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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2010 question paper for the guidance of teachers

9700 BIOLOGY

9700/41 Paper 4 (A2 Structured Questions), maximum raw mark 100

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International Examinations

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;	separates marking points
/	alternative answers for the same point
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A	accept (for answers correctly cued by the question or guidance on the mark scheme)
AW	alternative wording (where responses may vary more than usual)
underline	actual word given must be used by the candidate (grammatical variants excepted)
max	indicates the maximum number of marks that can be given
ora	or reverse argument

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1 (a) 1 mallard numbers have increased **and** the others have decreased **;**

decrease due to

2 pesticides / pollution / fertilisers **;**

3 change in temperature or pH of water **;**

4 lack of named food source **;**

5 increased competition / AW **;**

6 direct human interference on **lake ;** e.g. fishing / sailing etc
not related to marking point 2

mallard increase due to

7 doesn't eat, insects / molluscs / fish **;**

8 less other birds so less competition **;** [4 max]

(b) 1 cultural / aesthetic / leisure, reasons **;**

2 moral / ethical, reasons **;** e.g. right to exist / prevent extinction

3 resource material **;** e.g. wood for building / fibres for clothes / food for humans

4 ecotourism **;**

5 economic benefits **;**

6 ref. resource / species, may have use in future / AW **;** e.g. medical use

7 maintains, food webs **/** food chains **;** **A** description

8 nutrient cycling / protection against erosion **;**

9 climate stability **;**

10 maintains, large gene pool **/** genetic variation **;**

[4 max]

[Total: 8]

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2 (a) (i) 1 penicillin inhibits, enzyme / peptidase **;**

2 blocks / alters shape of, active site **;**

3 peptidoglycan chains cannot link up / stops cross-links forming **;**

4 cell wall weaker / AW **;**

5 turgor of cell not resisted (by cell wall) / AW **;**

6 cell / wall / bacterium, bursts **;** [3 max]

(ii) *any two from*

1 viruses do not have cell wall **;**

2 viruses do not have cytoplasm **;**

3 viruses do not have peptidoglycan **;**

4 viruses do not have peptidase **;** [2 max]

(b) *without antibiotic*

1 numbers of both wild-type and mutant strains, increase / hardly changes **;**

with antibiotic

2 numbers of both wild-type and mutant strains decrease **;**

3 mutant strains decrease more than wild-type **;** **A** faster
this subsumes marking point 2

4 after 24h, wild-type plateaus and mutant strain continues to decrease **;**

5 ref. comparative figures at any one time **;** *ignore units for bacteria*
blue with blue
red with red
red with blue – with antibiotic [4 max]

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(c) **(i)** 1 changes in, base / nucleotide, sequence **;** **A** named change e.g. substitution

2 alters, triplet code / codon **;**

3 enzyme has different, primary structure / amino acid sequence **;**

4 enzyme has different, 3D structure / tertiary structure / active site **;** [2 max]

(ii) *red and blue with antibiotic*

1 wild-type bacteria can produce glucans **or** mutant bacteria produce less glucans **;**

2 glucans bind with antibiotic **;**

3 wild-type more resistant to antibiotic **or** mutant bacteria less resistant to antibiotic **;** [2 max]

(d) 1 antibiotic, is selective agent / provides selective pressure **;**

2 resistant bacteria, survive / reproduce **;**

3 pass allele for resistance to offspring **;**

4 frequency of allele in population increases **;** [3 max]

[Total: 16]

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3 **(a)** 1 to give superovulation ;

2 follicles or oocytes, mature or develop, at the same time ; *ignore grow*

3 to prepare uterus for implantation ; [2 max]

(b) 1 germinal epithelial cell divides by mitosis ;

2 giving oogonia ;

3 primary oocyte divides by meiosis I (to give a secondary oocyte) ;

4 idea of diploid to haploid [3 max]

(c) *advantage*
ensure sperm enters oocyte / select (visibly) healthy sperm ;

disadvantage
unneeded parts of sperm enter producing unwanted effects
or
cannot tell whether a chosen sperm is genetically suitable ; [2]

