VISION GROUP

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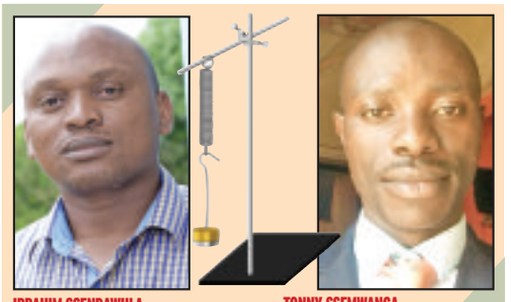
HOME SCHOOLING MATERIAL

PASS A' LEVEL

BIOLOGY, PHYSICS AND GENERAL PAPER

CONTINUATION

SOLUTIONS TO PHYSICS (APHY 004)



IBRAHIM SSENDAWULA
NABISUNSA GIRLS' SCHOOL

TONNY SSEMWANGA
MT ST HENRY'S H/S, MUKONO

6. (c) (ii) current flowing in the primary coil

$$\text{Efficiency} = \frac{\text{power output}}{\text{power input}} \times 100\%$$

$$\frac{80}{100} = \frac{I_S V_S}{I_P V_P} \Rightarrow \frac{80}{100} = \frac{12 I_S}{240 I_P}$$

But $I_S = \frac{P_{OUT}}{V_S} = \frac{36}{12} = 3A$

$$\therefore \frac{80}{100} = \frac{12 \times 3}{240 \times I_P}$$

$$\Rightarrow I_P = \frac{100 \times 12 \times 3}{80 \times 240} = 0.19A$$

(d) (i) Explanation of back *emf* in a d.c motor.
When a motor coil rotates in the magnetic field, an *e.m.f* is induced in the coil. The induced *e.m.f* acts in opposition to the applied voltage and is thus called a back e.m.f.

(ii) Significance of back *emf* in a d.c. motor.
- Provides the mechanical power for the motor to do work.
- Limits the current flowing in the coils that would otherwise burn out.

(iii) Relationship between back *emf* and efficiency of the motor.

Power supplied = mechanical power output + power lost as heat

$$I V = E_b I + I^2 R,$$

$$V = E_b + I R$$

$$\text{Efficiency} = \frac{\text{mechanical power developed}}{\text{power supplied}} \times 100\%$$

$$\text{Efficiency} = \frac{E_b I}{I V} \times 100\%$$

$$= \frac{E_b}{V} \times 100\%$$

Where V and Eb is supply voltage and back e.m.f respectively and R is the coil or amateur resistance.

(a) Peak value of an alternating current is the maximum value of the alternating current.
Root mean square value is the value of the steady / direct current which dissipates heat in a given resistor at the same rate as the alternating current.

(b) A resistor of resistance 200 Ω is connected across an alternating voltage, $V = 20\pi \sin 60\pi t$.
(i) Frequency of the alternating voltage.
Compare $V = 20\pi \sin 60\pi t$ with $V = V_o \sin 2\pi f t$

$60\pi = 2\pi f$

Then $f = \frac{60}{2} = 30\ Hz$

(ii) Mean power dissipated in the resistor.

From; $I_0 = \frac{V_0}{R} = \frac{20\pi}{200} = 0.1\pi A = 0.314A$

Average power $\langle power \rangle = \frac{I_0 V_O}{2} = \frac{V_O^2}{2R} = \frac{(20\pi)^2}{2 \times 200} = \frac{400\pi^2}{400} = 9.87\ W$

(c) (i) Showing that the current in the circuit leads the voltage by $\frac{\pi}{2}$.

Let $V = V_o \text{ Sin wt}$

from $Q = CV$

$$I = \frac{dQ}{dt} = \frac{d(CV)}{dt}$$

$$I = \frac{d}{dt}(CV_o \text{ Sin wt}) = CV_O\ w\ Cos\ wt$$

$$I = w\ CV_O\ Sin\left(wt + \frac{\pi}{2}\right)$$

$$I = I_O\ Sin\left(wt + \frac{\pi}{2}\right), \quad where\ I_O = w\ C\ V_O$$

If you compare the expressions for

$I = I_O\ Sin\left(wt + \frac{\pi}{2}\right)$ and the one for

$V = V_O\ Sin\ wt$, it has been shown that

current leads voltage by $\frac{\pi}{2}$.

(ii) Expression for the capacitive reactance in terms of frequency, and capacitance, C.

From; $I = w\ CV_O\ Sin\left(wt + \frac{\pi}{2}\right), \quad I_O = w\ C\ V_O$

Capacitive reactance, $X_C = \frac{V_O}{I_O} = \frac{V_O}{w\ CV_O} = \frac{1}{w\ C} = \frac{1}{2\pi f C}$

(iii) Given; Capacitance, C = 0.2 $\mu F = 0.2 \times 10^{-6} F$

Frequency, f = 100Hz

I_{rms} = 12mA = 12 × 10^{-3} A

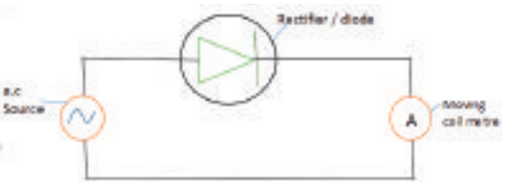
$X_C = \frac{1}{2\pi f C}$ and also $X_C = \frac{V_{rms}}{I_{rms}}$

$$\Rightarrow \frac{V_{rms}}{I_{rms}} = \frac{1}{2\pi f C}$$

$$\therefore V_{rms} = \frac{1}{2\pi f C} \times I_{rms} = \frac{1}{2 \times 3.14 \times 100 \times 0.2 \times 10^{-6}} \times 12 \times 10^{-3}$$

$$= 95.52\ V$$

(d) Working of a half wave rectifier type meter.



Current to be measured is fed to the meter through the rectifier / diode which conducts current in only one direction. So a direct current of varying magnitude flows through the meter. The moving coil meter is calibrated to measure root mean square values of current.

