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GCE O Level Biology (7040)

January 2005

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BIOLOGY 7040, MARK SCHEME

Symbols used in mark points
; indicates separate mark points
/ indicates alternatives
eq means allow any correct equivalent
R reject
I Ignore

Paper 1
Section A

1 a) antibodies;
phagoctytosis/ engulf/ description; **(2)**

b) similar genes/alleles/genotype / genetics;
HLA antigens/surface markers/ blood/ tissue types/ groups;
R 'same blood'
less/ no rejection / not attack / idea of foreign; **(3)**

c) bacteria;
viruses;
fungi;
protoctist; I examples **(2 max)**

d) (i) hepatic vein;
hepatic artery;
(hepatic) portal vein; **(3)**

(ii) bile duct; **(1)**

e) people don't want organs removed / religious objection;
donors may not carry cards / make their wishes known;
donors are of the wrong type/ don't match;
donated organs cannot be stored for long / administrative delay:
diseased organs; **(2 max)**

(Total 13 marks)

2 a) (i) no/ little germination at low temperature/-1/ increases;
most/ maximum/ optimum germination/ up to 4/ from 4;
no/ little germination at high temperature 14 / decreases; **(3)**

(ii) at -1 °C water is frozen / ice no water available;
no digestion / enzyme action / metabolic activity; **(2)**

b) 160; **(1)**

c) avoids growing in cold/winter/ ensures cold/ winter is over;
enables growth in warmer conditions; **(2)**

d) water/ moisture; enables enzyme action/ digestion / softens seed coat;;
oxygen; respiration; I air
warmth; qualified temperature; speeds up metabolism eq;
I heat/ unqualified temperature **(4 max)**

(Total 12 marks)

Section B

3 a) $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$
Lhs; Rhs; Balance;
Correct word equation = 1 **(3)**

b) (i) alveoli;
(alveoli) provide large surface area;
thin (walls) / short distance / one cell thick;
moist allows gases to dissolve;
capillary / blood supply carries oxygen away/ maintains gradient; **(4 max)**

(ii) leaf;
large surface area / broad;
thin;
stomata; I guard cells/pores
spongy mesophyll have air spaces/ allow diffusion;
moist allows gases to dissolve **(4 max)**

c) stomata reduce in size/ guard cells close;
less photosynthesis;
less / no oxygen given out;
less / no carbon dioxide absorbed;
less / no transpiration / water given out; **(3 max)**

d) internal intercostals muscles contract/ external intercostals muscles relax;
sternum / ribs/ chest moves inwards and downwards;
diaphragm relaxes/ returns to its dome shape;
volume of chest cavity/ thorax decreases;
pressure increase;
air forced out of lungs / down pressure gradient; **(5 max)**

e) **C** exercise & no exercise / range of exercise;
O same person / age/ gender/ mass /diet etc;
R repeat;
M number of breaths per minute / per time period;
S same temperature/ time of day/ environmental factor;
Expected results increased rate; **(6)**

(Total 25 marks)

4 a) (i) Nitrogen fixing bacteria / *Azotobacter* / *Clostridium* / *Rhizobium*;
Nitrogen (gas);
to ammonia / ammonium compounds / amino acids; **(3)**

(ii) Nitrifying bacteria / *Nitrosomonas* / *Nitrobacter;*
Ammonia to nitrite;
Nitrite to nitrate; (ammonia to nitrate=1)
(ammonia to nitrite and nitrate =2) **(3)**

(iii) denitrifying bacteria / *pseudomonas (denitrificans)* / *thiobacillus (denitrificans)*;
nitrates to nitrites / ammonia;
nitrates to nitrogen gas; **(3)**

b) (i) number/population of organisms;
at each (feeding/ trophic) level;
labelled pyramid (organisms or levels); **(3)**

(ii) mass of organisms;
at each (feeding level / trophic) level;
labelled pyramid (organisms or levels); **(3)**

c) named pollutant;
source;
effect; **(3)**

d) **C** fertiliser and no fertiliser or range of conc.;
O same species / number or mass of algae;
R replication;
M measure mass/surface/count algae etc.;
S same volume of water;
same carbon dioxide/light/temp/eq;
same time;
RES more in fertiliser; **(7)**

