PRIMARY SIX

LESSON 1: Use of Adverbs

Learning Outcomes

By the end of this lesson, you should be able to:

i) identify ways of doing things.

ii) use of adverbs in your daily life activities.

You will need:

• a pen
• a book

Introduction

An adverb is a word that tells more about a verb, an adjective and another adverb. Adverbs tell us how an action is done: when? why? how? and where?

Examples

i) The cyclist is riding slowly.

ii) Children should cross the road carefully.

Activity 1

Use the correct form of the word in the brackets to complete the sentences below. Examples have been given to guide you.

1. Tino cleverly avoided the punishment. (clever)

2. Uganda's population is steadily rising. (steady)

3. St Thomas choir sang the second compulsory song beautifully. (beauty)

4. The host welcomed us warmly. (cheer)

5. We patiently waited for his return from Ojipaku market. (patience)

6. Italians have seen the more serious coronavirus attacked. (worse)

7. They answered the question wisely. (wise)

8. A machete is usually bigger than a knife. (usual)

9. The hungry boy ate the mango greedily. (greed)

10. The hunter bravely attacked the lion in its den. (brave)

Activity 2

Order of Adverbs

When more than one adverb is used in a sentence, they usually follow in this order: manner (how?), place (where?) and time (when?).

Example

The pedestrian crossed the road carefully (how?) at the zebra crossing (where?) yesterday (when?).

From the sentences below, underline the adverbs of manner, place and time.

1. The traffic officer called the driver loudly at the junction in the morning.

2. Many cyclists ride carelessly at the traffic lights every day.

3. The bus driver spoke politely to the passenger on the bus on Tuesday.

4. My mother nicely made cakes from the kitchen last weekend.

5. It rained heavily in our area last year.

LESSON 2: Informal Letter Writing

Learning Outcomes

By the end of this lesson, you should be able to:

i) express your views on safety on the road.

ii) write a letter about safety on the road.

Introduction

Letter writing is one way of sending a message between or among people. You can write a letter to a friend, parents, relatives and many others.

Activity 1

1. (a) Write a letter to your father appreciating him for his effort to keep everybody well in this period of COVID-19 pandemic. Wish him a longer stay in this life. Use your school address.

(b) The letter below has some words missing. Using the words in the box, complete it by filling in the gaps correctly.

reap advise purpose academic not arua discussions hear dear examinations
4 (c) (i) Diffraction – is the spreading of waves beyond their geometrical shadows.
(ii) Factors affecting the extent of diffraction include:
- The wavelength \( \lambda \) of the waves being diffracted.
- The size of the object constituting the geometrical shadow i.e. size of the obstacle or size of the opening through which the waves pass.

(d) (i) Sound waves are refracted when they are passed through areas of different temperatures. The higher the temperature, the faster the speed of sound.

**Refractive of sound during day**
During the day, the ground is hot and this makes the layers of air near the ground to be hot and less dense while those above the ground are generally cool and denser. The wavefronts from the source are refracted away from the ground (earth’s surface).

The intensity or loudness of the sound waves thus diminishes since the velocity of sound is proportional to the square-root of its absolute temperature.

**Refractive of sound during night**
During the night, the ground is cool and this makes layers of air near the ground to be cool and denser while those above (in the sky) to be warm and less dense. The wavefronts from the source are thus refracted towards the ground earth’s surface) hence making it easier to hear sound waves over long distances.

**SECTION C:**
(ii) The blue colour of the sky:
- Light is scattered easily when it meets a particle of a similar size to its own wavelength \( \lambda \).
- Blue light with the shortest wavelength is scattered more and dominate the sky.
- Light is scattered easily when it meets a particle of a similar size to its own wavelength.

(iii) Blue colour of the sky:
- The blue colour of the sky is due to the fact that the blue light is scattered more than the other white sunlight because of its shorter wavelength.
- The blue light scatters easily when it hits the particle of the same size as its own wavelength.
- The sky then appears blue.

(iii) (i) Electromagnetic moment – is the magnetic torque experienced by a current carrying conductor (coil) placed in a vacuum where the coil exerts a force of \( 2.0 \times 10^{-3} \) N per metre length on each other.

(ii) The apparatus is set up as shown above.

- DCFE is a conducting frame such that AD = AE.
- With no current flowing, the zero screw (adjuster) is adjusted until the frame DCFE balances horizontally.
- The switch is closed and the arm CD is repelled downwards.
- Masses are added to the scale pan until the horizontal balance of the frame DCFE is restored.
- The value of the mass M in the scale pan is measured, together with the separation, \( d \), between arms CD and GH.
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- The value of mass M in the scale pan is measured, together with the separation, \( d \), between arms CD and GH.

(c) Consider a cross section of the wires P, Q and R as shown below.

- The force \( F_1 \) per metre on wire \( Q \) due to wire \( P \).
- The force \( F_2 \) per metre on wire \( Q \) due to wire \( R \).

\[ F_1 = \frac{F_{PQ}}{l} = \frac{\mu_0 I_1 I_2}{2\pi l} \text{ N m}^{-1} \]
\[ F_2 = \frac{F_{RQ}}{l} = \frac{\mu_0 I_1 I_2}{2\pi l} \text{ N m}^{-1} \]

Let \( F_1 \) = force per metre on wire \( Q \) due to wire \( P \).

(iii) The bright blue of the sky:
- The blue light is scattered more than the white sunlight because of its shorter wavelength.
- The blue light scatters easily when it hits the particle of the same size as its own wavelength.
- The sky then appears blue.

6. (a) (i) Electromagnetic induction – is the production of an induced e.m.f. in a coil, (conductor or circuit) whenever the magnetic flux linked with it changes.

(ii) (i) Mutual induction is a process in which an e.m.f. is induced in a circuit due to changing current flowing in the same circuit.

Mutual induction is a process in which an e.m.f. is induced in a circuit due to changing current flowing in the same circuit.

