

**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**

**9700/22**

Paper 2 (AS Structured Questions), maximum raw mark 60

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

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Mark Scheme abbreviations:

; separates marking points

/ alternative answers for the same point

**R** reject

**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) (i) transcription first process and exocytosis final process ;  
correct order for remaining three processes (3, 4, 2) ; [2]  
accept words and mixture of words and letters

(ii)

F ;  
A / D  
A ;  
C  
D ;

| events                      | order of events | cell location (letter) |                    |
|-----------------------------|-----------------|------------------------|--------------------|
| exocytosis                  | 5               | F                      | cell membrane ;    |
| protein modification        | 3               | A / D<br>A+D           | Golgi and/or RER , |
| secretory vesicle formation | 4               | A                      | Golgi ;            |
| transcription               | 1               | C                      | nucleus ,          |
| translation                 | 2               | D                      | RER ;              |

[3]

- (b) 1 vesicle / vacuole, moves towards, cell, surface / membrane ;  
A plasma membrane R if lysosome  
2 fusion / described, of vesicle with membrane ; R attach / bind / combine  
3 ref. to (fluid nature of) phospholipids ;  
4 contents / AW, secreted / released / exported / removed / emptied / excreted ;  
A waste material / digested material  
5 active process / energy-requiring / ATP used / AW ;  
R 'active transport' R endocytosis [max 3]

- (c) (i) AUG ; [1]

- (ii) 1 secondary structure /  $\alpha$ -helix /  $\beta$ -(pleated) sheet ;  
2 tertiary structure / description / folding / complex 3D shape ;  
3 formation of named bond(s) ; R if peptide bond in list  
4 quaternary structure / description (e.g. assembly of polypeptides) ;  
5 glycosylation / formation of glycoproteins / addition of carbohydrate(s) or sugar(s) ;  
R hydrocarbon chain  
6 addition of, non-protein portion(s) / prosthetic group(s) / named example ;  
A haem / iron / Fe / copper / Cu / magnesium / Mg / AW  
7 removal of some amino acids ; R one amino acid  
8 polypeptide(s) cut into two or more pieces ;  
9 AVP ; e.g. ref. to exposure to water molecules and folding  
R ref. to amino acids coded for by stop codons [max 2]

[Total: 11]

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- 2 (a) communicable / transmissible / contagious / transferable / AW ;  
**A** passed from one (infected), host / organism / one person, to another  
**A** 'passed on'  
 caused by, a pathogen / microorganism / *at least two* named types of pathogen ;  
**A** virus, bacterium, fungus, protoctist, worm ;  
**R** parasite unqualified by two types [max 2]
- (b) *Plasmodium, falciparum / ovale / vivax / malariae* ;  
**A** phonetic spellings for specific name, **A** plasmodium  
**R** if specific name first, [1]
- (c) (i) (only) female feeds on blood / male does not feed on blood ;  
 female requires blood (protein) for (development of) eggs ;  
 (only) female carries, pathogen / disease-causing organism / *Plasmodium* / parasite ;  
**A** (only) female transmits the disease  
 (only) female is vector ; **ora ignore** female carries, the disease / malaria [max 1]
- (ii) anti-coagulant (in saliva) is passed when mosquito, sucks blood / feeds / bites / takes a blood meal ;  
 anti-coagulant prevents blood clotting when mosquito, sucks blood / feeds / bites / takes a blood meal ; [max 1]
- (iii) *in marking accept*  
*Plasmodium* / pathogen / causative organism / malarial organism *where parasite is given below*  
*short time (in blood plasma)*  
 for exposure to cells of the immune system / AW ;  
 next stage(s) of life cycle inside cells ;  
**A** sporozoites into merozoites in liver /  
 merozoites into schizonts in red blood cells  
 parasite gains, food / energy, from cells ;  
 parasite, reproduces / multiplies, inside (liver / red blood) cells ;  
 damage to / bursting of / lysis of / impaired function of, cells ;  
 (antimalarial) drugs cannot penetrate (liver / red blood) cells ;  
 parasite, concealed / 'hides', from host immune system ;  
**A** antigen concealment ;  
 no symptoms, until parasite leaves cells / while parasite is in cells ;  
*idea that* people incubating disease are symptomless ;  
**A** symptomless carriers  
*idea that* treatment unlikely to prevent spread from infected person ;  
 AVP ; *examples*  
 different stages provide problems with drug / vaccine development  
 AVP ; mode of action of potential drugs – block attachment sites on cells  
 parasite in blood cells allows testing by taking blood samples  
 further development of any idea given above [max 2]