[Total: 7]

4 **(a)** 1 binds to receptors (on liver cell membranes) ;

2 conversion of glucose to glycogen / glycogenesis ;

3 (because) insulin activates enzyme ; e.g. glucokinase / phosphofructokinase / glycogen synthase

4 increased use of glucose in respiration ;

5 increased uptake of glucose / increased permeability to glucose (of liver cells) ; [3 max]

(b) **(i)** 1 mRNA (found in β cells) is only from gene coding for insulin / AW ;

2 large numbers (of mRNA coding for insulin) ;

3 (whereas) DNA has all genes ;

4 (so) restriction enzymes needed ; [2 max]

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(ii) 1 cut plasmid (DNA) **;**

2 at specific, base sequence / site **;**

3 leaving sticky ends (that will join with insulin gene) **;** [2 max]

(c) (i) *all statements must be comparative*
inhaled (accept ora for injected)
1 insulin concentration rises more rapidly when inhaled **;**

2 higher peak **;**

3 falls, more rapidly **/** earlier **;**

4 (after 150 mins) lower (than injected) **;**

5 use of comparative figures **;** *figures for both at one time* [3 max]

(ii) 1 glucose conc. is linked to insulin conc. **;**

inhaled (accept ora for injected)
2 (initially) glucose falls because insulin conc. rises **;**
this subsumes marking point 1

3 glucose conc. falls lower because insulin conc. is higher **;**
this subsumes marking point 1

4 (later) glucose rises higher because insulin conc. is lower **;**
this subsumes marking point 1

5 use of figures **;**
e.g. one glucose conc. for inhaled and one for injected at one time
or
one glucose conc. linked to an insulin conc. at one time
(either inhaled or injected) [3 max]

(iii) *advantages:*

1 faster response time **;**

2 less chance of, infection / contamination **;**

3 good for people with needle phobia **;** *max 1*

disadvantages :

4 could cause larger swings in blood glucose concentration **;**

5 may need to taken more often / not long lasting **;**

6 possible variability of dose / AW **;** *max 1* [2 max]

[Total:15]

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5 **(a)** 1 oxygen availability low (when soil is flooded) **;**

2 plants carry out anaerobic respiration **;**

3 ethanol produced **;**

4 roots can continue to respire **;** [2 max]

(b) **(i)** (store of) nutrients **;** **A** named nutrient *ignore food / water / fibre*

for, germination / growth of embryo **;** [2]

(ii) protein in aleurone layer **;**

which is removed in white rice **;** *ora* [2]

(iii) endosperm makes up a greater proportion of the total mass in white rice **;**
or
brown rice has more, lipid / fibre / protein, than white rice so less carbohydrates per gram **;** [1 max]

(iv) 1 cheap source of food **;**

2 high, energy value / fibre content **;**

3 high in carbohydrate **;**

4 contain wide range of nutrients **or** three named nutrients **;**

5 cereal grains store well **;**

6 because they contain very little water **;** [2 max]

[Total: 9]

6 **(a)** variation / different form, of a gene **;** [1]

(b) *marks for reasons only*
Hb^A Hb^A
low – susceptible to / die from, malaria **;**

Hb^A Hb^S
high – no (full blown) SCA / have SC trait **;**
not, susceptible to / likely to die from, malaria **;**

Hb^S Hb^S
low – susceptible to / die from, SCA **;** [4]

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(c) 1 *USA* malaria not selection pressure **;**

2 Hb^S no advantage **;**

3 due to outbreeding **;**

4 genetic testing can lead to termination of pregnancy **or** testing / counselling, leads to not having children **;** [2 max]

[Total: 7]

7 (a) 1 apical bud is source of auxin ;

2 auxin inhibits growth of side shoot ;

3 remove bud and auxin conc falls ;

4 this allows cell, division / elongation, to take place (in side shoots) ; [3 max]

(b) 267 **;;**

accept suitable working for one mark e.g. $\frac{110 - 30}{30}$ (× 100)

or

accept 266.7 for one mark [2]