(iii) (i) When switch K is closed, bulb B is seen to light up.
A changing magnetic flux linking coil Y due to changing current in coil X causes an induced e.m.f. to be induced in Y thus inducing a current that flows in the circuit causing the bulb to light up.

(ii) Inserting iron rod in coil X, increases or enhances the magnetic flux linking coil Y from coil X.
This increases the magnitude of the induced e.m.f. linking coil Y thus increasing the induced current flowing through the circuit of coil Y. A large power dissipation occurs in the bulb causing the brightness of the bulb to increase.
In one revolution of the disc, all radii cut across the magnetic flux between P and Q, the magnetic flux $\phi$, is given by:

$$\phi = BA$$

If the disc makes $f$, revolutions in one second, then the rate of cutting of the magnetic flux is

$$\frac{d\phi}{dt} = Br f$$

By Faraday’s law, this is the magnitude of induced e.m.f. $E$

Induced between the axle and the rim.

$$E = \frac{d\phi}{dt} = Br f$$

Alternatively, the speed of the wheel at the axle $u = 0$ ms$^{-1}$ and the speed of the wheel at the rim = $v$ ms$^{-1}$

average speed, $v_a = \frac{\text{Total distance}}{\text{Total time}} = \frac{u + v}{2}$

But, induced e.m.f. = $Blv_a$ where, $l = r$

$$E = Brv_a$$

$$E = Br \left(\frac{u + v}{2}\right)$$

$$\therefore E = Brue$$

(ii) $f = 1200$ rev. min.$^{-1} = \frac{1200 \times 2 \pi}{60} = 20$ Hz

$$A = \pi r^2 = 3.14 \times 1.0^2 = 3.14 \times 10^{-2} \text{m}^2$$

$$E = Br^2 f$$

$$= 2.5 \times 10^{-7} \times 3.14 \times 10^{-2} = 20 \times 10^{-4} \text{V}$$

$$\therefore E = 1.57 \times 10^{-4} \text{V}$$

(d) An a.c. generator.

\[\text{Current } I \text{ to be measured is passed into the coil via the terminals } T_1 \text{ and } T_2.\]

A magnetic field is created inside the coil, and the soft iron piece near the open end of the coil gets attracted towards the coil with a force approximately proportional to the square of the current through the coil.

The sharpest point of the soft iron metal piece receives the greatest force of attraction and rotates towards the north-seeking pole piece (N-S).

The deflection $\theta$ is proportional to the mean of the square current i.e. $\theta \propto <I^2>$. Hence the scale is non-linear (square scale).

$$L = \frac{m}{dt}$$

$$= \frac{m}{4\pi \varepsilon_0 n^2 \varepsilon_0}$$

$$\therefore a = \frac{9.0 \times 10^{-5}}{4.45 \times 10^{-10}} = 2.022 \times 10^5 \text{ N} \text{ away from each other.}$$

$$\text{(d) (i) Instantaneous Power} = L_i^2 \sin^2 \theta f f$$

$$\text{(d) (ii) At resonance, } X_i = X_i$$

$$\frac{1}{2\pi f} = \frac{2nfL}{f^2} = \frac{l_0}{4\pi f}$$

$$\therefore \text{resonant frequency } f_0 = \frac{1}{2\pi f}$$

Electric field lines connect points of different potentials, thus if the field lines were at other angles to the surface other than 90$^\circ$ they would cancel out each other, since electric force on any charge acts along the direction of the field.

Electric field lines do not cross each other, so this can only be achieved if they are normal to the surface of the conductor.

(ii) Keeping other factors constant one of the plates of the charged capacitor is connected to the cap of the G.L.E and the divergence $\theta$ is noted.

A dielectric material is then placed between the plates of the electric field and the divergence is measured.

8. (a) (i) Electric field line is the path or direction taken by a +1C point charge placed in an electric field.

(ii) Note the following:

- Direction of the field lines should be towards the charge.
- Number of field lines must be the same from each charge.
- Neutral point x, must be midway.
- Coulomb’s law states that the force acting on two point charges is space is directly proportional to the product of the magnitude of the charges and inversely proportional to the square of their distance of separation.
- The oil spray works:

The spray gun designed to produce tiny droplets of the oil paint has one of its terminals connected to the metal panel which is earthed and the other to the positive terminal of a generator.

Highly pressured oil droplets pass through the nozzle of the gun and get charged positively by friction and influence the generator when connected to the positive terminal of the generator.

The charged droplets then get attracted to the body of the object being sprayed e.g. car and this creates uniform coating of paint on the body of the object.

The droplets also travel along the lines of force of the field so as to reach hidden parts of the body.

Read about other devices such as DC motor and DC generator.
From $F = ma$, acceleration $a = \frac{F}{m}$.

Using the circuit diagram below, $P$, $Q$ and $R$ are standard resistors, while $S$ is a variable resistance.

Every conductor is considered as an equi-potential surface.

**Electrostatics**

(a) (i) Electric field intensity is the force exerted on a unit charge.

(b) (i) Temperature coefficient of resistance: Consider a material whose resistance at $0^\circ C$ is $R_0$, temperature coefficient of resistance is the fraction of $R_0$ by which the resistance of a material increases per kelvin temperature rise.

Or It is the change in resistance of a material per degree (or kelvin) rise in temperature divided by the resistance of the material at $0^\circ C$.

(ii) When metals are heated, the atoms vibrate about their equilibrium positions with larger amplitudes. More frequent collisions result, causing the number of charges (electrons) crossing any given section of the conductor to increase, hence current flowing also increases. A reduction in the current flowing causes the resistance to decrease. Thus increases with increase in temperature.

In semi-conductors, increase in temperature liberates more electrons from the valency band to the conduction band. This increases the available charge carriers thus relatively increasing the number of electrons crossing a given section of the material. As a result, current flowing through the semi-conductor increases hence reducing resistance.

Therefore, increase in temperature of the semi-conductor leads to a reduction in resistance hence the negative temperature coefficient of resistance.

