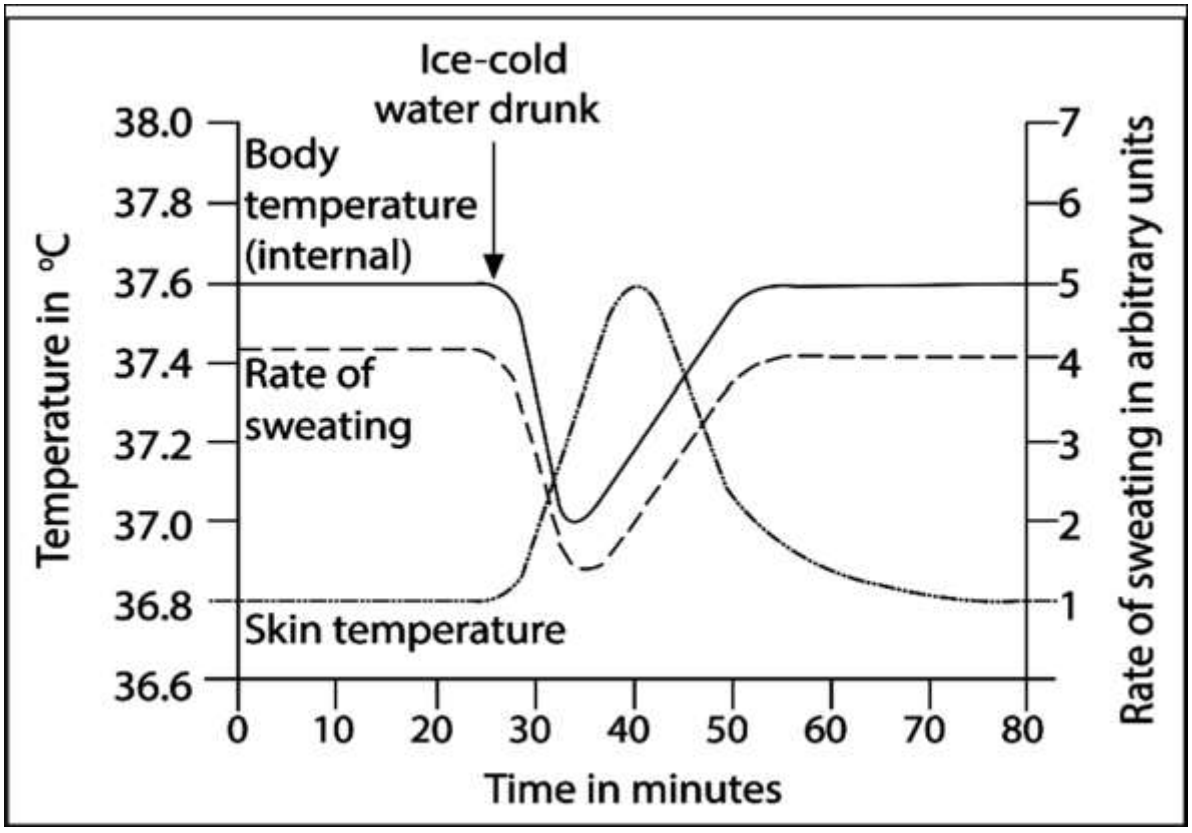
MARKING GUIDE FOR SET II

1.0. In an experiment, a person sat inside a large container which was kept at a constant temperature of 25°c. After 23 minutes, a person drunk 500cm³ of ice cold water. The person's internal temperature was measured near the brain by attaching a temperature probe to the ear drum. Measurements of the person's internal temperature, skin temperature and the rate of sweating are shown in the graph. Study it very well and provide appropriate responses.



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STANDARD ABBREVIATIONS USED.

A Semicolon (;) –separates each point.
An oblique stroke (/)- separates alternative within the a mark point.
Underlining of a word or phrase means the term must be used by candidate**.**
Brackets- used to indicate contexts for which a mark point is valid
Accept or reject- shows answers which should be allowed or not allowed.

a) Compare the changes in the skin temperature and internal body temperature after ice-cold water was drunk. (05 marks)

<table>
<tr><th>Descriptions</th><th>Advice</th></tr>
<tr><td>
<u>Similarities</u>.
(Both) the skin and internal body temperature.
Increases;
Decreases;
Attain maximum level;
Remained constant;
Equivalent or same or equal at 31 minutes and 45 minutes;
<u>Differences.</u>
<table>
<tr><th>Body temperature</th><th>Skin temperature</th></tr>
<tr><td>Attain a minimum value;</td><td>No minimum attained;</td></tr>
<tr><td>No peak attained;</td><td>Attained peak;</td></tr>
<tr><td>Above 49 minutes and below 31 minutes is higher;</td><td>Above 49 minutes and below 31 minutes is lower;</td></tr>
<tr><td>Between 31 minutes and 48 minutes is lower</td><td>Between 31 minutes and 48 minutes is higher;</td></tr>
</table>
</td><td>Any (02 marks) Heed to the use of “Both”

Any (03 marks) -Accept complete statements with while/whereas.</td></tr>
</table>

b) Describe the relationship between the internal body temperatures and following measurable variables after ice cold water was drunk.