(c) *days 2 to 8*

D1 no increase in length with paste plus auxin (compared to control) **;**

E2 auxin moves from paste into plants **;**

E3 inhibits growth **;**

days 8 to 13

D4 increase in length occurs (with paste and auxin) **;**

E5 less auxin left **;**

D6 supportive figs ; e.g. two blue points on two days plus units or one red and one blue point on same day plus units

must have at least one D (description) and one E (explanation) to score 3 marks [3 max]

[Total: 8]

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8 (a) 1 absorb light **;** **A** harvest light / trap light **R** collect light

2 pass <u>energy</u> to, primary pigment / chlorophyll / reaction centre **;** [2 max]

(b) *cyclic photophosphorylation*

1 electron emitted returns to, PSI / same photosystem or same chlorophyll molecule **;**

non-cyclic photophosphorylation

2 electron emitted from PSII absorbed by PSI **;**

3 reduced NADP produced **;**

4 photolysis occurs **;** **A** splitting of water

5 (photolysis) only involves PSII **;**

6 oxygen produced *3 max*

accept ora for cyclic for marking points 3, 4 and 6

mark to max 3 if cyclic and non-cyclic are described the wrong way round [4 max]

(c) (i) some other factor becomes limiting / temperature no longer limiting **;**

CO_2 / light intensity **;** [2]

(ii) line falls towards 70°C **;** [1]

(iii) *rate of photosynthesis falls*
enzyme / rubisco, denatured / AW **;**

substrates not able to fit active site / AW **;** [2]

(d)

adaptation	how the adaptation helps photosynthesis
thin cell wall	greater light penetration / short diffusion distance (for gases) **;**
cylindrical shape	air spaces **;**
large vacuole	chloroplasts near outside of cell for better light absorption / maintains turgor **;**
chloroplasts can be moved within the cell	absorb maximum light / avoid excessive light intensities **;**

[4]

[Total: 15]

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9 (a) *do not credit marking points out of sequence*
prophase 1

1 idea of condensation of chromosomes ;

2 homologous chromosomes pair up / bivalent formed ;

metaphase 1

3 homologous chromosomes / bivalents, line up on equator ;

4 of spindle ;

5 by centromeres ;

6 independent assortment / described ;

7 chiasmata / described ;

8 crossing over / described ;

anaphase 1

9 chromosomes move to poles ;

10 homologous chromosomes / bivalents, separate ;

11 pulled by microtubules ;

12 reduction division ;

metaphase 2

13 chromosomes line up on equator ;

14 of spindle ;

anaphase 2

15 centromeres divide ;

16 <u>chromatids</u> move to poles ;

17 pulled by microtubules ;

18 ref. haploid number ;

allow 4 ***or*** *14*
allow 11 ***or*** *17* [9 max]

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(b) 19 change in, base / nucleotide, sequence (in DNA) ;

20 during DNA replication ;

21 detail of change ; e.g. base, substitution / addition / deletion

22 frame shifts / AW ;

23 different / new, allele ;

24 random / spontaneous ;

25 mutagens ;

26 ionising radiation ;

27 UV radiation / mustard gas ; [6 max]

[Total: 15]

10 (a) 1 ATP as universal energy currency ;

2 light energy needed for photosynthesis ;

3 ATP used conversion of GP to TP ;

4 ATP used to regenerate RuBP ;

5 (energy needed for) anabolic reactions ;

6 protein synthesis / starch formation / triglyceride formation ;

7 activation energy ;

8 (activate) glucose in glycolysis ;

9 active transport ;

10 example ; e.g. sodium / potassium pump

11 movement / locomotion ;

12 example ; e.g. muscle contraction / cilia beating

13 endocytosis / exocytosis / pinocytosis / bulk transport ;

14 temperature regulation ; [9 max]

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(b) 15 idea of lipid > protein > carbohydrate / AW **;** **A** lipid has more energy than either protein or carbohydrate