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- (d) if virus / bacterium / disease used instead mark to max 3  
in marking accept  
*Plasmodium* / pathogen / causative organism / malarial organism where parasite is given below

distribution described for one mark

either

(mainly in) tropics / between the tropics

or

any **two** named, areas and/or countries, affected ;

e.g. *areas* (sub-Saharan) Africa, Central America, South America, South Asia, Central Asia, Middle East, Caribbean

e.g. *countries* India, Sri Lanka, China, Vietnam, Cambodia, Brazil, Kenya

discussion to max four

- 1 (areas where) both parasite, **and**, vector / mosquito / Anopheles, are present ;
- 2 *Anopheles* / mosquito / vector, survives / breeds / lives, in, hot and humid areas / moist tropical areas ; **ora** **A** standing / stagnant, water
- 3 parasite, needs to reproduce within the mosquito (at temperatures above 20°C) ;
- 4 eradicated in some countries / any e.g. (USA, Italy) ;
- 5 ref to LEDCs and, poor / non-existent, control programmes ;  
**A** poor health facilities / poor drug supplies / AW
- 6 mosquitoes resistant to, DDT / insecticides / pesticides ;
- 7 parasite resistant to, chloroquine / drugs ;
- 8 link between human population density and *Anopheles* ;  
e.g. human activity provides (lots of) breeding sites for *Anopheles*
- 9 occurs where named high risk group(s) exist ;  
e.g. refugees, HIV-positive pregnant women (more likely to pass HIV to unborn children), (young) children
- 10 (outside tropics) disease spread by, travellers / tourists / migrants / refugees ;
- 11 AVP ;  
most cases / over 90% cases, in (sub-Saharan) Africa  
not, at high altitude / in deserts  
different species of *Plasmodium* differ in geographical distribution / AW  
misdiagnosis (so not reported)  
changing pattern linked to, global warming / changes in land use / deforestation / irrigation / other relevant named

**R** references to sickle cell

[max 4]

[Total: 11]

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- 3 (a) spherical / ball-shaped / AW ; **A** round(ed) / circular  
has tertiary structure ; **R** 3D  
hydrophilic / polar, (R) group(s), on outside / face to watery exterior ;  
hydrophobic / non-polar, (R) group(s), in centre ;  
water soluble ; [max 3]
- (b) (i) *idea that plant cell walls and fungal cell walls have different components*  
fungal cell walls made of, glucans / chitins / fungal cellulose / different components to  
plant cell walls ; **A** peptidoglycan / murein  
**A** plant cell walls contain cellulose, but fungi do not  
*idea of specificity in context of question*  
enzymes are specific ;  
**A** specificity explained e.g. both substrates not complementary / shape of active site  
specific to one substrate [2]
- (ii) 1 (at optimum pH) maximum / peak, activity ; **A** most efficient / works best  
2 above / below, optimum, activity declines ;  
**A** description / graph sketched with pH and rate / activity  
3 changing pH changes hydrogen ion concentration ;  
4 hydrogen / ionic, bonds (between amino acids), break / disrupted ;  
5 hydrogen / ionic, bonds, important in maintaining shape of, tertiary structure / active  
site ;  
**R** 4 and 5 if refer to disulfide, hydrophobic interactions, peptide  
*at sub-optimum pH*  
6 active site / tertiary, shape altered ; **A** enzyme denatured  
7 charges at the active site may be affected ;  
8 further detail ; e.g. transfer of electrons may not be possible  
9 the substrate may be altered by pH changes ; **R** cell wall unqualified  
10 (therefore) substrate no longer fits / ES complexes not formed ; [max 3]
- (c) osmosis, defined in terms of water potential / used in correct context ;  
0% and / or 0.4%  
higher / less negative, water potential outside so water enters ;  
  
0%, higher / less negative, water potential than 0.4%, so cells burst ; *ora*  
  
0.9%  
equal / same, water potential inside and outside cells, water in = water out ;  
**A** no net movement of water / ref. to isotonic / no water potential gradient  
**R** 'no osmosis' / no movement of water  
  
1.5% and / or 3.0%  
lower / more negative, water potential outside so water moves out ;  
  
3.0%, lower / more negative, water potential than 1.5% so cells, smaller / AW ; [max 4]
- (d) cells, increase in size / burst ; **A** vacuole increases in size **R** becomes turgid  
no cell wall to, prevent cell bursting / withstand (turgor) pressure ;  
**A** *idea that* cell membrane alone cannot withstand increase in size / bursting [2]

[Total: 14]

|               |                                               |                 |              |
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**4 (a)**

vaccine }  
macrophages }

antigens

lymphocytes } ;

mitosis

plasma cells

and

T<sub>h</sub>-lymphocytes ;

