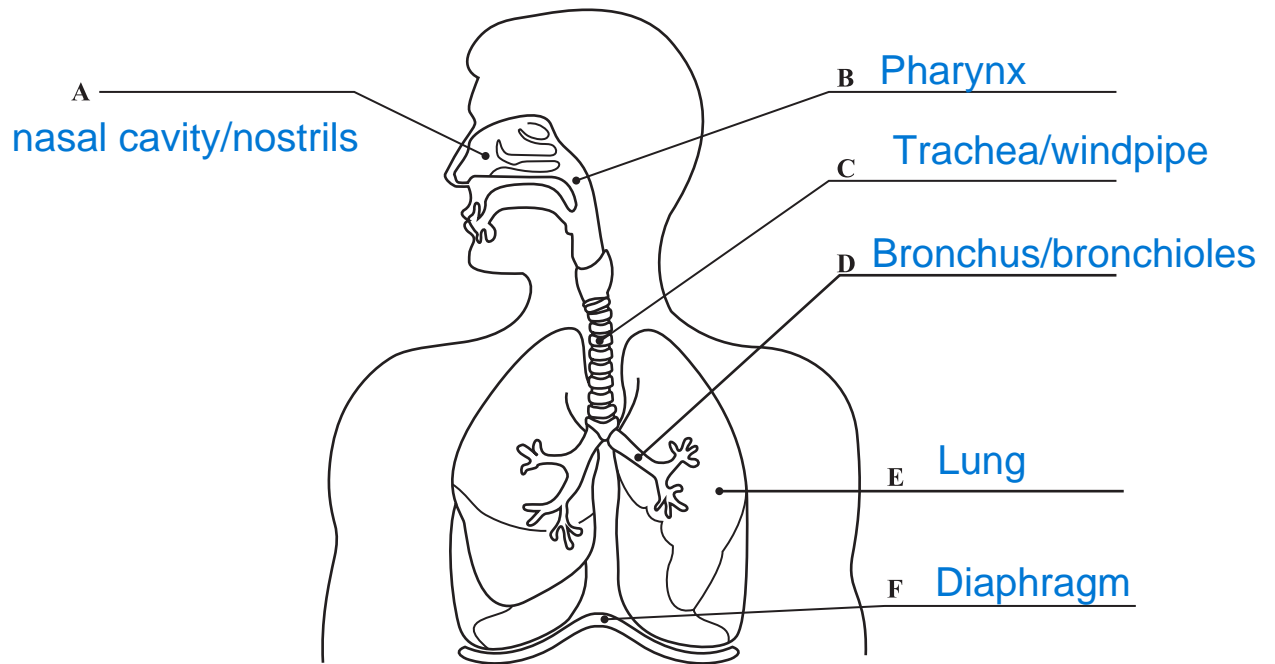


Figure 5. Diagram of human respiratory system

(6 marks)

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- (b) State TWO characteristics that the respiratory surface used for gaseous exchange in human beings has in common with the respiratory surface used in flowering plants. Explain how EACH characteristic makes the respiratory surface suitable for gaseous exchange.

Large surface area allows for more gaseous exchange to take place quickly whereas for a small surface area there is a reduction of gaseous exchange.

The respiratory surface is thin which allows for rapid diffusion.

The respiratory surfaces are kept moist since oxygen and carbon dioxide must be dissolved to facilitate diffusion.

(4 marks)

(c) Advertisements for electronic cigarettes promise to supply nicotine to the body without the harmful effects of cigarette smoke. These cigarettes are promoted as a healthier alternative to smoking regular cigarettes.

- (i) Outline the effects of THREE named components of cigarette smoke, **other** than nicotine, on the human body.

Effects of components of cigarette smoke

- Tar: cancer of mouth, throat, lungs/ causes lungs to blacken and reduces lung function/staining of teeth/gums
- Carbon monoxide: combines with haemoglobin and reduces oxygen-carrying capacity.
- Particles: stop cilia from sweeping out mucus from bronchial tubes leads to bronchitis; emphysema/short breath/difficulty breathing
- Acrolein in vapour: constriction of bronchioles leading to bronchitis; difficulty breathing

(3 marks)

- (ii) Outline TWO ways in which the use of nicotine in electronic cigarettes may be harmful to the human body.

Effects of nicotine in e-cigarette

- Affects neurotransmitter substances/affects brain function/speeds up action of the CNS.
- Adrenalin released/heart rate increased
- Blood pressure increased
- Blood platelets adhere / clot/clump/stick to each other.
- Fatty substances increase in the blood.
- Increases blood glucose levels
- Raises metabolic rate
- Reduces appetite/ causes weight loss in the long term
- Artery walls thicken and harden.
- ADH secretion increases / urine reduces
- Causes addiction/dependency/craving

(2 marks)

Total 15 marks

5. (a) Name THREE components of human blood that are important in protecting the body against pathogenic diseases and state the function of EACH.

Blood components for protection against pathogens

• Phagocytes engulf and destroy bacteria/pathogens.

• Lymphocytes produce (specific) antibodies to destroy disease causing bacteria.

• Platelets cause clotting/prevent entry of pathogens/prevent exposure to environment.

