

STUDY • PRACTICE • SUCCEED

IB 360



IBDP

BIOLOGY

Standard & Higher Level

For **NEW** syllabus

Answer key and markscheme



NTK Publishing Limited

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The markschemes have been developed independently by the publisher and the content is in no way connected with nor endorsed by the International Baccalaureate Organization.

Chapter 1

Cell biology

Multiple-choice questions

- | | | | | |
|------|------|------|------|-------|
| 1. B | 2. C | 3. A | 4. C | 5. C |
| 6. B | 7. D | 8. D | 9. D | 10. C |

Structured question

Question 1

- (a) DNA replication in S phase / interphase;
sister chromatids (of chromosomes) are identical;
chromosomes line up at the equator / metaphase plate / middle of cell (in metaphase);
spindle microtubules / fibres attach to centromeres (in metaphase);
centromeres split / sister chromatids separate (in anaphase);
each pole / daughter / nuclei receives the same (number of) chromosomes;
identical sets of chromosomes in each daughter nucleus; [4 max]
- (b) (metabolically) active period in cell cycle;
DNA replication in S phase;
ensure daughter cells / nuclei receive identical genetic materials / information;
protein synthesis / transcription / translation;
duplication of organelles / named organelles *e.g.* chloroplast, mitochondrion;
increase in cell size / growth;
preparation for mitosis;
checkpoints to ensure phases are completed / errors are not transmitted to daughter cells;
cells with errors go into G_0 phase; [4 max]

(c) Award [1 max] for correct sequence of phases: prophase, metaphase, anaphase, telophase;

in prophase:

supercoiling / condensation of chromatin (into chromosomes);

breakdown / degeneration of nuclear envelope / membrane;

attachment of spindle microtubules / fibres to centromeres;

in metaphase:

chromosomes line up at equator / metaphase plate / middle of cell;

in anaphase:

shortening / breakdown of spindle microtubules / fibres;

splitting of centromeres;

chromosomes / sister chromatids move to opposite poles of cell;

in telophase:

chromosomes reach the (opposite) poles of the cell;

nuclear envelope / membrane re-forms;

chromosomes uncoil / relax (into chromatin);

two genetically identical nuclei formed;

[7 max]

Reject "contraction" of spindle microtubules.

Chapter 2

Molecular biology

Multiple-choice questions

1. C 2. A 3. B 4. A 5. B
6. D 7. A 8. D 9. C 10. D

Structured questions

Question 1

(a) 30; [1]

(b) mutation changes DNA base sequence (of gene);
cause a change in mRNA / codon sequence;
during transcription;
result in change in amino acid sequence (of polypeptide);
during translation;
amino acid sequence / primary structure (of polypeptide) determines three-dimensional conformation / tertiary structure (of polypeptide / protein);
alter three-dimensional conformation of active site;
not complementary to substrate;
cannot form enzyme-substrate complex;
lock-and-key model; [7 max]

(c) aerobic (cell respiration); [1]

(d)

<i>Triglycerides</i>	<i>Carbohydrates</i>
more energy stored <u>per unit mass</u> / 4 000 kJ per 100 g	less energy stored <u>per unit mass</u> / 1 760 kJ per 100 g;
long-term storage	short-term storage;
less easily used for cell respiration	can be converted to sugars easily;
less soluble in water	more soluble in water;
stored around organs / under skin	stored in liver / muscles; [3 max]

Award [1] for each correct row.

A table is not required but the difference between triglycerides and carbohydrates must be made clear.

Question 2

(a) correct structure of water molecules;

line within a water molecule labelled covalent bond;

line between water molecules labelled hydrogen bond;

[2]

Award [0] if fewer than three water molecules are drawn.

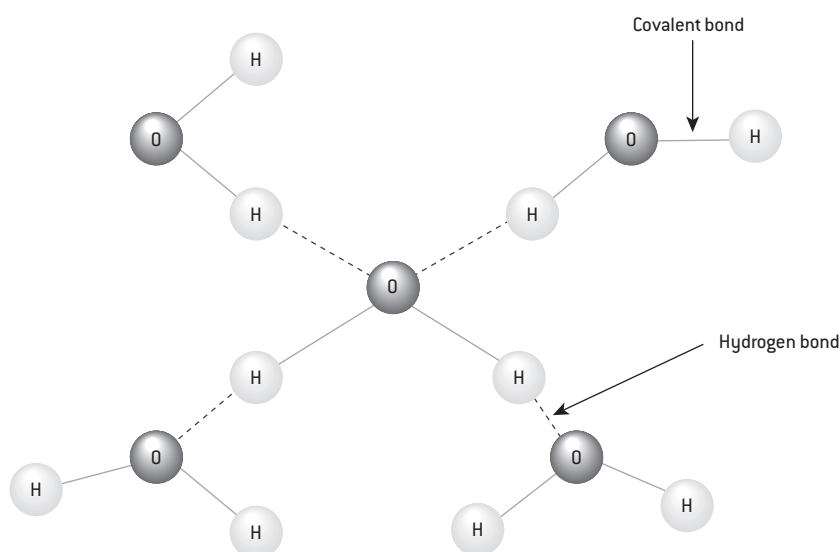
Award [1] for either covalent bond or hydrogen bond if they are drawn in the same style.

Reject more than one hydrogen bond connected to a hydrogen atom.

Reject more than two hydrogen bonds connected to an oxygen atom.

Reject intramolecular hydrogen bonds.

Ignore incorrect bond angles.



(b) cohesion / thermal property / solvent property;

cohesion:

maintain cell shape;

thermal property:

maintain stable temperature / coolant;

solvent property:

medium for (metabolic) reactions;

[2]

Award [1] for a property and [1] for a correctly identified significance.

(c) breaking of ionic bonds / covalent bonds / hydrogen bonds / hydrophobic interactions;

due to vigorous vibrations / increase in kinetic energy;

disruption of three-dimensional conformation / tertiary structure;

denaturation;

[3 max]

Reject reference to polarity.

Ignore active site.

Chapter 3

Genetics

Multiple-choice questions

- | | | | | |
|------|------|------|------|-------|
| 1. B | 2. B | 3. D | 4. B | 5. D |
| 6. A | 7. A | 8. D | 9. C | 10. D |

Structured question

Question 1

(a) embryo splitting;

extract sperms and eggs (from donors);

allow fertilization to form zygote;

zygote divides by mitosis to form embryo;

split embryo into smaller cell masses;

culture embryos in nutrient medium / Petri dish / *in vitro*;

transfer embryos into (uterus of) surrogate mother for implantation;

birth of genetically identical offspring;

OR

somatic-cell nuclear transfer;

collect somatic cells (from donor);

isolate nucleus from somatic cell;

collect egg cells from a female;

remove nucleus of egg cell;

to form enucleated egg;

fuse somatic cell / nucleus with enucleated egg;

stimulate fused cell to divide using electric shock / pulses;

culture fused cell in medium to form embryo;

introduce embryo into (uterus of) surrogate mother for implantation;

birth of offspring genetically identical to somatic cell / nucleus donor;

[6 max]

*Award marks for description of **either** method.*

- (b) red-green colour blindness is caused by a recessive allele;
 red-green colour blindness is sex-linked / gene for colour blindness on X chromosome only;
 males only have one allele and females have two;
 males inherit X chromosome from the female parent;
 females inherit one X chromosome from each parent;
 males have 50% chance of being colour blind if mother is carrier / heterozygous;
 males are colour blind if mother is colour blind / homozygous recessive;
 normal males have carrier daughters if female is colour blind / homozygous recessive;
 normal males have 50% chance of having carrier daughter if female is heterozygous / carrier; **[5 max]**
Allow use of Punnett grids with symbols in correct format but do not award marks for Punnett grids only.