[3]

no ecf from **(a)** to **(b)**

**(b) 1** active (artificial) immunity ;

**2** memory cells / immunological memory ;

3 *idea that many specific, B-cells / T-cells / lymphocytes, in the body ;*

**A large(r) clones of specific, B- / T-cells or lymphocytes**

*actual invasion by the pathogen*

**4** fast secondary (immune) response ;

5 fast increase in antibodies / immediate production of antibodies ;

**ignore** incorrect type of cell secreting antibodies

**6** high(er) concentration of antibodies are produced ; **A** more antibodies produced

7 pathogen destroyed before person becomes ill / AW ; **R** antigen

**A pathogen do not, increase in number / infect cells / AW**

[max 3]

(c) *two points to look for*

(if) most / sufficient / many / AW, people / children, immunised / vaccinated :

**A herd immunity**

reduces the pool of infected, people / children, in the, community / population ;

**A fewer people can catch disease and be source of infection**

**A** protects those unvaccinated as, disease / illness, does not spread

**A less chance of transmission**

**A pathogen cannot develop in immunised people**

**A reduced exposure to pathogen**

[max 2]

**[Total: 8]**

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5 (a) glycogen ; [1]

(b) xerophyte / xerophyllic ; **A** phonetic e.g. zerophyte [1]

(c) haploid (cell) ; **A** monoploid [1]

(d) (primary) producer ; **R** first **ignore** autotrophic [1]

(e) (nitrogen) fixation ; **A** nitrogen fixing bacteria [1]

[Total: 5]

6 (a) (i) squamous / pavement (epithelial) ; [1]

(ii) stretch / expand, on inspiration and recoil on expiration ; **R** contraction

(stretch) to increases, surface area / volume of air, for, diffusion / gas exchange ;

(recoil) to help, expel air / force air out ; **A** carbon dioxide

**A** if destroyed then cannot expel air

prevent alveoli, bursting / breaking / AW ;

ref. to emphysema if elastic fibres destroyed ; [max 2]

(b) *award two marks if correct answer (anything in range 336–346)  
allow +/- 1 mm in reading the line (74–76 mm)*

75000  $\mu\text{m}$  / 220  $\mu\text{m}$  =  
341 ;;

*if answer incorrect, award one mark for correct measurement with unit and division by 220  
award one mark if correct answer given to one or more decimal places* [2]

(c) *look for two ideas – follow usual rules for marking numbered answer lines*

thin, alveolar wall / epithelial lining / AW ;

**A** short diffusion distance (between air in alveolus and blood in capillary)

**A** squamous cells are thin

**R** thin, membrane / cell membrane **R** large surface area

surrounded by, capillaries / capillary network ;

**A** close contact with, capillaries / blood (vessels / cells)

**A** many capillaries

**A** large area of alveolus in contact with, capillaries / blood [2]

|               |                                               |                 |              |
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**(d) max 3 if no ref. to diffusion**

(named) gas(es), diffuse down, pressure gradients / concentration gradient / AW ;

**A** from high(er) partial pressure to low(er) partial pressure

**A** high(er) concentration to low(er) concentration

**ignore** 'along a concentration gradient'

*in the answers accept the following AWs*

*capillaries / haemoglobin for blood*

*lungs for alveoli*

*body for tissues*

**lungs**

*valid statement linking information in table below – 1 mark for each row*

*comparison in partial pressure may be 'higher / lower' not both or high and low, but if not then figures have to be given*

| <b>blood</b>                                        | <b>ref. to gas</b> | <b>blood partial pressure</b> | <b>alveolar air partial pressure</b> | <b>gas exchange</b>          |
|-----------------------------------------------------|--------------------|-------------------------------|--------------------------------------|------------------------------|
| in pulmonary artery / entering alveolar capillaries | $pO_2$             | 5.33 / lower                  | 13.87 / higher                       | into blood from alveolus ;   |
|                                                     | $pCO_2$            | 6.00 / higher                 | 5.33 / lower                         | out of blood into alveolus ; |

**respiring tissue**

*valid statement linking information in table below – 1 mark for each row*

| <b>blood</b>                                     | <b>ref. to gas</b> | <b>blood partial pressure</b> | <b>tissue partial pressure</b> | <b>gas exchange</b>        |
|--------------------------------------------------|--------------------|-------------------------------|--------------------------------|----------------------------|
| in systemic artery / entering tissue capillaries | $pO_2$             | 13.33 / higher                | < 5.33 / lower                 | into tissue from blood ;   |
|                                                  | $pCO_2$            | 5.33 / lower                  | > 6.00 / higher                | out of tissue into blood ; |

[max 4]

**R** differences between  $pO_2$  and  $pCO_2$  in the same place

**[Total: 11]**