(Total 25 marks)

5 a) (i) protein;
catalyst / speeds up reaction;
<u>example and action</u>; **(3)**

(ii) work best at / optimum temperature;
low rate at <u>low and high</u> temperature;
low temperature low kinetic energy / little molecular movement / collisions;
at high temperature denature/ substrate no longer to fit into active site; **(4)**

(iii) works best at / optimum / work less well at high and low pH;
denature / change shape of active site / substrate cannot bind; **(2)**

b) **C** temp measured at start and at end / temp. rise;
O bread used;
R repeat/calculate average;
M mass of food;
volume of water;
S reducing heat loss / same distance away;
completely burnt; **(7 max)**

c) (i) photosynthesis;
as coolant;
reactant / medium for chemical reactions / acts as solvent;
transport medium;
support / turgor; **(3 max)**

(ii) (heat) insulation / keeping warm;
shock absorption / protection;
for energy/ respiration;
energy store;
buoyancy / water proofing;
(insulation of) nerve cells;
solvent for vitamins A and D;
phospholipids / cell membrane; **(3 max)**

(iii) for energy/ respiration;
energy store;
cellulose / cell wall;
nucleic acids / DNA / RNA; **(3 max)**

(Total 25 marks)

6 a) auxin;
bends / grows towards light / positive;
phototropism;
photosynthesis; **(4)**

b) grows / bends down/ positive;
geotropism;
water;
minerals;
anchorage / support; **(4)**

c) insulin released;
from pancreas;
islets of Langerahns;
glucose to glycogen;
in liver/ muscles;
blood glucose returns to normal/ reduced;
water leaves cells / osmosis/ dehydration/ more urine;
Diabetes/ glaucoma/ blindness / eq.; **(6 max)**

d) receptor;
sensory/ afferent neurone;
relay / intermediate neurone;
motor / efferent neurone;
synapse;
passage of impulse on diagram;
effector/muscle/biceps; **(5)**

e) **C** different amounts of caffeine / coffee;
O same age / mass / sex / person;
R repeat / use several people;
M how quickly / speed of response;
timing in seconds / milliseconds;
S same conditions for testing temperature / lighting/eq; **(6)**

(Total 25 marks)

7 a) (i) carbon dioxide;
water;
respiration / oxidation of food;
in cells **(3 max)**

(ii) urea;
from protein / amino acid / deamination;
in liver;
contains water;
contains salts / minerals / uric acid / nitrogenous waste; **(4 max)**

b) more sweat;
evaporation of sweat produces cooling;
vasodilation;
increase flow of blood near skin surface;
hair lies flat on skin / erector muscles relax;
less air trapped; **(6)**

c) (i) egestion is removal of undigested food/ faeces;
excretion is removal of waste products/ metabolic waste; **(2)**

(ii) urethra from the bladder to the outside / from bladder to penis;
ureter carries urine from the kidney to the bladder; **(2)**

(iii) breathing is movement of air into / out of the lungs / ventilation;
respiration is the release of energy / oxidation of food; **(2)**

d) **C** two or more temperatures;
O same plant / same size /same species;
R repeat;
M use potometer;
distance/ mass / volume and time;
S same stated environmental (temp /humidity /light / wind);
cut under water / vaseline / oil;
RES increased; **(6 max)**

(Total 25 marks)

Paper 2

1 a) $6O_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$;
LHS; RHS; Balanced; **(3)**

b) (i) prevent photosynthesis;
destarch/ so starch used up / converted to glucose;
used in respiration; **(3)**

(ii) boil in ethanol;
use water bath;
to remove chlorophyll;
add iodine solution; **(4)**

(iii) brown / yellow/ white/ colourless area correct;
blue/ black 3 areas correct; **(2)**

(Total 12 marks)