(c) (i) Using the circuit diagram below, $P$, $Q$ and $R$ are standard resistors, while $S$ is a variable resistance. $\Rightarrow V_P = 0$

(d) (i) Using the circuit diagram below, $P$, $Q$ and $R$ are standard resistors, while $S$ is a variable resistance.

The effective capacitance of the parallel network $C' = C_1 + C_2$

$C' = 4 + 2 \times 6 \mu F = 6.0 \times 10^{-3} \mu F$

The effective capacitance of the series network, $\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2}$

$\Rightarrow C = 2.0 \mu F$

Total charge in the system, $Q = CV = 2.0 \times 10^{-3} \times 12$

$= 24.0 \times 10^{-4} \mu C$ or $24 \mu C$

P.d. across $2 \mu F$ charge, $V' = \frac{Q}{C} = \frac{24.0 \times 10^{-6}}{6.0 \times 10^{-6}}$

$\Rightarrow V' = 4.0 V$

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10. (a) (i) E.m.f. is the energy used (or work done) to move one coulomb of charge around a complete circuit which includes the source of e.m.f. itself.

Or Is the terminal p.d. across a cell or battery (the source) on an open circuit.

(ii) $\theta$ is the terminal p.d. across a cell or battery (the source) on an open circuit.

(iii) p.d. is the p.d. across opposite faces of a resistor of resistance $\Omega$ when the current flowing through it is 1 A.

(iii) ohm is the resistance across opposite faces of the material having a p.d. of 1 volt when a current of 1 ampere flows through it.

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(b) Effective resistance of the circuit $R = (5 + X) \Omega$

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When S is adjusted until the centre zero galvanometer G shows no deflection, same current $I_1$ passes through P and Q. Similarly, at balance point, same current $I_2$ flows through R and S.

The p.d. across $\frac{P}{R} = p.d. across R$

i.e. $I_1 \times p = I_2 \times R$....(i)

The p.d. across $\frac{Q}{S} = p.d. across S$

$I_1 \times Q = I_2 \times S$....(ii)

Equation (i) + (ii) $\Rightarrow \frac{I_1}{I_2} = \frac{I_2}{I_2} \Rightarrow \frac{I_1}{I_2} = \frac{R}{Q}$ ; This expression is the balance condition of a wheatstone bridge.

(ii) Using $R_0 = R_2(1 + a \times 0)$

When $0 = 0^\circ C$, $\Rightarrow 3 = R_0(1 + a \times 0)$

$3 = R_0$ .......(i)

When $0 = 90^\circ C$, $\Rightarrow R_{90} = R_0(1 + 90 a)$

$20 = 3(1 + 90 a)$ .......(ii)

Solving equations (i) and (ii) gives,

$\alpha = \frac{1}{90} \left( \frac{20}{3} - 1 \right)$

$\Rightarrow \alpha = 6.30 \times 10^{-2} \Omega$
PHYSICS PAPER 1 (APHY 003)

SECTION A

1. (a) (i) Distinguish between fundamental and derived quantities. State any two examples of each. (ii) The velocity V of sound travelling along a rod made of material of Young's modulus Y and density ρ is given by

\[ V = \sqrt{\frac{Y}{\rho}} \]

Show that the formula is dimensionally consistent.

(b) (i) Account for the existence of intermolecular forces. (ii) Sketch a graph of potential energy against separation of two molecules in a substance and explain the main features of the graph.

(c) A uniform rod AB weighing 100kg and 0.75 m long is hinged to a vertical wall at end A and held horizontally by a stretched thin wire of diameter 0.8 mm fixed at end B and at C on the vertical wall, 1.0m above A. If the wire was initially 1.23 m long, find: (i) the tension in the wire. (ii) Young’s modulus for the wire.

2. (a) (i) Define relative density. (ii) With the aid of a diagram(s), describe how you would measure the relative density of a liquid using Archimedes’ principle and the principle of moments.

(b) (i) Define surface tension and state its dimensions. (ii) Explain the variation of surface tension of a liquid with temperature.

(iii) Show that the surface tension of mercury is 0.4 Nm⁻¹ and use this value to calculate the pressure difference between two bulbs immersed in a bath at temperatures 60°C and 20°C.

(c) Mercury is poured into a glass U-tube with vertical limbs of diameters 3mm and 10mm respectively. If the angle of contact between mercury and glass is 120° and the surface tension of mercury is 0.4 Nm⁻¹, calculate the difference in levels of mercury in the limbs.

(d) A gas of volume 2 litres at a temperature of 27°C and pressure of 210 kPa is heated at constant pressure and the volume doubles. It is then cooled at constant volume back to its original temperature before finally being compressed isothermally to its original volume.

(Gas constant, \( R = \frac{8.31 \text{ J mol}^{-1}\text{K}^{-1}}{} \))

(i) Draw a p-V diagram of the whole cycle (ii) Find the net work done by the gas.

(d) The pressure P of an ideal gas of density \( \rho \) is given by

\[ P = \frac{\rho V T}{M} \]

where \( V \) is the mean-square speed of its molecules. Using this expression, show Avogadro’s hypothesis holds.

6. (a) (i) Define the term specific heat capacity of a substance.

(ii) Outline four measurements carried out in determining Young’s modulus of a material.

(b) (i) Define angular velocity and centripetal acceleration. (ii) Draw sketch graphs to show the variation of relative intensity of black body radiation with wavelength for different temperatures.

(ii) Explain the mechanism of heat transfer in metals. (iii) Explain the appearance of a metal ball placed in a dark room when its temperature is progressively raised from room temperature to just below melting.

(c) An electrical heater rated 500W is immersed in a liquid of mass 2.0 kg contained in a large thermos flask. The liquid is heated from 60°C to 200°C in 2 minutes. Calculate the energy supplied to the heater and the thermal conductivity of copper = 400 Wm⁻¹K⁻¹.

SECTION B

(a) (i) State Charles’s law. (ii) Describe an experiment to verify Charles’s law. (b) (i) State the conditions necessary for a reversible isothermal process. (ii) A fixed mass of gas at a pressure \( P \) and volume \( V \) expands isothermally to a pressure \( P' \) and volume \( V' \). Derive an expression for the work done by the gas.

