**231/2**

**BIOLOGY (Theory)**

**2 Hours**

**KENYA CERTIFICATE OF SECONDARY EDUCATION**

**FORM FOUR BIOLOGY PAPER 2**

**MARKING SCHEME**

**SECTION A**

**FORM FOUR BIOLOGY PAPER 2 MARKING SCHEME 2021**

1. An investigation was carried out to study the effects of the concentration of sucrose solutions on pieces of tulip stem 44mm in length. The pieces were placed in different concentrations of sucrose solutions and measured after two hours of immersion. The results are shown in the table below.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Sucrose concentration (moles per litre) | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 |
| Length after 2 hours (mm) | 50 | 48 | 46 | 44 | 42 | 42 | 42 |

* 1. Explain the effect of the 0.2 moles per litre sucrose solution on the length of the pieces of the tulip stem. (3mks).

0.2 moles/l is hypotonic to cell sap of the tulip stem cells; the cells therefore gained water by osmosis; and increased in length;

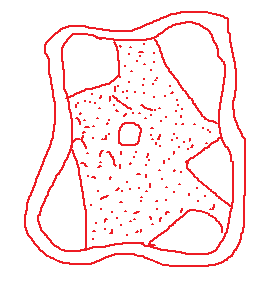
* 1. Use information from the table to predict the concentration of a sucrose solution isotonic to the cells in the tulip stem. (1mk).

0.5 moles/l

* 1. (i) Give the term which would be used to describe the cells in the tulip stem after immersion in a solution with a sucrose concentration of 0.7 moles per litre. (1mk)

Plasmolysed;

ii. Draw the appearance of a cell from the tulip stem after immersion in a solution with a sucrose concentration of 0.7 moles per litre. (2mks).



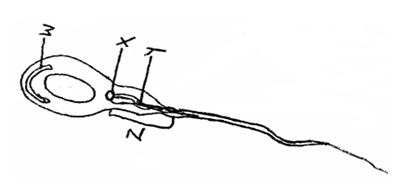
d) State one role of the process being investigated in plants. (1mk)

Feeding in insectivorous plants;

Absorption of water;

Opening and closing of the stomata;

2.Below is a diagram of a sperm cell.



(a) Identify parts labeled **X** and **Y**. (2 marks)

X - Centriole

Y - Axial filament

(b) Explain how parts **W** and **Z** adapt the cell to its function. (4 marks)

W / acrosome; release (hydrolytic) enzymes which digest the plasma membrane of ovum enabling the penetration of sperm;

Z / middle piece has many mitochodria; to generate energy; (used in swimming of the sperm cell towards ovum;

(c) Using letter **P** identify or label on the diagram the part of the cell rich in DNA.(1 mark)

(d) State the function of part **X**. (1 mark)

Formation of spindle fibres / play a role in cell division

3. Polydactyl is a genetic disorder in which people inherit an extra digit. Polydactyl is caused by a dominant allele (B). The table below describes the different genotypes for polydactyl.

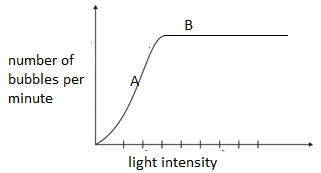
1. Complete the table below by giving the correct genotype, alleles of each genotype and the expected number of fingers per hand. (4mks)

|  |  |  |
| --- | --- | --- |
| Genotype | Alleles | Expected number of digits per hand. |
| Homozygous dominant | BB | Six |
| Homozygous recessive | bb | five |
| Heterozygouys. | Bb | six |

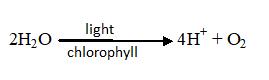
1. The table below shows results of marriages between various parents. Complete the table by writing the probability of each marriage producing a child with polydactyl. One has been done for you. (2mks)

|  |  |
| --- | --- |
| Parental genotypes. | Probability of child with polydactyl |
| Bb X BB | 1 |
| Bb X bb | 0.5 |
| Bb X Bb | 0.75 |

4. Kenyan pond weed (Elodea kenyiensis) is a common water plant that produces tiny air bubbles of oxygen during photosynthesis. The number of bubbles produced per minute indicates the rate of photosynthesis. The graph shows how the rate of photosynthesis in the pond weed relates to light intensity.