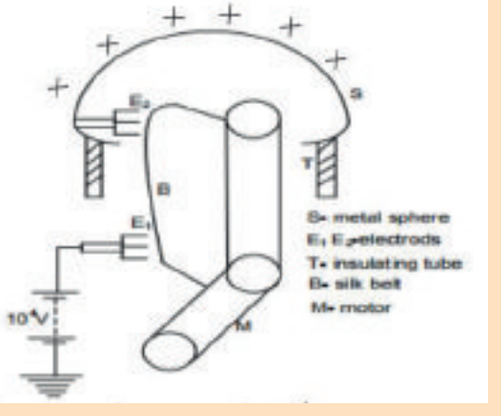
(e) Explain the advantage of a.c over d.c in power transmission.
A.C voltages can be stepped up or down as required.
When voltage is high, current is low and power dissipated in the transmission wire is small.
However, this is not the case with D.C. It can not be transformed or stepped up or down. This implies that a large current flows during its transmission and this leads to a large amount of energy to be lost in form of heat in the transmission wires.

SECTION D.

8. (a) (i) Characteristics of an equipotential surface.
- All points on an equipotential surface have the same potential; therefore no current flows in it.
- There is no electric field along any direction lying in the surface, or the electric field lines are at right angles to the equipotential surfaces.
- Work done in moving a charge from one point to another on the equipotential surface is zero.

(ii) Examples of an equipotential surface.
- Surface of a charged metal sphere
- Surface of the earth.

(b) (i) Structure and action of the Van der Graaf generator.



- The lower electrode E_1 is maintained at a high positive potential relative to the earth.
- The high electric field intensity at the spikes of the electrode ionizes air around them.
- Positive ions are repelled onto the silk belt driven by the motor.
- The positive charge is carried up wards by the belt.
- As the charge approaches the upper electrode, it induces negative charge on the spikes of the electrode and a positive charge on the outer surface of the metal shell through the connecting rod.
- The high electric field intensity at the spikes of the

Turn to next page

electrode E_2 ionises air around it repelling negative ions onto the belt as it attracts the positive ions.

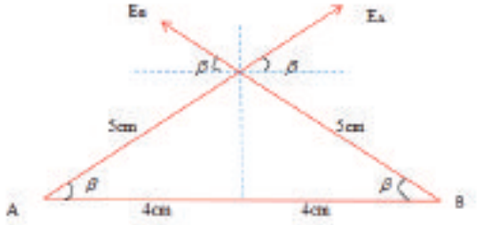
- The negative ions neutralises the positive charge on the belt before it goes over the upper pulley.
- This process is repeated until the metal shell is about 10^6V positive relative to the earth.

(iii) Factors that limit maximum voltage obtainable in a Van de Graaf generator.

- Insulating properties of the air around the generator; It determines the down voltage of the surrounding atmosphere.
- The potential of the lower electrode; It determines the amount of positive charge induced on the belt.
- The speed of the motor that runs the belt.

(c) Charging two insulating bodies rubbed together.
When two dissimilar insulators are rubbed together, heat is generated due to friction. This heat is sufficient to make the material of lower work function release electrons that are taken up by the other material. The one which loses electrons becomes positively charged while the one which gains electrons becomes negatively charged.

(d) Calculating the electric field intensity at point C.



$$Cos\beta = \frac{4}{5} \Rightarrow \beta = 36.9^0, Sin\beta = \frac{3}{5}$$

$$E_A = \frac{kQ_A}{r^2} = \frac{9\times10^9 \times 0.1\times10^{-6}}{(5\times10^{-2})^2} = 3.6\times10^5\, NC^{-1}$$

Thus; $$\overline{E_X} = \begin{pmatrix} 3.6\times10^5 \cos\beta \\ 3.6\times10^5 \sin\beta \end{pmatrix} = \begin{pmatrix} 2.88\times10^5 \\ 2.16\times10^5 \end{pmatrix} NC^{-1}$$

$$E_B = \frac{kQ_A}{r^2} = \frac{9\times10^9 \times 0.05\times10^{-6}}{(5\times10^{-2})^2} = 1.8\times10^5\, NC^{-1}$$

$$\overline{E_Y} = \begin{pmatrix} -1.8\times10^5 \cos\beta \\ 1.8\times10^5 \sin\beta \end{pmatrix} = \begin{pmatrix} -1.44\times10^5 \\ 1.08\times10^5 \end{pmatrix} NC^{-1}$$

$$E = \sqrt{(1.44)^2 + (3.24)^2}\times10^5$$
$$= 3.55\times10^5\, NC^{-1}$$

$$\tan\alpha = \frac{E_Y}{E_X} = \frac{3.24}{1.44} = 2.25 \Rightarrow \alpha = 66.04^0$$

9. (a) (i) Capacitance of a capacitor is the ratio of the magnitude of charge on either plates of the capacitor to the potential difference between the plates.

(ii) Expression for the energy stored in a capacitor of capacitance, C and charged to a p.d, V.
Suppose the p.d between the plates at some instant is V. But when a small charge of δq is transferred from the negative plate to the positive plate, the p.d increases by δq .

The work done to transfer the charge is;

$$\delta W = (V + \delta V)\,\delta q = V\ \delta$$

But $$V = \frac{q}{C} \therefore \delta w = \frac{q}{C}\delta q$$

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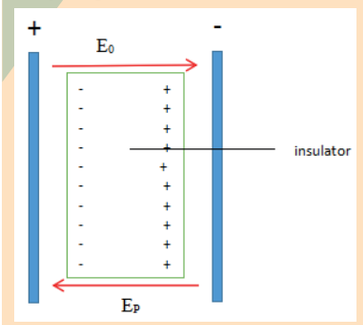
Total work done, W to charge the capacitor from 0 to Q is;

$$W = \int_0^Q \frac{q}{C}\, dq = \frac{1}{2} C V^2$$

(b) (i) Effect of placing an insulator between the plates of a charged capacitor.



When an insulator (dielectric) is placed between the plates of a charged capacitor, the nuclei of the molecules of the dielectric are urged in the direction of the field and the electrons in the opposite direction.
The molecules thus get polarised or distorted. The surfaces of the dielectric near the capacitor plates develop charges opposite to those on the adjacent plates while charges inside the dielectric cancel out.
Since the charge on the dielectric are not conductible, the electric field intensity E_p develops between the surfaces of the dielectric in a direction opposite the applied field E0.
The resultant electric field intensity, E is thus reduced , $(E = E_O - E_P)$.
Since $E = \frac{V}{d}$, reduction in E also reduces V. Also from $C = \frac{Q}{V}$, a reduction in V leads to an increase in C.
Hence capacitance of a capacitor increases when an insulator (or dielectric) is inserted between its plates.

