DRAFT/PROPSED MARKING GUIDE.

UMTA JOINT MOCKS 2023

UACE BIOLOGY PAPER 2

P530/2

BIOLOGY PAPER 2

SECTION A (40 MARKS)

1. The figure 1 below shows the rate of glucose reabsorption and excretion from mammalian kidney in relation to the glucose concentration in the plasma. To be considered here also is Renal plasma Ratio index of glucose, as the ratio of concentration of glucose in renal fluid to the concentration of the same glucose in blood plasma. Study figure 1 carefully and use it to answer questions that will follow.

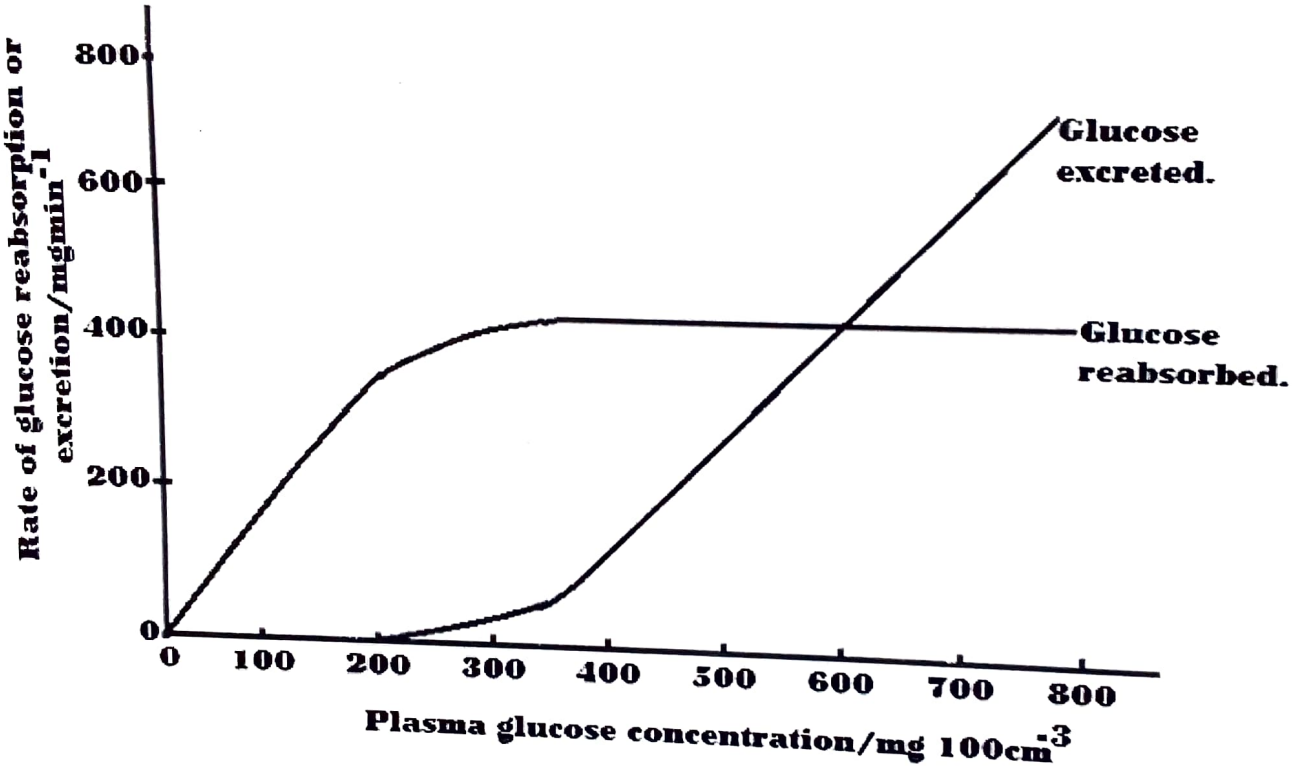

Figure 1

(a) Compare the rate of glucose reabsorbed and excreted by the mammalian kidney in relation to glucose in plasma. (09 marks)

Similarities,

- In both, the rate of glucose absorption and excretion is the same at plasma glucose concentration of 600mg $100cm^{-3}$;
- Both the rate of glucose absorption and excretion reach maximum ;
- Both rate of glucose absorption and excretion increase between plasma glucose concentration of 200 and 800mg $100cm^{-3}$;
- In both, rate of glucose absorption and excretion was initially very low ;