a). write the equation to account for the air bubbles. (1mk)



b). Name the factor that affects photosynthesis at point A. Explain. (2mks)

-amount of light intensity;

-increase in light intensity increases the rate of photosynthesis;

c). explain why the rate of photosynthesis does not increase any further at high light intensity.(point B) (2mks)

-Due to other limiting factors; example carbon (IV) oxide concentration; temperature;

d). Explain the role of the following in photosynthesis ;

i) Chlorophyll. (1mk)

-Trap light for photolysis;

ii) Water. (1mk)

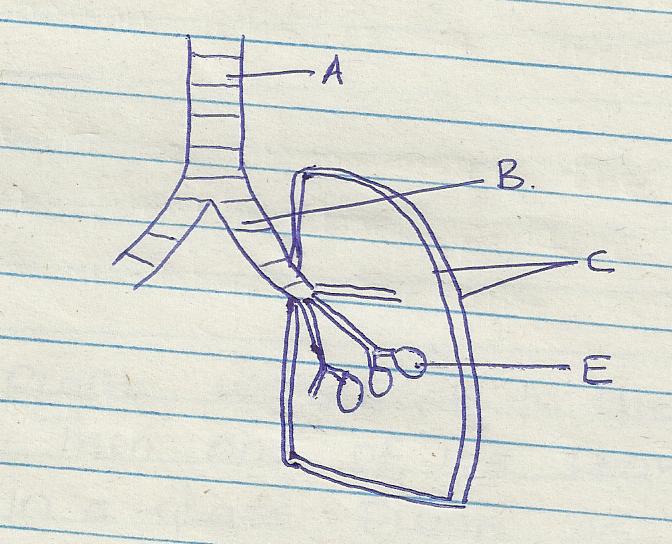
-Provision of Hydrogen ions which combine with carbon (IV) oxide to form simple sugars;

e). Name one product of the light stage of photosynthesis used in the dark stage of photosynthesis. (1mk)

-hydrogen ions;

-ATP molecules;

5. Study the diagram below and answer the questions that follow.



a) Name the part labeled A and B (2marks)

A-trachea

B-bronchus

b) State the function of the part labeled C (2marks)

secrete pleural fluid which reduce friction

enclose lungs

c) How is he part labeled E adapted to its function (2marks)

Thin epithelium do reduce distance for diffusion;

Moist surfaces to dissolve gases before they diffuse;

Well vascularized to transport diffusing gases;

d) Identify the structure that perform the same function as one illustrated above in (2marks)

i) Amoeba

Cell membrane

ii) Fish

gill filaments

**SECTION B (40 Marks)**

***Answer question 6 (compulsory) and either questions 7 or 8 in the spaces provided after questions 8***

6. In an ecological study a certain insect population and that of predators was estimated in a certain grassland over a period of one year.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Month | Jan | Feb | March | April | May | June | July | Aug | Sep | Oct | Nov | Dec |
| No of insects | 10 | 20 | 16 | 24 | 50 | 85 | 45 | 18 | 12 | 30 | 48 | 70 |
| No of predator | 10 | 12 | 8 | 10 | 16 | 30 | 10 | 4 | 2 | 2 | 5 | 20 |
| Rainfall amount(mm) | 20 | 6 | 55 | 350 | 500 | 250 | 12 | 10 | 25 | 190 | 240 | 30 |

1. Using the information above plot on the same axis the graph of number of insects and number of predators against time in months. (7mks)

Axis 2mks

Scale 2mks

Plotting 1mks

Curve 1mk

Labeling of curve 1mk

1. Suggest what happens to the insects population during dry month.(2mks)

Insect population decreases; due to drying of grass hence less food and little habitat and camouflage from predators; migration, stiff competition for food;

1. Explain the relationship between th insect population and that of the predators.(3mks)

As the insect population increases the number of predators increases; due to adequate food; and as the insect population decreases the number of predators decreases due to less food;

1. Suggest what happens to the predators population during the dry month.(2mks)

Decreases due to fewer insects hence less food ; more competition (for food) hence migration or death which causes the population to decrease;

1. Name the trophic level occupied by (3mks)
2. Predator.

Secondary consumer;

1. Insect.

Primary consumers;

1. Grass.

Producers;

1. Name the method used to estimate population of (3mks)

i). Predator.

