**UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS**

**GCE Advanced Subsidiary Level and GCE Advanced Level**

# MARK SCHEME for the May/June 2009 question paper

# for the guidance of teachers

## 9700 BIOLOGY

**9700/04** Paper 4 (A2 Structured Questions), maximum raw mark 100

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**1 (a) (i)** 18 **;** [1]

**(ii)** 0.72 **;**

*allow ecf from* **(i)** [1]

**(b)** 1 RQ value falls steeply, initially / 40–80 min **;**

2 then, very little change / AW **;**

3 sugar / carbohydrate, metabolised at start **;** **A** named carbohydrate

4 then fat metabolised **;**

5 (due to) fasting / carbohydrate running out **;** [4 max]

**(c)** 1 increase in rate of respiration **;**

2 kinetic energy increases / more enzyme-substrate complexes / enzyme activity increases **;**

3 effects of too high a rise in temperature **;** e.g. denaturation of enzymes

4 AVP **;** e.g. $Q_{10} = 2$ [2 max]

**[Total: 8]**

**2 (a)** *oestrogen*
follicle (cells) / granulosa (cells) / theca **;**

*progesterone*
corpus luteum **;** **A** follicle (cells) [2]

**(b)** 1 (oestrogen / progesterone affect) hypothalamus / <u>anterior</u> pituitary **;**

2 inhibit secretion of, FSH / LH / GnRH **;**

3 follicles do not develop **;**

4 no ovulation **;** **R** ref to eggs

5 ref. negative feedback **;**

6 alters <u>cervical</u> mucus to stop sperm **;**

7 prevents implantation / effect on endometrium **;** **R** endometrium thickens [4 max]

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**(c)** *any two from*

1 (advantage of smaller population), less poverty / less starvation / less disease ;

2 greater care for children that are born ;

3 (benefit to adult women), fitter women / more women working ;

4 more promiscuity ;

5 more, STD / breast cancer / cervical cancer ;

6 population decrease ; [2 max]

**[Total: 8]**

**3** **(a)** 1 loss of habitat ; **A** deforestation

2 building / industry / farming / localised use of wood ; *ignore logging / timber production*

3 difficulty in finding food ; **A** increased competition **R** no food

4 poaching / hunting ;

5 ref. ivory trade ; [3 max]

**(b)** 1 of no use to humans ;

2 protected in burrows ;

3 variety of food ;

4 small quantity of food required ;

5 short gestation ;

6 large number of offspring ;

7 camouflaged ;

8 (sophisticated) early warning system ; [3 max]

**[Total: 6]**

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**4 (a) (i) A** pericarp / fruit coat

**B** scutellum / cotyledon

**C** plumule / embryo shoot

**D** radicle / embryo root
*0 or 1 = 0 marks, 2 or 3 = 1 mark, 4 = 2 marks* **;** **;** [2]

**(ii)** 1 food / starch / nutrients **;**

2 for use, during germination / before photosynthesis / before leaves emerge above ground **;**

3 to provide <u>glucose</u> for, respiration / ATP production **;** *ignore energy*

4 to produce cellulose for cell wall production **;**

5 to produce protein for, cell division / growth (of plant) **;** **R** growth of cells [3 max]

**(b) (i)** 1 permanently **;**

2 binds with / blocks, <u>active site</u> **;**

3 binds with, another part of enzyme / allosteric site **;**

4 change (shape) of <u>active site</u> **;** [2 max]

**(ii)** *when acetylcholinesterase is inhibited*
1 acetylcholine <u>remains attached</u> to receptors (on post-synaptic membrane) **;**

2 sodium channels on post-synaptic (membrane) <u>remain open</u> **;**

3 <u>membrane</u> remains depolarised **;**

4 action potentials / nerve impulses, continue to be produced **;** [2 max]

**(c)** 1 different sequence of, bases / nucleotides, causes different, sequence of amino acids / primary structure **;**

2 acetylcholinesterase has a different, shape / tertiary structure **;**

3 acetylcholine can still bind with, active site / acetylcholinesterase / enzyme **or** active site remains functional **;**

4 (but) pyrethrum / inhibitor, cannot bind with, acetylcholinesterase / enzyme **;**

5 inhibition is allosteric / AW **;** [3 max]

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**(d) (i)** 1 below 0.5 *μ*g no insects killed in either group **;**

2 at 0.5 *μ*g hybrid insects killed but resistant insects survived **;**

3 at 10 *μ*g all insects killed in hybrid group but only 80% killed in resistant group **;**

4 at 30 *μ*g all insects killed in both groups **;**
*penalise lack of units once* [3 max]