Sample Punnett grid:
 X^C : X chromosome with a normal colour vision allele
 X^c : X chromosome with a colour blind allele
 Y: Y chromosome without the allele

		Carrier mother ($X^C X^c$)	
		X^C	X^c
Normal father ($X^C Y$)	X^C	$X^C X^C$ Normal female	$X^C X^c$ Carrier female
	Y	$X^C Y$ Normal male	$X^c Y$ Colour blind male

(c) *preparation:*

karyogram is an image / a photo of chromosomes in a cell / nucleus;
(embryonic) cells collected by chorionic villus sampling / CVS / amniocentesis;
cells in metaphase (of mitosis / meiosis I) are isolated;
chromosomes arranged in (homologous) pairs;
by size (and shape);
by location of centromere;
by banding;

application:

identification of sex;
males have XY chromosomes, females have XX chromosomes;
used to identify abnormal number of chromosomes / non-disjunction / abnormal chromosome structure;
example of condition caused by chromosomal abnormalities *e.g.* Down syndrome caused by trisomy 21 / other
named conditions; **[8 max]**

*Award [6 max] for preparation procedure and [2 max] for application.
Reject "gender".*

Chapter 4

Ecology

Multiple-choice questions

- | | | | | |
|------|------|------|------|-------|
| 1. D | 2. A | 3. D | 4. A | 5. B |
| 6. C | 7. B | 8. D | 9. B | 10. A |

Structured questions

Question 1

- (a) light energy (from the Sun) converted to chemical energy in organic compounds;

by producers / autotrophs / plants;

by photosynthesis;

energy from producers to consumers;

by feeding / consumption;

from organisms to decomposers;

through death / excretion / decomposition;

energy loss between trophic levels;

by respiration / uneaten / undigested materials / excretion / egestion / movement / heat loss;

about 90% of energy is lost / only 10% passed to a higher trophic level;

amount of energy decreases towards higher trophic levels;

[7 max]

- (b) plants / producers absorb inorganic nutrients from soil / habitat;

to synthesize organic compounds;

by photosynthesis;

using light energy;

organic nutrients pass from producers / autotrophs / plants to consumers / animals;

decomposers secrete digestive enzymes / carry out external digestion;

break down non-living organic matter;

decomposers are fungi / bacteria / (methanogenic) archaeans;

release inorganic nutrients / ions into soil / habitat / ecosystem;

detritivores break down large non-living organic matter into smaller organic wastes;

[6 max]

- (c) burn less fossil fuels;
reduce use of vehicles / use public transport;
afforestation / reforestation;
reduce deforestation;
use alternative energy source;
consume local food;
consume less meat;
Accept other appropriate answers.

[4 max]

Question 2

- (a) decompose non-living organic matter into methane (CH₄);
release methane into atmosphere;
decomposers;
decomposition in anaerobic conditions;
in water-logged soil / peatlands / digestive system of cattle;

[3 max]

- (b) *mesocosm*:

enclosure of an area in a natural habitat;
resemble natural condition while allowing variables to be controlled;
to study effect of a factor on an ecosystem;
example of variables studied *e.g.* pH, temperature, light intensity;
minimize disturbance to natural habitat;
closed mesocosms allow only exchange of energy;
demonstration of sustainability of ecosystems;

quadrat:

to estimate population size;
division of area into grids / coordinates;
random sampling / random position of quadrats / random number of coordinates;
identify species inside quadrat; count number of individuals in quadrats;
divide total number of individuals by total sampled area, then multiply by total area to estimate population;
suitable for small immotile / slow-moving organisms / named example / *vice versa*;

[6 max]

Award [3 max] for each method.

(c) *bleaching of coral reefs:*

increase in ocean temperature;

increased concentration of dissolved carbon dioxide / acidity / decrease in ocean pH;

expulsion of mutualistic / symbiotic algae by corals;

death of coral polyps;

one other appropriate example:

effect on an identified ecosystem *e.g.* extinction of polar bears;

link to climate change *e.g.* melting of Arctic ice cap;

cause of damage to ecosystem *e.g.* loss of habitat;

[6 max]

Award [0] if consequence is not related to ecosystem.

Chapter 5

Evolution and biodiversity

Multiple-choice questions

1. A 2. C 3. D 4. C 5. C
6. D 7. C 8. A 9. C 10. C

Structured question

Question 1

- (a) not in the same clade / not monophyletic / polyphyletic; [1]
Reject paraphyletic.
- (b) variation of tail length in ancestral population;
peacocks with longer tails attract more mates / females;
produce more offspring;
pass on (gene / allele causing) long tails to (male) offspring;
proportion of peacocks with long tails increases in population / allele frequency increase;
peacocks with shorter tails produce fewer offspring; [4 max]
Reject description of survival.
- (c) crossing over in prophase I / metaphase I;
random orientation / independent assortment of homologous chromosomes;
random fertilization; [3]
- (d) feather;
beak;
scales on legs;
wings;
warm-blooded / endothermic;
hard-shelled / calcareous eggs; [3 max]
Accept other appropriate answers.
- (e) analogous structure; [1]

Chapter 6 Human physiology

Multiple-choice questions

- | | | | | |
|------|------|------|------|-------|
| 1. C | 2. A | 3. D | 4. B | 5. C |
| 6. B | 7. A | 8. C | 9. A | 10. A |

Structured question

Question 1

(a) Award [1] for each of the following structures clearly drawn and labelled.

type I pneumocyte;

type II pneumocyte;

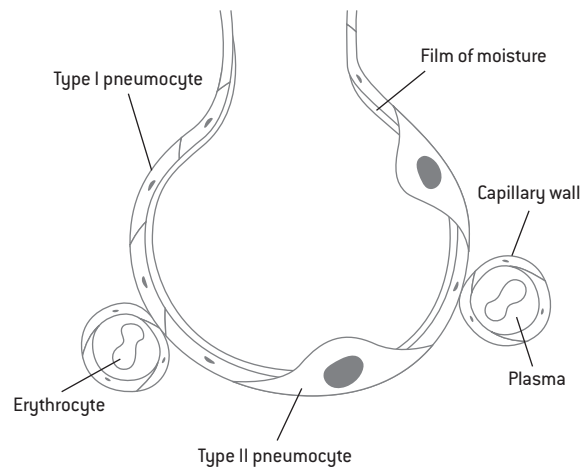
film of moisture / surfactant;

capillary wall / endothelium;

plasma / blood;

red blood cell / erythrocyte;

[4 max]



- (b) sodium ion;
potassium ion;
proteins;
glucose;

[2 max]

Accept other appropriate answers.

- (c) *e.g. minerals*
active transport / diffusion (without digestion);
e.g. proteins
active transport / diffusion after digestion (into amino acids);
e.g. glucose
active transport / co-transport with sodium ion / diffusion;
Award [1 max] for each nutrient named in (b).

[2 max]

- (d) liver;

[1]

Chapter 7

Nucleic acids

Multiple-choice questions

- | | | | | |
|------|------|------|------|-------|
| 1. B | 2. C | 3. C | 4. B | 5. B |
| 6. A | 7. C | 8. B | 9. A | 10. B |

Structured question

Question 1

- (a) primary structure; [1]
- (b) DNA replication *in vitro* / outside cell;
using dideoxyribonucleic acid nucleotides / dideoxyribonucleoside triphosphates / ddNTPs;
deoxyribonucleic acid nucleotides / deoxyribonucleoside triphosphates / dNTPs / (*Taq*) DNA polymerase;
using polymerase chain reaction / PCR technique;
random termination of DNA synthesis;
produce DNA fragments of different lengths / sizes;
separate DNA fragments by gel electrophoresis;
length of fragments used to deduce position of base; [5 max]
- (c) regulators of gene expression / promoter / other named examples;
introns;
telomeres;
genes for tRNA;
tandem repeats / satellite DNA / highly repetitive sequences; [2 max]

- (d) RNA polymerase binds to DNA;
at promoter;
RNA polymerase unwinds double helix;
mRNA synthesized from 5' to 3';
using antisense DNA strand (as template);
transcription stops at terminator;
splicing removes introns from mRNA in eukaryotes;
mRNA binds to (small subunit of) ribosome;
ribosome arrives at start codon / initiation;
ribosome moves along the mRNA / translocation from 5' to 3';
tRNA carries amino acids to ribosome;
anticodons on tRNA pair with codons on mRNA;
complementary base pairing / A pairs with U, G pairs with C;
amino acids attached to tRNA by tRNA-activating enzymes;
peptide bonds form between amino acids;

[8 max]

Chapter 8

Metabolism, cell respiration and photosynthesis

Multiple-choice questions

1. D 2. B 3. A 4. B 5. C
 6. B 7. C 8. B 9. A 10. C

Structured question

Question 1

- (a) loss of hydrogen (ion) / H / H⁺; [1]
Reject reference to oxygen or electrons.

- (b) 2; [1]

(c)

<i>Krebs cycle</i>	<i>Calvin cycle</i>
oxidation of substrate / intermediate	reduction of substrate / intermediate;
formation of ATP / ADP + P _i → ATP	hydrolysis of ATP / ATP → ADP + P _i ;
reduction of NAD / NAD ⁺ / hydrogen / electron carrier	oxidation of reduced NADP / NADPH + H ⁺ / NADPH / NADPH ₂ / hydrogen / electron carrier;
production of carbon dioxide / decarboxylation	fixation of carbon dioxide / carbon fixation / carboxylation;
occur in matrix / mitochondrion	occur in stroma / chloroplast;

[3 max]

Award [1] for each correct row.