@ 1 mark, max = 03 marks

Differences between,

Rate of glucose reabsorbed	Rate of glucose excreted
- Increases rapidly between 0 and 200mg$100cm^{-3}$,	- None between 0 and 200mg$100cm^{-3}$;
- Remains constant between 350 and 800mg$100cm^{-3}$,	- Increases rapidly between 350 and 800mg$100cm^{-3}$;
- Reaches maximum at lower plasma glucose concentration of 350mg$100cm^{-3}$,	- Reaches maximum at higher plasma glucose concentration of 800mg $100cm^{-3}$;
- Is higher between 0 and 350mg$100cm^{-3}$,	- Is lower between 0 and 350mg$100cm^{-3}$
- Is lower between 350 and 800mg$100cm^{-3}$,	- Is higher between 350 and 800mg$100cm^{-3}$;
- Begins to increase from 0mg$100cm^{-3}$,	- Begins to increase from plasma glucose concentration of 200mg $100cm^{-3}$;
- Maximum reached is lower,	- Maximum reached is higher ;

@ 1 mark , maximum = 06 marks.

(b) Explain the effect of plasma glucose concentration on rate of Glucose,

(i) Reabsorption. (09 marks)

(ii) Excretion. (10 marks)

b (i)

Increasing plasma glucose concentration from 0mg/100cm^{-3} upto 350mg/100cm^{-3} leads increase in the rate of glucose reabsorption ; to a maximum ; this is because glucose concentration in blood is kept at the norm/set point ; and the body still demands for more glucose ; to respire ; resulting into more glucose being actively reabsorbed ; by the cells of the proximal convoluted tubules ; from the renal fluid back into the blood stream ; until the concencentration of glucose in blood slightly exceeds the norm ;

Increasing plasma glucose concentration from 350mg/100cm^{-3} to 800mg/100cm^{-3} , leads to rate of glucose concentration to remain constant/has no effect on the rate of glucose reabsorption ; this is because glucose concentration in blood is in excess and has exceeded the norm/hyperglycaemia occurs ; and there is no further need to actively reabsorb glucose from renal fluid back into blood stream ;

@ 1 mark, maximum = 09 marks.

Accept this alternative,

Increasing plasma glucose concentration from 0 to 200mg100cm^{-3}, leads to rapid increase in rate of glucose reabsorption ; this is because glucose concentration in blood is still within the set point(norm) ; the body requires more glucose ; to respire ; resulting into more glucose to be actively reabsorbed ; back into blood stream ; by the cells of the proximal convoluted tubule ; Increasing plasma glucose concentration from 200 to 350mg100cm^{-3}, leads to gradual/slow increase in rate of glucose reabsorption ; until a maximum ; this is because concentration of glucose in blood is beginning to exceed the norm in blood ; causing less demand for glucose and less glucose will be selectively reabsorbed back into blood stream ;

Increasing plasma glucose concentration from 350 to 800mg100cm^{-3}, causes rate of glucose reabsorption to remain constant/has no effect on rate of glucose reabsorption ; this is glucose concentration in blood has much exceeded the setpoint(norm)/hyperglycaemia occurs ; no more glucose is selectively reabsorbed back into the blood stream ;

@ 1 mark , maximum = 09 marks.

b(ii) Increasing plasma glucose concentration from 0 to 200mg100cm^{-3} upto 800mg/100cm^{-3} , leads increase in excretion of glucose ; this is because glucose concentration has become in excess in blood and has exceeded the norm ; but the beta cells in the islets of Langerhans in the pancreas ; fail to secrete the hormone insulin/secreted insufficient amounts of the hormone insulin into blood stream ; or the liver cells were simply insensitive to the effect of the hormone

insulin ; glucose levels fail to be regulated by the liver back to normal ; glucose concentrations rise in blood above the norm/hyperglycaemia occurs ; this prevented further active reabsorption of glucose ; from renal fluid ; back to the blood stream ; glucose retained in the renal fluid continue to be excreted in the urine/glycosuria occurs ;

@ 1 mark , maximum = 10 marks.

(c) What will be the value of the Renal plasma Ratio of glucose in the Kidney relative to index equal to 1.0, beyond plasma glucose concentration 0f 360mg $100cm^{-3}$. Explain your answer.
(03 marks)

The value of Renal plasma Ratio for glucose will be greater than 1.0 ; this is because failure of selective reabsorption of all glucose back into blood stream in the proximal convoluted tubule ; causes concentration of glucose in renal fluid to become greater ; than in the blood plasma ; so, renal plasma ratio of glucose increases beyond 1.0.