(c) A gas of volume 2 litres at a temperature of 27°C and pressure of 210 kPa is heated at constant pressure until its volume doubles. It is then cooled at constant volume back to its original temperature before finally being compressed isothermally to its original volume.

(\( \text{Gas constant}, \ R = \frac{8.31 \text{ J mol}^{-1}\text{K}^{-1}}{} \))

(i) Draw a p-V diagram of the whole cycle (ii) Find the net work done by the gas.

(d) A beam of 2 x 10⁻¹⁶ Nitrogen atoms, each of mass 2.32 x 10⁻²⁶ kg is incident normally on a wall of a cubical container of edge 4.5 cm. The beam is reflected through 180°. If the mean speed of the atoms is 500m/s, find the pressure exerted by the Nitrogen gas.

SECTION C

8. (a) (i) Define the term escape velocity. (ii) State the conditions necessary for a reversible isothermal process.

(b) A satellite of mass 100 kg revolves round the earth in a parking orbit at a height \( h \) above the earth’s surface. Calculate the value of \( h \).

9. (a) (i) Define the term specific heat of a substance. (ii) State the characteristics of the photoelectric effect.

(b) With use of a well labelled diagram, describe a simple experiment to demonstrate photoelectric effect.

(c) Sodium has a work function of 2.3 eV and it is illuminated by light of wavelength 5.0 x 10⁻⁴ m. Find the: (i) Threshold frequency of sodium. (ii) Maximum velocity of the photoelectrons emitted. (iii) Stopping potential with light of this wavelength.

(d) (i) Explain any one application of photoelectric effect. (ii) Draw a sketch graph of photo-current against potential difference across a photo-cell for two different intensities but the same frequency of incident radiation.

10. (a) (i) Define the term thermal conduction. (ii) State the S.I unit of specific charge. (iii) Describe with the aid of a diagram how specific charge of positive ions can be determined using a mass spectrometer.

(b) A beam of singly ionized carbon atoms passes undeflected through a region of crossed magnetic and electric fields of 0.10 T and 1.0x10⁻⁵ C respectively. When it enters a region of uniform magnetic field, it is deflected through an arc of radius 0.75m. Calculate the magnetic flux density of this field. (Mass of carbon atom is 2.0x10⁻²⁸ kg)

(c) (i) Draw a graph to illustrate the variation of Ionisation current and p.d across an ionisation chamber and explain its main features. (ii) Explain how ionisation chamber can detect ionizing radiation.
SECTION A

1. Which form of learning is acquired after continuous repetition of a non-reinforced stimulus?
   A. Insight learning.
   B. Imprinting.
   C. Habituation.
   D. Exploratory learning.

2. The graphs in figures 1 and 2 below show the amounts of cellular materials A, B, C, and D in different cells extracted from cells of different body parts of the same organism. Which of them is hereditary material?

   ![Figure 1](image1.png)  
   ![Figure 2](image2.png)

   - A. Only physically observable characteristics are used.
   - B. High amounts of amino acids for synthesizing the required enzymes to breakdown the virus.
   - C. Ability to rapidly clot blood and block the spread of the virus.
   - D. Tough layer of keratin on the skin to prevent entry of the virus to the inner tissues.

3. A healthy person at rest but respiring on both carbohydrate and fat would most likely have respiratory quotient of
   A. 0.7
   B. 0.85
   C. 1.0
   D. 1.2

4. Which body defence is the best in reducing your risk of getting Covid-19?
   A. High number of cilia in the lining of respiratory passages to trap viral particles before they enter.
   B. High amounts of amino acids for synthesizing the required enzymes to breakdown the virus.
   C. Ability to rapidly clot blood and block the spread of the virus.
   D. Tough layer of keratin on the skin to prevent entry of the virus to the inner tissues.

5. Figure 3 below shows results obtained from an investigation on the effect of different concentrations of sucrose solution on strips of fresh pawpaw leaf stalks. Which strip was placed in most dilute solution?

   ![Figure 3](image3.png)

   - A. D
   - B. C
   - C. B
   - D. A

6. During phylogenetic classification:
   A. Only physically observable characteristics are used.
   B. Evolutionary relationships among organisms are used.
   C. Only organisms that interbreed to form viable offspring are considered.
   D. Organisms with dissimilar features but closely related.

7. Which of the following is the role of Luteinising hormone during spermatogenesis in male humans?
   A. Stimulates testes cells to complete development of spermatozoa from spermatids.
   B. Stimulates testes cells to secrete inhibin hormone in blood.
   C. Stimulates Leydig cells to secrete testosterone hormone in blood.
   D. Inhibits anterior pituitary gland from secreting follicle stimulating hormone.

8. Which of the following processes are restricted to mitosis only?
   - A. Genetic crossing over, independent assortment, mutation, DNA replication.
   - B. Genetic crossing over, independent assortment, mutation, DNA replication.
   - C. Genetic crossing over, independent assortment, mutation, DNA replication.
   - D. Genetic crossing over, independent assortment, mutation, DNA replication.

9. Which of the following statements is inconsistent in relation to human sperm cell?
   A. The acrosome contains a lytic agent which dissolves the egg membrane during fertilization.
   B. The nucleus is haploid and contains circular DNA.
   C. The axial filament runs through its centre and consists of the 9+2 fibre arrangement.
   D. The middle piece contains numerous mitochondria to supply the necessary energy for propulsion.