A table is not required but the difference between Krebs cycle and Calvin cycle must be made clear.

- (d) (chlorophyll in) photosystem II absorbs light;
 electrons excited from (chlorophyll in) photosystem II;
 excited electrons captured by electron carriers;
 electrons passed through electron transport chain / ETC;
 on thylakoid membrane;
 energy released from reduction-oxidation / redox reactions (of electron carriers);
 to pump protons / hydrogen ions;
 from stroma to intermembrane space of thylakoid / thylakoid space;
 proton gradient created across thylakoid membrane / high concentration of protons / hydrogen ions in thylakoid space / intermembrane space;
 protons / hydrogen ions diffuse from intermembrane space / thylakoid space to stroma;
 through ATP synthase / synthetase;
 formation of ATP from (condensation of) ADP and P_i / $ADP + P_i \longrightarrow ATP$;
 (non-cyclic) photophosphorylation;
 electrons excited from photosystem I enters ETC;
 in cyclic photophosphorylation; **[8 max]**
Reject ATPase.
- (e) oxygen binds to active site of rubisco / ribulose biphosphate carboxylase(/oxygenase);
 less glycerate 3-phosphate / GP formed;
 competitive inhibition; **[2 max]**

Chapter 9

Plant biology

Multiple-choice questions

- | | | | | |
|------|------|------|------|-------|
| 1. C | 2. D | 3. B | 4. D | 5. A |
| 6. C | 7. C | 8. B | 9. B | 10. C |

Structured question

Question 1

(a) (apical) meristem; [1]

(b) form new cells by mitosis;
elongation of root;
indeterminate growth;
deep / long root system allows access to groundwater / increase surface area; [3 max]

(c) starch converted to glucose;
glucose and fructose condense to form sucrose;
sucrose loaded into sieve tubes at source;
by active transport / co-transport with protons / hydrogen ions;
by companion cell;
increase solute concentration at source;
water flows into sieve tubes (at source);
by osmosis;
high hydrostatic pressure at source;
unloading of sucrose at sink;
reduce solute concentration at sink;
water flows out of sieve tubes (at sink);
low hydrostatic pressure at sink;
water flows down hydrostatic pressure gradient (from source to sink);
pressure-flow model / mass flow model; [9 max]
Award [1] for conversion from starch to sucrose.

- (d) auxin / indoleacetic acid / IAA produced by shoot / root tip;
auxin / indoleacetic acid / IAA diffuses along shoot / root;
differential distribution of auxin / indoleacetic acid / IAA;
by auxin efflux pumps;
response to light / gravity / other appropriate named stimuli;
auxin / indoleacetic acid / IAA stimulates shoot growth / inhibit root growth;
in region of elongation;
tropism is growth response to a directional stimulus;

[4 max]

Chapter 10

Genetics and evolution

Multiple-choice questions

- | | | | | |
|------|------|------|------|-------|
| 1. A | 2. D | 3. A | 4. A | 5. D |
| 6. A | 7. B | 8. C | 9. B | 10. D |

Structured questions

Question 1

- (a) Award [4 max] for description of gene linkage.

genes on the same chromosome;

tend to be inherited by the same daughter cell / gamete / nucleus / do not segregate independently;

produce non-Mendelian ratio / not 9 : 3 : 3 : 1 / 1 : 1 : 1 : 1;

recombination caused by crossing over / chiasmata formation;

in prophase I / metaphase I (of meiosis);

Award [4 max] for an example of genetic cross.

definition of alleles;

parental genotypes and phenotypes;

genotypes and phenotypes of offspring;

parental and recombinant offspring labelled;

[8 max]

Reject examples not illustrating gene linkage.

- (b) homologous chromosomes pair up / form bivalents / undergo synapsis;

crossing over / formation of chiasmata;

in prophase I / metaphase I;

exchange / recombination of alleles between non-sister chromatids (of homologous chromosomes);

random orientation of (homologous) chromosome pairs in metaphase I;

random orientation of sister chromatids in metaphase II;

2^n combinations of chromosomes;

non-disjunction changes chromosome number;

[5 max]

Award [1 max] for random orientation if phase / division not specified.

- (c) skin colour controlled by multiple genes / is polygenic;
 alleles of each gene lead to production / no production of melanin / skin pigments;
 alleles are co-dominant;
 individuals inherit different combinations of alleles;
 different frequency of melanin- / pigment-producing alleles;
 a range of phenotypes / from light skin colour to dark skin colour; [4 max]

Question 2

- (a) Award [1 max] for the following structures clearly drawn and labelled.
 homologous chromosomes — drawn as a tetrad;
 sister chromatids — joined at the centromere;
 centromere — same position on both chromosomes;
 chiasma — labelled at the point of crossing; [3 max]

- (b) crossing red-eyed male flies with white-eyed female flies;
 red eye is dominant / white eye is recessive;
 expected ratio (red : white) = 3 : 1 (according to Mendelian genetics);
 all male offspring had white eyes, all female offspring had red eyes;
 exception / discrepancy to Mendelian ratio;
 discovery of sex linkage / genes located on X chromosome; [4 max]
 Accept use of other crosses that illustrate sex linkage of **eye colour in fruit flies** (*Drosophila melanogaster*).
 Reject “wild type” and “mutant” without reference to dominance.
 Accept appropriate description of gene linkage.

- (c) speciation is the formation of new species;
 speciation requires (reproductive) isolation of populations / gene pools;
 isolation prevents gene flow / interbreeding / hybridization;
 geographical isolation and example *e.g.* separation by mountains;
 temporal isolation and example *e.g.* different flowering times;
 behavioural isolation and example *e.g.* different courtship behaviours;
 genetic isolation and example *e.g.* polyploidy;
 different selection pressures on isolated populations / gene pools;
 populations no longer able to interbreed / produce fertile offspring;
 speciation can be allopatric or sympatric; [7 max]
 Accept other appropriate types of isolation mechanisms.
 Ignore classifying isolation mechanisms as *prezygotic* or *postzygotic*.

Chapter 11

Animal physiology

Multiple-choice questions

- | | | | | |
|------|------|------|------|-------|
| 1. D | 2. A | 3. C | 4. D | 5. D |
| 6. B | 7. C | 8. C | 9. D | 10. C |

Structured questions

Question 1

- (a) sperms move to oviduct (through cervix and uterus);
receptors on plasma membrane of sperms bind to proteins on egg / zona pellucida / vitelline membrane;
acrosome releases (hydrolytic) enzymes;
digestion of zona pellucida / vitelline membrane / corona radiata;
plasma membrane of sperm and egg / secondary oocyte fuse;
fusion of male and female gametes / sperm and egg / secondary oocyte / fertilization;
release / exocytosis of cortical granules into zona pellucida;
to prevent polyspermy;
male / sperm nucleus enters egg / secondary oocyte;
secondary oocyte completes meiosis II;
male and female nuclei fuse / a zygote is formed;
zygote divides by mitosis (to form embryo);
cleavage of embryo;
formation of blastocyst / blastulation;
embedment / attachment of blastocyst onto endometrium; **[8 max]**
Reject "uterine lining".
- (b) monoclonal antibodies specific to human chorionic gonadotropin / HCG;
HCG secreted by embryo;
test for HCG in urine;
colour change if HCG is detected; **[2 max]**
- (c) estrogen level increases;
progesterone level decreases;
increased sensitivity of uterus / uterine wall to oxytocin;
oxytocin stimulates muscle contraction (of uterine wall);
muscle contraction forms positive feedback with oxytocin; **[4 max]**

(d) antidiuretic hormone;

effect:

increase permeability of collecting duct to water;

stimulate cells to express more aquaporins (on plasma membrane);

[2 max]

Award [1 max] for effects of ADH.

Question 2

(a) *similarities:*

osmoregulation associated with excretion (of nitrogenous wastes);

reabsorption of water controlled by salt concentration;

involve removal of water from body fluid / blood / hemolymph and reabsorption;

involve behavioural responses / example of behavioural response;

involve active transport of salts;

differences:

<i>Osmoregulation in humans</i>	<i>Osmoregulation in insects</i>
occur in kidneys	occur in Malpighian tubules;
occur in specialized organ	associated with digestive system;
involve hormonal / endocrine control	no hormonal / endocrine control;

[6 max]

Award [1 max] for each correct row of differences.

A table is not required by the difference between osmoregulation in humans and insects must be made clear.

Award [6 max] only if answer contains both similarities and differences.