**(ii)** 1 resistant and susceptible insects are homozygous **;**

2 hybrid insect is heterozygous **;**

3 hybrid insect shows codominance / mutant allele and normal allele both have an effect **;**
*allow ref to gene here* [2 max]

**[Total: 17]**

**5 (a)** *marking points refer to batch culture*
1 (penicillin) is a secondary, metabolite / product **; R** *Penicillium*

2 more penicillin is produced (per unit time) **; A** higher yield *comparative statement*

3 in the later stages of growth (of the culture) / after main growth phase is over **;**

4 (penicillin produced when, fungus / *Penicillium*,) is short of nutrients **; R** no nutrients left

*alternative points for 2 and 3 for continuous culture (ora)*
2a less penicillin is produced (per unit time) **;** *comparative statement*

3a continuous culture remains in, exponential / active growth, phase **;** [3 max]

**(b)** *description*
*when pH is controlled (blue unbroken line)*
1 penicillin is produced throughout the time period **;**

*when pH not controlled (blue dotted line)*
2 penicillin production increases to a maximum and then decreases **;**

3 2 penicillin figs plus 2 time figs (to support 1 or 2) **;** *ignore pH figs*

*explanation*
4 (pH affects) enzymes (involved in penicillin production) **;**

*when pH is controlled*
5 optimum pH for enzymes is at approx pH 7 **;**

*when pH not controlled*
6 pH, high / above 7, decreases / stops, penicillin production **;**

7 (pH, high / above 7), causes change in active site of enzymes / AW **;** [4 max]

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**(c)** 1 penicillin affects (bacterial) cell wall production ; **A** affects cross-linkages

2 inhibits, glycoprotein peptidases / enzymes involved with constructing (bacterial) cell wall ;

3 viruses do not have cell walls ; [2 max]

**[Total: 9]**

**6 (a)** 1 increases, cellular uptake of glucose (from blood) / membrane permeability to glucose ;

2 (by), liver / muscle / adipose, cells ;

3 increased, respiration / metabolism, of glucose ; **A** increased glycolysis

4 causes conversion of glucose to, glycogen / fat ; **A** inhibits glycogenolysis

5 (blood glucose concentration maintained between) 80–120 mg per 100 $cm^3$ ;
**A** single value between 80–120 [3 max]

**(b)** 1 it is identical to human insulin / ora ;

2 (more) rapid response ;

3 no / fewer, rejection problems / side effects / allergic reactions ;

4 ref. to ethical / moral / religious, issues ;

5 cheaper to produce in large volume / unlimited availability ; **R** cheap to produce

6 less risk of, transmitting disease / infection ;

7 good for people who have developed tolerance to animal insulin ; [2 max]

**(c) (i)** 1 single target site will be in correct resistance gene ;

2 (gene to be inserted has) complementary sticky ends to target site sticky ends ;

3 more cuts would fragment plasmid ; [2 max]

**(ii)**

| circle of DNA taken up by bacteria | bacteria resistant to ampicillin | bacteria resistant to tetracycline |
|---|---|---|
| unaltered plasmids | ✓ | ✓ ; |
| recombinant plasmids that have taken up the wanted gene | ✓ | × ; |
| circles of the wanted gene | × | × ; |

[3]

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**(d) (i)** 1 risk spread of resistance to other bacteria **;**

2 spread of resistance makes the use of antibiotics less effective / AW **;**

3 via, conjugation / transformation / uptake of plasmids **;** **A** description

4 via, 'phage / transduction **;** **A** description

5 ref. R plasmid multiple resistance (MDR) / extreme resistance (XDR) **;** [3 max]

**(ii)** 1 gene for fluorescent substance **;**

2 source of gene **;** e.g. from jellyfish

3 substance fluoresces when exposed to appropriate light **;**

or

4 lacZ gene / gene for β-galactosidase **;**

5 splits non-blue substrate **;**

6 product is blue **;** [2 max]

**[Total: 15]**

**7** **(a)** key **;** *black upper case, chestnut lower case*

gametes **;**

offspring genotypes **and** chestnut identified **;**

25% / 0.25 / ¼ / 1 in 4, (probability) **;** *ignore ratios* [4]

**(b)**

| | | | | |
|---|---|---|---|---|
| *parental genotype* | $aaCC^{CR}$ | | AaCC | |
| *parental phenotype* | palomino / cream | | black **;** | |
| *gametes* | **aC** | **$aC^{CR}$** | **AC** | **aC ;** |
| *offspring genotypes* | **AaCC** | **aaCC** | **AaCCCR** | **$aaCC^{CR}$ ;** |
| | | | *any order* | |
| *offspring phenotypes* | **black** | **chestnut** | **black** | **palomino / cream ;** |
| | | | *order linked to genotype order* | |