16 comparative figures **;** e.g. 39.4, 17.0 and 15.8 *accept any two*

17 kJ g^{-1} / per unit mass **;**

18 more hydrogen atoms in molecule, more energy **;**

19 lipid have more, hydrogen atoms / C-H bonds **;**

20 (most) energy comes from oxidation of hydrogen to water **;**

21 using reduced, NAD / FAD **;**

22 in ETC **;**

23 detail of ETC **;**

24 ATP production

[6 max]

[Total: 15]

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GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2010 question paper for the guidance of teachers

9700 BIOLOGY

9700/42 Paper 4 (A2 Structured Questions), maximum raw mark 100

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1 (a) 1 mallard numbers have increased **and** the others have decreased **;**

decrease due to

2 pesticides / pollution / fertilisers **;**

3 change in temperature or pH of water **;**

4 lack of named food source **;**

5 increased competition / AW **;**

6 direct human interference on **lake ;** e.g. fishing / sailing etc
not related to marking point 2

mallard increase due to

7 doesn't eat, insects / molluscs / fish **;**

8 less other birds so less competition **;** [4 max]

(b) 1 cultural / aesthetic / leisure, reasons **;**

2 moral / ethical, reasons **;** e.g. right to exist / prevent extinction

3 resource material **;** e.g. wood for building / fibres for clothes / food for humans

4 ecotourism **;**

5 economic benefits **;**

6 ref. resource / species, may have use in future / AW **;** e.g. medical use

7 maintains, food webs **/** food chains **;** **A** description

8 nutrient cycling / protection against erosion **;**

9 climate stability **;**

10 maintains, large gene pool **/** genetic variation **;**

[4 max]

[Total: 8]

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2 (a) (i) 1 penicillin inhibits, enzyme / peptidase **;**

2 blocks / alters shape of, active site **;**

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4 cell wall weaker / AW **;**

5 turgor of cell not resisted (by cell wall) / AW **;**

6 cell / wall / bacterium, bursts **;** [3 max]

(ii) *any two from*

1 viruses do not have cell wall **;**

2 viruses do not have cytoplasm **;**

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4 viruses do not have peptidase **;** [2 max]

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1 numbers of both wild-type and mutant strains, increase / hardly changes **;**

with antibiotic

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3 mutant strains decrease more than wild-type **;** **A** faster
this subsumes marking point 2

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5 ref. comparative figures at any one time **;** *ignore units for bacteria*
blue with blue
red with red
red with blue – with antibiotic [4 max]

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(c) **(i)** 1 changes in, base / nucleotide, sequence **;** **A** named change e.g. substitution

2 alters, triplet code / codon **;**

3 enzyme has different, primary structure / amino acid sequence **;**

4 enzyme has different, 3D structure / tertiary structure / active site **;** [2 max]

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3 wild-type more resistant to antibiotic **or** mutant bacteria less resistant to antibiotic **;** [2 max]

(d) 1 antibiotic, is selective agent / provides selective pressure **;**

2 resistant bacteria, survive / reproduce **;**

3 pass allele for resistance to offspring **;**

4 frequency of allele in population increases **;** [3 max]

[Total: 16]

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3 **(a)** 1 to give superovulation ;

2 follicles or oocytes, mature or develop, at the same time ; *ignore grow*

3 to prepare uterus for implantation ; [2 max]

(b) 1 germinal epithelial cell divides by mitosis ;

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4 idea of diploid to haploid [3 max]

(c) *advantage*
ensure sperm enters oocyte / select (visibly) healthy sperm ;

disadvantage
unneeded parts of sperm enter producing unwanted effects
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cannot tell whether a chosen sperm is genetically suitable ; [2]

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4 **(a)** 1 binds to receptors (on liver cell membranes) ;

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4 increased use of glucose in respiration ;

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(b) **(i)** 1 mRNA (found in β cells) is only from gene coding for insulin / AW ;

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3 (whereas) DNA has all genes ;

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(ii) 1 cut plasmid (DNA) ;

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1 insulin concentration rises more rapidly when inhaled ;

2 higher peak ;

3 falls, more rapidly / earlier ;

4 (after 150 mins) lower (than injected) ;

5 use of comparative figures ; *figures for both at one time* [3 max]