(b) contraction of flexor bends joint;

contraction of extensor straightens joint;

flexor and extensor are antagonistic;

joint formed by (pieces of) exoskeleton;

muscle action coordinated by nervous system;

muscle contraction stimulated by nerve impulses;

[4 max]

(c) higher chance / success of fertilization;

prevent dehydration of gametes;

higher gamete survival;

fewer gametes are required / wasted / less energy required for producing gametes;

[2 max]

Accept other appropriate answers.

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MARKSCHEME

BIOLOGY

Standard Level

Practice Test

Paper 1

1. D

2. B

3. B

4. C

5. C

6. C

7. A

8. B

9. A

10. C

11. A

12. B

13. C

14. D

15. B

16. B

17. B

18. A

19. C

20. C

21. C

22. A

23. A

24. A

25. B

26. D

27. D

28. A

29. A

30. D

MARKSCHEME

BIOLOGY

Standard Level

Practice Test

Paper 2

Mark Allocation

Candidates are required to answer **all** questions in Section A and **one** out of **two** questions in Section B. Maximum total = **50 marks**.

1. Each row in the “Question” column relates to the smallest subpart of the question.
2. The maximum mark for each question subpart is indicated in the “Total” column.
3. Each marking point in the “Answers” column is shown by means of a tick (✓) at the end of the marking point.
4. A question subpart may have more marking points than the total allows. This will be indicated by “**max**” written after the mark in the “Total” column. The related rubric, if necessary, will be outlined in the “Notes” column.
5. An alternative wording is indicated in the “Answers” column by a slash (/). Either wording can be accepted.
6. An alternative answer is indicated in the “Answers” column by “**OR**” on the line between the alternatives. Either answer can be accepted.
7. An alternative markscheme is indicated in the “Answers” column under heading **ALTERNATIVE 1** etc. Either answer can be accepted.
8. Words inside chevrons « » in the “Answers” column are not necessary to gain the mark.
9. Words that are underlined are essential for the mark.
10. The order of marking points does not have to be as in the “Answers” column, unless stated otherwise in the “Notes” column.
11. If the candidate’s answer has the same “meaning” or can be clearly interpreted as being of equivalent significance, detail and validity as that in the “Answers” column then award the mark. Where this point is considered to be particularly relevant in a question it is emphasized by **OWTTE** (or words to that effect) in the “Notes” column.
12. Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.
13. Occasionally, a part of a question may require an answer that is required for subsequent marking points. If an error is made in the first marking point then it should be penalized. However, if the incorrect answer is used correctly in subsequent marking points then **follow through** marks should be awarded. When marking, indicate this by adding **ECF** (error carried forward) on the script. “ECF acceptable” will be displayed in the “Notes” column.
14. Do **not** penalize candidates for errors in units or significant figures, unless it is specifically referred to in the “Notes” column.

Section B

Extended response questions – quality mark

- Extended response questions for HLP2 each carry a mark total of **[16]**. Of these marks, **[15]** are awarded for content and **[1]** for the quality of the answer.
- **[1]** quality mark is to be awarded when:
 - the candidate's answers are clear enough to be understood without re-reading
 - the candidate has answered the question succinctly with little or no repetition or irrelevant material.
- It is important to judge this on the overall answer, taking into account the answers to all parts of the question. Although, the part with the largest number of marks is likely to provide the most evidence.
- Candidates that score very highly on the content marks need not necessarily automatically gain **[1]** mark for quality (and *vice versa*).

Section A

Question		Answers	Notes	Total
1.	a	presence of <u>three homologous</u> chromosomes «in a nucleus / cell» ✓		1
	b	a. meiosis I ✓ b. <u>total</u> number of Down syndrome cases caused by error in meiosis I is larger than that in meiosis II ✓	<i>Accept appropriate use of data from table. Accept use of maternal data instead of total. Reject comparison between different parental origins.</i>	2
	c	a. more cases of Down syndrome caused by error in maternal meiosis ✓ b. «mean» maternal age higher in cases of Down syndrome than control ✓ c. «mean» paternal age lower in cases of Down syndrome than control ✓		3
	d	a. $\frac{7}{118} \times 100\%$ ✓ b. 5.9% ✓	<i>Award [2] for correct answer.</i>	2
	e	a. $0.1 \times 10 / \frac{0.1}{100} \times 1000 = 1$ ✓ b. 29 ✓	<i>Allow any number between 28 and 30. Award [2] for correct answer.</i>	2
	f	a. recorded prevalence is lower «than curve / trend» ✓ b. inaccurate data due to low birth rate / natality / fertility in older mothers ✓ c. diseased fetuses / embryos have higher chance of miscarriage / death during pregnancy ✓	<i>Accept other appropriate answers.</i>	2 max

Question		Answers	Notes	Total
2.	a	$\frac{4.5 \text{ cm}}{80 \mu\text{m}} = 562.5 \checkmark$	<i>Accept any number between 550 and 575.</i>	1
	b	a. eukaryotic \checkmark b. presence of membrane-bound organelles / <u>named</u> membrane-bound organelle / internal membrane system \checkmark		2
	c	a. mitochondrion is site of <u>aerobic</u> respiration \checkmark b. provide ATP \checkmark c. for muscle contraction / growth / repair \checkmark	<i>Reject "energy".</i>	2 max

Question		Answers	Notes	Total
3.	a	chlorophyll ✓		1
	b	plants utilize more red light and blue light for <u>photosynthesis</u> / cannot utilize green light for <u>photosynthesis</u> effectively ✓	<i>Allow use of correct wavelengths of visible light.</i>	1
	c	<p>a. split into oxygen and hydrogen «ions» «and electrons» ✓</p> <p>b. oxygen is a by-product ✓</p> <p>c. electrons used to produce ATP «in electron transport chain / ETC» ✓</p> <p>d. hydrogen «ions» «and electrons» used to produce / reduce organic compounds ✓</p> <p>e. in light-independent reactions / Calvin cycle ✓</p>		2 max

Question		Answers	Notes	Total
4.	a	<p><i>a.</i> a group of living organisms that can interbreed ✓</p> <p><i>b.</i> to produce <u>fertile</u> offspring ✓</p>		2
	b	<p><i>a.</i> scientific / binomial name made up of <u>two</u> names / parts ✓</p> <p><i>b.</i> genus name <u>and</u> species name ✓</p> <p><i>c.</i> genus name followed by species name ✓</p> <p><i>d.</i> only first letter of genus name capitalized ✓</p> <p><i>e.</i> written in italics <u>or</u> underlined ✓</p> <p><i>f.</i> unique combination to designate species ✓</p> <p><i>g.</i> show evolutionary / phylogenetic relationship ✓</p>		3 max

Question	Answers	Notes	Total
5. a	<p><i>a.</i> deoxyribose, phosphate «group» <u>and</u> nitrogenous base ✓</p> <p><i>b.</i> phosphate «group» forms covalent / phosphodiester bond with deoxyribose ✓</p> <p><i>c.</i> base form covalent bond with deoxyribose ✓</p> <p><i>d.</i> <u>adenine</u>, <u>thymine</u>, <u>guanine</u> and <u>cytosine</u> ✓</p> <p><i>e.</i> double stranded / double helix ✓</p> <p><i>f.</i> antiparallel strands ✓</p> <p><i>g.</i> complementary base pairing / A pairs with T <u>and</u> G pairs with C ✓</p>	<p><i>Accept use of an <u>annotated</u> diagram of a nucleotide / DNA molecule.</i></p>	4 max
b	<p><i>similarities:</i></p> <p><i>a.</i> both composed of nucleotides / pentose, phosphate groups and nitrogenous bases ✓</p> <p><i>b.</i> both are polynucleotides ✓</p> <p><i>c.</i> both contain adenine, cytosine and guanine ✓</p> <p><i>differences:</i></p> <p><i>d.</i> deoxyribose in DNA, ribose in RNA ✓</p> <p><i>e.</i> DNA is double-stranded, RNA is single stranded ✓</p> <p><i>f.</i> thymine in DNA, uracil in RNA ✓</p> <p><i>g.</i> DNA is helical and RNA is not ✓</p>	<p><i>Award [2 max] for similarities.</i></p> <p><i>Award [2 max] for differences.</i></p> <p><i>Names, not letters, are required for nitrogenous bases.</i></p>	4 max