(6 marks)

GO ON TO THE NEXT PAGE

- (b) Marianne, a one-month-old baby acquires immunity from her mother through breastfeeding. Marianne's father accidentally punctures his finger with a nail but does not need a tetanus antiserum injection because he received a tetanus vaccine the previous year.

Explain how the type of immunity that Marianne acquired from breastfeeding differs from the type of immunity that her father acquired from his vaccine. In your explanation, state the name of EACH type of immunity.

Marianne's immunity:

- Natural passive/immunity
- Antibodies produced by mother
- Mother's antibodies pass to baby through colostrum/breast milk/breastfeeding

Father's immunity:

- Artificial/Active immunity
- Antibodies are produced by father's own lymphocytes/immune system after vaccination
- Vaccine contains (weakened/small dosage of) antigens/pathogens
- Memory cells produced

(5 marks)

- (c) The authorities prevent children who are not immunized from registering in public schools.

Suggest TWO reasons why some parents may have a valid concern about immunizing their children and TWO reasons why the authorities maintain their position on preventing the entry of unvaccinated children.

Parents' concern about immunization

- Vaccine not considered safe/may cause their children to become sick/disabled
- May cause the child to die
- Religious/cultural concerns e.g. Rastafarian.
- The manner in which the vaccine is made/ tested/given e.g. vegetarians may not want to use a vaccine tested on animals.

Authorities' position

- Unvaccinated children can transmit disease to other children.
- Cause transmission to adults.
- Contributes to loss of productivity
- Increased absentee from school/work.
- Contributes to increased medical costs.

(4 marks)

Total 15 marks

6. (a) Describe how the process of mitosis results in the production of identical cells in **asexual** reproduction.

Description of process

- Stage 1/Prophase – Each Chromosome consists of two sister chromatids appears short and fat/Nuclear membrane disappears/Nucleolus shrinks and disappears/Centrioles move to opposite sides of the cell/Spindle fibres form

- Stage 2/Metaphase – chromatids/ chromosomes line up on the equator of the cell. chromosomes attach to spindle fibre at the centromere

- Stage 3/Anaphase – chromatids/chromosomes pulled apart to opposite poles/Exact copies of chromosomes are at both sides/opposite poles of the cell

- Stage 4-6/Telophase – Nuclear envelope around the group of chromosomes to make a nucleus/new nucleus forms. Nucleolus re-appears. Cytokinesis take place. Cell membrane develops down the middle of cell to divide into two (cleavage) cells

Four daughter cells are formed, each with the haploid number of chromosomes whose compositions are different. The chromosomes then become long and thin, so they are no longer visible

(6 marks)

- (b) Plants that reproduce **sexually** have some advantages compared to those that reproduce only asexually. Outline TWO advantages and THREE disadvantages of sexual reproduction.

Advantages

- Varies genetically from parents so may adapt better to surroundings and provides the material for evolution.
- Reduces competition among offspring for similar resources due to variation.
- Dispersal of fruits/seeds/seedlings occurs at a distance from parents so reduced competition for resources
- Reduced chance of extinction/better chance of the species surviving or not becoming extinct.

Disadvantages

- Successful reproduction depends on availability of male (pollen) and female flower (Ovule) parts.
- Reproduction may require external agents such as insects, wind, water/nectar for pollination
- Can only be pollinated by the same species
- Sexual reproduction takes longer to occur.
- Takes a longer time to colonise an area
- Seeds produced may not be viable.
- Seeds/fruits produced require dispersal mechanisms which may be unreliable.
- May produce fewer offspring/not on a large scale
- May not get beneficial traits from parents.
- Unable to predict the genotype of the offspring due to events in meiosis (random assortment, crossing over)

(5 marks)

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- (c) (i) Scientists have successfully cloned animal species. Suggest TWO reasons why humans may choose to clone animals.

- Humans prefer the particular species/Animal has favourable/rare characteristics e.g. fast race horse, high yield of food (e.g. milk, meat), wool, disease resistance
- Able to withstand local environment e.g. heat tolerance
- To increase the population of domestic pet species/food plants
- Produce many offspring with the same genetic make-up
- Repopulate endangered species
- Produce offspring from infertile animals
- Produce offspring from genetically modified organisms
- To maintain the animal species continually
- Prevents introducing undesirable genes
- To demonstrate that it is possible to clone the animal/for experimental purposes

(2 marks)

- (ii) Outline TWO ethical issues related to the cloning of humans.

Ethical issues

Religious:

- Playing God (Creator)
- Denigrates human dignity/ may devalue human life- no longer a sanctity- seen as a product;
- Unnatural way to procreate
- Several embryos created which are unused and eventually destroyed-morally wrong
- Undermines traditional concept of the family

Technology - low success rate, can lead to genetic disorder

(2 marks)

Total 15 marks

Social

- Confused personal identity/psychological development of the clone
- Can rob/steal someone's identity/ no longer unique

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Question No.

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SUBJECT: BIOLOGY – Paper 02

PROFICIENCY: GENERAL

REGISTRATION NUMBER:

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2. Ensure that this slip is detached by the Supervisor or Invigilator and given to you when you hand in this booklet.
3. Keep it in a safe place until you have received your results.

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I hereby acknowledge receipt of the candidate's booklet for the examination stated above.

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Supervisor/Invigilator

Date: _____