(ii) 1 glucose conc. is linked to insulin conc. ;

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2 (initially) glucose falls because insulin conc. rises ;
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3 glucose conc. falls lower because insulin conc. is higher ;
this subsumes marking point 1

4 (later) glucose rises higher because insulin conc. is lower ;
this subsumes marking point 1

5 use of figures ;
e.g. one glucose conc. for inhaled and one for injected at one time
or
one glucose conc. linked to an insulin conc. at one time
(either inhaled or injected) [3 max]

(iii) *advantages:*

1 faster response time ;

2 less chance of, infection / contamination ;

3 good for people with needle phobia ; *max 1*

disadvantages :

4 could cause larger swings in blood glucose concentration ;

5 may need to taken more often / not long lasting ;

6 possible variability of dose / AW ; *max 1* [2 max]

[Total:15]

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5 **(a)** 1 oxygen availability low (when soil is flooded) **;**

2 plants carry out anaerobic respiration **;**

3 ethanol produced **;**

4 roots can continue to respire **;** [2 max]

(b) **(i)** (store of) nutrients **;** **A** named nutrient *ignore food / water / fibre*

for, germination / growth of embryo **;** [2]

(ii) protein in aleurone layer **;**

which is removed in white rice **;** *ora* [2]

(iii) endosperm makes up a greater proportion of the total mass in white rice **;**
or
brown rice has more, lipid / fibre / protein, than white rice so less carbohydrates per gram **;** [1 max]

(iv) 1 cheap source of food **;**

2 high, energy value / fibre content **;**

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4 contain wide range of nutrients **or** three named nutrients **;**

5 cereal grains store well **;**

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3 due to outbreeding **;**

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2 auxin inhibits growth of side shoot ;

3 remove bud and auxin conc falls ;

4 this allows cell, division / elongation, to take place (in side shoots) ; [3 max]

(b) 267 **;;**

accept suitable working for one mark e.g. $\frac{110 - 30}{30}$ (× 100)

or

accept 266.7 for one mark [2]

(c) *days 2 to 8*

D1 no increase in length with paste plus auxin (compared to control) **;**

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(b) *cyclic photophosphorylation*

1 electron emitted returns to, PSI / same photosystem or same chlorophyll molecule **;**

non-cyclic photophosphorylation

2 electron emitted from PSII absorbed by PSI **;**

3 reduced NADP produced **;**

4 photolysis occurs **;** **A** splitting of water

5 (photolysis) only involves PSII **;**

6 oxygen produced *3 max*

accept ora for cyclic for marking points 3, 4 and 6

mark to max 3 if cyclic and non-cyclic are described the wrong way round [4 max]

(c) (i) some other factor becomes limiting / temperature no longer limiting **;**

CO_2 / light intensity **;** [2]

(ii) line falls towards 70°C **;** [1]

(iii) *rate of photosynthesis falls*
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substrates not able to fit active site / AW **;** [2]

(d)

adaptation	how the adaptation helps photosynthesis
thin cell wall	greater light penetration / short diffusion distance (for gases) **;**
cylindrical shape	air spaces **;**
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chloroplasts can be moved within the cell	absorb maximum light / avoid excessive light intensities **;**

[4]

[Total: 15]

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9 (a) *do not credit marking points out of sequence*
prophase 1

1 idea of condensation of chromosomes ;

2 homologous chromosomes pair up / bivalent formed ;

metaphase 1

3 homologous chromosomes / bivalents, line up on equator ;

4 of spindle ;

5 by centromeres ;

6 independent assortment / described ;

7 chiasmata / described ;

8 crossing over / described ;

anaphase 1

9 chromosomes move to poles ;

10 homologous chromosomes / bivalents, separate ;

11 pulled by microtubules ;

12 reduction division ;

metaphase 2

13 chromosomes line up on equator ;

14 of spindle ;

anaphase 2

15 centromeres divide ;

16 <u>chromatids</u> move to poles ;

17 pulled by microtubules ;