Section B

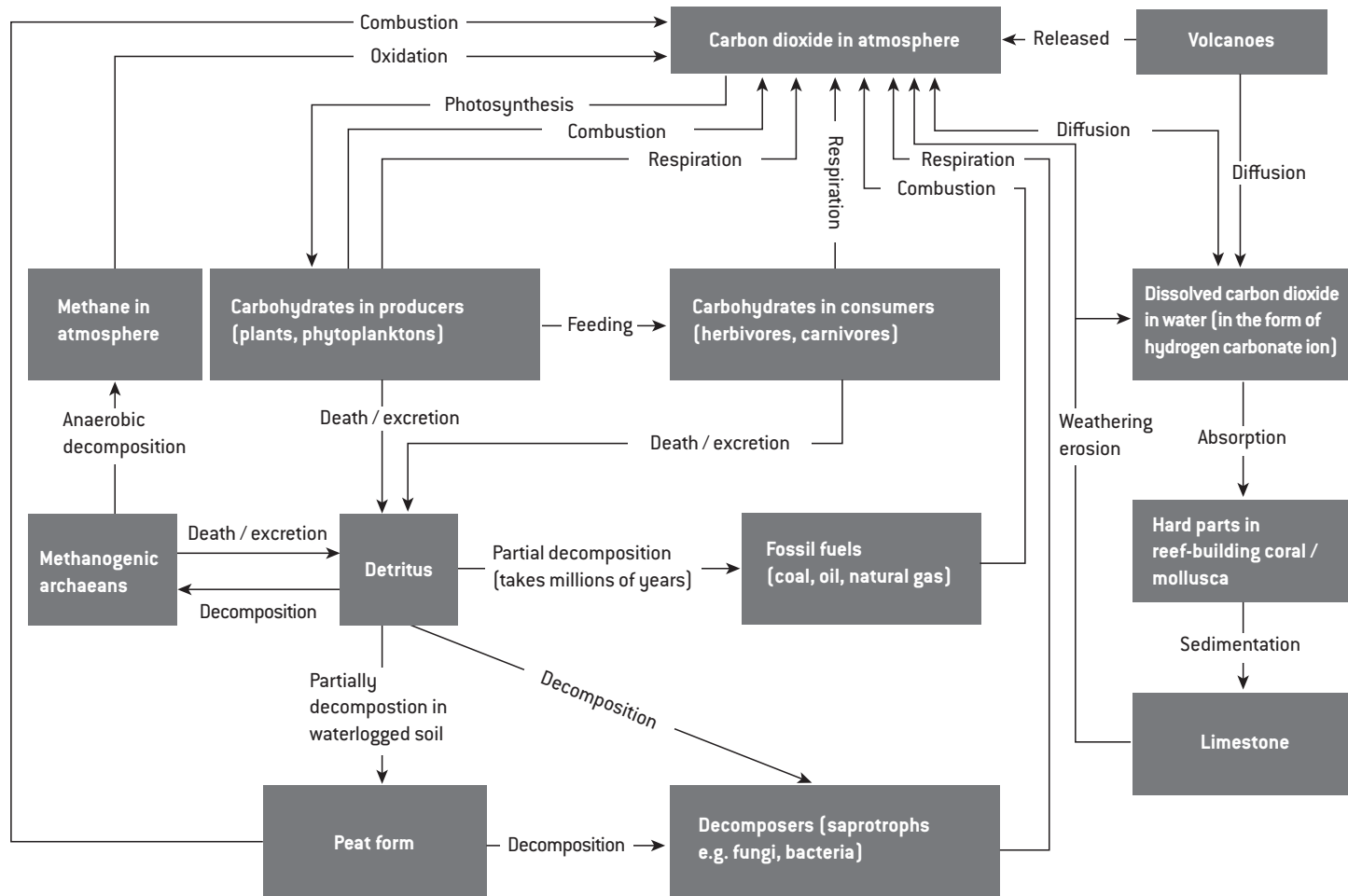
Clarity of Communication: [1]

The Candidate's answers are clear enough to be understood without re-reading. The candidate has answered the question succinctly with little or no repetition or irrelevant material.

Question		Answer	Notes	Total
6.	a	<p>a. <u>carbon dioxide</u> / CO₂ in atmosphere / air ✓</p> <p>b. carbon in atmosphere linked to producers / autotrophs / plants with arrow labelled photosynthesis ✓</p> <p>c. consumers / animals linked to producers / autotrophs / plants with arrow labelled feeding / consumption ✓</p> <p>d. producers / autotrophs / plants <u>and</u> consumers / animals linked to carbon in air with arrow labelled «cell» respiration ✓</p> <p>e. producers / autotrophs / plants <u>and</u> consumers / animals linked to decomposers / bacteria / fungi / methanogen«ic archaeans» with arrow labelled «and excretion» ✓</p> <p>f. decomposers / bacteria / fungi linked to carbon in atmosphere with arrow labelled «cell» respiration / «aerobic» decomposition ✓</p> <p>g. producers / autotrophs / plants linked to carbon in atmosphere with arrow labelled combustion / forest fire ✓</p> <p>h. decomposers / bacteria / fungi / methanogen«ic archaeans» linked to fossil fuels / coal / oil / natural gas with arrow labelled fossilization / «partial» decomposition ✓</p> <p>i. fossil fuels / coal / oil / natural gas / peat linked to carbon in atmosphere with arrow labelled combustion ✓</p> <p>j. carbon in atmosphere linked with <u>dissolved</u> carbon dioxide / hydrogen carbonate ions in ocean / water / aquatic habitats with arrows labelled diffusion ✓</p>	<p><i>Award mark only if arrow points in correct direction.</i></p>	4 max

Question	Answer	Notes	Total
a	<p><i>k.</i> producers / autotrophs / plants / consumers / animals / reef-building corals / mollusca linked with carbon in water with arrows labelled diffusion ✓</p> <p><i>l.</i> decomposers / bacteria / methanogen«ic archaeans» linked to <u>methane</u> / CH_4 in atmosphere with arrow labelled <u>anaerobic</u> decomposition ✓</p> <p><i>m.</i> decomposers / bacteria / methanogen«ic archaeans» linked to peat with arrow labelled «partial» decomposition ✓</p> <p><i>n.</i> consumers / animals / reef-building corals / mollusca linked to limestone with arrow labelled fossilization / deposition / sedimentation ✓</p> <p><i>o.</i> limestone linked to carbon in water / atmosphere with arrow labelled weathering / erosion / corrosion ✓</p> <p><i>p.</i> oxidation of methane in atmosphere ✓</p> <p><i>q.</i> carbon dioxide emitted by volcanoes ✓</p>		5 max

Sample drawing of the Carbon cycle:



Question	Answer	Notes	Total
b	<p><i>a.</i> Earth absorbs short-wave radiation / visible light / ultraviolet «from the Sun» ✓</p> <p><i>b.</i> Earth re-radiates long-wave radiation / infrared ✓</p> <p><i>c.</i> greenhouse gases in atmosphere absorb long wave radiation / infrared ✓</p> <p><i>d.</i> examples of greenhouse gases ✓</p> <p><i>e.</i> atmospheric concentration of greenhouse gases has increased ✓</p> <p><i>f.</i> due to combustion of fossil fuels / cattle ranching / other appropriate sources ✓</p> <p><i>g.</i> «global average» atmospheric temperature increases ✓</p> <p><i>h.</i> disruption of climate / weather pattern ✓</p> <p><i>i.</i> disruption of thermohaline circulation / ocean conveyor belt ✓</p>		4 max

