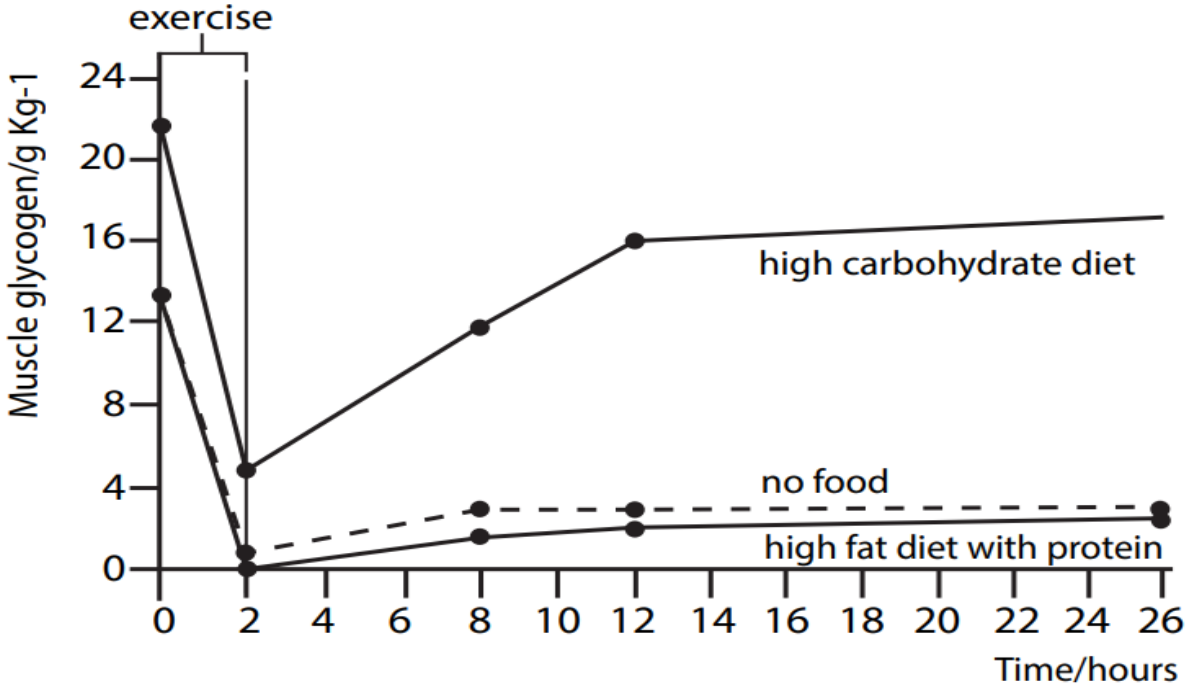
SET III-UACE GUIDE CBTI

N.B- QUESTION ONE IS COMPULSORY TO ALL CANDIDATES.

1. An **Investigation** was carried **out to study the rate of usage of Muscle glycogen during exercise and replenishment after the exercise (Recovery). Before** and **after** the exercise, **two subjects** were fed on **High Carbohydrate diet** and **High Fat diet with protein** and **one subject was not Fed.** The results are shown on the graph. Study it carefully and **provide suitable answers.**



(a) Compare the **Muscle glycogen** for **High Carbohydrate diet** and **High fat diet with protein during the** investigations.

(07 marks)

Description.	**Comment**
Similarities. **(Both) the muscle Glycogen for High Carbohydrate diet and High Fat diet with protein :** **Increase/rise; (Accept a range of 02-hours to 12-hours)** **Fall/decrease; (Accept a range of 0-hour to 02-hours)** **Initially are high; (Accept at 0-hour)** **Attain minimum value; (Accept at 2-hours)**	**(03 marks)**

Start at 0 hour;	

Differences.

High Carbohydrate diet	High fat diet with protein
Muscle Glycogen attains higher Minimum	Muscle Glycogen attains lower minimum;
Muscle Glycogen doesn't fall to zero	Muscle Glycogen Falls to Zero;
From 12 hours to 26 hours, Muscle Glycogen increases slightly/gradually	Muscle Glycogen remained almost constant;
Muscle Glycogen was higher throughout	Muscle Glycogen was lower throughout;
Initially/At 0-hour, Muscle glycogen was higher	Initially/At 0-hour, Muscle glycogen was lower;
From 02- hours to 12- hours, Muscle Glycogen increases rapidly	Muscle Glycogen increases gradually;

(04marks)
Accept statements with While or Whereas used.