(i) Rate of sweating. (05 marks)

Increase in time from 27 minutes to 32 minutes, both the internal body temperature and rate of sweating decreases; (rapidly)
Increase in time from 32 minutes to 57 minutes, both the internal temperature and rate of sweating increases;
Beyond 57 minutes, both the body temperature and rate of sweating remained high and constant at the initial value;
Both attained minimum value; Both attained maximum value;

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(ii) Skin temperature. (05 marks)

At 25 minutes/initially, core temperature is higher while skin temperature is lower;
Immediately after ice-cold water was drunk, body temperature decreases rapidly to minimum while skin temperature increases rapidly to peak; increase in temperature further, Body temperature increases rapidly while skin temperature decreases;
Finally, Body temperature remained constant while skin temperature continues to decrease gradually;
Skin temperature attains peak while core temperature doesn't peak; Skin temperature has no minimum while body temperature attain minimum;
Both core temperature and skin temperature decreases; Both core temperature and skin temperature increases;
Both are equivalent at 31 minutes and 45 minutes;

a) Account for the relationships above in b(i) and (ii) (15 marks)

Core temperature and rate of sweating.

Increase in time from 27 minutes to 32 minutes, both the body internal body temperature and rate of sweating decreases because Ice-cold water in the gut caused withdrawal of heat from blood and core tissues by conduction; Fall of body tissue or blood temperature below norm/normal/set-point caused activation of the posterior hypothalamus/heat gain centre/cold centre; which inhibited sweating;
Increase in time from 32 minutes to 57 minutes, both the internal temperature and rate of sweating increases because posterior hypothalamus triggers mechanisms for heat generation and conservation; increasing core temperature.
Generations.
Shivering/involuntary contraction of skeletal muscles; adrenaline and thyroxine increases metabolism; brown-fats to increase thermogenesis or heat production;
Conservation.
Vasoconstriction of superficial arterioles; raised hair;
Increased core temperature activates the heat loss centre/heat centre/anterior hypothalamus which trigger sweating leading to loss of latent heat of vaporization;

Beyond 57 minutes, both the body temperature and rate of sweating remained constant at the initial value because of restoration of the parameters to norm/normal level;

Core temperature and skin temperature.

At 25 minutes/Initially, core temperature was higher while skin temperature was lower because skin temperature fluctuates basing on the environmental temperature and body position while core temperature is maintained constant;

Further increase in time, body temperature decreases rapidly while skin temperature increases rapidly because ice cold water in the gut withdrawals heat from blood by conduction causing fall in body temperature; cold blood activated heat gain center which inhibit sweating; latent heat of vaporization is not lost; increasing skin temperature. Body temperature increases rapidly while skin temperature decreases because heat generation and conservation mechanisms increase core temperature and skin temperature decreases due to loss of latent heat of vaporization following sweating;

Body temperature remained constant while skin temperature continues to decrease gradually because core temperature restored to norm and the skin continued to lose the latent heat of vaporization;

d) Suggest

(i) Why the ice-cold water was not given before 23-minutes of the experiment. (01 marks)

To allow the subject equilibrate with the surroundings;

(ii) Conclusions that can be made from the experiment. (02 marks)

Direct relationship between core temperature and rate of sweating; AVP-

Rate of sweating increases with increase in core temperature; direct relationship between rate of sweating and skin temperature;

Skin receptors play a little role in the regulation of the core temperature; indicated by rise in the skin temperature after ice water was drunk;

Thermoregulatory centres responds to changes in the core temperature; or Blood temperature.