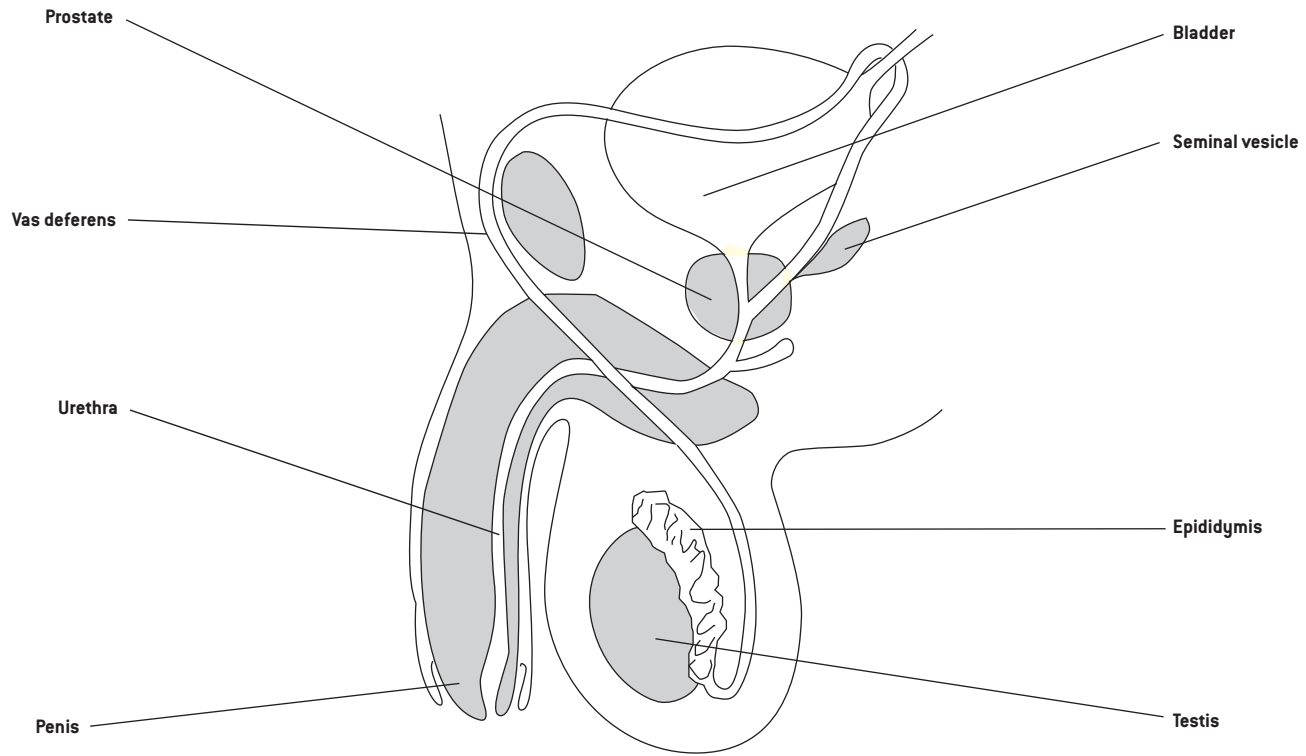
Question	Answer	Notes	Total
c	<p><i>a.</i> over-reproduction of offspring results in struggle for survival ✓</p> <p><i>b.</i> selection pressure causes differential survival / reproduction ✓</p> <p><i>c.</i> individuals with more favourable characteristics are more likely to survive ✓</p> <p><i>d.</i> they are more likely to reproduce / produce more offspring ✓</p> <p><i>e.</i> frequency / proportion of individuals with these characteristics increases ✓</p> <p><i>f.</i> pass on their characteristics / genes / alleles ✓</p> <p><i>g.</i> frequency / proportion of individuals with these characteristics decreases ✓</p> <p><i>h.</i> survival of the fittest ✓</p> <p><i>i.</i> variation results from mutation / meiosis ✓</p> <p><i>j.</i> only heritable characteristics are passed on ✓</p> <p><i>k.</i> e.g. evolution of peppered moths / antibiotic resistance ✓</p>	<p><i>Reject "number".</i></p> <p><i>Reject "number".</i></p> <p><i>Accept correct reference to crossing over / independent assortment / fertilization.</i></p> <p><i>Accept any appropriate named example.</i></p>	6 max

(Plus up to [1] for quality)

Question	Answer	Notes	Total
7. a	<p><i>example:</i></p> <p>a. Bt corn / cotton / transfer of Bt gene to corn / cotton ✓</p> <p><i>benefits:</i></p> <p>b. increase crop production / reduce loss of crops to pests ✓</p> <p>c. less pesticides / chemicals used / less chemical pollution ✓</p> <p><i>harmful effects:</i></p> <p>d. non-target insects / species may be killed ✓</p> <p>e. risk of introducing gene to / genetic pollution of wild species ✓</p>	<p><i>Accept other appropriate answers.</i></p> <p><i>Award [1 max] for one named example.</i></p> <p><i>Award [2 max] for specific benefits.</i></p> <p><i>Award [2 max] for specific harmful effects.</i></p>	4 max

Question	Answer	Notes	Total
	<p>b</p> <p><i>a.</i> testis ✓</p> <p><i>b.</i> urethra ✓</p> <p><i>c.</i> penis ✓</p> <p><i>d.</i> epididymis ✓</p> <p><i>e.</i> vas deferens / sperm duct ✓</p> <p><i>f.</i> seminal vesicle ✓</p> <p><i>g.</i> prostate «gland» ✓</p> <p><i>h.</i> bladder ✓</p> <p><i>i.</i> scrotum ✓</p> <p><i>j.</i> erectile / penis tissue ✓</p>	<p><i>Award [1] for each structure clearly drawn and labelled that conforms to the guidelines given in Notes.</i></p> <p><i>connected to epididymis «inside scrotum»</i></p> <p><i>shown as double line joining the bladder to the tip of penis</i></p> <p><i>with urethra through it</i></p> <p><i>shown joined to testis and vas deferens</i></p> <p><i>shown joined to epididymis</i></p> <p><i>sac shown branched off from vas deferens / behind prostate</i></p> <p><i>shown at the junction of vas deferens and urethra</i></p> <p><i>shown above the prostate</i></p> <p><i>shown around testes</i></p> <p><i>shown inside penis around urethra</i></p>	<p>4 max</p>

Sample drawing of the male reproductive system:



Question	Answer	Notes	Total
c	<p>a. follicle-stimulating hormone / FSH stimulates development of follicles ✓</p> <p>b. FSH stimulates secretion of estrogen «from developing follicle» ✓</p> <p>c. estrogen stimulates repair / thickening of endometrium ✓</p> <p>d. estrogen stimulates LH secretion ✓</p> <p>e. estrogen inhibits FSH secretion at low levels «by <u>negative</u> feedback» ✓</p> <p>f. estrogen stimulates FSH secretion at high levels «by <u>positive</u> feedback» ✓</p> <p>g. luteinizing hormone / LH stimulates ovulation ✓</p> <p>h. LH stimulates development of corpus luteum ✓</p> <p>i. LH stimulates secretion of progesterone «from corpus luteum» ✓</p> <p>j. progesterone stimulates thickening / maintains thickness of endometrium / prepares endometrium for implantation ✓</p> <p>k. progesterone inhibits secretion of LH / FSH «from pituitary gland» «by <u>negative</u> feedback» ✓</p> <p>l. fall in progesterone level results in breakdown of endometrium / menstruation ✓</p> <p>m. correct reference to negative / positive feedback ✓</p>	<p><i>Reject “estrogen / progesterone thickens / repairs endometrium”.</i></p> <p><i>Reject “uterine / uterus lining”.</i></p> <p><i>Reject “estrogen / progesterone thickens / repairs endometrium”.</i></p> <p><i>Reject “uterine / uterus lining”.</i></p>	7 max

(Plus up to [1] for quality)

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MARKSCHEME

BIOLOGY

Higher Level

Practice Test

Paper 1

1. A

11. A

21. D

31. C

2. C

12. A

22. B

32. D

3. A

13. C

23. C

33. B

4. B

14. B

24. A

34. D

5. B

15. C

25. B

35. B

6. D

16. B

26. A

36. D

7. B

17. D

27. D

37. D

8. C

18. D

28. D

38. A

9. A

19. C

29. B

39. B

10. B

20. A

30. A

40. B

MARKSCHEME

BIOLOGY

Higher Level

Practice Test

Paper 2

Mark Allocation

Candidates are required to answer **all** questions in Section A and **two** out of **three** questions in Section B. Maximum total = **72 marks**.

1. Each row in the “Question” column relates to the smallest subpart of the question.
2. The maximum mark for each question subpart is indicated in the “Total” column.
3. Each marking point in the “Answers” column is shown by means of a tick (✓) at the end of the marking point.
4. A question subpart may have more marking points than the total allows. This will be indicated by “**max**” written after the mark in the “Total” column. The related rubric, if necessary, will be outlined in the “Notes” column.
5. An alternative wording is indicated in the “Answers” column by a slash (/). Either wording can be accepted.
6. An alternative answer is indicated in the “Answers” column by “**OR**” on the line between the alternatives. Either answer can be accepted.
7. Words inside chevrons « » in the “Answers” column are not necessary to gain the mark.
8. Words that are underlined are essential for the mark.
9. The order of marking points does not have to be as in the “Answers” column, unless stated otherwise in the “Notes” column.
10. If the candidate’s answer has the same “meaning” or can be clearly interpreted as being of equivalent significance, detail and validity as that in the “Answers” column then award the mark. Where this point is considered to be particularly relevant in a question it is emphasized by **OWTTE** (or words to that effect) in the “Notes” column.
11. Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.
12. Occasionally, a part of a question may require an answer that is required for subsequent marking points. If an error is made in the first marking point then it should be penalized. However, if the incorrect answer is used correctly in subsequent marking points then **follow through** marks should be awarded. When marking, indicate this by adding **ECF** (error carried forward) on the script. “ECF acceptable” will be displayed in the “Notes” column.
13. Do **not** penalize candidates for errors in units or significant figures, unless it is specifically referred to in the “Notes” column.