(b) **Describe** the changes in the **Muscle glycogen** during the investigations for,

(i) High carbohydrate diet. **(03 marks)**

From 0-hour to 2-hours, Muscle Glycogen decreases rapidly/sharply/drastically to Minimum;
From 2-hours to 12-hours, Muscle Glycogen increases rapidly;
From 12-hours to 26-hours, Muscle Glycogen increases gradually;

(ii) No Food. **(03 marks)**

From 0-hour to 2-hours, Muscle Glycogen decreases rapidly/sharply/drastically to Minimum;
From 2-hours to 08-hours, Muscle Glycogen increases gradually;
From 08-hours to 26-hours, Muscle Glycogen remains constant;

(iii) High fat diet with protein. (03 marks)

From 0-hour to 2-hours, Muscle Glycogen decreases rapidly/sharply/drastically to Zero;
From 2-hours to 12-hours, Muscle Glycogen increases gradually;
From 12-hours to 26-hours, Muscle Glycogen remains almost constant;

(c) **Give** an account for **Muscle glycogen during recovery** following

(i) High carbohydrate diet. (07 marks)

From 2-hours to 12-hours, Muscle Glycogen increases rapidly because Carbohydrates are digested in the gut/alimentary canal forming large quantities of glucose; absorbed quickly into blood stream by either diffusion or active transport; Beta-cells of Islets of Langerharns (Pancreas) ; detect rise in blood sugar (glucose) level above the norm/set-point/reference point/normal level; secrete Insulin hormone which attaches to receptors on the Sarcolemma; increases glucose (Permeability) uptake by Muscle cells which convert excess glucose to large quantities of glycogen; (Glycogenesis)
From 12-hours to 26-hours, Muscle Glycogen increases gradually/Slightly because of depletion of glucose in blood hence low glycogenesis;

(ii) No food. (05 marks)

From 2-hours to 08-hours, Muscle Glycogen increases gradually because starvation causes glucose levels to fall below the norm; stimulates secretion of hormones like Glucagon and cortisols (gluco-corticoids); which cause gluconeogenesis; by promoting conversion of lactate, amino-acids and glycerols to glucose which is taken up by muscle cells for glycogenesis;
From 08-hours to 26-hours, Muscle Glycogen remains constant because of depletion of glucose;

(d) **Explain** the **differences** in the change of **Muscle glycogen** for the curve of **High Carbohydrate diet** and **no Food** during recovery period**.**

(05 marks)

High carbohydrate diet causes Muscle Glycogen to be higher throughout and increases rapidly than in absence of Food; because Higher Carbohydrate diet provides large quantities of glucose than Gluconeogenesis; for glycogenesis.
During glucose scarcity, body prioritizes energy (ATP) conservation and maintaining of blood glucose levels for functioning of key organs like brain over glycogenesis;
From 12-hours to 26 hours, Mass of glycogen increased gradually after feeding on high carbohydrate diet while remained constant when not fed; because of depletion/low levels of glucose in both cases;

(i) Calculate the average change in **mass of glycogen** during the first **2 minutes** of exercise for the three athletes.

(03 marks)

High Carbohydrate diet.	**Rate of change** $= \frac{22-5}{2-0}$; **$= 8.5\ g\ kg^{-1}\ hr^{-1}$;** **2 halves = one mark.**
No Food	**Rate of change** $= \frac{13-1}{2-0}$; **$= 6\ g\ kg^{-1} hr^{-1}$;** **2 halves = one mark.**
High Fat diet with protein	**Rate of change** $= \frac{13-0}{2-0}$; **$= 6.5\ g\ kg^{-1}\ hr^{-1}$;** **2 halves = one mark.**

Units must be well portrayed.

(ii) Suggest why **Muscle glycogen** decreases during the exercise**.** **(02 marks)**

Muscles require energy (ATP) to Contract; stored glycogen is metabolized to release energy;

(iii) What conclusion can you draw from the experiment**?**
(02marks)

Exercise uses up Glycogen rapidly/exercise lead to decrease in muscle glycogen levels/Glycogen is the primary source of energy for exercises;

Glycogen replenishment takes longer time than Consumption/usage;

Diet has impact on the muscle glycogen levels; ie High carbohydrate diet leads to much glycogen storage followed by absence of food and finally high fat diet with protein;

SECTION B (60 MARKS)

Answer three Questions from this section.