2 a) (i) A cell wall;
B vacuole; R food vacuole
C chloroplast; **(3)**

(ii) S cell membrane shrunk away from cell wall;
V vacuole smaller;
W cell wall shown as double line **(3)**

b) chloroplasts;
cell wall;
large vacuole;
regular shape **(2 max)**

c) water enters cell;
by osmosis;
increase volume;
cell may burst;
no cell wall; **(3 max)**

(Total 11 marks)

3

A	46
B	2;
C	3;
D	2;
E	3;
F	2;
G	5;

(Total 6 marks)

4 a)

Tooth letter	Name of Tooth
A	Incisor
B	Canine
C	Premolar
D	Molar

(4)

b) (i) cellulose; **(1)**

(ii) mutualism/symbiosis **(1)**

c) (i) Benedicts;
boil; **(2)**

(ii) plant tissue;
liquid line drawn and labelled water;
or
liquid;
Benedicts; **(2)**

(iii) graph bottom left; **(1)**

(Total 11 marks)

5 a) (i) A oesophagus;
B stomach;
C pancreas;
D large intestine; **(4)**

(ii) peristalsis;
muscle;
contraction; **(2 max)**

b) (i) RR/ homozygous dominant/ resistant; **(1)**

(ii) rr/ homozygous recessive/ non resistant; **(1)**

(iii) Rr/ heterozygous; **(1)**

(iv) Rr Rr; Parents wrong parents up to 2 TE
R or r R or r; gametes
RR Rr Rr rr; offspring **(3)**

(Total 12 marks)

6 a) (i) plasma; **(1)**

(ii) working either 27.5 or /50 x 100;
55;; **(2)**

(iii) water;
glucose
amino acids;
fatty acids;
glycerol;
hormones/ named hormone;
vitamins / named vitamin;
minerals/ named mineral;
(plasma) proteins/ named;
antibodies;
CO_2;
urea; **(2 max)**

b) (i) less red blood cells;
lack of haemoglobin; **(2)**

(ii) contains haemoglobin;
biconcave/ large SA (/volume Ratio);
no nucleus; **(2 max)**

(Total 9 marks)

7 a) highest in the buds;
decreases with age/ least in oldest leaf eq;
correct reference to figs.; **(3)**

b) auxin produced in buds;
required for development / growth; **(2)**

c) (i) Adrenal glands; **(1)**

(ii) increase heart rate;
increase breathing rate;
more blood to muscles;
increase metabolic rate;
pupil dilates;
glycogen to glucose;
inhibits peristalsis;
increases sweating; **(2 max)**

(Total 8 marks)

8 a) two antennae;
three body parts/ head, thorax abdomen;
six legs; **(2)**

b) (i) hidden from other organisms;
food for offspring; **(2)**

(ii) dung is a source of minerals;
oxygen;
active transport;
respiration; **(3 max)**

(iii) adult;
larva/ maggot;
pupa; **(3)**

(Total 10 marks)

9 a) (i) phytoplankton;
minnow; **(2)**

(ii) zooplankton;
minnow/needle fish/osprey **(2)**

b) (i) falls/decreases; **(1)**

(ii) loss of energy/eq.;
by excretion/respiration/movement etc; **(2 max)**

c) (i) concentration builds up/ bioaccumulation/ lowest at producer/
higher as move up the chain; **(1)**

(ii) many plankton eaten by minnows/many minnows eaten by needle fish/ eq;

DDT cannot be excreted/ broken down/ decomposed; **(2 max)**

d) (i) using one organism to control another;
example of predator and prey; **(2)**

(ii) does not pollute/ harm the environment;
specific/does not affect / kill other organisms/build up;
disrupt food chains;
lasts longer / no need to reapply;
no resistance develops; **(2 max)**

(Total 14 marks)

10 The table below lists some biological processes. Complete the table to show the substance linked with each process. The first one has been done for you.