Section B

Extended response questions – quality mark

- Extended response questions for HLP2 each carry a mark total of **[16]**. Of these marks, **[15]** are awarded for content and **[1]** for the quality of the answer.
- **[1]** quality mark is to be awarded when:
 - the candidate's answers are clear enough to be understood without re-reading
 - the candidate has answered the question succinctly with little or no repetition or irrelevant material.
- It is important to judge this on the overall answer, taking into account the answers to all parts of the question. Although, the part with the largest number of marks is likely to provide the most evidence.
- Candidates that score very highly on the content marks need not necessarily automatically gain **[1]** mark for quality (and *vice versa*).

Section A

Question		Answers	Notes	Total
1.	a	40 «bp» ✓	<i>Allow any number between 35 and 45.</i>	1
	b	<p>a. shorter «average» distance «between start codon and NFR» in <i>S. kluyveri</i> ✓</p> <p>b. less variation in distance in <i>S. kluyveri</i> ✓</p> <p>c. some genes have NFR more than 400 bp from / upstream of start codon in both ✓</p> <p>d. percentage of genes with NFR between 80 bp and 400 bp from / upstream of start codon decreases with distance ✓</p>		3 max
	c	promoter ✓	<i>Reject regulatory sequences in prokaryotes.</i>	1
	d	histone«s» ✓	<i>Allow correctly named histone units.</i>	1
	e	<p>a. reduce nucleosome signals ✓</p> <p>b. reduce binding / coiling / association with histones in 5' upstream region / promoter of gene ✓</p>		2
	f	<p>a. reduce «rate of» transcription ✓</p> <p>b. prevents binding of <u>RNA</u> polymerase «to promoter» ✓</p>		2
	g	<p>a. transcription rate decreases in the absence of galactose / presence of glucose ✓</p> <p>b. conserve amino acids / ATP / energy ✓</p> <p>c. ribosomes / transcription / translation machinery can be reserved for production of other proteins ✓</p> <p>d. glucose is the preferred respiratory substrate ✓</p> <p>e. transcription rate increase in presence of galactose only / absence of glucose ✓</p> <p>f. allow «yeast» cell to utilize galactose <u>for respiration</u> ✓</p>		4 max

Question		Answers	Notes	Total
2.	a	1 : 1 / 1.01 : 1 / 1 : 0.99 ✓		1
	b	a. genotype of parents ✓ b. genotypes of offspring ✓ c. phenotypes and phenotypic ratio of offspring ✓		3
	c	a. e.g. war ✓ b. increase death rate / mortality of <u>males</u> ✓ OR c. e.g. social / national / anti-natal / one-child policy ✓ d. promote sexual selection «for males / against females» ✓	<i>Award [1] for a factor and [1] for an explanation.</i>	2

Question		Answers	Notes	Total
3.	a	a. undifferentiated / unspecialized cells that possess the ability to divide <u>and</u> differentiate / specialize along different pathways / into different types of «specialized» cells ✓		1
	b	a. embryonic stem cells from embryo and adult stem cells from adult / correctly named adult tissue ✓ b. embryonic stem cells are totipotent/pluripotent but adult stem cells are multipotent/ oligopotent / unipotent ✓ OR embryonic stem cells are more potent/has higher potency/adult stem cells are less potent/has lower potency ✓	OWTTE	2
	c	a. cancer / tumour cells divide rapidly / have short cell cycle ✓ b. replication of mitochondria in interphase / G ₁ phase ✓ c. high metabolic rate «for synthesis / replication» ✓ d. production of ATP for cell division / growth ✓		2 max
	d	production of ATP for muscle contraction / breaking of cross-bridges «between actin and myosin» / high metabolic rate ✓		1

Question	Answers	Notes	Total
e	<p>a. endosymbiotic / endosymbiosis theory / symbiogenesis ✓</p> <p>b. double membrane (of mitochondrion) ✓</p> <p>OR</p> <p>70S ribosome ✓</p> <p>OR</p> <p>circular DNA ✓</p> <p>OR</p> <p>naked DNA / DNA not associated with proteins / histones ✓</p> <p>OR</p> <p>replicate by <u>binary fission</u> / <u>budding</u> ✓</p> <p>OR</p> <p>cell without mitochondria cannot synthesize new ones ✓</p>	<p><i>Accept other appropriate answers.</i></p>	<p>2</p>

Question		Answers	Notes	Total
4.	a	placentals are more closely related to marsupials than monotremes ✓ <i>OR</i> placentals diverged from marsupials after divergence of monotremes from other mammals ✓	<i>OWTTE</i> <i>OWTTE</i>	1
	b	mammary glands / hair/fur / sweat glands / external ear / pinna ✓	<i>Accept other appropriate answers. Reject placenta / endothermy / liver young.</i>	1
	c	a. comparison of base / DNA / amino acid sequence ✓ b. difference «in base / DNA / amino acid sequence » caused by mutation ✓ c. species / clades / groups with more different bases / amino acids diverge earlier ✓ d. mutation rate used to estimate time of divergence / ref. to molecular clock ✓ e. molecular evidence is more precise / accurate than morphology / anatomy ✓ f. comparison of base / DNA sequence is more precise than comparison of amino acid sequence ✓ g. reclassification of groups / clades / species ✓	<i>OWTTE</i>	3 max

Question	Answers	Notes	Total
d	<p>a. exchange of materials between maternal and fetal blood ✓</p> <p>b. diffusion of nutrients / <u>named</u> nutrient / oxygen from maternal blood to fetal blood ✓</p> <p>c. diffusion of wastes / <u>named</u> waste from fetal blood to maternal blood ✓</p> <p>d. attach fetus to uterus / uterine wall ✓</p> <p>e. secrete estrogen and progesterone ✓</p> <p>f. separate maternal and fetal blood ✓</p> <p>g. prevent immune response of mother against fetus ✓</p> <p>h. prevent damage of fetal blood vessels by high maternal blood pressure ✓</p>	<i>Accept other appropriate answers.</i>	3 max
e	<p>a. afferent arteriole wider than efferent arteriole ✓</p> <p>b. accumulation of blood / high blood / hydrostatic pressure in <u>glomerulus</u> ✓</p> <p>c. plasma flows from capillaries / glomerulus into <u>Bowman's</u> / <u>renal capsule</u> ✓</p> <p>d. only small molecules pass through / large molecules and blood cells blocked by basement membrane ✓</p> <p>e. passive process ✓</p>		3 max

Section B

Clarity of Communication: [1]

The Candidate's answers are clear enough to be understood without re-reading. The candidate has answered the question succinctly with little or no repetition or irrelevant material.

Question	Answers	Notes	Total
5.	<p>a</p> <p><i>temperature:</i></p> <p>a. activity increases with temperature as molecules collide more frequently ✓</p> <p>b. enzyme is denatured when temperature is higher than optimum ✓</p> <p><i>pH:</i></p> <p>c. activity decreases at pH other than optimum as enzyme is denatured ✓</p> <p><i>substrate concentration:</i></p> <p>d. activity increases with substrate concentration as molecules collide more frequently ✓</p> <p>e. activity levels off / reaches a plateau as all active sites are occupied / bound to substrate ✓</p> <p><i>inhibitor:</i></p> <p>f. competitive inhibitor reduces activity by occupying / binding to active site ✓</p> <p>g. non-competitive inhibitor reduces activity by altering conformation of active site ✓</p>	<p><i>Award [1 max] for the effect of each factor.</i></p> <p><i>Reject "higher chance of collision".</i></p> <p><i>Reject "higher chance of collision".</i></p>	4 max

Question	Answers	Notes	Total
b	<p><i>a.</i> formation of cell / body structures <i>e.g.</i> collagen ✓</p> <p><i>b.</i> catalysis of / speeding up metabolic reactions <i>e.g.</i> rubisco ✓</p> <p><i>c.</i> transport across «plasma» membrane <i>e.g.</i> sodium-potassium pump ✓</p> <p><i>d.</i> transport of substances «in blood» <i>e.g.</i> hemoglobin ✓</p> <p><i>e.</i> coordination of body functions <i>e.g.</i> insulin ✓</p> <p><i>f.</i> defence against pathogens / antigens <i>e.g.</i> immunoglobulin ✓</p> <p><i>g.</i> formation of external structures <i>e.g.</i> spider silk ✓</p> <p><i>h.</i> detection of stimuli <i>e.g.</i> rhodopsin ✓</p> <p><i>i.</i> movement <i>e.g.</i> actin ✓</p>	<p><i>Award [1] for each function and a named example of protein.</i></p> <p><i>Accept other appropriate answers.</i></p> <p><i>Allow correctly named type of enzyme.</i></p> <p><i>Allow correctly named type of immunoglobulins.</i></p>	4 max