2. (a) Why is **inflammation** a useful body **defensive** mechanism**?**
(10 marks)

Prevents spread of infections; and speeds up the healing process; Histamine; leads to local vasodilation/Increased diameter of blood vessels/Capillaries; and Permeability/more leaky capillaries; Vasodilation leads to increased blood reaching damaged area carrying more oxygen and nutrients which are metabolized to provide energy for repair of damaged tissues; more blood clotting factors/Fibrinogen for rapid clotting; more interferon preventing viral infections, more complement proteins for rapid phagocytosis, more neutrophils/Phagocytes for rapid engulfing of pathogens; Increased permeability of capillaries results into formation of excess tissue fluid (Oedema) which inactivates and removes toxins; increases diapedesis/migrations of the neutrophils to engulf or remove pathogens in the intercellular spaces;

b) Explain how the Following **Factors** regulate the **heart rate.**

(i) Movement of the Limbs. **(05 marks)**

Stretch receptors in the Muscles and tendons; send afferent impulses to the brain/Cardio-vascular centre; to prepare for Fall in oxygen levels and build-up of carbondioxide; cardio-vascular centre initiates impulses to the SAN (Sino-atrial node) via sympathetic nerves; and terminals release adrenaline or noradrenaline increasing the heart rate;

(ii) Secretion of adrenaline. **(05 marks)**

Adrenaline increases the permeability of the SAN to the Sodium ions/high sodium conductance; by opening many sodium voltage gated channels; rapid influx of the sodium ions along the electrochemical gradient; rapid depolarization leading to rapid release of the cardiac impulses/waves of excitations; which spread rapidly to the cardiac muscles and shorten the intervals between ventricular systoles;

3. (a) Describe how the **Sodium Ions** enter the **axon** during the passage of the **action potential.** **(07 marks)**

Action potentials form local circuits/local currents; Axoplasm/inside of neurone has high concentration of sodium ions; which diffuse side-ways/laterally; causing depolarization of the adjacent axonal membrane; threshold depolarization causes sodium voltage gated channels open; leading to new influx of sodium ions along the chemical and electrical gradient; and processes repeated throughout the axonal membrane;

(b)(i) How does **thyroxine** control **metabolic rate** through **the negative Feedback loop.** **(07 marks)**

Hypothalamus detects fall in the level of thyroxine below the norm/normal level/set point in blood; releases TRF(H)(Thyrotropin releasing Factor or Hormone) ; stimulating the anterior Pituitary gland to secrete TSH (Thyroid stimulating hormone) ; which stimulates thyroid gland to secrete thyroxine (Tetra-iodothyronine) increasing level of cellular metabolism;
When thyroxine in blood exceeds the critical level (norm); inhibits the release of TRF by hypothalamus; and TSH by the anterior pituitary gland reducing release of thyroxine;

(ii) How do **hormones** affect the **target cell(s)?** **(06 marks)**

Hormones bind to target cell(S); on specific protein receptor sites; hormone-receptor complexes cause biochemical (Physiological) changes inside cells;

Steroid hormones/Lipophilic/lipid soluble enter cell; bind with target receptors in the cytoplasm forming complexes; complexes enter the nucleus, bind with DNA and influence transcription;

4. (a) Explain why the **Loop of Henle** is described as **hair pin counter-current Multiplier system.** **(05 marks)**

Counter-current- Loop of Henle has descending and ascending limbs; with tubular fluid flowing in opposite direction;

Hair pin- Loop of Henle arranged in a hair pin shape/U-shape; with descending limbs inserted deep in the medulla; then bends to become ascending limb in the renal cortex;
Multiplier system- loop of Henle maintains a steep concentration/osmotic gradient in the medulla; ascending limb actively pumps sodium chloride into the interstitium; and water

leaves the descending limb and collecting ducts by osmosis; concentration of renal fluid in the descending limb always higher than ascending limb at any level; with the U-bend/deepest part more concentrated than the rest;

10 halves= 05 marks.

b (i) Explain the **role** of the **hypothalamus** as a **thermostat** in the body. **(10 marks)**