(ii) Conductor instead of the insulator placed between the plates of the capacitor.
A conductor has free electrons which move randomly with in its lattice.
On placing the conductor in between the plates of the capacitor, the electrons are urged to move in the direction opposite to that of the field set up in the capacitor, and thus causes charge to directly flow from one plate to the other, so no charge is stored.

(iii) Uses of a dielectric.

- Keeps the plates of a capacitor apart.
- Increases the capacitance of a capacitor
- Reduces the chances of electric break down so that large p.d scam be with stood.

(c) Given; V = 300V, heat capacity, c = 400JK^{-1}, $\theta = 0.6K$

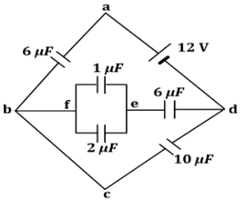
Energy stored = $\frac{1}{2}CV^2$

Heat dissipated in the coil = $c\theta$

Energy stored = heat dissipated in the coil

$$\frac{1}{2}C(300)^2 = 400\times0.6 \qquad C = \frac{400\times0.6\times2}{300\times300} = 5.33\times10^{-3}F$$

(d)



Net charge contained in the network.
First consider capacitors of 1 μF and 2 μF (parallel). Let C_1 be their effective capacitance.

Then; $C_1 = 1\ \mu F + 2\ \mu F = 3\ \mu F$

Then, C_1 is in series with the 6 μF .

Let C_2 be their effective capacitance

Then; $C_2 = \frac{1}{6} + \frac{1}{3} = \frac{6\times3}{6+3} = \frac{18}{9} = 2$

A simplified network is shown in the figure below.

2 μF and 10 μF are in parallel. Let their effective capacitance be C_3;
Then; $C_3 = 2\ \mu F + 10\ \mu F = 12\ \mu F$
Finally, C_3 is in series with the 6 μF ;
So effective capacitance for the network is,

$$C = \frac{1}{6} + \frac{1}{12} = \frac{12\times6}{12+6} = \frac{72}{18} = 4\mu F$$

Charge in the network, $Q = CV = 4\times10^{-6}\times12 = 4.8\times10^{-5}C$

10. (a) (i) Electromotive force of a battery is the energy supplied by the battery to transfer 1C of charged around a complete circuit in which the battery is connected.

(ii) Derivation of an expression for the efficiency of the circuit.
Power delivered to the load, Pout = IV
Power supplied by the battery, Pinput = I E

$$\text{Efficiency } \eta = \frac{Pout}{Pinput}\times100\%$$

$$= \frac{IV}{IE}\times100\%$$

$$= \frac{V}{E}\times100\%$$

But $V = IR$ and $E = I(R+r)$

$$\therefore \eta = \frac{R}{R+r}\times100\%$$

(b) (i) Maximum power output $\boldsymbol{P_{max} = \frac{E^2}{4r}}$

$$\text{Power output } P_o = IV = \left(\frac{E}{R+r}\right)\times\left(\frac{ER}{R+r}\right)$$

$$\text{Power output } P_o = \frac{E^2}{(R+r)}R$$

$$At \text{ max } imum \text{ power, } P\max, \ \frac{dPo}{dR} = 0$$

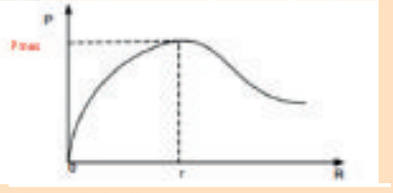
$$\frac{dPo}{dR} = E^2\frac{\left[(R+r)^2 - 2R(R+r)\right]}{(R+r)^4} = 0$$

As R tends to zero, P tends to zero.
As R tends to α , P tends to zero;
So, R = r;

$$P_{max} = \frac{E^2}{(r+r)^2}r$$

Power output, $P_{max} = \frac{E^2}{4r}$, as required.

(ii) Graph showing variation of power output against resistance.



(c) (i) *e.m.f of cell Y*

$$V_{AB} = \left(\frac{20}{20+10}\right)\times2 = \frac{40}{30} = \frac{4}{3}V$$

$$p.d/cm = \frac{4/3}{100} = \frac{1.33}{100}Vcm^{-1}$$

EMF of cell Y = p.d across the 90 cm of AB

$$= \frac{4}{300}\times90 = 1.2\text{ V}$$

SOLUTIONS (APHY 004)

(ii) *Internal resistance, r of Y*

When K_2 is closed;

p.d across 5Ω resistor , V = p.d across 75.5 cm length

$$= \frac{4}{300} \times 75.5$$

But E = I (R + r) = 1.2 -----(i)

V = IR -----(ii)

(i) ÷ (ii)

$$\frac{R+r}{R} = \frac{1.2 \times 300}{4 \times 75.5} = 1.19$$

$$\frac{5+r}{5} = 1.19$$

$$5 + r = 5.95$$

$$r = 0.95\ \Omega$$

(iii) *Balance length when both K_1 and K_2 are closed.*

When K_2 is closed, cell Y supplies current I through the circuit of 5Ω.

And Internal resistance, r=0.95 Ω

From, E = I(R+r)

1.2 = I (5+0.95)=5.95 I

$$I = \frac{1.2}{5.95} = 0.202A$$

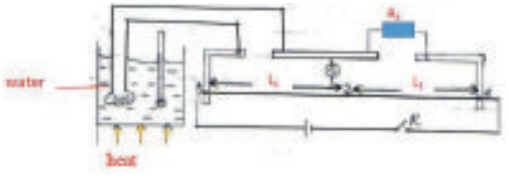
P. d across 5Ω *resistor = p.d across balance length, l*

Note: When K1 is closed, the 10 Ω resistor is out of the circuit. So the p.d per cm changes from when K1 is open.

$$5 \times 0.20 = \left(V_{AB} \Big/ 100\right) l = \frac{2}{100} l$$

$$l = \frac{5 \times 0.20 \times 100}{2} = 50..0cm$$

(d) Measurement of temperature coefficient of resistance of a material in form of a wire.

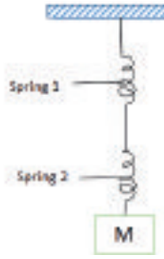


The apparatus is set up as shown above.
The specimen is made into a coil and immersed in a water bath.
The ends of the coil are connected to the left hand gap of the metre bridge and a standard resistor Rs in the right hand gap.
Switch k is closed the water bath heated.
After thorough stirring,a suitable temperature, θ is recorded.
The balance lengths L_1 and L_2 are measured and recorded.
The procedure is repeated for different values of temperature, θ and the
results are tabulated including values of $R_\theta = \frac{L_1}{L_2} R_s$
A graph of R_θ against θ is plotted.
Its slope, S is determined.
The mean temperature coefficient of resistance, α is determined from; $\alpha = \frac{S}{R_s}$.