Question	Answers	Notes	Total
c	<p><i>a.</i> <u>primary structure</u> is amino acid sequence «of a polypeptide» ✓</p> <p><i>b.</i> determine «interactions maintaining» higher levels of structures ✓</p> <p><i>c.</i> <u>secondary structure</u> is local folding / folding of a segment «of a polypeptide» ✓</p> <p><i>d.</i> maintained by hydrogen bonds between <u>carboxyl and amino</u> groups «of peptide bonds» ✓</p> <p><i>e.</i> <i>e.g.</i> α-helix, β-pleated sheet ✓</p> <p><i>f.</i> <u>tertiary structure</u> is three-dimensional conformation «of polypeptide» ✓</p> <p><i>g.</i> maintained by disulfide bridges / ionic bonds / hydrogen bonds / hydrophobic interactions between <u>side groups</u> / <u>variable radicals</u> «of amino acid residues» ✓</p> <p><i>h.</i> ionic / hydrogen bonds formed by polar amino acids ✓</p> <p><i>i.</i> disulfide bridges / hydrophobic interactions formed by non-polar amino acids ✓</p> <p><i>j.</i> <u>quaternary structure</u> contains two or more polypeptide chains ✓</p> <p><i>k.</i> <i>e.g.</i> in hemoglobin, collagen ✓</p>		7 max

(Plus up to [1] for quality)

Question		Answers	Notes	Total
6.	a	<p><i>procedure:</i></p> <p>a. introduction of plant tissues / cells onto agar / culture medium ✓</p> <p>b. agar contains nutrients <i>e.g.</i> glucose, amino acids ✓</p> <p>c. use of plant hormones <i>e.g.</i> auxins, cytokinins ✓</p> <p>d. use of aseptic technique ✓</p> <p>e. formation of callus «by mitosis / cell division» ✓</p> <p>f. differentiation to form explant ✓</p> <p>g. transfer explants to other growth media <i>e.g.</i> soil, water ✓</p> <p><i>application:</i></p> <p>h. rapid production of plant varieties ✓</p> <p>i. production of virus-free plants ✓</p> <p>j. propagation / conservation of rare / endangered species ✓</p>	<p><i>Award [2 max] for procedure and [2 max] for applications.</i></p> <p><i>Accept other appropriate applications.</i></p>	4 max

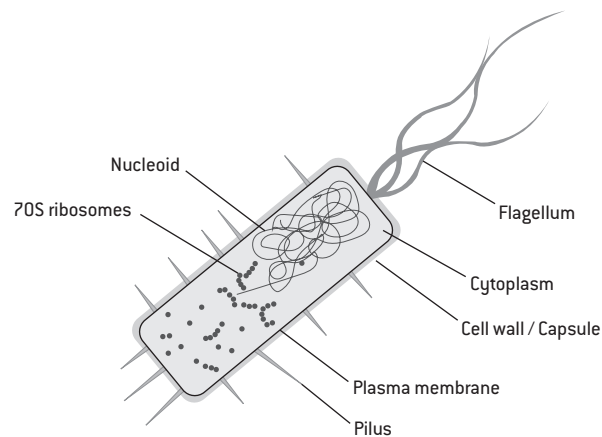
Question	Answers	Notes	Total
b	<p><i>a.</i> shallow and widespread roots to absorb rainwater / deep roots to absorb groundwater ✓</p> <p><i>b.</i> succulent tissues to store water ✓</p> <p><i>c.</i> reduced leaves / spines to reduce surface area ✓</p> <p><i>d.</i> low growth form / small size to reduce surface area / surface area to volume ratio / exposure to wind ✓</p> <p><i>e.</i> thick waxy cuticle to reduce evaporation «from epidermis» ✓</p> <p><i>f.</i> sunken stomata to trap water vapour / reduce concentration gradient ✓</p> <p><i>g.</i> hairs on leaves to trap water vapour / reduce concentration gradient ✓</p> <p><i>h.</i> rolled leaves to trap water vapour / reduce concentration gradient ✓</p>	<p><i>Accept other appropriate answers.</i> <i>Reject physiological adaptations</i> <i>e.g. CAM, C₄ metabolism.</i></p>	4 max

Question	Answers	Notes	Total
c	<p>a. flowering affected by duration of light / photoperiod ✓</p> <p>b. phytochrome ✓</p> <p>c. P_r <u>and</u> P_{fr} ✓</p> <p>d. P_r absorbs red light ✓</p> <p>e. P_{fr} absorbs far-red light / infrared ✓</p> <p>f. P_r converted to P_{fr} in white light / daylight / sunlight ✓</p> <p>g. P_{fr} converted to P_r <u>slowly</u> / <u>gradually</u> in dark ✓</p> <p>h. P_{fr} stimulates flowering in long-day plants ✓</p> <p>i. P_{fr} inhibits flowering in short-day plants ✓</p> <p>j. long-day plants flower when dark period shorter than the <u>critical period</u> ✓</p> <p>k. enough P_{fr} remains at the end of night ✓</p> <p>l. short-day plants flower when dark period longer than the <u>critical period</u> ✓</p> <p>m. little P_{fr} remains at the end of night ✓</p>		7 max

(Plus up to [1] for quality)

Question	Answers	Notes	Total
7. a	<p>a. plasma membrane ✓</p> <p>b. cytoplasm ✓</p> <p>c. cell wall / capsule ✓</p> <p>d. nucleoid «region» / naked DNA ✓</p> <p>e. plasmid ✓</p> <p>f. flagellum ✓</p> <p>g. pilus ✓</p> <p>h. 70S ribosome ✓</p>	<p><i>Award [1] for each structure clearly drawn and labelled that conforms to the guidelines given in Notes.</i></p> <p><i>shown as single line around cytoplasm</i></p> <p><i>region enclosed by plasma membrane but not in other organelles</i></p> <p><i>shown as double line outside plasma membrane</i></p> <p><i>shown as closed loop / circle at centre</i></p> <p><i>shown as closed loop / circle in cytoplasm smaller than the nucleoid DNA</i></p> <p><i>shown as long double line with closed end</i></p> <p><i>shown as short double line with closed end shorter and more numerous than flagella drawn</i></p> <p><i>shown as small solid dots in cytoplasm</i></p>	4 max

Sample drawing of prokaryotic cell:



Question	Answers	Notes	Total
	<p>b</p> <p><i>a.</i> surface area is proportional to rate of exchange / heat loss ✓</p> <p><i>b.</i> volume is proportional to rate of consumption of nutrients / oxygen / production of wastes / heat ✓</p> <p><i>c.</i> exchange is less efficient than consumption / production ✓</p> <p><i>d.</i> cell size is limited ✓</p> <p><i>e.</i> large cells need to divide ✓</p> <p><i>f.</i> cells in exchange surfaces need to have specialized shape ✓</p>		<p>5 max</p>

Question	Answers	Notes	Total
c	<p><i>a.</i> two daughter nuclei in mitosis, four daughter nuclei in meiosis ✓</p> <p><i>b.</i> same number of chromosomes as parent cell in mitosis, half the number of chromosomes as parent cell in meiosis ✓</p> <p><i>c.</i> genetically identical daughter nuclei in mitosis, genetically different daughter nuclei in meiosis ✓</p> <p><i>d.</i> no pairing of homologous chromosomes in mitosis, pairing of homologous chromosomes / formation of bivalents / synapsis in meiosis ✓</p> <p><i>e.</i> one «nuclear» division in mitosis, two «nuclear» divisions in meiosis ✓</p> <p><i>f.</i> no separation of homologous chromosomes in mitosis, separation of homologous chromosomes «in anaphase I» in meiosis «I» ✓</p> <p><i>g.</i> no crossing over «in prophase» in mitosis, crossing over «in prophase I / metaphase I» in meiosis «I» ✓</p> <p><i>h.</i> chromosomes line up at equator «in metaphase» in mitosis, homologous chromosomes line up at equator «in metaphase I» in meiosis «I» ✓</p> <p><i>i.</i> mitosis for growth / repair / asexual reproduction, meiosis for sexual reproduction / gamete formation ✓</p> <p><i>j.</i> mitosis occurs in unicellular / small multicellular organisms / meristems / stem cells, meiosis occurs in reproductive organs / gonads ✓</p>	<p><i>Reject daughter cells</i></p> <p><i>Reject diploid nuclei in mitosis</i></p> <p><i>Reject meiosis occurs in sex cells / gametes</i></p>	6 max

(Plus up to [1] for quality)