*ecf can be applied to offspring genotypes and phenotypes* [4]

**[Total: 8]**

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**8** **(a)** M – palisade ;

N – vascular bundle / phloem and xylem / vein ; [2]

**(b)** 1 ref. ABA absence ;

2 $H^+$ transported out of guard cells, actively / using ATP ;

3 low $H^+$ conc / negative charge, inside cell ;

4 $K^+$ channels open / $K^+$ diffuses into cell ;

5 water potential of cell falls ; **A** decrease in solute potential

6 water moves into cell by osmosis ;

7 volume of guard cells increase / turgor increases ;

*guard cells:*

8 have hoops of cellulose microfibrils which ensure increase in length rather than diameter ;

9 have ends that are joined together ;

10 have, thicker inner walls / thinner outer walls ;

11 curve apart / bend, (to open stoma) ; [6 max]

**(c)** **(i)** cyclic photophosphorylation ; [1]

**(ii)** photolysis ;

(water splits into) $2e^-$, $2H^+$ and $(½)O_2$ ;

enzyme is involved ; [2 max]

**(iii)** ATP ; [1]

**(iv)** hydrogen carrier ;

GP, reduced / hydrogen added ; **R** $H_2$

to, TP / 3 carbon sugar ;

uses ATP ; [2 max]

**[Total: 14]**

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**9 (a)** 1 code is three, bases / nucleotides ; **A** triplet code

2 (gene) mutation ; **R** chromosome mutation

3 base, substitution / addition / deletion ;

4 addition / deletion, large effect (on amino acid sequence) ;

5 frame shift ;

6 completely new code after mutation / alters every 3 base sequence which follows ;

7 (substitution) often has no effect / silent mutation ;

8 different triplet but same amino acid / new amino acid in non-functional part of protein ;

9 (substitution) may have big effect (on amino acid sequence) ;

10 could produce 'stop' codon ;

11 sickle cell anaemia / PKU / cystic fibrosis ;

12 reference to transcription or translation in correct context ; **A** description

12a AVP ; e.g. protein produced, is non-functional / not produced / incomplete [7 max]

**(b)** 13 individuals in population have great reproductive potential / AW ;

14 numbers in population remain roughly constant ;

15 variation in members of population ;

16 environmental factors / named factor (biotic or abiotic) ; *linked to 17 and 18*

17 (cause) many, fail to survive / die / do not reproduce ;

18 those best adapted survive / survival of the fittest ;

19 (reproduce to) pass on alleles ; **R** genes

20 genetic variation leads to change in phenotype ;

21 ref: changes in, gene pool / allele frequency ;

22 over time produces evolutionary change ;

23 new species arise from existing ones / speciation ;

24 directional / stabilising, selection ; [8 max]

**[Total: 15]**

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**10 (a)** 1 selective reabsorption ;

2 (pct cells have) villi / microvilli / large surface area ;

3 (pct cells have) many mitochondria ;

4 $Na^+$ leave pct cells ;

5 by active transport ;

6 $Na^+$ concentration falls in (pct) cells / $Na^+$ concentration gradient ;

7 $Na^+$ (diffuse) from lumen into (pct) cells ;

8 through, transporter / carrier, proteins ; *ignore channel proteins*

9 cotransport ;

10 of, glucose / amino acids / vitamins / chloride ions ;

11 (from pct cells) into intercellular fluid ; *linked to 10*

12 (then) diffusion into blood ; *linked to 10*

13 (normally) all glucose reabsorbed ;

14 some water reabsorbed ;

15 some urea reabsorbed ;

16 AVP ; e.g. creatinine secreted into lumen [8 max]

*accept sodium ions but reject sodium or Na*
*penalise once only*

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**(b)** 17 ADH affects collecting duct **;**

18 binds to receptor on membrane **;**

19 <u>increase</u> membrane permeability (to water) / <u>more</u> water channels **;**

20 ref. enzyme controlled reactions **;**

21 produces (active) phosphorylase **;**

22 (which causes) vesicles with, water channels / aquaporins **;** *must be linked to 23*

23 to, move to / fuse with, (plasma) membrane **;**

24 <u>more</u> water flows out of collecting duct **;**

25 down / along, water potential gradient **;**

26 (then) into blood **;**

27 urine (more) concentrated / small volume of urine **;**

28 ref. negative feedback **;**

29 AVP **;** e.g. role of loop of Henle in creating water potential gradient
movement of urea increases water potential gradient [7 max]

**[Total: 15]**

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