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**UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS**

GCE Advanced Level

# MARK SCHEME for the November 2004 question paper

## 9700 BIOLOGY

**9700/04** **Paper 4 (Structured Question A2 Core), maximum raw mark 60**

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. This shows the basis on which Examiners were initially instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began. Any substantial changes to the mark scheme that arose from these discussions will be recorded in the published *Report on the Examination*.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes must be read in conjunction with the question papers and the *Report on the Examination*.

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**Grade thresholds** taken for Syllabus 9700 (Biology) in the November 2004 examination.

| | maximum mark available | minimum mark required for grade: | | |
|---|---|---|---|---|
| | | A | B | E |
| Component 4 | 60 | 45 | 40 | 23 |

The threshold (minimum mark) for B is set halfway between those for Grades A and C.
The threshold (minimum mark) for D is set halfway between those for Grades C and E.
The threshold (minimum mark) for G is set as many marks below the F threshold as the E threshold is above it.
Grade A* does not exist at the level of an individual component.

**November 2004**

GCE A LEVEL

# MARK SCHEME

## MAXIMUM MARK: 60

SYLLABUS/COMPONENT: 9700/04

BIOLOGY
Paper 4 (Structured Question A2 Core)

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**1 (a) 1** chlorophyll absorbs mainly red and blue light;

**2** light absorbed by antenna complex;

**3** energy transferred;

**4** reaction centres/P700/P680;

**5** light energy excites electron(s)/reference passing to higher energy level;

**6** electron lost from chlorophyll **3 max**

**(b) 1** water is split into $H^+$ and $OH^-$;

**2** electron removed from $OH^-$;

**3** to replace electron from photosystem/chlorophyll;

**4** OH breaks down into $O_2$ and water;

**5** $H^+$ used to form reduced NADP;

**6** reference correct, balanced equation; **3 max**

**(c) 1** reference flow of electrons along ETC;

**2** reference to pumping $H^+$ across membrane;

**3** reference to $H^+$/proton gradient across the thylakoid membrane;

**4** flow of protons down gradient;

**5** via ATPase/stalked particles;

**6** formation of ATP from <u>ADP and $P_i$</u>;

**7** cyclic, electron returns to original photosystem;

**8** non-cyclic, electron from PSII to PSI; **3 max**

**(d)** reference increased efficiency/short diffusion distance/close together; **1**

**Total 10**

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**2 (a) 1** reference to $Na^+/K^+$ pump;

**2** active process/ATP used;

**3** $Na^+$ (pumped) out and $K^+$ (pumped) in;

**4** high $Na^+$ outside and high $K^+$ inside axon;

**5** membrane slightly more leaky to $K^+$/more $K^+$ leaks out than $Na^+$ leaks in/ reference to some $K^+$ channels open;

**6** inside more negative than outside; **3 max**

**(b) 1** reference stimulation;

**2** opening of $Na^+$ channels;

**3** $Na^+$ diffuses in (across axon membrane);

**4** inside more positive than outside/outside more negative than inside;

**5** potential across the membrane changes; **3 max**

**(c) 1** reference to closing $Na^+$ channels;

**2** opening of $K^+$ channels;

**3** $K^+$ diffuses out (across axon membrane);

**4** (charge on the $K^+$) restores the membrane/resting potential;

**5** reference to slight overshoot/hyperpolarisation;

**6** reference $K^+$ channels close; **3 max**

**(d) 1** electrical vs chemical;

**2** (impulses) along nerve cells vs (hormones) through blood;

**3** rapid vs slow;

**4** response immediate vs relatively slow;

**5** responses short lived vs long lived; **3 max**

**Total 12**

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**3 (a) 1** no increase below 40 au;