(iii) Why the skin temperature does not give an accurate measurement of the core body temperature. (05 marks)

Skin is found outside/peripheral organ; core temperature is for visceral organs/internal organs/internal temperature; skin temperature varies with environmental temperature; while core temperature shows no variation with environmental temperature; skin gain or loses heat by radiation, convection conduction and evaporation;

SECTION B (60 MARKS)

1.0a)(i)Why are homeostatic mechanisms often described as detection-correction systems? (05 marks)

Physiological factor/parameter/variable changes from norm/normal/set-point/reference point; Body detects changes/deviations; using nervous or hormonal or both; reverses the changes back to norm/set-point; extent of correction monitored by negative feedback mechanism;

(ii) Explain how the Positive feedback mechanism in response to cold ambient temperatures occurs in elderly people.(07 marks)

Elderly people have detoriated sensory system; and suffer from hypothermia; when body starts to feel cold, body fails to respond by generating and conserving the heat; it goes uncorrected; as body temperature falls, metabolism falls/decreases and produces less heat; and cools down even more quickly; and death occurs if the core temperature falls too low;

b) Describe how the metabolic pathways show homeostasis at molecular level in a cell. (08 marks)

End product inhibits first enzyme in the pathway; if the concentration of end product increases above norm/normal/set-point; greater inhibition of the first enzyme; few/less end products produced and its concentration returns to norm;

if the concentration of end product falls below the norm; less inhibition of the first enzyme; more end products will be produced and its concentration returns to norm; concentration of the chemical maintained relatively constant by negative feedback mechanism or end-product inhibition;

2.0a) Describe how the following non-specific immune defensive mechanisms combat pathogens in our bodies.

(i) Mechanical defence. (05 marks)

Cilia; sweeps bacteria and other dust particles; (out of the lungs)
Hair; trap dust/filter air; (drawn in the upper airway)
N.B-Hair in the nose, ears.

Reject Skin and mucous membrane. They are physical barriers as opposed to mechanical barriers asked.

(ii) Biological defence. (05 marks)

Normal micro-flora; competes for nutrients with pathogens;
Phagocytes; ie. neutrophils and macrophages engulf pathogens;
Basophils or Mast cells; secrete histamine which initiate or mediate inflammatory response;

(iii) Chemical defence. (05 marks)

Fluids e.g. Urine, saliva, tears, mucus, genital; contain chemicals eg lysozyme or muramidase which kills bacteria; sebum with antibacterial properties; salts inhibits growth of pathogens; fibrinogen for blood clotting; gastric juice; contain enzymes for pathogen digestion and acids to inhibit pathogen growth; interferon prevent viral infection of cells; pyrogens stimulate increase in core body temperature to augment immune response;
Cerumen/ear wax trap dust or small pathogens;

b) Explain the significance of inflammation as a second line of defence in our bodies. (05 marks)

Histamine causes local vasodilation of arterioles; and increased permeability/more leaky blood capillaries/blood vessels;
Increased local vasodilation of arterioles causes increase in blood supply which brings more white blood cells/Phagocytes that engulf pathogens; remove debris; more Fibrinogen for rapid blood clotting; more nutrients speeding up repair of damaged tissues; more oxygen for increased energy production to repair damaged tissues;
More Interferons preventing cell to cell viral infection; more Complement proteins (opsonins) coat more bacteria making them more susceptible or vulnerable to phagocytosis;
Increased permeability of capillaries results into formation of excess tissue fluid (Oedema); inactivates and removes toxins; increases diapedesis by neutrophils to allow engulfing or removal of pathogen in the intercellular space;
Serotonin/5-Hydroxytryptamine causes local vasoconstriction to reduce blood loss;

3.0a) Explain how the effects of light intensity, nutrient availability and turbulence interact to control aquatic primary productivity. (12 marks)

clean water readily absorbs sunlight to deeper layers; required by aquatic/marine plants to from chlorophyll and chloroplasts; chlorophyll harvests/traps sunlight required for photosynthesis; opening of stomata for diffusion of carbon dioxide which is a raw material for photosynthesis; increased illumination/light intensity of water results into higher rate of photosynthesis; accumulating higher concentration of organic matters; nutrients such as nitrates and phosphates; are required for metabolism eg respiration; and also formation of proteins which contribute to organic matter; nutrients such as magnesium is required for chlorophyll formation; (low) intensity of light/nutrients lowers primary productivity; low nutrients lowers metabolism and organic matter formation; increased turbulence increases diffusion/supply of oxygen for aerobic respiration to sustain metabolism; through increasing surface area to volume ratio for rapid diffusion of oxygen to deeper layers;

b) Describe the different statutory guidelines put in place to reduce risks from insecticide use in modern times. (08 marks)

Setting minimum standards for workers handling pesticides e.g. wearing protective clothings;
Increased use of non-persistent pesticides eg. Organo-phosphates;
Increased use of selective pesticides;
Better toxicity testing to establish the effect of insecticides on non-target organisms; e.g. bees.
Better monitoring techniques to ensure pests have reached their economic damage threshold before spraying;
Development of better application techniques e.g. seed dressing and baits which localize insecticides to kill target organism;
Delaying resistance by reducing insecticide use and use of a series of insecticides to prevent resistance to any;

4a) Describe the factor that affect the rate of water absorption from the soil by plants. (08 marks)

