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BIOLOGY

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Paper 2

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SECTION A

1. (a) (i) 35 % (+/-1) *(units required)* ***[1]***

(ii) SU-R ***[1]***

(iii) BR is a broader spectrum herbicide (than GP) / chemical composition of BR is more effective against plant than GP;
natural resistance of corn (*Zea mays*) plants to glyphosphate (GP);
application/concentration of herbicide was unequal;
climatic factors affected applications; ***[1 max]***

(b) (i) genome/genetic makeup / genes/DNA (of crop) has been altered;
the alteration is artificial and achieved by means of recombinant DNA technology; ***[1 max]***

(ii) stay fresh tomatoes / delayed ripening reduces spoiling;
frost resistant strawberries; ***[1 max]***
ring spot resistant papayas;
golden rice;
insect resistant potatoes (lectins);
N.B. Other acceptable answers may appear. Ensure that the feature is implied in the name supplied. Question asks for examples "other than corn".

(c) (i) *Award **[1 max]** for any of the following which refer to the comparison of BR-R and SU-R in graph 1.*
SU-R = 60 % survival, BR-R = 45 % / SU-R has higher survival than BR-R;
SU-R offers more resistance than BR-R;
*Award **[1 max]** for any of the following which refer to the comparison of BR-R and SU-R in graph 2.*
BR-R performs (slightly) better when combined with SU-R;
SU-R performs less well when combined with BR-R;
*Award **[2 max]** to a candidate who combines these marks into a single statement:*
SU-R = 60 % survival, BR-R = 45 %, BR-R and SU-R combined = 50%; ***[2 max]***

(ii) BR-R could interfere with SU-R expression / effects cancelled each other out;
the maximum benefit for each is independent, not additive; ***[1 max]***

(d) a combination of any two of the four should give better protection than any one individually / there is no clear pattern in the data;

reason:
results of individual herbicide resistant genes might suggest results different from those actually seen in graph 2;
GU-R and SU-R individually give highest resistance, (but when combined, give the same resistance);
in graph 1, GP-R and BR-R give least resistance, but in graph 2 give highest resistance / GP-R and BR-R are additive;
data shows interference between BR-R and GU-R; ***[3 max]***
*Award **[1]** for any additional valid statement about the effects on survival when combing two herbicide resistance genes in the same plant.*

*Award **[2 max]** for reason.*

2. (a) change in environment is sensed/detected;
response to bring the system back to normal state/set point / within limits;
when the normal state reached, the response is stopped;
this prevents over reaction;
internal environment fluctuates around norm / small fluctuations; ***[3 max]***
Examples are acceptable only if they support marking points given above.

(b) *Award **[1]** for an arrow <u>from</u> "increased body temperature" <u>pointing</u> to "temperature receptors".* ***[1]***

(c) (autonomic) nervous system / endocrine ***[1]***

3. (a) meiosis;
crossing over;
independent assortment;
sexual reproduction/fertilization/recombination;
mutations;
environmental; ***[2 max]***

(b) species produce more offspring that can survive;
populations will show variation;
individuals with favourable traits will survive;
some variations are inherited;
favourable (inherited) variations will increase in numbers; *accept converse answer*
environmental changes will provide further selection;
sustained selection of favourable traits will result in evolution / results in speciation; ***[3 max]***
Evolution or speciation must be addressed in order to receive full marks.
N.B. Examples are acceptable only if they support marking points given above.

4. (a) enzymes are specific for their substrate / lock and key model / energy requirements for reactions with substrates vary;
each step of the pathway is unique / different substrate at each step;
finer control of metabolic pathways; ***[2]***

(b) *Either, temperature*: ***[3 max]***
each enzyme has an optimal temperature for its maximum activity;
(small) temperature increases result in increased enzyme activity to a point/optimum;
increase activity due to increased movement of molecules / increased kinetic energy or conversely stated;
temperature increases above the optimum causes (progressive) loss of activity due to denaturation/shape changes

or, pH: ***[3 max]***
each enzyme has an optimal pH for its maximum activity;
as pH varies from optimal pH, enzyme activity diminishes / becomes inhibited;
loss of activity is due to denaturation/shape changes;
gain or loss of hydrogen ions distorts tertiary shape of enzyme;
homeostatic mechanisms maintain optimal conditions for enzyme activity; ***[3 max]***
Credit marking points above if illustrated by a suitably annotated graph.

5. (a) – U – A – G – G – U – C – C – A – G – U – U – C – ***[1]***

(b) DNA;
RNA polymerase;
(ribose) nucleotides / ribonucleotides / RNA nucleotides;
transcription factors;
nucleoside/ribonucleoside triphosphates;
Any two of the following: A / C / G / U; ***[3 max]***

SECTION B

6. (a) *Award **[1]** for every **two** of the following structures, accurately drawn and correctly labelled.*
ribosomes (attached or free);
rough ER;
smooth ER;
lysosome;
Golgi apparatus/body;
mitochondrion;
nucleus;
plasma membrane/cell (surface) membrane;
nucleolus;
nuclear membrane/envelope;
centriole(s);
peroxisome;
vesicles;
cytoskeleton; ***[4 max]***
*Award only **[3 max]** if any plant structures are included.*

