

MARKSCHEME

November 2001

BIOLOGY

Standard Level

Paper 2

SECTION A

1. (a) sodium chloride / salt system is faster;
rates of change decrease in both systems as time passes / concentration gradients in both systems decrease with time;
the rate of diffusion of sucrose (out of the bag) is slower than the rate of diffusion of salt (out of the bag);
sucrose (system) continues to increase for 160 min but the NaCl / salt system only increases for 40 min;
the rate of osmosis in the sodium chloride (system) is faster than the rate of osmosis in the sucrose (system);
Award [1] for: the graphs showing the rate of change in mass and volume for the NaCl solution follow the same pattern / the graphs showing the rate of change in mass and volume for the sucrose solution follow the same pattern **[2 max]**
- (b) *Only [1] possible without units.*
mass: 0.11 (\pm .01) g min⁻¹ / 6.6 g hour⁻¹;
volume: 0.17 (\pm .01) cm³ min⁻¹ / 10.2 cm³ hour⁻¹;
Award [1] for 3 g in 30 min and 5 cm³ in 30 min (units needed) **[2]**
- (c) osmosis / diffusion of water;
movement of water from high to low water concentration / movement of water from low to high solute concentration;
movement of water down the water concentration gradient;
movement of water from high water potential (outside the bag) to low water potential (inside the bag); **[2 max]**
- (d) while water is still entering (at a slower rate), solute / salt / NaCl is leaving;
solute (sodium chloride) has greater mass per particle than water;
as rate of osmosis begins to decrease, rate of NaCl diffusion becomes more noticeable resulting in decreasing masses;
water accounts for most of the volume change but both solute / NaCl and water account for the changes in mass; **[2 max]**
- (e) the higher the water concentration of the environment, the faster the vacuoles must pump to maintain equilibrium;
the contractions reach zero when *P. caudatum* is isotonic to its environment;
the higher the salt concentration, the lower the water concentration, so the amount of osmosis into the cell is reduced; **[1 max]**
- (f) cells would gradually swell;
cells would eventually rupture / dead paramecia; **[1 max]**

2. (a) karyotyping [1]
- (b) cells are grown until many of them are actively dividing;
cells arrested in metaphase (using colchicine);
cells are (ruptured and) stained to reveal the banding;
a photograph is taken of stained chromosomes;
the photograph is cut up;
chromosomes are arranged in homologous pairs / in order by size, shape, banding; [2 max]
- (c) Trisomy 21 / Down's Syndrome;
female; [2]
3. (a) *Award [1] for*
an arrow drawn from eating to low blood sugar labelled raises blood sugar;
an arrow drawn from eating to low blood sugar labelled decreases / stops /
reduces;
an arrow drawn from eating to hunger centre of brain labelled as reduces
stimulation / stops; [1 max]
- (b) nervous system;
endocrine / hormone system;
respiratory system;
circulatory system;
excretory system;
digestive system; [2 max]
- (c) *To receive full marks a named example must be included.*
reference, using a named example (*other than that in (a)*), to a set point /norm;
deviation causes feedback mechanisms to take corrective measures to regain
homeostasis / return system to set point / norm; [2 max]

note: homeostasis may be referred to as either a theoretical state of being or a process executed to cause a theoretical state of “being in balance”.

SECTION B

(Remember, up to TWO 'quality of construction' marks per essay)

4. (a) carbohydrates yield monosaccharides / reducing sugars;
(do not accept glucose as a substitute for monosaccharides / reducing sugars)
proteins yield amino acids;
fats yield fatty acids / alkanolic acids and glycerol; **[3]**
- (b) foods are digested mechanically in mouth and stomach;
foods are digested by enzymes in specific regions of the digestive tract / alimentary canal;
carbohydrates are digested in the mouth (generally into disaccharides);
carbohydrates are digested in the small intestine;
enzymes that digest carbohydrates include ... *(one should be named e.g. amylase, maltase, ptyalin, sucrase, lactase)*;
proteins are partially digested in the stomach (into polypeptides);
proteins are digested in the small intestine (into amino acids);
enzymes that digest proteins include ... *(one should be named e.g. proteases, dipeptidase, pepsin, etc.)*;
fats are digested in the small intestine;
fat digestion is facilitated by bile;
enzymes that digest fats include ... *(one should be named e.g. lipase)*; **[8 max]**
- (c) *At least one consequence should be explained with its connection to a balanced diet in order to achieve full marks.*
balanced diet contains sufficient joules / calories;
to obtain adequate ATP / energy for daily activities;
balanced diet contains essential amino acids and fatty acids;
for growth and repair / synthesis of a body's proteins, cell membranes *etc.*;
balanced diet includes adequate minerals and vitamins;
for chemical reactions and structures (strong bones and teeth, muscle contraction, nerve transmission, *etc.*);
the amount of each nutrient required is determined by the individual (age, activity level, sex, genes, nursing or not, pregnant, *etc.*);
deficiency diseases result when there is inadequate distribution of essential nutrients;
specific example of a deficiency disease (*e.g. scurvy*);
anorexia / bulimia / obesity are eating disorders that are types of dietary imbalance;
distinction between malnutrition (inadequate distribution of nutrients) and under or over nourishment (lack of or excess of food);
If vegetarian or vegan diets are included, there must be reasoning as to why these diets are balanced / not balanced in order to gain a mark. **[7 max]**