Capture recapture;

1. Insect.

Capture recapture;

1. Grass.

Quadrat

7. State and explain various areas where knowledge about genetics is applied.(20mks)

1. Plant and animal breeding**;**

Breeding is done by artificial selection; (that is selectively choosing plants and animals with desirable qualities for breeding) done either by inbreeding or cross breeding;

Cross breeding is preferred to inbreeding for purposes of increasing heterozygosity;

Offsprings resulting from a cross breed often possess hybrid vigour; which has been put to good use in plant and animal breeding;

Example

A cross between *Dura* and *Pisifera varieties of wheat results to Tenera* variety which has good qualities of both varieties, i. e. thick mesocarp yielding high quantity of oil, relatively thin endocarp for ease of oil extraction, large kernel for large quantity of oil;

(any other example)

1. **Blood transfusion;**

Blood typing is done before transfusion to ensure compatibility of donor and recipients blood groups;

Tests for ABO and Rhesus antigens are done to consider the effect that the recipient’s antibodies will have on donor’s antigens**;**

Knowledge of human blood typing and matching has also been used in solving disputed parentage;

1. **Genetic counseling;**

This is provision of information by specialists and advise on genetically inherited disorders, the risks and outcomes; to enable the person to arrive at an informed decision;

1. **Genetic engineering;**

This is the identification os a desirable gene, altering, isolation and transferring the gne from one living organism to another;

A rapidly reproducing living organism is used in the production of useful life saving substances; e.g hormone like insulin; antibiotics

Genetic engineering has also made it possible to produce genetically modified organisms(transgenics) which have resulted in increased production in crops and domestic animals;

Genetic engineering is applied in the following areas,

* Environment,
* Farming;
* Medicine in the production of –hormones e.g insulin, medicinal protein, production of vaccines,
* Gene therapy,

1. Crime detection;

Through a series of genetic techniques the patterns of DNA base sequence is prepared and produced in a film;

The DNA is unique to each individual

At the scene of crime ,a specimen from suspect is obtain and DNA extracted from the developed

specimen; then compared to the DNA pattern at the scene of crime to isolate the culplit from

several suspect;

DNA fingerprinting can also be conclusively used in solving disputed parentage;

DNA extracted from the child, the mother and the father is matched to determine the biological parents;

1. Cloning;

Where a group of cells arise from single individual cells without fertilization;

Cloning of plants results to tissue culture techniques through which new variety of crops have been produced;

1. Human genome;

Genome is total genetic content of any cell in an organism;

All genes on all the chromosomes

It aims at gene mapping to identify specific positions occupied by specicific genes on a chromosome.

-sequencing of genes.

8.a) Describe the process of fertilization in flowering plant. (15mks)

b) State the changes that take place in a flower after fertilization. (5mks)

-Pollen grains stick to the stigma surface; surface of the stigma produces a chemical substances ; which stimulates the pollen grain to produce a pollen tube // germinate;

-The pollen tube grows down ( into the tissues of the style ( from which it derives nutrients;

-The generative nucleus divides to give rise to two male nuclei; and embryo sac has eight nuclei; 2 synergids ; egg cell ; two polar nuclei ; three antipodal cells;

-When the pollen tube reaches the micropyle the tube nucleus in the pollen tube degenerates// disintegrates ; one male nucleus fuses with eggs cell ovum ; and forms a zygote; which develops into embryo;

-The other male nucleus fuses with two polar nuclei ; to form triploid nucleus; which develops into endosperm; the process involves double fertilizations;

**b) Changes in flower after fertilization**

- Interguments of ovule – seed coat / testa

- Zygote – embryo ;

- Triploid nucleus – endosperm ;

- Ovary wall – pericarp;

- Ovary -fruit;

- Ovule – seed

- Any other part // style / petal / calyx / stamen // corolla // stigma – dry // falls off;