10. Which of the following hormone secretion is stimulated by presence of another hormone in blood?
    A. Insulin and Luteinising hormone.
    B. Glucagon and follicle stimulating hormone.
    C. Insulin and follicle stimulating hormone.
    D. A and B

11. Which of the following sets of processes is important for photosynthesis?
    A. Energy radiation
    B. Exposure of myosin binding site on the actin filament.
    C. Leaf closing movements in the ABA signal.
    D. Both B and C

12. Which of the following statements is inconsistent in relation to human sperm cell?
    A. The acrosome contains a lytic agent which dissolves the egg membrane during fertilization.
    B. The nucleus is haploid and contains circular DNA.
    C. The axial filament runs through its centre and consists of the 9+2 fibre arrangement.
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    A. The acrosome contains a lytic agent which dissolves the egg membrane during fertilization.
    B. The nucleus is haploid and contains circular DNA.
    C. The axial filament runs through its centre and consists of the 9+2 fibre arrangement.
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14. Which of the following statements is inconsistent in relation to human sperm cell?
    A. The acrosome contains a lytic agent which dissolves the egg membrane during fertilization.
    B. The nucleus is haploid and contains circular DNA.
    C. The axial filament runs through its centre and consists of the 9+2 fibre arrangement.
    D. The middle piece contains numerous mitochondria to supply the necessary energy for propulsion.

15. Which of the following statements is inconsistent in relation to human sperm cell?
    A. The acrosome contains a lytic agent which dissolves the egg membrane during fertilization.
    B. The nucleus is haploid and contains circular DNA.
    C. The axial filament runs through its centre and consists of the 9+2 fibre arrangement.
    D. The middle piece contains numerous mitochondria to supply the necessary energy for propulsion.

16. Which of the following statements is inconsistent in relation to human sperm cell?
    A. The acrosome contains a lytic agent which dissolves the egg membrane during fertilization.
    B. The nucleus is haploid and contains circular DNA.
    C. The axial filament runs through its centre and consists of the 9+2 fibre arrangement.
    D. The middle piece contains numerous mitochondria to supply the necessary energy for propulsion.

17. Which of the following statements is inconsistent in relation to human sperm cell?
    A. The acrosome contains a lytic agent which dissolves the egg membrane during fertilization.
    B. The nucleus is haploid and contains circular DNA.
    C. The axial filament runs through its centre and consists of the 9+2 fibre arrangement.
    D. The middle piece contains numerous mitochondria to supply the necessary energy for propulsion.

18. Which of the following statements is inconsistent in relation to human sperm cell?
    A. The acrosome contains a lytic agent which dissolves the egg membrane during fertilization.
    B. The nucleus is haploid and contains circular DNA.
    C. The axial filament runs through its centre and consists of the 9+2 fibre arrangement.
    D. The middle piece contains numerous mitochondria to supply the necessary energy for propulsion.

19. Which of the following statements is inconsistent in relation to human sperm cell?
    A. The acrosome contains a lytic agent which dissolves the egg membrane during fertilization.
    B. The nucleus is haploid and contains circular DNA.
    C. The axial filament runs through its centre and consists of the 9+2 fibre arrangement.
    D. The middle piece contains numerous mitochondria to supply the necessary energy for propulsion.

20. Which of the following hormone secretion is stimulated by presence of another hormone in blood?
    A. Insulin and Luteinising hormone.
    B. Glucagon and follicle stimulating hormone.
    C. Adrenaline and gastrin.
    D. Oestrogen and Luteinising hormones.

21. Which of the following statements is inconsistent in relation to human sperm cell?
    A. The acrosome contains a lytic agent which dissolves the egg membrane during fertilization.
    B. The nucleus is haploid and contains circular DNA.
    C. The axial filament runs through its centre and consists of the 9+2 fibre arrangement.
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    A. The acrosome contains a lytic agent which dissolves the egg membrane during fertilization.
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    C. The axial filament runs through its centre and consists of the 9+2 fibre arrangement.
    D. The middle piece contains numerous mitochondria to supply the necessary energy for propulsion.

23. Which of the following statements is inconsistent in relation to human sperm cell?
    A. The acrosome contains a lytic agent which dissolves the egg membrane during fertilization.
    B. The nucleus is haploid and contains circular DNA.
    C. The axial filament runs through its centre and consists of the 9+2 fibre arrangement.
    D. The middle piece contains numerous mitochondria to supply the necessary energy for propulsion.

24. Which of the following statements is inconsistent in relation to human sperm cell?
    A. The acrosome contains a lytic agent which dissolves the egg membrane during fertilization.
    B. The nucleus is haploid and contains circular DNA.
    C. The axial filament runs through its centre and consists of the 9+2 fibre arrangement.
    D. The middle piece contains numerous mitochondria to supply the necessary energy for propulsion.

25. Which of the following statements is inconsistent in relation to human sperm cell?
    A. The acrosome contains a lytic agent which dissolves the egg membrane during fertilization.
    B. The nucleus is haploid and contains circular DNA.
    C. The axial filament runs through its centre and consists of the 9+2 fibre arrangement.
    D. The middle piece contains numerous mitochondria to supply the necessary energy for propulsion.

26. Which of the following statements is inconsistent in relation to human sperm cell?
    A. The acrosome contains a lytic agent which dissolves the egg membrane during fertilization.
    B. The nucleus is haploid and contains circular DNA.
    C. The axial filament runs through its centre and consists of the 9+2 fibre arrangement.
    D. The middle piece contains numerous mitochondria to supply the necessary energy for propulsion.

27. Which of the following statements is inconsistent in relation to human sperm cell?
    A. The acrosome contains a lytic agent which dissolves the egg membrane during fertilization.
    B. The nucleus is haploid and contains circular DNA.
    C. The axial filament runs through its centre and consists of the 9+2 fibre arrangement.
    D. The middle piece contains numerous mitochondria to supply the necessary energy for propulsion.
**Biology Paper 1 (ABIO 003)**

1. Cut off the tip of the shoot.
2. Cut of the tip of the shoot and replaced it with a polythene in between it and the lower part of the shoot.
3. Attach it to a klimostat.
4. Cut of the tip of the shoot and replaced it with agar block in between it and the lower part of the shoot. In which of the setups did the shoot bend towards the unidirectional source of light as it grows.

A. I
B. II
C. III
D. IV

22. Which of the following reactions occurs in organisms to resist changes in pH after addition of a little amounts of acids?