PHYSICS QUESTIONS (APHY 005)

SECTION A

1(a)(i) Define gravitational field strength.
(ii) Describe a simple experiment to determine the acceleration due to gravity using a spiral spring and a set of masses.
(b)(i) State four characteristics of simple harmonic motion.
(ii)



Two identical springs are arranged as shown in figure 1 above. The force constants of the springs are K_1 and K_2 respectively. A known mass is attached to the free end of spring two. Show that if mass M is pulled slightly downwards and then released, the resultant motion is simple harmonic with frequency

$$f = \frac{1}{2\pi}\sqrt{\frac{k_1 k_2}{M(k_1+k_2)}}$$

(c) What is the banking of a road?
(d) Explain why:
(i) the maximum speed of a car on a banked road is higher that on unbanked road.
(ii) a body tied at the end of the string and whirled in a horizontal circle flies off along a straight line when the string breaks.

2. (a)(i) Define the coefficient of viscosity?
(ii) What are the dimensions of coefficient of viscosity from first principles?
(iii) Describe an experiment to determine the coefficient of viscosity using Poiseuille's method.
(c) Explain the effect of increasing temperature on viscosity of fluids.
(d) (i) Define terminal velocity?
(ii) A small metal sphere of radius 2mm and mass 0.3g falls under gravity, centrally down a wide tube filled with a liquid at 30°C. The density of the liquid is 600Kgm^{-3}. The sphere attains a terminal velocity of 40.0cms^{-1}. The tube is emptied and filled with another liquid at the same temperature and density 800Kgm^{-3}. When the metal sphere falls centrally down the tube, it moves with terminal velocity of 25cms^{-1}. Determine the ratio of the coefficient of viscosity of the second liquid to that of the first liquid.

3. (a) State Newton's law of motion?
(b) (i) Distinguish between perfectly inelastic collision and an inelastic collision.
(ii) Ball A of mass 400g moving with a speed of 20ms^{-1} collides with another ball B of mass 500g approaching it with a speed of 24ms^{-1}. After collision ball reverses its direction and moves with a speed of 18ms^{-1}. Prove that B also reverses its direction and check whether Newton's law holds if the collision took 0.05 seconds.
(c) (i) Define conservative force.
(ii) Show that a body falling freely under the influence of gravity obeys the principle of conservation of mechanical energy.
(d) (i) Define time of flight as applied to projectile motion.
(ii) A body was projected at an angle of θ^0 to the horizontal with a speed of 20ms^{-1} from a point 5m above the ground. Calculate the velocity with which it hits the ground.

4. (a) (i) State the laws of solid friction.
(ii) Describe an experiment to measure the coefficient of kinetic friction.
(b)(i) Define the joule.
(ii) A truck of mass 100kg is travelling in a straight line on a level ground with an initial speed of 20ms^{-1}. After a distance of 30m, the ground slopes at an angle of 30^0 to the horizontal. The frictional resistance of the ground is 5N per kilogram. Find how far up the slope the truck will travel before coming to rest if the engine was switched off just at the start of the slope.
(c) State two instances where increasing friction can be:
(i) helpful
(ii) wasteful
(d) (i) State the work energy theorem.
(ii) Derive work-energy equation.

SECTION B

5. (a)(i) What is meant by the term thermometric property?
(ii) Give two examples of thermometric properties.
(b) (i) With the aid of a well labelled diagram, describe the structure and mode of operation of an optical pyrometer.
(ii) State one advantage and one disadvantage of a pyrometer.
(c) Define specific latent heat of a substance.
(d) A well lagged copper calorimeter of mass 0.01 kg contains 0.20kag of water and 0.05kg of ice at 0°C. Steam at 100°C, containing condensed water at the same temperature is passed into the mixture until the temperature of the calorimeter and its contents is 30°C. If the increase in mass of the calorimeter and its contents is 0.025kg;
(i) Calculate the mass of condensed water in the wet steam.
(ii) State any assumptions you have made.
(e) Explain why there is no change in temperature when a substance is melting.

6. (a)(i) What is dew point?
(ii) Explain briefly how dew is formed.
(b) State the difference between saturated vapour and unsaturated vapour.
(c) (i) What is saturated vapour pressure.
(ii) Describe an experiment to determine the S.V.P of a liquid.
(d) (i) Define boiling point of a liquid.
(ii) A closed vessel contains a mixture of air and alcohol vapour. The pressure in the vessel at 20°C is 1.7 × 10^{4}Nm^{-2}. When the mixture is heated at constant volume to 78°C, the normal boiling point of alcohol, the pressure in the vessel becomes 1.14 × 10^5 Nm^{-2}. Determine the S.V.P of alcohol at 20°C, assuming that the vapour remains saturated, and that atmospheric pressure is 1.0 × 10^{5}Nm^{-2}.

7. (a)(i) Define an isothermal and an adiabatic change of a gas.
(ii) Give two examples of adiabatic changes.
(iii) How could, the changes in (a)(i) above be achieved.
(b)(i) What are the characteristics of an ideal gas?
(ii) Derive an expression $p = \frac{1}{3}\rho\overline{c^2}$ for an ideal gas.
(iii) What does $\overline{c^2}$ represent in the equation in (b)(ii) above.

SECTION C

8. (a)(i) With the aid of a well labelled diagram, describe the structure and mode of operation of C.R.O.
(ii) Give two uses of a C.R.O.
(b)(i) What are cathode rays?
(ii) State four properties of cathode rays.
(iii) Described briefly how the sign od charge of cathode ray is determined.
(c) A narrow beam of electrons is emitted from a small electron gun within a glass bulb that contains enough gas to glow where the beam strikes. Using 300V to accelerate the electrons, a uniform magnetic field of magnetic flux density 7.3 × 10^{-4} T produces radius of 8.0cm. Obtain a value of $\frac{e}{m}$ of the electrons.