Process	Substance linked with the process
Development of healthy bones	**Calcium/ phosphorus/vitamin D;**
Transpiration	**Water;**
Ability to see in dim light	**Vitamin A;**
Joining DNA in genetic engineering	**(Ligase)**
Cutting DNA in genetic engineering	**Restriction (endonuclease);**
Gas production during decomposition	**Carbon dioxide/ methane;**
Conversion of glycogen to glucose	**Glucagon;**
Eutrophication	**Minerals/ b=named mineral/ fertiliser;**

(Total 7 marks)

BIOLOGY 7040, CHIEF EXAMINER'S REPORT

General Comments

Once again the examiners were impressed by the knowledge and understanding shown by the candidates taking the papers this January.

Paper 1

There was little evidence of the candidates running out of time. However, a few candidates did attempt to answer more than three questions from Section B. These candidates rarely scored highly.

Section A

Question 1

This question was answered well by most candidates who were able to use their knowledge of biology and the information in the passage to produce sensible responses.
Part (a) required two ways that white blood cells attacked a transplanted organ. Almost all candidates' responses included reference to phagocytosis and the better responses also included antibody production.
Part (b) asked for suggestions as to why transplants from close relatives are more likely to succeed. The best candidates described the common alleles leading to common surface markers and therefore reducing the chance of rejection.
Most candidates were able to name, for part (c), bacteria and viruses as two types of organisms that could cause infection.
In part (d) many candidates correctly identified the three blood vessels and the bile duct.
Part (e) proved more challenging with only the best students being able to gain both marks. A statement about the unwillingness of relatives to agree to organs being donated gained credit. Other creditworthy responses included difficulties in getting the organ to match the recipient or that organs cannot be stored for very long.

Question 2

This question required candidates to describe data on the effect of temperature on germination and draw conclusions from it.
In part (a) the examiners expected the responses to note that germination increased as temperature increased, with no germination at -1 and maximum at 4 and no germination at 14. Candidates generally did well on this but failed to explain why no germination took place at -1. The examiners required the observation that at -1 no water is available as it is frozen or ice. Credit was also given to responses that explained that enzyme activity would be low at low temperatures.
Part (b) required candidates to calculate the number of seeds that germinated at 1, ie 32% of 500. Almost all candidates were able to do this correctly.
In part (c) only a few candidates were able to explain that by requiring a long period of chilling the seeds did not grow until winter was over. This ensured that growth occurred in warmer conditions. Many candidates described conditions as unsuitable or inappropriate but did not refer to temperature or growth.
Part (d) was well answered with almost all candidates able to give the conditions required for germination.

Section B

A few candidates chose to attempt to answer more than three questions from this section. This meant that they could not spend the expected time on any of their choices and thus they rarely scored well.

Question 3

This question was the second most popular choice being attempted by 78% of the candidates.

In part (a) most responses included the correct equation for respiration with only a few candidates giving the equation for photosynthesis.

In part (b) candidates needed to describe the structures of the alveoli and the leaf tissues and explain how they are adapted to maximise gas exchange. The very best responses described, for example, how the moist lining of the alveoli allows gases to dissolve and pass through the cell membranes.

Part (c) required candidates to explain how reducing the light intensity would lead to a reduction in stomatal width and reduce the release of oxygen, the absorption of carbon dioxide and the release of water vapour.

In part (d) candidates generally found little problem in describing the mechanisms involved in breathing out. Some failed to gain full credit because they described the volume and pressure changes without specifying that these are changes in volume of the chest cavity not of the lungs.

The examiners were encouraged to see many candidates using the CORMS prompts, described in past examiner's report, to help answer part (e). These candidates usually did well and gained most marks for their designs. For this experiment the following model could be used:

C exercise and no exercise or a range of exercises
O same person or same age/ gender/ mass/ etc.
R repeat tests
M measure number of breaths per minute
S same temperature/ time of day/ other environmental variable
Expected results increase in breathing rate with exercise.

Question 4

This was the least popular question, and was answered by only 37% of the candidates.

Part (a) asked for the role of bacteria in the nitrogen cycle. Many excellent answers were seen by the examiners and this is an area were the candidates have prepared well for the examination.