A. $HCO_3^- + H^+ \rightarrow H_2CO_3 + H_2O$
B. $HCO_3^- + OH^- \rightarrow CO_3^{2-} + H_2O$
C. $HCl \rightarrow H^+ + Cl^-$
D. NaCl $\rightarrow Na^+ + Cl^-$

25. Urticle and saccule respond to:

A. Vertical movements only
B. Lateral movements only
C. Vertical and lateral movements respectively
D. Lateral and vertical movements respectively

26. Which of the following is the characteristic used to classify fungi into different phyla?

A. Cross pollination.
B. Whether it is unicellular or multicellular.
C. Heterozygous gene.
D. Animal pollination.

27. Figure 6 below shows the pattern of inheritance of a genetic disorder called phenylketonuria in a family lineage.

Which gene causes phenylketonuria?

A. Homozygous recessive gene.
B. Homozygous dominant gene.
C. Heterozygous gene.
D. Homozygous condition gene.

28. An insect flew from the anther of a flower with pollen grains attached to its body and stood on the stigma of another flower but on the same plant depositing pollen grains on it. What is the type of pollination carried out by the insect?

A. Insect pollination.
B. Self-pollination.
C. Cross pollination.
D. Animal pollination.

29. Which of the following pairs is a characteristic of an efficient homeostatic system?

A. Large deviations from the norm and deviations slowly restored back to the norm.
B. Small deviations from the norm and deviations slowly restored back to the norm.
C. Large deviations from the norm and deviations slowly restored back to the norm.
D. Small deviation from the norm and deviations rapidly restored back to the norm.

30. A individual of blood group A cannot receive blood donated by an individual of blood group B because his or her blood contains:

A. antibody b while the donor blood contains antigen B.
B. antigen A while the donor blood contains antibody a.
C. antigen A while the donor blood contains antigen B.
D. antibody b while the donor blood contains antibody a.

31. Which of the following does not apply during evolutionary process?

A. Generational changes acquired are passed to the next generation.
B. Organisms exert selection pressure on the environment.
C. Changes in the environment select an organism either for or against them.
D. The less adapted organisms to the changes in the environment are selected against.

32. The table 2 below shows the relative number of stomata and relative transpiration rates for four different plant species.

<table>
<thead>
<tr>
<th>Plant species</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative number of stomata mm$^{-2}$ of leaf (upper:lower leaf surface)</td>
<td>3.50:0.30</td>
<td>10.15:4.75</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relative transpiration rate (upper:lower leaf surface)</td>
<td>15:30</td>
<td>20:50</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Which plant species carries out the highest rate of cuticular transpiration due to having the thinnest cuticle?

A. D
B. C
C. B
D. A

33. Which of the following is the role of gastrin hormone in the stomach?

A. Activates the sperm and the ovum prior to fertilisation.
B. Stimulates contraction of gall bladder to release bile.
C. Increases carbon dioxide concentration in the atmosphere against them.
D. Retaining urea in the body to maintain body fluids osmotic pressure above that of the sea.

34. Afforestation has often been recommended as a measure to slow down global warming and climate change. Which of the following explains the role of afforestation in global warming?

A. Reduces carbon dioxide concentration in the atmosphere by decreasing plant cover hence lowering rate of ozone depletion.
B. Increases carbon dioxide concentration in the atmosphere leading to formation of acidic rains.
C. Increases oxygen concentration in the atmosphere by increasing plant cover hence lowering ozone depletion.
D. Increases plant cover reducing effects of soil erosion and heat retention on the soil.

35. When two species compete in an ecosystem:

A. The species whose members are smaller in size get extinct.
B. Less fit organisms all die.
C. Respective partitioning occurs between the species overtime.
D. Population size of a species that needs little resources increases.

36. Which of the following conditions are advantageous for RuBP when functioning in C4 plants but not in C3 plants?

A. Low carbon dioxide and high oxygen concentrations.
B. Accumulated high carbon dioxide and high oxygen concentrations.
C. Low carbon dioxide and low oxygen concentrations.
D. Accumulated high carbon dioxide and low oxygen concentrations.

37. Which of the following factors are likely to affect the number and diversity of species reaching an area?

A. Geographical barriers.
B. Size and nature of the area.
C. Distance to be covered by organisms during dispersal.
D. Reproductive potential of a species of organisms.

38. During which stages of cardiac cycle are the ‘lub’ and ‘dub’ heard sounds produced?

A. Atrial systole and ventricular diastole respectively.
B. Ventricular diastole and atrial diastole respectively.
C. Ventricular systole and atrial systole respectively.
D. Atrial diastole and atrial systole respectively.

39. Marine teleost’s overcome the challenge of dehydration of their tissues due osmotic outflow of water by

A. Actively extruding salts using chloride secreting cells in the gills.
B. Eliminating nitrogenous waste in form of ammonia.
C. Not ingesting sea water and having high ultrafiltration rate in the kidney.
D. Retaining water in the body to maintain body fluids osmotic pressure above that of the sea.

40. Which of the following is the role of gastrin hormone in control of digestion?

A. Stimulates pancreas to increase secretion of pancreatic juice.
B. Stimulates contraction of gall bladder to release bile.
C. Inhibits emptying of the stomach into the duodenum.
D. Stimulates gastric gland to secrete gastric juice rich in hydrochloric acid.

### SECTION B

41. A student constructed a model to represent blood circulation in human as shown below. Study and compare it with your knowledge of the actual human circulatory system to answer the questions that follow.

![Blood Circulation Model](image)

a) Name the actual structures that correspond to the following model parts:

A, B, C, D, Pump 1 and Pump 2.

b) The directions V, X, Y and W represent the directions of blood flow. Suggest two differences between blood contents in vessels X and Y in a real circulatory system.

c) Suggest the natural sources from which oxygen and the glucose would be derived in real life situation.

d) i) Identify four errors in assembling the model.

ii) Show how the model errors in (d) (i) above would lead to undesirable conditions if they were to occur in human.