(Remember, up to TWO ‘quality of construction’ marks per essay)

5. (a) diagram: **[4 max]**
[1] for the appropriate shape;
[1] for each trophic level together with a named organism (*sunlight is not a trophic level but could be included in the diagram*);

explanation: **[4 max]**

energy pyramids show amount of energy per trophic level in the community;
organisms without chlorophyll / consumers / heterotrophs eat producers / organisms with chlorophyll / autotrophs to obtain energy;
each link of a food chain loses energy of movement and heat from the chain;
only the energy retained by the molecules of the organisms at the time it is consumed can contribute to the next level of the pyramid / roughly 10 % of energy available at each trophic level is converted into new biomass in the trophic level above it;
pyramids of energy always have a normal pyramidal shape (unlike pyramids of numbers or biomass);
this pyramid assumes that the ecosystem is in balance / that no food is being transported into the system;

[8 max]

- (b) energy comes from the sun / radiant energy from the sun powers ecosystems;
to make organic molecules, radiant energy is transformed by chlorophyll / photosynthesis uses radiant energy;
organic molecules are transformed by cellular respiration;
cellular respiration releases heat into the environment (lost from the ecosystem’s community);
ATP is used for movement (kinetic energy) which is also (energy) lost from the ecosystem’s community;
(“organic molecules” can be substituted with food molecule / carbohydrate / sugar / glucose).

[3 max]

- (c) Award [2] for each of three factors. No marks for just naming a factor. However, award [1] for a factor with a method of measurement and then award a second mark for mentioning any of the elements of the factor or any of the considerations.

Factor	Method of measurement;	Elements of factor;	Considerations;
light	light meter;	intensity / variation / day length;	placement of meter / cloud cover;
temperature	thermometer / recording thermometer;	range, variability;	placement of thermometer;
water	probes (e.g. pH) / pH paper / secchi disk / cobalt chloride paper;	quality / humidity / precipitation / availability / depth / speed / pH / turbidity;	variability;
wind	anemometer / wind flag / weather vane;	speed, direction;	variability - seasonal / daily;
soil	test kits;	amount of organic matter / profile / pH / nitrate / potash / phosphate levels / particle size / porosity / water content;	depth / vegetation / bedrock;
dissolved O ₂	test kit (titration) / dissolved O ₂ probe/sensor;	concentration / depth variations / correlation to other factors;	
dissolved CO ₂	test kit (titration);	concentration / depth variations / correlation to other factors;	

indication of the need for repeated measurements [1];

[7 max]

(Remember, up to TWO ‘quality of construction’ marks per essay)

6. (a) Law of Segregation states that genes occur in pairs called alleles; that alleles are separated during meiosis (I) / during gamete formation; chromosomes with alleles on them replicate and undergo meiosis; each gamete contains only one copy of each allelic pair; [3]
- (b) variation among members of a population / species is what allows natural selection to occur;
Darwin’s argument states that more offspring are born than can survive; there is a struggle for survival (“*survival of the fittest*” is acceptable); variations within a species that promote survival will be naturally selected; variations (arise from several sources) occur due to recombination of alleles during sexual reproduction;
haploid gametes are made by meiosis during which segregation occurs; crossing-over which occurs during meiosis provides even more variations within a species;
during fertilisation haploid cells join to become diploid (normal in number); evolution is the cumulative effect of natural selection (of variants within a population); new species arise when there has been enough selection of variations to render the population different; [7 max]
- (c) Award [1] for each of the following; an answer which mentions only advantages or only disadvantages should not receive full marks.
cloning is a reproductive process that produces offspring that have the same genes as an original;
vegetative propagation especially prevalent among plants is a cloning process;
cloning among animals is less likely to occur without human manipulation;
cloning is currently used to develop successful crops;
cloning is beginning to be used to improve quality of herd animals for agricultural profit;
cloning reduces variability providing consistent quality;
from a farmers’ point of view, cloning is useful economically;
from a species point of view, cloning reduces stability / diversity promotes stability;
variability is useful to a species in times of crisis when a variant may be able to survive the stress thus promoting survival;
cloning of animals may lead to cloning of humans which will result in many ethical problems;
greater susceptibility to certain diseases; [8 max]
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