@ 1 mark = 03 marks.

(d) Suggest with reasons, the effect of intravenous injection of sufficient hormone insulin, on the rate of glucose excretion.
(06 marks)

Rate of glucose excretion will decrease rapidly, then gradually ; until no further rate of glucose excretion occurs ; this is because in the liver, the hormone insulin stimulates liver cells ; to carry out activities that return the glucose concentration in blood plasma back to normal ; such activities include, rapid conversion of excess glucose to glycogen/increased oxidative break down of glucose to generate energy ; prevents formation of glucose from proteins and lipids/prevents break down of glycogen to glucose ;

OR

has no effect on rate of glucose excreted because liver cells remain insesitive to insulin hormone, glucose levels fail to be regulated by the liver back to normal, glucose concentration rise above the norm, glucose retained in renal fluid thus continue to be excreted in the urine.

@ 1 mark = 06 marks.

(e) Outline complications a person is likely to suffer from, resulting from excess glucose levels in blood.
(03 marks)

- ~~Diabetes/hyperglycaemia ;~~
- Impaired vision/loss of sight by the eyes ;
- Difficulty in healing of any wound of any kind ;
- Wastage of muscle tissues ;
- Loss of weight ;
- Body fatique/Tiredness ;
- Coma ;

- death
- frequent urination.
- Dehydration.

Any correct 3 @ 1 mark , maximum = 03 marks.

TOTAL = 40 MARKS

SECTION B

2. (a) Describe the significance of membrane of red blood cells being impermeable to outflux of positive ions in transport of respiratory gases. (10 marks)

This permits hydrogen ions (H+) to accumulate/hydrogen ions (H+) concentration becomes higher in red blood cells ;

At respiring tissues, hydrogen ions in red blood cells bind onto oxyhaemoglobin ; causing rapid dissociation/breakdown of the oxyhaemoglobin ; oxygen molecules are released ; which diffuse out ; of the red blood cells into the respiring cells ;

At the lung capillaries , the hydrogen ions combine with hydrogen carbonate ions (HCO_3^-) in red blood cells ; weak carbonate acids are formed ; which rapidly dissociate/break down to release carbondioxide ; the carbondioxide ; diffuse out of the red blood cells into the alveoli of the lungs ; to be breathed out.

@ 1 mark , maximum = 10 marks

(b) Discuss consequences of a blood group A person donating blood to a patient whose blood group is O. (10 marks)

In the blood of the patient (recipient), antibodies α (agglutinins α) are present in the blood plasma ; which quickly reacts with the Agglutinogens A ; in the cell membrane of the red blood cells of the donar (blood group A person) ; in an anti-body antigen reaction causing agglutination (blood cells stick together) ; the agglutinated blood can block smaller arterioles/blood vessels ; resulting into poor blood circulation ; that may cause heart failure/ organs failure/ damage of the organs ;

The anti-bodies α also react with the cell membrane of the red blood cells, causing the cell membrane to rupture ; haemoglobin molecules are released into the blood plasma ; these later block pores on the basement membrane of Bowman's capsule ; excretion of urea is prevented ; accumulation of urea in blood leads to complications and subsequently death ;

@ 1 mark , maximum = 10 marks.

TOTAL = 20 MARKS

3. (a) Distinguish between nitrification and nitrogen fixation. (06 marks)

Differences between,

NITRIFICATION	NITROGEN FIXATION.
▪ Involve oxidation of ammonia or ammonium compounds ; to nitrates ;	▪ Involve oxidation of gaseous nitrogen ; to nitrates or ammonia ;
▪ occurs in two stages ;	▪ Is a single stage process ;
▪ carried out by a free living nitrogen bacteria ,	▪ carried out by both free living bacteria and symbiotic bacteria ;
▪ Takes place in the soil,	▪ Takes place in soil, root nodules and atmosphere ;
▪ Involve nitrifying bacteria like nitrococcus, nitrobacter, Nitrosomonas	▪ Involve nitrogen fixing bacteria like pseudomonas nitrificans , Rhizobium ; Azotobacter

@ 1 mark = 06 marks

(b) Explain how each of the following conditions arise and what are their ecological significance in an ecosystem,

(i) Resource partitioning. (07 marks)

(ii) Net primary productivity. (07 marks)

(a)(i)

Resource partitioning occurs when ever, organisms of different species occupy different areas within the same ecological niche ; feed on different parts of the same food source/ different species of organisms feed at different times of the day ;

The significance of Resource partitioning is that it avoids intense interspecific competitions ; and overcrowding in that area ; enabling organisms of different species to co-exist within the same ecological niche ; and weaker individuals can survive alongside the better adapted ones ; natural resources are maximumly utilized ; and extinction of weaker species of organisms is prevented ;

@ 1 mark , maximum = 07 marks.