18 ref. haploid number ;

allow 4 ***or*** *14*
allow 11 ***or*** *17* [9 max]

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(b) 19 change in, base / nucleotide, sequence (in DNA) ;

20 during DNA replication ;

21 detail of change ; e.g. base, substitution / addition / deletion

22 frame shifts / AW ;

23 different / new, allele ;

24 random / spontaneous ;

25 mutagens ;

26 ionising radiation ;

27 UV radiation / mustard gas ; [6 max]

[Total: 15]

10 (a) 1 ATP as universal energy currency ;

2 light energy needed for photosynthesis ;

3 ATP used conversion of GP to TP ;

4 ATP used to regenerate RuBP ;

5 (energy needed for) anabolic reactions ;

6 protein synthesis / starch formation / triglyceride formation ;

7 activation energy ;

8 (activate) glucose in glycolysis ;

9 active transport ;

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11 movement / locomotion ;

12 example ; e.g. muscle contraction / cilia beating

13 endocytosis / exocytosis / pinocytosis / bulk transport ;

14 temperature regulation ; [9 max]

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(b) 15 idea of lipid > protein > carbohydrate / AW **;** **A** lipid has more energy than either protein or carbohydrate

16 comparative figures **;** e.g. 39.4, 17.0 and 15.8 *accept any two*

17 kJ g^{-1} / per unit mass **;**

18 more hydrogen atoms in molecule, more energy **;**

19 lipid have more, hydrogen atoms / C-H bonds **;**

20 (most) energy comes from oxidation of hydrogen to water **;**

21 using reduced, NAD / FAD **;**

22 in ETC **;**

23 detail of ETC **;**

24 ATP production

[6 max]

[Total: 15]

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GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2010 question paper for the guidance of teachers

9700 BIOLOGY

9700/43 Paper 4 (A2 Structured Questions), maximum raw mark 100

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1 (a) 1 pollution **;**

2 environment / habitat, change qualified **;** e.g. increase in water temperature / change in water pH

3 overfishing **;**

4 loss of food / more competition for food **;**

5 direct human interference qualified **;** e.g. pleasure boats [3 max]

(b) variety of / different / total number of, species **;**

genetic diversity of species / AW **;** [2]

(c) *any three from*

1 tourism / leisure **;**

2 economic benefits **;**

3 food for humans **;**

4 ref. resource / species, may have use in future / AW **;**

5 maintains, food webs / food chains **;** **A** description

6 nutrient cycling **;**

7 maintains, (large) gene pool / genetic variation **;** [3 max]

[Total: 8]

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2 (a) 1 ref. differentiation / specialisation **;**

2 ref. Sertoli cell **;**

3 forms flagellum **;** **A** tail

4 detail (of flagellum) **;** e.g. microtubules

5 acrosome **;**

6 detail (of acrosome) **;** e.g. contains enzymes / modified lysosome

7 many mitochondria **;** [4 max]

(b) *accept normal or healthy for undamaged*
accept abnormal or unhealthy for damaged

1 undamaged sperm move into lower chamber **or** damaged sperm stay in upper chamber **;**

2 undamaged sperm have negatively charged (proteins) **or** damaged sperm lack negatively charged (protein) **;**

3 undamaged sperm are, attracted to positive plate / repelled by negative plate **;**
ora for damaged sperm

4 idea that undamaged sperm which have, moved / matured, slowly (in epididymis) **;**
ora for damaged sperm [3 max]

[Total: 7]

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3 (a) (i) hybridoma ; [1]

(ii) 1 identical (antibodies) **or** produced by cloning ;

2 variable regions / antigen binding sites, all identical **or** (antibodies) are specific to one antigen ; [2]

(iii) *Mark text first*

1 (four) polypeptides ; *plural*

2 two heavy **and** two light chains ; **A** long and short

3 ref. disulphide, bridges / bonds ;

4 ref. variable regions / binding sites ; [3 max]

(b) (i) 1 HAT cannot be metabolised / AW ;

2 HAT inhibits mutant myeloma cells / AW ; [2]

(ii) 1 mouse spleen cells can metabolise HAT / AW ;