9.(a) Define the following terms:
(i) atomic number
(ii) mass number
(iii) isotopes
(b) Describe the structure and action of a G-M tube.
(c) A source of half-life 130 days contains initially 1.0 × 10^{20} radioactive atoms and the energy released per disintegration is 8.0 × 10^{-33}J. Calculate:
(i) activity of the source after 260 days have elapsed.
(ii) total energy released during this period.
(d) (i) Sketch a graph of number of atoms present against time for a radioactive nuclide and use it to explain how the decay constant is calculated.
(ii) Explain briefly why the the G-M tube has an anode made of tiny wire and some halogen gas.

10. (a) What is meant by work function?
(b) State the law of photoelectric emission.
(c) Sodium has a work function of 2.0eV and is illuminated of wave length 150nm.
(i) Calculate the maximum speed of the emitted electrons.
(ii) Find the threshold frequency.
(d) With the aid of a well labelled diagram, describe how the stopping potential of a metal is measured.
(e) Describe an application of a photocell.

Friday, June 26, 2020

PASS A'LEVEL

BIOLOGY PAPER 2 ANSWERS (ABIO 006)

THE TEACHERS

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TRINITY SENIOR ACADEMY, BWEBAJJA

BEN OCAN,
ST MARY'S COLLEGE, KISUBI

SECTION A

1. a) i) **Similarities**

- Both pigments P1 and P2 have lowest light absorption at wavelength 800nm.
- Both pigments have the same light absorption at wavelengths of 400nm.
- From wavelength of 500nm to 660nm both had increase in light absorption.
- From wavelength 730nm to 800nm both pigments had rapid decrease in light absorption.

Differences

- Pigment P1 has the highest light absorption at wavelength of 730nm while pigment P2 has the highest light absorption at wavelength of 660nm.
- Pigment P1 has one peak absorption of light at wavelength 730nm while pigment P2 has two peak absorption of light at light wavelengths of 450nm and 660nm.
- Beyond light wavelength of 660nm pigment P1 has higher light absorption than pigment P2.
- From light wavelength 400nm to 660nm Pigment P2 has a higher light absorption than pigment P1.
- The maximum light absorption of pigment P2 is higher than the maximum light absorption of pigment P1.

ii) **Similarities**

- From light wavelength 400nm to 500nm both plants A and B had no flowers produced.
- At light wavelength 700nm both plants had similar average numbers of flowers.
- Beyond light wavelength of 730nm hinders flower formation in both plants A and B.
- Both plants A and B had only one peak of flower formation as the light wavelength increased.

Differences

- From light wavelength of 600nm to 660nm plant A could not flower only plant B could flower.
- Beyond light wavelength of 700nm plant B could not flower only plant A was able to flower.
- Plant A has highest average numbers of flowers at light wavelength of 730nm while plant B the highest average numbers of flowers at light wavelength of 660nm.
- The peak of average flowering for plant A is higher than that of plant B.

b) i) P1 represents phytochrome P_{fr} with peak light absorption of 730nm while P2 represents phytochrome P_r whose peak light absorption is 660nm.

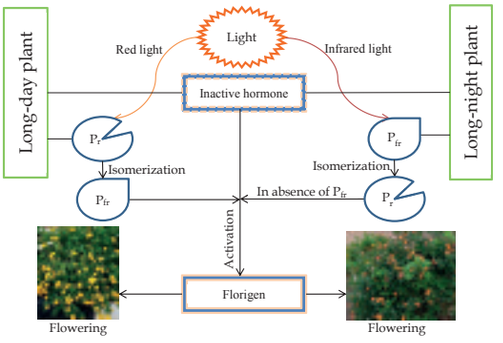
ii) A: 10 hours per day B: 8 hours per day

ii) For plant A: The time taken for the plants to flower started rising, meaning that longer day exposures to light do not favour flowering in such plants while shorter day/longer night exposures favour their flowering.
For plant B: The time taken for the plants to flower started decreasing, meaning that longer day exposures to light favour flowering in such plants while shorter day/longer night exposures favour their flowering.

c) i) Plant B

ii) Plant A

iii) Phytochrome P_{fr} (P1) stimulates growth of flower buds into flowers in long-day plants while on the other hand it inhibits flower buds in long-night plants.
Plant A: On exposure to longer night/shorter day period, infrared light causes phytochrome P1 (P_{fr}) to isomerise into P2 (P_r) and accumulates. Lower amount of P_{fr} but higher amount of P_r causes inactive hormone to be converted to florigen that enables appropriate enzymatic activities that cause development of flowers to occur.
Plant B: On exposure to shorter night/longer day period, red light causes phytochrome P2 (P_r) to rapidly isomerise into P1 (P_{fr}) and accumulates. Higher amount of P_{fr} binds to genes that initiate appropriate enzymatic activities that cause development of flowers to occur.



NOTE: Shapes of chemicals and choices of plants were not meant to depict their true natures BUT purely concept development by the authors for ease of understanding to learners.

d) i) Florigen hormone ii) Leaves

SECTION B

2. a) i) Solitary and random
Organisms are individually distributed with no particular distribution pattern within the habitat. If they are distributed quite away from each other then they are said to be over dispersed.

- Solitary and uniform/even

Here single organisms have specific patterns of distribution within the habitat.

- Aggregate/clumped and uniform/even

This aggregated population applies to many animals that are found living freely together in a habitat with specific patterns of distribution while clumped population applies to many plants growing in a habitat with specific patterns of distribution e.g. elephant grass, banana plantation etc.

- Aggregate and random/uneven

Here the aggregate population is of many animals that are living freely together in a habitat without specific patterns of distribution while the clumped population applies to many plants growing in a habitat without specific patterns of distribution e.g. spear grass.

ii) **Solitary and random distribution**

- Organisms are large and can defend themselves as individuals.
- Absence of or limitedly distributed predators in the habitat.
- Required resources such as food, mates, light, shelter, water, etc. are readily available in all areas of the habitat.

Solitary and uniform/even distribution

- Organisms are also large and can defend themselves as individuals.
- This is due to regular pattern of distribution of the resources within the habitat.
- In such a habitat, there is low competition between organisms.

Aggregate/clumped and uniform/even
In the case of animals:

- They are usually weak to defend themselves as individuals.
- Specific or regular pattern of distribution of resources within the habitat.
- Animals may seek protection by cooperation, where animals of different species may alert of physically scare enemies/predators of another species.
- Distributions of the resources are in specific uniform patterns within the habitat.
- Species specific behaviour towards members of the same species such as in parental care, nature of mating.