**2** (most) rapid production above 60 au;

**3** correct reference to Figs.; **2 max**

**(b) 1** glucose to pyruvate/glycolysis;

**2** pyruvate to lactate;

**3** reference lactate dehydrogenase;

**4** in absence/shortage of oxygen to muscles;

**5** pyruvate acts as a hydrogen acceptor;

**6** reduced NAD to NAD/NAD regenerated; **3 max**

**(c) 1** lactate must be oxidised;

**2** extra oxygen required;

**3** this is the oxygen debt; *linked to point 2* **3**

**(d)** more anaerobic respiration/insufficient oxygen supply; **1**

**Total 9**

**4 (a) A** $H^N H^S$;

**C** $H^S H^S$; **1**

***(b)*** *parental genotype* $H^N H^S$ X $H^N H^s$ ;

*gametes* $H^N$ $H^s$ I $H^N$ $H^S$ ;

| *offspring genotypes* | $H^N H^N$ | $H^N H^S$ | $H^N H^S$ | $H^S H^S$ |
|---|---|---|---|---|
| *phenotypes* | (normal) | (carrier) | (carrier) | anaemia *identified* |

;

probability = ¼/0.25/25%; **4**

*Reject X Y references*

*Penalise once for use of different symbols (in **(b)**)* **Total 5**

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**5 (a) 1** pools separate fish;

**2** reference to geographic isolation/allopatric;

**3** prevent interbreeding AW;

**4** no gene flow/AW;

**5** conditions different in the different pools;

**6** different characteristics selected for in the different pools;

**7** reference genetic drift; **4 max**

**(b) 1** conditions remain the same within each pool;

**2** idea of extreme phenotypes selected against/do not survive;

**3** only those fish well adapted to conditions in each pool survive; **3**

**(c) 1** reference competition between species/niche and competitive exclusion;

**2** reduction in number of species/not all species will survive;

**3** species restricted to different areas;

**4** all/most species survive;

**5** one species likely to be better adapted than all the other species;

**6** reference hybridisation/interbreeding/no interbreeding;

*1 and 2 linked*

*3 and 4 linked* **2 max**

**Total 9**

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**6** ***(a)*** *Describe the main features of the Krebs Cycle. [9]*

***(b)*** *Explain the role of NAD in aerobic respiration. [6]*

**(a)** **1** matrix;

**2** of mitochondrion;

**3** acetyl CoA combines with oxaloacetate;

**4** to form citrate;

**5** 4C to 6C;

**6** decarboxylation/produce $CO_2$;

**7** dehydrogenation/oxidation;

**8** $2CO_2$ released;

**9** reduced NAD produced; *accept reduced coenzyme for one mark - annotate 9/10*

**10** reduced FAD produced;

**11** ATP produced;

**12** series of steps/intermediates;

**13** enzyme catalysed reactions;

**14** oxaloacetate regenerated;

**15** AVP; **9 max**

**(b)** **16** coenzyme;

**17** for dehyrogenase;

**18** reduced;

**19** carries electrons;

**20** and protons/$H^+$/H/hydrogen; **R** $H_2$/hydrogen molecules

**21** from Krebs cycle;

**22** and from glycolysis;

**23** to cytochromes/electron transfer chain;

**24** reoxidised/regenerated;

**25** ATP produced;

**26** 3/2.5 (molecules of ATP) per reduced NAD; **6 max**

**Total 15**

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**7** ***(a)*** *Describe the use of recombinant DNA technology in the synthesis of human insulin by bacteria [9]*

***(b)*** *Explain the advantages of treating diabetics with human insulin produced by genetic engineering [6]*

**1** mRNA coding for insulin/isolate gene for human insulin;

**2** from beta cells of islets of Langerhans/pancreas;

**3** reference to reverse transcriptase;

**4** to cDNA;

**5** reference PCR/DNA polymerase/double strand;

**6** reference sticky ends/AW;

**7** use of vector/virus/plasmid;

**8** reference endonuclease/restriction enzymes;

**9** to cut plasmid;

**10** reference DNA ligase to join DNA;

**11** inserted into suitable host cell/E.coli/bacteria;

**12** reference method of insertion;

**13** identification of modified bacteria;

**14** reference growth/culture of engineered bacteria in fermenters; **9 max**

**(b) 15** constant/reliable supply all year round/unlimited supply;

**16** less risk of contamination/infection;

**17** identical to insulin produced in the body;

**18** less/no risk of allergic reaction;

**19** does not stimulate the immune system;

**20** fewer side effects;

**21** can be produced without the killing of animals/ethical reason;

**22** cheaper/easier to extract and purify;

**23** more available/large amount;

**24** more rapid response; **6 max**

**Total 15**

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