2 because they have suitable enzyme ; [2]

(iii) 1 so that only fused cells survive **or** unfused myeloma cells die ;

2 identifies, cells to be cloned / fused cells ; [2]

(c) 1 can be done at home / easy to use / non-invasive ;

2 cheap ;

3 result produced quickly ;

4 result likely to be accurate ;

5 can be done early in pregnancy ;

6 safe to use ; [4 max]

[Total: 16]

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4 (a) 1 water lost by, evaporation / transpiration ;

2 no water uptake (by roots) ; [2]

(b) (i) 1 as water potential increases, oxygen uptake increases ;
must be stated

2 levels off (at 5 kPa / at 225 au) ;

3 figures ; *two water potential plus two oxygen uptake figures plus kPa* [2 max]

(ii) 1 succinate converted to oxaloacetate ;

2 dehydrogenation / oxidation ;

3 NAD, is reduced / accepts hydrogen ;

4 (hydrogens move to) ETC ;

5 hydrogen splits into protons and electrons ;

6 electrons pass along ETC ;

7 ADP + Pi ⟶ ATP ;

8 oxygen, receives protons and electrons / is final electron acceptor, to form water ; [4 max]

(c) (i) 1 water leaves mitochondrion ; **A** other named organelle

2 by osmosis / down water potential gradient ;

3 idea mechanical disruption to membranes ;

4 membranes made of <u>phospholipid</u> (bilayer) ;

5 hydrophilic heads / glycoproteins / glycolipids, form fewer hydrogen bonds with water ;

6 reduces, stability / fluidity (of membrane) ;

7 ref. (proteins with) hydrophilic channels ; [3 max]

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(ii) 1 inner membrane (of mitochondrion) / cristae, site of ETC ;

2 fewer carriers held in position ;

3 fewer electrons pass along ETC ;

4 less ATP produced / less energy released ;

5 less oxygen required to act as electron acceptor ;

6 protons can move freely through the damaged inner membrane ;

7 proton gradient not formed ;

accept ora for less damaged membranes for marking points 2–7 [3 max]

(d) 1 extensive / deep, roots ;

2 <u>leaves</u> have small surface area ;

3 <u>leaves</u>, are curled / are waxy / have bulliform cells / have hinged cells ;

4 reduced stomata numbers / stomata in pits ; [2 max]

[Total: 16]

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5 **(a)** 1 AAV2.5T infects more cells than AAV / AW ;

2 both increase until 20 days ;

3 AAV2.5T falls after 20 days but AAV remains steady ;

4 figures ; *two intensities on a single day* [2 max]

(b) 1 infected cells fluoresce (when luciferin added) ;

2 able to identify infected cells ; [2]

(c) 1 correct form of (CFTR) protein made ;

2 delivered to / inserted into, membrane ;

3 acts as chloride channel ;

4 chloride ions leave cell ;

5 water leaves cell ;

6 normal / less viscous, mucus formed ;

7 give credit to mention of one symptom reversed ;
e.g. no blockage of airways / less chance of infections [4 max]

[Total: 8]

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6 (a) 86 **;;** **A** -86

accept suitable working for one mark e.g. $\frac{1400-190}{1400}\times 100$

or

accept 86.4 for one mark [2]

(b) 1 drought reduced available food **or** fewer small seeds produced **;**

2 finches with larger beaks survived **or** finches with smaller beaks died **;**

3 able to open tough fruits / ora **;**

4 able to feed on larger seeds / ora **;**

5 tough fruit / size of seed, acted as selection pressure **;** [3 max]

(c) directional / evolutionary **;**

selection pressure acts on one extreme (of range) **;** [2]

[Total: 7]

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7 **(a)** 1 removal / elimination, of waste products ;

2 of metabolism ;

3 (which are) toxic ;

4 (or) substances excess (to requirements) ; [2 max]

(b) 1 homeostasis / AW ;

2 change in water potential ;

3 detected by (osmo)receptors ;

4 in hypothalamus ;

5 response via effector ;

6 ADH released ;

7 effect on collecting duct ;