Plants live together by clumping due to:

- Uniform distribution and concentration of resources such as water, certain mineral salts etc. in particular regions of habitat but in regular patterns.
- Nature of vegetative propagation such as rhizomes, runners, budding etc. either artificially or naturally.
- Mode of dispersion like several seeds deposited in faeces.

Aggregate and uniform/even

- Animals may seek protection by cooperation, where animals of different species may alert or physically scare enemies/predators of another species.
- Distributions of resources are in specific uniform patterns within the habitat.
- Species specific behaviour towards members of the same species such as in parental care, nature of mating.
- In such a habitat, there is relatively less severe competition between organisms.
- Plants live by uniform clumping distribution and concentration of resources such as water, certain mineral salts etc. in particular regions of habitat but in regular patterns.
- Nature of vegetative propagation such as rhizomes, runners, budding etc. either artificially or naturally.
- Mode of dispersion like several seeds deposited in faeces of animals along their corridors of grazing.

b) The apparent production of seeds/propagules. Producing many seeds increases chances of being transferred by dispersal agents to fertile soils while producing fewer seeds reduces such chances.

- Suitability of the soil as determined by its pH, texture, aeration, water content (that is why some plants survive as xerophytes, mesophytes, hydrophytes and halophytes), nutrient contents, etc.
- The extent to which competition within and outside the species occurs. If the competition is favourable then the dispersal becomes successful while unfavourable completion reduces chances of successful dispersal.
- Higher numbers of consumers present may feed and destroy them at a higher rate while still young but when such consumers are fewer the propagules have higher chances of survival.
- Adaptations of propagules for dispersal and subsequent germination. E.g., amount of food stored. Some produce large numbers of seeds with small amount of food content in cotyledons/endosperms for their establishment while others produce few seeds that are large with large amounts of food contents. Small seeds are light in weight and are easily dispersed by agents like wind, insects or mammals. This increases the chance of distribution with the result that a great number may land on fertile soils and be more successful. Disadvantage here maybe in overcrowding and possible destruction by microbes. Large seeds are bulky to be carried over long distances by dispersal agents. Given that they also have much stored food, they are often searched for by animals for their food contents – hence subjected to being destroyed and reducing chances of adequate distribution. Many plants of this kind have been modified by having their seed being tasteless, poisonous, hard protective coats, repellent smell, etc.
- Some plants produce two types of inflorescence; one for large seeds and the other for small seeds to balance risk of destructions by animals and ease of being carried away from parent plants. E.g. Umbrella tree (a fast-growing 'weedy tree')
- Relief feature of the area. Sloppy areas may also promote plants that bear large fruits that often fall freely when ripe and roll away from the parent plants.

BIOLOGY PAPER 2 ANSWERS (ABIO 006)

 Timing of dispersal when germination is most likely to be successful; like during early rainy season – hence dispersal is best at late dry season. This implies that flowering occurs during late rainy or early dry season when agents of pollination are more effective while fruiting occurs during late dry season at the time when dispersal agents are also more mobile.
 Precision in dispersal whereby the propagules are deposited in places suitable enough for germination and growth. E.g. some seeds deposited in animals' dung are provided with convenient manure soil for germination and subsequent growth. Also Themeda triandra (acil in Acoli) has fruits that have persisted long calyx and sharp/pointed base with hairs projecting away from the base (refer to figure below).

Themeda triandra (Acil in Acoli)

They mature in dry season. The persistent calyx in the fruit twists into a helical shape in the process of drying. When an animal brushes onto it the hairs stick the fruit on the animal that enable the seed to be dispersed away from the parent plant. When the environment becomes more humid, like at the beginning of wet season the heavy side of the fruit faces downwards (with the pointed end into the soil), the persisted calyx untwists resulting penetrating the seed into the soil.

3. a) Endosymbiotic theory suggests that aerobic bacteria (protomitochondria) and photosynthetic bacteria (cyanobacteria/ protochloroplasts) were once free-living bacteria which became engulfed by a nucleated cell. Both bacteria had single membranes. The two categories of bacteria had high mutualistic values to the nucleated cell and the three started co-existing among themselves. The protomitochondria became the current mitochondria while the protochloroplasts became the current chloroplasts. They now live as eukaryotic cell.

b) Both have double membranes, the outer membrane being derived from the plasma membrane of the host's nucleated cell.
 Each of them has DNAs, meaning that they had abilities to multiply on their own while maintaining their characteristics.
 Each has matrix as fluid medium in which biochemical reactions can occur.

c) Cholesterol molecules maintains flexibility of the membrane more fluid by making it less fluid at higher temperature but more fluid at lower temperature.
 Phospholipids control the selective permeability of and fluid nature of the membrane.
 Glycolipids have branched surfaces to the outside for increased recognition of substances by the respective cells as well as anchoring the membrane to be more stable.
 Proteins for structural support, electron carriers, active transport of materials across the membrane, enzyme for catalyzing reactions that energy require active transport, recognition sites for some chemical substances and energy transducers
 Glycoproteins are also recognition sites for substances like transmitters and hormones.

d) To increase the surface area to volume ratio by pushing the cytoplasm to the outer edge of the cell forming a thin layer in which exchange of materials readily occurs.
 They control cell volume, shape and provide support in that their membranes contain greater concentration of solutes inside it which develops a high osmotic potential that causes water to move into it to maintain the turgidity of the cell required for support in non-woody plants.

 They contribute to the colour of plant parts such as flower petals, pericarp of fruits due to accumulation of pigments like carotenes and anthocyanins.
 They are depository sites for excretory substances mainly in old leaves which eventually fall off to release the excreta.
 Some secondary products such as alkaloids and tannins that some contain may offer protection from consumption by herbivores.
 They can also serve as a food store. Some dissolved materials such as sucrose and mineral salts may be food reserves which can be utilized by the cytoplasm.
 Plant vacuoles may contain hydrolytic enzymes and so act like lysosomes. When the cell dies, the tonoplast loses its partial permeability and the enzymes escape into the cytoplasm causing autolysis.