42. A student was given a punishment of lifting a bench above his shoulder for over 10 minutes the class saw the bench lowering and falling against the student’s efforts to maintain its level up.

i) Show the bench to lower.

ii) Show how the model errors in (d) (i) above would lead to undesirable conditions if they were to occur in human.

43. A student was given a punishment of lifting a bench above his shoulder for unlimited time duration. When he persevered for over 10 minutes the class saw the bench lowering and falling against the student’s efforts to maintain its level up.

a) Name the muscle properties that:

i) Maintained the bench above the student’s shoulder.

ii) Made the bench to lower.
BIOLOGY PAPER 1
(ABIO 003)

b) Suggest the physiological explanation for the lowering and the bench falling off.

45. a) Give precise meanings of the following terms:
   i) Behaviour
   ii) Migration
   iii) Territoriality

b) Suggest five ways in which migration and territoriality benefit the animals that practise such behaviours?

44. The following graph shows application of some antibiotic on two strains of bacteria J and K in one of the countries in Africa. The data only demonstrate the averages from five hospitals over a period of nine years of application of the antibiotic. All the bacteria were established to be having haploid numbers of chromosomes.

   a) i) What biological process is being demonstrated by this data?
   ii) Explain the effects identified in (a) (ii) above.
   iii) To what extent did haploid numbers of chromosomes contribute to the information provided compared to if the bacteria were diploid?

b) To what extent did haploid numbers of chromosomes contribute to the information provided compared to if the bacteria were diploid?

c) Predict and state the effects of the hospital policies towards application of the antibiotic from:
   i) year 2 to year 3.
   ii) year 3 to year 8.

d) What measure was most effective in controlling bacteria strain K?

45. Fish uses fins to propel it forward as well as maintaining its stability. Using illustration, show on a single fish how the following maybe brought about:
   a) Force required to propel fish forward.
   b) Instability by pitching.
   c) Control of pitching.

46. a) What is photosynthesis?
   b) Why is a high level of respiratory gases affect photosynthesis?
   c) Explain how high carbon dioxide is not as important to C4 plants as it is to C3 plants in influencing the rate of photosynthesis.

ANSWERS TO GENERAL PAPER (AGP002)

Question 1

SECTION A

1. Domestic violence is any form of behaviour whose purpose is to gain power and control over a spouse or partner. It ranges from sexual and psychological to physical abusive acts, including neglect, spouse-battering and child abuse.

Causes of domestic violence

- Poverty as it makes people irritable and stressed. It also leads to lack of basic needs like medical care, food and others, hence resulting in misunderstandings.
- Addiction to drugs, such as narcotics as they may cause the user to lose their sense of understanding and transfer anger to members of their family.
- Breakdown in communication as this may lead to individuals being ignorant of another's likes and dislikes, which causes misunderstandings.
- Cultural differences in terms of language, food, marriage requirements and other aspects may result in disagreement.
- Misinterpretation and ignorance of men's, women's and children's rights.
- Income inequality and change in social status.
- Barrenness and impotence.
- Extended family conflicts.
- Polygamy and its associated evils.
- Peer pressure and influence from either parents or children.
- Lack of mutual trust in a partner in terms of finance, faithfulness, etc.
- Physical or mental illnesses, such as post-traumatic stress disorder, may result in violence.
- Violent personality of a partner.
- Lack of policy enforcement against physical, sexual and psychological tortures of partners.

Solutions to domestic violence

- Counselling by relatives, elders, in-laws to settle disputes among family members.
- Make penalties for domestic violence consistent and firm.
- Encourage prevention programmes for example teach young people the dangers of being abusers.
- Increase funding for sectors dealing with family violence prevention.
- Help women to be economically independent as many have seen to stay in abusive relationships for fear of being homeless due to inability to sustain themselves and their children.
- Religious leaders should strengthen good morals in homes.
- Discourage infidelity in relationships.
- Partners should embrace communication in relationships.
- Make research and give a clear picture of statistics for the cases so that the problem can be dealt with easily.

Question 2

Parental negligence refers to a deliberate practice or decision that involves neglect by the parent or guardian in the provision of basic needs for the welfare of their children. Juvenile delinquency, on the other hand, is a form of misbehaviour among young people below the age of 18. It includes theft, fighting, use of vulgar language and harassment.

Parental negligence as a cause

- Parents have become too busy to have enough time for their children's upbringing and welfare.
- Some parents do not give proper guidance or caution to their children.
- Poor parents do not support their children with basic upkeep needs for personal administration.
- Some parents are violent and abusive to the children, thereby making them uncomfortable to stay in the homes.
- General breakdown in effective communication between parents and their children, given the fact that some parents are harsh or hostile to their children.

Other factors

- Negative peer pressure/influence among the young people.
- Influence of drug abuse and addiction.
- Breakdown in the traditional African family value system.
- Negative influence of the media through persuasive and nude models.
- Permissiveness accorded to children today.
- Increased stress and frustration among young people.
- Weak laws regarding juvenile offenders.

Question 3

Food insecurity refers to a situation where there is insufficient food supply at a household level or in a country for a period of time.

Ways

- Support farmers with fast-yielding crop varieties.
- Improve the storage facilities to ensure food is not eaten up immediately after harvest.
- Institute deliberate policies to control population and minimise consumption.
- Educate the population on the value of having adequate food at household level.
- Use improved/modern farming methods to ensure high quality production.
- Diversify food varieties for example cereals, tubers and grains.
- Enforce strict laws to guard against reckless handling of food within the household and the nation at large.
- Support existing organisations that work towards ensuring sufficient food supply.
- Revive co-operative societies that encourage people to have enough food at every household.
- Provide more funds to organisations, such as the National Agricultural Advisory Services (NAADS) and National Agricultural Research Organisation (NARO) so that they can increase capacity for value addition.

Question 4

The teaching of science subjects is a deliberate policy that aims at promoting science-related disciplines in areas of education, innovation and research among learners. The main science subjects include physics, biology, chemistry, mathematics and agriculture.