In part (b) although most candidates gained some credit, some failed to earn full marks by failing to describe the pyramids as representing the numbers of organisms at each trophic level.

Most candidates were able to provide a pollutant and describe its source and effect in part (c).

The experimental design item in part (d) also lends itself to be modelled using the CORMS prompt as follows:

C fertiliser and no fertiliser or a range of fertilisers
O same species /number or mass of algae
R repeat
M measure mass / volume / surface area covered by algae
S same volume of water in pond / container
same carbon dioxide / light / temperature in pond
left for same stated period of time
Expected results more algal growth in fertiliser

Question 5

This was the second least popular question, answered by only 45% of the candidates.
In part (a) candidates were required to describe an enzyme. Most were able to describe it as a biological catalyst and many could give an example and describe its function. Only the very best mentioned that enzymes were proteins. Candidates then needed to describe and explain the effect of temperature on the functioning of an enzyme. While they could often describe the effect in terms of an optimum temperature few could explain the effect in terms of kinetic theory. More candidates were able to describe denaturing at higher temperatures. Most could describe the effect of pH but some failed to earn full credit because they did not mention optimum pH.
In part (b) the candidates who had carried out or read about or discussed this simple experiment did well. Those who had not failed to earn many marks.
In part (c) many candidates gained full credit for functions of water, carbohydrate and lipid.

Question 6

This was quite a popular question, answered by 55% of the candidates.
In part (a) many candidates were able to describe the positively phototropic response of shoots and describe the role of auxin in the response and how it enables maximum exposure to light for photosynthesis.
Likewise in part (b) many candidates could describe the positively gravitropic response of roots and explain how it enables the plant to absorb water and minerals and anchor the plant in the growing medium.
In part (c) candidates who had prepared the response to an increase in blood glucose scored highly. Some weaker candidates confused glycogen with glucagon.
In part (d) candidates who had learnt the reflex arc gained full credit.
Part (e) also lent itself to the use of the CORMS prompt as follow:

C caffeine and no caffeine or different amounts of caffeine
O Same person/ same age/ mass/ gender etc.
R repeat take several measurements of reaction time
M time how quickly the subject responds to stimulus
time in milliseconds
S same conditions for testing / temperature /lighting /time of day etc.

Question 7

This was by far the most popular choice being answered by 95% of the candidates.
In part (a)(i) the better candidates could gain full credit by describing the release of carbon dioxide and water by the respiring cells. In part (ii) weaker candidates stated that urea is produced in the kidney.
In part (b)(i) some responses failed to earn full credit because they did not refer to an **increase** in sweating following an increase in temperature. Others did not link the evaporation of sweat to the cooling effect.
In part (c) most could distinguish between egestion and excretion and breathing and respiration but several made errors in distinguishing urethra and ureter.
Part (d), although a familiar experiment to many candidates, could also be helped by using the CORMS prompt as follows:

C two or more temperatures
O same plant / same species / size etc.
R repeat each reading
M use potometer
Distance moved by bubble or mass or volume of water in a stated time
S same environmental condition/ humidity / light / wind speed etc.
Precaution in setting up apparatus cut stem under water / seal with Vaseline etc.
Expected results increase in transpiration with increased temperature.

Paper 2

Question 1

Writing a balanced chemical equation proved a straightforward task for most. Only the occasional student forgot to balance the equation, and a similar small number wrote the equation for respiration in error. Most appreciated that a plant in the dark would be destarched, though only the better candidates explained why by making reference to respiration and lack of photosynthesis. The starch test for a leaf was surprisingly poorly described. Common errors included not stating that the ethanol had to be hot, not stating that a water bath should be used for safety reasons, and not stating that the ethanol removes the chlorophyll. Many students struggled to complete the diagram of the leaf accurately to show a labelled blue black area in three places and the correct yellow brown area.

Question 2

Labelling the cell parts was easy for most but the drawing of a plasmolysed cell posed problems. Marks were credited for a cell wall shown as a double line, a cell membrane shrunk from the inner part of the cell wall and a vacuole that was smaller. In part (b) most recalled acceptable differences and it was pleasing to note that many were able to explain that a red blood cell in water would absorb water by osmosis, would swell and eventually burst.