Hypothalamus thermo-receptors have a set point/norm; which is a reference for monitoring body temperature; receives impulses from thermo-receptors in the skin and deep body tissues; and senses the temperature of blood flowing through the brain; when tissues temperatures are lower than normal; cold-centre/posterior hypothalamus triggers heat production; and inhibits activity of the hot centre in order to conserve heat in the body; When tissue temperatures are higher than normal, hot centre/anterior hypothalamus; triggers responses that decrease heat production; increasing heat loss by inhibiting the activity of the cold centre;

(ii) Explain how the **ectothermic behaviour** of the **camel** allows its survival in **hot areas**. **(05 marks)**

During hot sunny day, Camel tissues store much heat to prevent loss of large amounts of water by evaporation; much heat is lost at night and the following day temperature climbs from abnormally low point; which prevents reaching lethal value by the end of the day; Reduces heat gain during the day; by maintaining a low thermal gradient between the surrounding air and its body;

5. **Describe** the **Physical** and **chemical processes** by which **solar energy** is converted into the **chemical energy of ATP**. **(10 marks)**

Non-cyclic photophosphorylation/Z-scheme.

Light is absorbed/harnessed/harvested by PSII and PSI; and passed to chlorophyll-a/primary Pigment reaction Centre;

Irradiated chlorophyll emits electrons; picked up by primary electron acceptors; which pass them to electron carriers and redox reactions release energy used to form ATP;

Positive PSI chlorophyll a is stabilized by electrons from PSII; and PSII chlorophyll a is stabilized by electrons from water photolysis;

Cyclic Photophosphorylation.

Light absorbed by PSI and passed to chlorophyll-a; emits electrons which are picked up by Primary electron acceptor; passed along a chain of carriers back to PSI and energy released is used to form ATP;

(b) Explain the **adaptations** of **plants** growing in **salt marshes to** their habitat. **(10 marks)**

Tissues tolerate high salinities in mud and sand;

Extensive system of rhizomes for propagation, anchorage and water storage;

Numerous adventitious roots to increase surface area for water absorption and support;

Actively secrete salts into and out of the cells basing on water potential of the surrounding for water conservation;

Alternate permeability of cell walls to ions to reduce ion entry or loss; Narrow leaves to reduce water loss;

Xeromorphic features eg hairy leaves to reduce water loss;

Photosynthetic pigments adapt them to carry out photosynthesis at low light intensity;

Tough thick leaves to withstand water waves/currents;

Tissues tolerant to dehydration when tide is out;

Aerenchymae/Aerenchymas allow transport of oxygen when submerged in water;

6. (a)(i) What is meant by **a Sere?** **(03 marks)**

Different stages in succession; when particular communities dominate; leading to final stable climax community;

(ii) Describe how **succession occurs** when the **spores or seeds land** on **a dry rocky surface.** **(07 marks)**

Spores or seeds germinate into Pioneer species like lichens and Algae; which break down rocks to form soils;
Lichens die and decompose to form a thin soil favourable for species such as mosses and ferns can grow;
Larger plants grow as soil deepens, e.g. grasses and small flowering plants; Soil continues to deepen as the larger plants die and are decomposed;
Shrubs, ferns and small trees begin to grow, out-competing the grasses and smaller plants to become the dominant species;
Finally, the soil is deep and rich enough in nutrients to support large trees; which become the dominant species; and the climax community is established;
Animals undergo a similar series of successional largely determined by the plant types available for food and habitats; dead lichens provide food for animals such as detritus-feeding mites; growth of mosses and grasses provides food and habitats for insects, millipedes, and worms; followed by secondary consumers, such as centipedes, which feed on these organisms; development of flowering plants, including trees supports communities of butterflies and moths as well as larger organisms, such as reptiles, mammals, and birds; **14 halves = 07 marks.**

(b) (i) Explain the **Origins** of the **green-house gases. (05 marks)**

Car exhausts emit CO_2;

Combustion of Fossil fuels emits CO_2;

Ruminant fermentations produce methane;

Aerosol propellants contain Chlorofluorocarbons;

Anaerobic fermentation in swamps and paddy fields produce methane;

Respiration of all living organisms produces CO_2;

(ii) Describe how the **green-house effect** occurs. **(05 marks)**

Short wave length of solar radiation penetrate the atmosphere and strike the earth's surface; reflected from the earth's surface as longer wave length infrared radiations; absorbed by greenhouse gases eg methane, carbon dioxide and Chlorofluorocarbons in the atmosphere;

Trapped infra-red radiations are continually re-radiated between the earth's surface and greenhouse gases; resulting into average increase in earth's temperature;