4. a) DNA is a complex molecule composed of phosphate, deoxyribose sugar and four complementary nitrogenous molecules. It has two polynucleotide chains called stands. Each strand has alternating phosphate and deoxyribose molecules that form the backbone with a nitrogenous base bonded to each deoxyribose. The nitrobenous bases project inwards. The two strands are coiled in a right-handed fashion into double helical structure in a way that they are antiparallel to each other. For each strand, one extreme end terminates in a phosphate group while the opposite end terminates in a deoxyribose sugar. Every complete turn of the double helix has ten base pairs – hence ten pairs each of the deoxyribose sugar and phosphate group. The nitrogenous bases are paired in such a way that cytosine base is held to guanine base by triplet of hydrogen bonds while adenine base is held to thymine base by double hydrogen bones. The numbers of cytosine therefore the same as that of guanine and that of adenine is the same as that of thymine.

b) Chromosomes only become visible during cell division as a process towards reproduction – hence inheritance.
 Only DNA which is stable from generation to generation. I.e. once formed it has little or no change over time.
 Amount of DNA nearly remains constant for all cells in a given species e.g. there are 46 chromosome molecules (hence DNA) in man.
 When DNA is affected by mutation there is evidence of change in characteristic expression of an organism.
 Griffith experiment on Pneomococcus bacteria (the virulent is infectious and has a coat while the avirulent is non-infectious and has no coat) suggests that when DNA from dead virulent strain was injected into avirulent variety the latter developed coat and could infect and kill.

c) i) Mitochondria and chloroplast in a series of reactions.

ii) Absorption of nitrates by roots that are eventually transported to leaves.
 Reduction of nitrates to produce amino group (NH_2).
 Chemical combination of amino group with carbohydrate skeleton such as α-ketoglutarate derived from Krebs cycle.
 Transfer of amino group from one carbohydrate skeleton to another in the process of transamination to produce the required amino acid.

5. a) (i)
The bigger the size the smaller the surface area to volume ratio due to large volume while the smaller the size the larger the surface area to volume ratio.

(ii) During gaseous exchange, oxygen in the inhaled air diffuses across the respiratory surface and supplied round the body. The oxygen is used during respiration with carbon dioxide being released in the process. The carbon dioxide diffuses out of the body across the respiratory surface during gaseous exchange.

b) Gaseous exchange in bony fish is more efficient than in cartilaginous fish. This is because blood containing high carbon dioxide concentration and low oxygen move in the gill filament in an opposite direction to the flow of water in the gill cavity that contains high oxygen concentration and low carbon dioxide concentration. This concentration gradient is maintained throughout the distance traveled by water over the gill surfaces. This enables bony fish to extract more oxygen from water and release more carbon dioxide into water than cartilaginous fish whose blood flow is parallel to that of flow of water. As the distance covered by water, over the gills increases the differences in concentration of oxygen and carbon dioxide keeps reducing to the extent that the diffusion gradient diminishes by the time water emerges out of the gills. This results in continuous reduction in the ability of gills in cartilaginous fish to absorb oxygen and subsequently release carbon dioxide.

c) Exhaled air contains more carbon dioxide than inhaled air. This is because carbon dioxide produced during respiration is released during exhalation together with previously inhaled carbon dioxide since it is not used in the body.
Exhaled air contains less oxygen than in inhaled air. This is because some of the oxygen in the inhaled air diffuses into blood to be used in respiration.

6. a) (i) Is the transfer of mature pollen grains from the anther to the stigma either of the same plant or a different plant but of the same species as that of the plant of the pollen grain. This transfer is aided by pollinating agents such as wind and insects.

(ii) The pollen grain absorbs water and nutrients from the stigma to germinate a pollen tube. The pollen tube is controlled by the pollen tube nucleus and being both positively chemotropic to chemicals secreted by the ovary and negatively aerotropic. The pollen tube grows in the style towards the ovary. On reaching the micropyle, the generative nucleus divides by mitosis to form two male nuclei. The tip of the pollen tube disintegrates to release the male nuclei inside the ovule. The first male nucleus fertilises the egg nucleus to form a zygote while the second male nucleus fertilises the two polar nuclei that later grow into an endosperm.

b) **Similarities**
 Both involve fusion of gametes.
 In both, fertilisation occurs in the female reproductive organ.

Differences

Alternation of generation in bryophytes	Sexual reproduction in flowering plants
Gametophyte generation is dominant stage	Sporophyte generation is the dominant stage
Gametes are formed by mitosis	Gametes are formed by meiosis
Requires external water for fertilisation	Does not require water for fertilisation
Male gametes are flagellated	Male gametes are not flagellated
Spores are formed	Seeds are formed

c) Presence of much smaller gametophyte generations that are well protected by a sporophyte reduces the risk of drying up.
 Male gametes transferred within pollen grains and pollen tubes to female gametes; hence, fertilisation is not dependent on external water.
 The fertilized ovules remain within the parent sporophyte for some time from which it obtains protection and food before dispersal increase their chances of survival.
 Occurrence of secondary growth improves support to expose leaves to greater heights for effective light absorption and other resources.
 Presence of true roots that enable strong anchorage and much absorption of nutrients.
 Presence of epidermis containing waterproof cuticle prevent them from desiccation
 Presence of stomata on the epidermis of aerial parts facilitate gaseous exchange between the plant and the environment.

GENERAL PAPER ANSWERS (AGP005)

SECTION A

1. **A large population refers to a situation where in a country, the total number of people is far greater than the available natural resources.**

Positive impact (P)

- Provides a wider market for goods produced locally or imported.
- Ensures security/defence of a country.
- Availability of a higher labour force – particularly in agriculture and industries.
- Increased development of towns and other urban centres.
- Provides a large tax base, since there are many people from whom the government can obtain taxes.
- Ensures access/provision of social services by the government.
- Full resource utilisation.

Negative impact (N)

- Congestion
- Brings about unemployment leading to poverty.
- Crime/insecurity is high leading to numerous crime related cases.
- Leads to increased pressure on land.
- Increases dependence on foreign aid
- Strains government expenditure
- People are forced by circumstances to migrate from the rural areas to urban places.
- Faster spread of diseases.

2.**Science is the process of systematic investigation experimentation and analysis of data leading to logical conclusions.**

Technology is application/utilisation of scientific knowledge, equipment and methods in industrial or practical production.