Question 3

Only the very best candidates scored highly in this question. Many candidates do not know how many wings a dipteran insect possesses. Of the other questions, the most challenging seemed to be the calculation of energy transfer.

Question 4

Most appreciated that all four tooth types were drawn. Many wrongly thought that B was the diastema, and a small number of candidates confused the premolar and molar teeth. Most recalled that cellulose is the carbohydrate found in plant cell walls and most also appreciated that the relationship was mutualism or symbiosis. Benedict's as a test for glucose is known by many, though candidates failed to score both marks if they made no reference to the need to heat the reagent. Drawing a control was challenging for most candidates. Many drew a test tube containing liquid and a leaf, but failed to label the liquid as water. Instead it was labelled as liquid from a sheep's stomach. An alternative control of liquid from a sheep's stomach mixed with Benedict's was credited. The bottom left hand graph was selected by very few. Most opted for the top right hand graph, presumably failing to understand the meaning of the axis labelled 'time taken for glucose to appear'.

Question 5

It was pleasing to note that candidates were able to recognise parts of the digestive system in a novel situation and to describe the role of peristalsis in moving food along the oesophagus. The identification of the correct genotypes was achieved by most, though less success was witnessed regards the genetic diagram. Candidates who failed to identify the correct genotypes of the parents lost one mark, but could still gain two marks by noting the genotypes of their gametes and their offspring.

Question 6

The vast majority of candidates knew that the yellow liquid in blood is plasma. Candidates who correctly calculated that the plasma constituted 55% of the sample gained full marks. Those who calculated a wrong percentage could still gain one mark if their working showed 27.5 or showed that they had divided a volume by 50 and multiplied by 100. The contents of plasma are well known and a long list of acceptable answers was put to good use. In part (b), it was pleasing to note that most realised that a deficiency of iron would result in fewer red blood cells because it is an important component of haemoglobin. The adaptations possessed by red blood cells are understood by many candidates, with haemoglobin and biconcave shape being popular responses.

Question 7
Candidates are encouraged to make reference to figures, as appropriate, when describing data. Apart from this observation, it was noted that many students appreciated that most auxin was in the bud and also that the concentration of auxin decreased as the leaves aged. In part (b), many students appreciated that auxin has a role in growth and development, though few deduced from the data that its source is from the bud. The effects of adrenaline in the body was well answered.

Question 8
Candidates are encouraged to be precise when recalling insect features. Antennae alone is not enough. A pair of antennae or two antennae is required. Similarly, they need to note that the insect body is not divided into three segments but three body parts, the head, thorax and abdomen. Part (b) posed difficulty for most. Many restated the stem, failing to appreciate the question hinged on the verb to bury. By burying the dung the beetles hide it from other organisms and keep their offspring well fed and safe from surface predation. The tunnels provide plant root cells with oxygen which they use in aerobic respiration to provide the energy they need to absorb minerals by active transport. This logic was beyond most students. The life cycle was correctly completed by most.

Question 9
Most candidates completed part (a) correctly. In part (b), many students understood that the number of organisms would decrease but only the better students who explained this was due to energy loss between trophic levels gave an acceptable example of how the energy might be lost. The bioaccumulation of DDT was appreciated by most candidates, but only the most able suggested that this was due to organisms at a trophic level eating many more organisms from the trophic level below, and that DDT was not being broken down. The term biological control is understood by most candidates, though the examples often given were somewhat tenuous. The better candidates easily recalled the benefits of biological control when compared to chemical insecticides.

Question 10
This question discriminated very well. It seemed that some candidates either failed to read the question carefully or did not understand the term substance.

BIOLOGY 7040, GRADE BOUNDARIES

Grade	A	B	C	D	E
Lowest mark for award of grade	130	110	91	81	57

Note: Grade boundaries may vary from year to year and from subject to subject, depending on the demands of the question paper.

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