(b) passive transport involves diffusion / movement of molecule down a concentration gradient / from high to low concentration;
osmosis is a form of passive transport;
osmosis is diffusion of water across a semi-permeable membrane;
ATP not required for this process;
energy for diffusion comes from the kinetic energy / Brownian movement of the diffusing molecules;
some molecules diffuse through the phospholipids bilayer;
examples of molecules which diffuse across membrane are gases / water / lipids / steroids / hydrocarbons;
larger molecules / hydrophilic molecules diffuse through membrane proteins/channels;
diffusion through membrane proteins/channels is facilitated diffusion;
facilitated diffusion is faster than normal diffusion;
facilitated diffusion is limited by the number/density of pores; ***[8 max]***

(c) clones are genetically identical individuals / cell lines / tissues;

risks to society:
cloning mammals is expensive/allocation of resources;
cloning could lead to copying selected individuals / equity concerns;
could lead to uncontrolled / unethical eugenics;

risks to individuals:
many cloned animals die soon after birth / die from complications / premature aging of clones;
cloned humans could experience identity crises/problems in psychological development;
reduction of human dignity;
cloned tissues will still possess genetic diseases;
risk for unknown consequences is too great;

belief systems:
artificial cloning in humans is opposed by some as being unnatural/against their religion;
cloning occurs naturally when identical twins form;

benefits:
cloning humans may help to provide tissues/organs for transplantation;
research in cellular mechanisms/developmental biology/possible medical breakthroughs; ***[6 max]***

*(Plus up to **[2]** for quality)*

7. (a) *Award **[1]** for each of the following correctly labelled.*
CO_2 in the atmosphere / water enters (green) plants/producers/autotrophs - *labelled* photosynthesis;
plants to animals/consumers - *labelled* feeding/grazing*;*
(dead) plants / animals to decomposers/saprotrophs; - *labelled* feeding/decomposition*;*
plants / animals to fossil fuels / coal / oil / gas – *labelled* fossilization*;*
fossil fuel to atmosphere – *labelled* combustion*;*
plants and animals to atmosphere – *labelled* respiration*;*
decomposers to atmosphere – *labelled* respiration; ***[5 max]***

(b) $CO_2 + H_2O \rightarrow (CH_2O)n + O_2$ / suitable photosynthesis equation;
amount of CO_2 absorbed (per unit time) can be measured;
measuring the increase of biomass (per unit time);
O_2 excretion (per unit time) can be measured;

methods for measuring the above:
volume of O_2 (bubbles) produced per unit time can be measured;
dry mass can be weighed;
increase in starch concentration in leaves (as measured by iodine);
use of pH indicator can monitor CO_2 uptake in water;
the rate of photosynthesis measured is relative because some of the CO_2 is produced by the plant internally through respiration;
the rate of photosynthesis measured is relative because some of the carbohydrates are used internally by the plant for respiration; ***[7 max]***

(c) carbohydrates and lipids contain a lot of chemical energy;
carbohydrates are readily used in cell respiration / sugars are quick access energy stores;
lipid molecules contain about twice as much energy as carbohydrates;
complex carbohydrates/polysaccharides/starch/glycogen are also long term energy stores;
lipids are long term energy reserves;
complex carbohydrates/polysaccharides/starch/glycogen and lipids are insoluble / will not diffuse out of cells;
complex carbohydrates/polysaccharides/starch/glycogen/lipids do not contribute (significantly) to osmotic pressure;
complex carbohydrates/polysaccharides/starch/glycogen can be converted into sugars by hydrolysis;
carbohydrates and lipids burn cleaner than proteins / do not yield N waste; ***[6 max]***

*(Plus up to **[2]** for quality)*

8. (a) *Award **[1]** for each of the following structures accurately drawn and correctly labelled.*
ovary/ovaries;
oviduct/fallopian tubes;
uterus/womb/muscular wall of uterus/myometrium;
lining of uterine wall/endometrium;
cervix;
vagina;
clitoris / vulva/labia; ***[5 max]***

(b) fertilization in the (upper) oviduct/fallopian tube;
fertilized egg is a zygote / diploid single cell;
cleavage (begins 24 hours) after zygote formation;
cilia propel embryo along oviduct;
rapid mitosis leads to morula/ball of cells;
blastocyst/hollow ball of cells forms;
implantation of blastocyst in the lining of uterine wall/endometrium;
chorionic villi penetrate the in the lining of uterine wall/endometrium; ***[5 max]***
Credit marking points above for a clearly drawn and correctly labelled diagram or flow chart.

(c) FSH and LH are produced by the (anterior) pituitary;
estrogen/estradiol and progestin/progesterone are produced by the ovary;
FSH stimulates the ovary to produce a follicle;
developing follicles secrete estrogen/estradiol;
estrogen inhibits FSH / negative feedback;
estrogen stimulates growth of endometrium/uterine lining;
estrogen stimulates LH secretion / positive feedback;
LH stimulates ovulation;
follicle becomes corpus luteum;
corpus luteum secretes estrogen and progesterone;
estrogen and progesterone maintain the lining of the uterus/endometrium;
estrogen and progesterone inhibit LH and FSH / negative feedback;
after two weeks corpus luteum degenerates;
ovarian hormone levels / progesterone / estrogen levels fall;
menstrual bleeding begins/lining of uterine wall/endometrium lost; ***[8 max]***
Credit marking points above for a clearly drawn and correctly labelled diagram or flow chart.

*(Plus up to **[2]** for quality)*