Root system; plants with extensive root systems absorb a lot of water compared with those with less developed root system;

Soil aeration; lack of oxygen and increased C02 concentration reduces rate of water uptake; because of reduced respiration than presence of high oxygen concentrations;

Available soil-water; much water available in soil increases rate of uptake while less water present reduces rate of uptake; too much water reduces aeration; and causes low rate of uptake due to reduced respiration than moderate water amounts;

Soil temperature; increased temperature increases uptake because of increased respiration and kinetic energy of water molecules; and low temperature reduces rate of uptake of water due to low kinetic energy and respiration;

Concentration of soil solution; higher concentration of soil solution than root tissues cause reduced water uptake and low concentration than cell sap of roots causes increased water uptake by osmosis;

Starch concentrations; increased amounts of starch increases uptake due to increased energy production during respiration than low amounts of starch;

b) Explain the evidences that show photosynthesis is a double stage reaction. (12 marks)

Evidence from temperature co-efficient; photochemical or light reaction temperature co-efficient (Q=1.0) or is unity; photochemical reactions doesn't increase with increase in temperature; For dark reaction doubles or triples;(Q10=2/3) reaction affected by temperature or temperature sensitive;

Intermittent or discontinuous light supply or alternate light and dark periods; intermittent light yields more photosynthetic products than continuous light supply of light of the same intensity; in continuous light, products of light stage accumulate and inhibit the dark stage; periods of darkness allows the Calvin cycle to slowly use up the products of the dark stage and so speed up the overall process;

Evidence from C02 reduction in dark stage; using tracer technique; heavy carbon or radioactive carbon in carbondioxide (14c02) is supplied;

Leaves placed in light showed reduction of C02 to carbohydrates; leaves placed in dark did not reduce C02 to carbohydrates;

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5.0a)(i) Explain why ATP is a better energy source compared to glucose. (08 marks)

ATP stores or releases a small manageable amount of energy at a time than glucose;

Small, soluble molecule; easily transported around cells;

Easily broken down in a single step reaction; energy released instantaneously;

Quickly remade from ADP and Pi; activate other molecules by transferring one phosphate group to them; (phosphorylation)

ATP can't pass out of the cell; cells always has immediate source of energy;

(ii) Explain how ATP is synthesized during Oxidative phosphorylation. (12 marks)

NAD (Nicotinamide adenine dinucleotide) accepts two hydrogen atoms; hydrogen atoms passed to FAD; (Flavin adenine dinucleotide) or FMN(Flavin mono-nucleotide) addition of the hydrogen atoms to carriers causes reduction; each time hydrogen atoms flow from NAD to FAD energy is released and used to form ATP; Hydrogen atoms passed on to co-enzyme Q which splits hydrogen atoms into protons and electrons; $FADH_2$ from Krebs cycle passes on its hydrogen atoms to Co-Q; electrons pass through a system of electron carriers/cytochromes through series of redox reactions; forming ATP from ADP and Pi; Final electron carrier is cytochrome oxidase; catalyzes combination of hydrogen atoms with oxygen forming water;

Energy associated with the flow of electrons and hydrogen atoms is used to pump hydrogen ions from the matrix into inter-membranal space; resulting into establishment of the electrochemical gradient between matrix and inter-membranal space; Protons pass back into the matrix through stalked granules along electrochemical gradient; electrical potential energy is used to form ATP catalyzed by ATPsynthetase;

6.0a) Explain how Disruptive selection may lead to the following.

(i) Balanced Polymorphism. (05 marks)

Increases extreme phenotypes in the population at the expense of intermediate forms; creating two distinct forms/types/morphs; each form is adapted to distinct environmental conditions; these form co-exists in the population; their numbers or proportions relatively constant and freely interbreeding;

(ii) Speciation. (05 marks)

Splits population into sub-populations or demes; if gene flow/interbreeding/migration prevented or isolation occurs; demes evolve along different lines due genetic drift, mutation and natural selections; as they adapt to different environmental conditions;

b) Describe the different mechanisms that preserve genetic diversity in the gene pools. (10 marks)

Mutations; introduces new alleles in the gene pool different from the already existing one;

Sexual reproduction; as a result of gene reshuffling/recombination during meiosis; results into genetically varied gametes;

Diploidy; two copies of each chromosome, heterozygous condition, recessive allele hidden from natural selection; increases heterozygosity and size of gene pool or variation;

Out breeding; crossing unrelated or distantly related parents; resulting into mixing of different alleles creating new genetic combinations;

Balanced polymorphism; maintains different phenotypes/morphs in the population; all morphs/alleles to greater or lesser extent are selected for or against by natural selection; achieved by a relative balance of advantages and disadvantages;