(ii)

The green plants (primary producers) trap sun light energy , using chlorophylls in their chloroplasts ; and the sun light energy is converted into chemical energy which is stored as carbohydrates/ when photosynthesis occurs chemical energy is stored as carbohydrates ; the rate at which the chemical energy is stored in carbohydrates per unit time per unit area is the gross primary productivity (GPP) ; some of these chemical energy stored is utilized by the primary

producers and in the process certain amount of energy is lost through respiration and photorespiration ; the amount of chemical energy remaining as carbohydrates per unit time per unit area is the net primary productivity (NPP) ;

This is significant in that, the net primary production is passed to the herbivores (primary consumers) when they feed on the primary producers ; many herbivores will survive ; and flow of energy is made possible and efficient in an ecosystem ; energy efficiently flow from the sun to the primary producers at one trophic level to the consumers in the next trophic levels ;

@ 1 mark , maximum = 07 marks

TOTAL = 20 MARKS

4. (a) Describe the roles particular proteins play in the process of DNA replication. (08 marks)

- The particular proteins are the specific enzymes ; which catalyse certain reactions ;
- Helicase enzyme ; catalyse breakage of hydrogen bonds enabling Deoxyribonucleic acid (DNA) to unwind ;
- DNA polymerase ; initiates the process and brings in position free nucleotides with bases complementary to those of the DNA nucleotide bases / catalyses condensation of free nucleotides / proof reads nucleotide base sequence formed and correct any errors ; - DNA ligase ; seals off any gaps between short fragments of polynucleotide chains (okazaki fragments) to complete formation of new DNA strands ;

@ 1 mark , maximum = 08 marks

(b) Account for how changes in pH from the norm will lower enzyme activity. (12 marks)

Decrease in pH below the optimum , lowers activities for some enzymes ; like amylases/lipases/peptidases ; this is because acidity increases/hydrogen ions (H+) concentrations increase ; negatively charged carboxyl groups of the amino acids of the enzyme proteins combine with the excess hydrogen ions ;

Where as, increase in pH above the optimum lowers activities for some enzymes ; such as pepsin ; this is because alkalinity increases/hydrogen ions concentrations decrease ; the positively charged amino groups of the amino acids of the enzyme proteins lose hydrogen ions ;

The lose of hydrogen ions or gain of the hydrogen ions by the amino acids of the enzyme proteins lead to ionic and hydrogen bonds to break/bonds become disrupted ; the precise three dimensional ~~and~~ shape of the enzymes are changed ; the structure and shape of the active sites of the enzymes are changed ; and the substrate molecules can not exactly fit onto the active sites/ enzymes become denatured ; few enzyme – substrate complexes and products are formed ;

@ 1 mark = 12 marks

TOTAL = 20 MARKS

5. (a) Compare the process of inhibition and that of transmission of nerve impulses across a chemical synapse. (09 marks)

Differences between the processes of,

Inhibition of nerve impulse across a chemical synapse.	**Transmission of nerve impulse across a chemical synapse.**
▪ Post synaptic membrane becomes hyperpolarized ,	▪ post synaptic membrane becomes depolarized ;
▪ potassium ions and chloride ions gates open ,	▪ potassium ions and chloride ions gate are closed ;
▪ Sodium ion gates ~~are~~ close on post synaptic membrane ,	▪ sodium ion gates are open on post synaptic membrane ;
▪ chloride ions diffuse ~~from~~ into post synaptic neurone ~~into~~ from synaptic cleft,	▪ chloride ions are retained inside the post synaptic neurone ;
▪ potassium ions diffuse from post synaptic neurone into synaptic cleft,	▪ sodium ions diffuse inside from the synaptic cleft into the post synaptic neurone ;
▪ causes no response to stimulus ,	▪ causes response to stimulus ;
▪ Neuro-transmitters or drugs bind onto specific receptor molecule on post synaptic membrane ,	▪ mainly neuro-transmitters bind onto the specific receptors on the post synaptic membrane ;

@ 1 mark , maximum = 05 marks.