Positive

- Increased training of teachers in the science-related subjects.
- Attracted the attention of foreign funding to improve science education.
- More construction of school infrastructure and facilities, etc.; e.g., laboratories.
- Increased research in the performance of science-based disciplines.
- Encouraged more learners to take on more science subjects.

Negative

- It has constrained the government in terms of teachers since those trained in these disciplines are few.
- Created a serious divide-and-rule situation among teachers of sciences and those of arts subjects.
- Encouraged lazy and weak learners to take on science combinations at A-Level.
- It has constrained school authorities and administrators in terms of effective planning, giving the inadequate materials to support science subjects.
- Many government-aided institutions lack qualified personnel for example teachers and laboratory attendants, which compromises the quality of science teaching.

Spelling = 05 marks
General expression = 00 marks
Definition = 05 marks
Content (causes and solutions) = (any 10 points x 05 marks each = 50 marks)
TOTAL = 50 marks

NOTE: Every essay must have a conclusion for Section A.
ANSWERS TO GENERAL PAPER

Activities:
a) 1. Fishing activities F
   2. Accommodation F
   3. Small-scale farming S

Rating of activities:
Activity | No activity | Best activity
--- | --- | ---
F | 0 | 5
K | 0 | 5
P | 0 | 5
S | 0 | 5

b) When reversed, all retain their weight totals except Michombero who changed from 4 to 5.

Activity rating:
Names | F | A | K | P | S | Total
--- | --- | --- | --- | --- | --- | ---
Kyasuru | 5 | 0 | 0 | 2 | 1 | 8
Owilla | 0 | 4 | 3 | 2 | 0 | 9
Tushabe | 0 | 0 | 2 | 0 | 7 | 2
Michombero | 5 | 0 | 0 | 2 | 0 | 7
Mukisa | 0 | 0 | 2 | 0 | 2 | 2

* represents =change

CHALLENGES CAUSED BY RISING FLOOD WATERS

- Loss of lives.
- Vast property damage.
- High costs of repairing and replacing flood-damaged roads, bridges, public roads, etc.
- Diseases due to contaminated water which carries raw sewage, leaked toxic chemicals and runoff hazardous waste that may pollute the water and cause infections.
- Destruction of crops and livestock.
- Contributes to mental health problems (trauma) due to the losses.
- Economic loss in form of destroyed businesses or wages.
- Downturns in regional tourism due to fear of accidents.
- Measures taken to mitigate the challenges

- Planting vegetation to retain extra water.
- Terracing hillsides to slow flow of water down hill.
- Constructing flood ways/man-made channels to divert flood water.
- Modifying homes and businesses to help them withstand floods.
- Restoring rivers to their natural courses.
- Investing in flood insurance policies.

GAMES AND SPORTS

- Football is popular and the most watched game.
- Cricket and soccer are also popular among the youth.
- Basketball and volleyball are also gaining popularity.

SECTION A

1. Account for the increased cases of deforestation in your country and suggest possible solutions to the problem.
2. Examine the challenges facing the judiciary system in your country.
3. “The increase in gender-based violence in Uganda is largely a result of poverty.” Discuss.
4. Justify the need for environmental conservation in your country.

SECTION B

5. The COVID-19 pandemic that started in the town of Wuhan in China has swept all over the world, with very few countries remaining unaffected. In Uganda, it led to the closing down of over 200 schools on 20th March, 2020. Many of the countries have been depending on their study materials in the newspapers and also over the Internet for those that have access. Seven friends from different top schools in the nation have decided to have a debate on TV on the motion that “Teachers are more important than doctors.” They are Peter, Allen, Mariam, Tendo, Shafik, Vincent and Wilber. All the social distancing rules were to be followed and the arrangement was as follows:

- All the participants sat in a straight line at the table.
- The speakers were to present alternating from each side.
- The chairperson took the middle seat.
- The proposers and opposers took opposite sides from the chairperson.
- The first speaker was seated next to the chairperson.

The following prevailed during the debate:

- Mariam was the first speaker. She stated that the teachers would train more doctors if many died during the pandemic.
- She was followed by Tendo.
- Mariam and Wilber had conflicting ideas.
- Tendo was seated further from Mariam than Wilber.
- Vincent was seated to the right hand side of Mariam.
- Wilber was seated between Tendo and Peter.
- Shafik was seated furthest from Wilber.

Questions:
(a) Show the seating arrangement at the table.
(b) i) Who was the chairperson of the debate?
ii) Who were the opposers of the motion?
(c) On which side was:
   i) the 3rd speaker in the debate?
   ii) the last speaker in the debate?
(d) Do you think Vincent and Wilber were on the same side? Give a reason for your answer.
(e) Examine the impacts of the COVID-19 pandemic on the economy of Uganda.

6. Read the passage below and answer the questions that follow.

While the influence of population growth on economic development is a subject of heated debate, the weight of scholarly opinion today supports the view that the poorest countries would be more likely to achieve reasonable per capita income growth if their birth rates declined. The connection between economic and population growth is often confused by a chicken-and-egg dilemma.

Economic growth often leads in declines in death rates and increase in immigration, both of which contribute to soil erosion, decline in water quality, loss of jobs and doubling the amount of pollutants in our environment. Governments find it easier to establish and maintain transportation infrastructure and provide social services as universal schooling. These lay the ground work for investment, innovation and economic growth.

In some cases, it is not possible, of course, that rapid population growth may contribute to economic growth at certain times and yet constrain it at others. In societies, fortunate enough to begin the development process with small populations and abundant natural resources, rapid population growth may indeed help spur economic development.

But in most developing countries today, populations are already large relative to the availability of natural resources and supplies of renewable natural water and farmland are scarce and often concentrated in a few hands. Under such circumstances, rapid population growth is especially likely to contribute to soil erosion, decline in water quality, loss of jobs and doubling the amount of pollutants in our environment. Governments find it easier to establish and maintain transportation infrastructure and provide social services as universal schooling. These lay the ground work for investment, innovation and economic growth.

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