8 return to, norm / set point ; [4 max]

(c) 1 blood diverted away from skin ;

2 less sweating ;

3 more water retained in body / high water potential in body ;

4 less water reabsorbed from collecting duct / AW ; [2 max]

[Total: 8]

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8 (a) 1 high rate of photosynthesis at 430–435 nm **and** 655 nm wavelengths ;

2 idea of (high) absorption of light at these wavelengths ;

3 highest rate, at 430–435 nm ;

4 shorter wavelengths have more energy ;

5 low(er rate) in, middle range / 500–600, of wavelengths ;

6 low light absorption here ;

7 absorbed light used for photosynthesis ;

8 in light-dependent stage ; [4 max]

(b) (i) ATP ;

reduced NADP ; [2]

(ii) 1 ATP provides energy ;

2 reduced NADP, is reducing agent / provides hydrogen ;

3 for converting GP to TP ;

4 (ATP used to) regenerate RuBP ; [3 max]

(c) process / photosynthesis, affected by more than one factor ;

rate is limited by the factor nearest its minimum value / AW ; [2]

(d) 1 enters leaf through (open) stomata ;

2 by diffusion ;

3 substomatal air space ;

4 many air spaces in spongy mesophyll ;

5 spaces between palisade cells ;

6 dissolves in moisture on cell (walls) ;

7 enters through cell walls ; [4 max]

[Total: 15]

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9 (a) 1 chiasma / crossing over ;

2 between non-sister chromatids ;

3 of, homologous chromosomes / bivalent ;

4 in <u>prophase 1</u> ;

5 exchange of genetic material / AW ; ***R*** *genes unqualified*

6 linkage groups broken ;

7 new combination of alleles ;

8 <u>independent assortment</u> (of homologous chromosomes) ;
R *random assortment*

9 at equator ;

10 (during) <u>metaphase 1</u> ;

11 possible mutation ;

12 random mating ;

13 random fusion / fertilisation of gametes ; [7 max]

(b) 14 phenotypic variation results from interaction of genotype and environment / VP = VG + VE ;

15 environment may modify expression of gene(s) ; *must be stated*

16 e.g. for size / mass / height ;

17 because, food / nutrient / ion, missing or in short supply ; **A** malnutrition

18 named, food / nutrient / ion, (missing or in short supply) ;

19 environment may, trigger / switch on, gene ; *must be stated*

20 ref. low temperature and change in animal colour ;

21 ref. high temperature and, curled wing in *Drosophila* / gender in crocodiles ;

22 ref. <u>UV</u> light and melanin production ;

23 ref. wavelength of light and, flowering / germination / fruit colour ;

24 other named trigger plus example ;

25 environment effect usually greater on polygenes / ora ;

26 environment may induce mutation affecting phenotype ; [8 max]

[Total: 15]

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10 (a) 1 nucleotide **;**

2 adenine + ribose / pentose + three phosphates **;**

3 loss of phosphate leads to energy release / hydrolysis releases 30.5 kJ **;**

4 ADP + Pi ⟷ ATP (reversible reaction) **;**

5 small packets of energy **;**

6 small / water soluble, so can move around cell **;**

7 used by cells as immediate energy donor **;**

8 link between energy yielding and energy requiring reactions / AW **;**

9 high turnover **;**

10 two examples of use **; ;** e.g. active transport **/** muscle contraction **/** Calvin cycle /

11 protein synthesis [8 max]

(b) 12 Pyruvate, cannot enter mitochondrion / remains in the cytoplasm **;**

13 becomes, hydrogen acceptor / reduced **;**

14 by reduced NAD **;**

15 from glycolysis **;**

16 converted to lactate **;**

17 lactate dehydrogenase **;**

18 allows glycolysis to continue **;**

19 no, decarboxylation / CO_2 removed **;**

20 single step **;**

21 reversible reaction / converted back to pyruvate **;**

22 by oxidation **;**

23 ref. oxygen debt **;**

24 ethanol produced **;**

accept ora for marking points 19–23 [7 max]

[Total: 15]

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