Similarities between processes of inhibition and transmission of nerve impulses across a chemical synapse ,

▪ In both, neurotransmitters bind onto specific receptors molecules on post synaptic membrane ;

▪ In both, mineral ions such as sodium ions and potassium ions diffuse across a post synaptic membrane ;

▪ Both occur upon arrival of nerve impulse at a chemical synapse ;

▪ In both neuro-transmitters are secreted from presynaptic knob into the synaptic cleft ; ▪ Both involve rapid diffusion of calcium ions across pre-synaptic membrane into pre-synaptic knob ;

@ 1 mark , maximum = 03 marks.

(b) Explain how resting potential is achieved and maintained immediately after passage of an impulse in an axon. (12 marks)

Resting potential is achieved immediately after an action potential ; membrane of an axon becomes more permeable to potassium ions/many potassium ion gates open ; while membrane of the axon becomes impermeable to sodium ions/sodium ion gates close ; potassium ions diffuse rapidly outside the membrane ; the outside of the membrane becomes relatively more positive while the inside becomes relatively more negative ; a resting potential of about -60mV to -70mV exists across the membrane ; any slight delay in the closure of the potassium ion gates upon resting potential being reached, causes the outside of the membrane to become more positive than normal and the membrane becomes hyperpolarized ; the resting potential becomes more negative than usual ;

The resting potential is ~~maintained~~ restored by the activities of the sodium-potassium pump ; in the membrane of the axon, which actively pump ; two molecules of potassium ions inside the membrane ; and actively pump three molecules of sodium ions outside the membrane ; maintaining constant the resting potential. which is followed by opening of potassium ions and consequent diffusion of potassium ions outside the membrane. @ 1 mark = 12 marks.

maximum 12

6. (a) How does polyploidy arise in a population and leads to evolution. (11 marks)

When all the pairs of the homologous chromosomes fail to get separated during ~~prophase~~ anaphase I of meiosis / non-disjunction of homologous chromosomes ; which can be induced by certain chemicals like colchicine or naturally induced ; this leads to formation of diploid gametes (2n) ; during fertilization random fusion of male and female diploid gametes or random fusion of a diploid gamete with another normal haploid one ; leads to formation of polyploid zygote which develops into polyploid individual ;

When chromosomes duplicate and deoxyribonucleic acids (DNA) replicate during interphase of mitosis ; and normal process of nuclear division and cytokinesis fail to occur ; tetraploid cells are formed.

When chromosomes of a diploid zygote (2n) doubles after fertilization ; a tetraploid hybrid (4n) develops .

In plants , polyploid individuals show new favourable characteristics/hybrid vigor ; such as increased resistance to diseases and drought/increased sizes/early maturity ; the polyploidy individuals are frequently more favoured by natural selection ; than the non-polyploid

individuals/ polyploids have a selective advantage over the non-polyploids ; and after many generations polyploids evolve into new distinct species.

@ 1 mark , maximum = 11 marks.

(b) Explain how industrial melanism account for evolution by natural selection. (09 marks)

Long ago, there pre-existed alight type of peppered moth in England ; due to sudden mutation another mutant dark (black) type of peppered moth emerged ; so, two variants of peppered moths existed, the non-mutant light type and the mutant dark (melanic) type of peppered moths ;

During industrial revolution in England, the industrial pollution blackened the entire environment/walls of building and the bark of the trees were blackened by the soot or smoke produced from the factories ;

In the population, both variants of the peppered moths were exposed to frequent and selective predation by particular species of birds ; the mutant dark (melanic) peppered moths were better adapted ; they camouflaged against the black back ground of the environment and they could not be easily spotted by the predatory birds ; they continued to survive ; and reproduced to pass their genes to the next generations ; and after many generations the melanic peppered moth evolved into distinct and dominant species of moths in most industrial areas ;

While the pre-existing light type of the peppered moths became less adapted and were conspicuous (easily spotted) against black back ground ; they were frequently eaten by the predatory birds ; and selected against/they were completely wiped out most industrial areas ;

@ 1 mark , maximum = 09 marks

TOTAL = 20 MARKS

END