Role in development

Science and technology boosts

- Industrialisation and efficiency
- Agriculture (increased production)
- Health and sanitation
- Transport and communication
- Building and construction
- Computerisation and automation
- Environmental management
- Entertainment
- Culture and education
- Security/defence
- Energy/power
- Food technology
- Domestic application of automation

3. **A national budget refers to a document/ financial tool prepared by the minister of finance and economic planning showing/ projecting incomes and expenditures of a nation in a given financial year.**

Reasons

- Raising the levels of economic activity through government expenditure.
- A budget plays a stabilization function as the government puts forth macro-economic policies.
- To improve the balance of payment position/correction of BOP deficit.
- Creation of employment opportunities through maintaining price stability.
- Encouragement in the private sector through undertaking the policy of planned investment in the public sector.
- Helping raise revenue for the government.
- Used as a yardstick to create balance in regional development/reducing regional imbalance in development.
- Mobilising masses to participate in different economic activities by providing and enabling environment- infrastructural development in specific places to enhance trade and transport of people.
- The need to reduce income inequality as a way of promoting equitable income distribution.
- The budget is a national framework for guiding and directing the allocation of natural resources.
- It is an incentive to work hard.

4. **The East African Community is an economic, administrative and political union of originally three member states. Most recently (in 2010), the membership was increased to five, bringing on board Rwanda and Burundi. The EAC is the union/the merging of the five East African countries to form one administrative unit and political union.**

The benefits (B)

- Likely to provide employment opportunities
- Provision of bigger and wider market
- Infrastructural development — schools, roads, railways
- Promotion of democratic practices — giving way for leadership change.
- Political stability likely to be fostered
- Cultural transformation
- Improved resource exploitation due to bigger pool
- Likely to boost trade due to free movement of people in the region
- Wider specialisation in member states.

Challenges (C)

- Different political and social ideologies that exist among countries in the East African block.
- Intrigue and other prejudices that characterise the East African region.
- Different levels of social economic trade patterns.
- No/lack of a uniform monetary currency in the region.
- Lack of one common language to unite the people.
- Sectarian tendencies based on tribes/ religion.
- Ignorance of the people of the benefits associated with merging countries into blocks.
- Absence of a strong central authority with the autonomy to discipline or recall member states that may not act in consistency with the objectives of the community.

THE TEACHERS

MOYA MARTIN GEORGE ZAPWE, KING'S COLLEGE, BUDO

NAKANWAGI JACKIE, OUR LADY OF GOOD COUNSEL SSS, GAYAZA

5 a) Patient 1 – Cancer department
Patient 2 – Radiology department
Patient 3 – Paediatric department
Patient 4 – Isolation department
Patient 5 – Cardiology department
Patient 6 – Maternity department
Patient 7 – Surgery department
Patient 8 – Physiotherapy department
Patient 9 – Intensive care department
Patient 10 – Surgery department

Note — Surgery has 2 patients of the 10.

b) Ratios — 1+3+4+6 =14……546 divide by 14 = 39

Outpatients — Ratio 1x39 = 39 patients
Surgery — Ratio 3x39 = 117 patients
Paediatrics — Ratio 4x39 = 156 patients
Maternity — Ratio 6x39 =234 patients

Total = 546 patients

ii) Outpatients average = 39 divide by 3 months (39 by 3) = 13 patients

c) Challenges faced by medical personnel (not challenges of the health system) include low salaries, late payments of salaries, lack of allowances, lack of equipment to use, inadequate numbers as per patient ratios, absenteeism of top administrators, lack of/poor housing conditions, etc.

6. a) MANIFESTATIONS OF INFATUATION

b) **How disagreement can be delt with.**

- Being committed to sticking together even in the most difficult time.
- Share everything with your partner even if the truth doesn't flatter you.

c) **THE MANIFESTATIONS OF INFATUATION**

- One's mind being consumed by the thoughts of another person.
- One thinking hard on how they want to reveal themselves to another.
- Instead of feeling secure,one thinks more of how to impress the other.
- One has an idealised vision of another which may not be accurate.
- One focuses on how to get the other person to like them and feel nervous because they don't know how the other feels.

d) **Meanings of words**

(i) **Fool-proof way to decipher**..... obvious move to withdraw
(ii) **Does not flatter you**.....has no positive representation
(iii) **Flame**.....keep the affair lively
(iv) **An idealised vision**.....one's own perception
(v) **Trivial**.....minor
(vi) **Realm**.....highest point
(vii) **Exacerbated**.....worsened
(viii) **Nightcap**.....a covering/sheild from reality
(ix) **The hassle of bickering**.....the urge to quarrel unnecessarily
(x) **Baggage**.....trouble/bother

GENERAL PAPER QUESTIONS (AGP06)

SECTION A

1. Examine the merits and demerits of political pluralism in Uganda.
2. Justify the need for wildlife conservation.
3. To what extent is family planning necessary to your country?
4. To what extent can rural electrification solve Uganda's environment problems?

SECTION B

5. Beginning in December 2019 in the region of Wuhan, China, a new coronavirus began manifesting in human beings. It has been named COVID-19, a shortened form of "coronavirus disease of 2019." This novel virus spreads incredibly quickly between people, due to its newness – no one on earth has an immunity to COVID-19, because no one had COVID-19 until 2019. While it was initially considered an epidemic in China, the virus spread worldwide. The WHO declared COVID-19 a pandemic in March, and by the end of that month, the world saw more than a half-million people infected and nearly 30,000 deaths.

With the coronavirus pandemic, people all over the world have become more aware of the best practices during a pandemic, from careful hand-washing to social distancing. Countries across the world, including Uganda, declared mandatory stay-at-home measures, closing schools, businesses, and public places. Public offices in Uganda were urged to only keep a skeletal essential staff. Organisation X decided to maintain only three departments of Human Resource, Audit and Production with a total of only 8 staff with not more than three of them in any department. Each of them has a different choice of standard operation procedures to observe in the order of merit, from hand washing with soap, wearing face masks, sanitising self and surfaces around, use of temperature guns, social distancing, quarantining, working from home and self-isolation

Bosco works in audit and does not like washing hands with soap and wearing a face mask

Francis works in human resource with only Moses who likes working from home

Esther and Hellen do not work in the same department as Bosco

Nancy likes self-isolation and does not work in production

George does not work in audit and does not like wearing face masks or using a temperature gun

One of those who work in audit likes washing hands with soap

The one who likes sanitising self and surfaces around works in human resource

Hellen does not like wearing face masks

Out of the eight, one of them does not follow any standard operating procedures

Questions

a) Allocate the employees to their actual departments and show how you arrived at your answer.

b) Differentiate between an epidemic and a pandemic.

c) Which of the employees will be:
(i) Most protected from contracting COVID-19.
(ii) Least protected from contracting COVID-19.

d) (i) Examine the socio-economic impact of COVID-19 virus to Ugandans.
(ii) What measures can be taken to mitigate future pandemics in your country?

Look out for answers next Friday