UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2009 question paper for the guidance of teachers

9700 BIOLOGY

9700/21 Paper 2 (Structured Questions AS), maximum raw mark 60

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UNIVERSITY of CAMBRIDGE
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1 (a) (i) circle around one *or* two variable regions **;** [1]

(ii) line(s) between **one** light polypeptide and **one** heavy polypeptide,
line(s) between the two heavy polypeptides **;**
maximum of six lines in each site [1]

(iii) **1** (disulfide) bonds are between, cysteine(s) / cysteine residues **;**
A between R groups S-H S-H
2 covalent bond **;**
3 strong bond / not easily broken **;**
4 hold, polypeptides / chains / protein , together **;** **R** proteins / strands
5 (in protein with) tertiary / quaternary (structure) **;**
6 maintain shape / stop loss of shape / prevent deforming **;**
A 3D structure **R** structure unqualified [3 max]

(b) **1** secreted / synthesised / produced / released, by, plasma cells / B lymphocytes / B cells **;**
2 combines / AW, with, antigens / pathogens / toxins / viruses / bacteria / microbes **;**
A 'bonds with' / 'sticks to' / 'attaches to' **R** 'disease'
3 ref to, specificity / described **;** *in context of antibody / B cells / antigen*
4 variable region is antigen binding region **;** **R** 'receptors on antibodies'
5 neutralises toxins / antitoxin(s) **;**
6 lysis of pathogens / described / lysin(s) **;** **R** breaks down
7 prevents viruses entering cells **;**
8 clumps / agglutinates / aggregates / AW, bacteria **;** **R** 'coagulation'
9 opsonisation / opsonins **;** **A** enable recognition
10 coats / AW, bacteria to facilitate phagocytosis **;** *only in context 8 or 9*
11 receptors on phagocytes for constant regions (of antibodies) **;** [4 max]

(c) **1** (carrier / channel protein for) facilitated diffusion / described **;**
A action of (co-) transport protein described
2 (carrier protein for) active transport / described **;**
3 cell recognition / distinguishing self from non-self / act as antigens / AW **;**
4 receptor **;** **A** binding site qualified in terms of, hormones / neurotransmitters / cytokines / cell signalling molecules **;**
5 T-cell receptor / described **;**
6 cell (to cell) adhesion / described **;**
7 enzyme **;**
8 form (hydrogen) bonds with, water / fluid surroundings, to stabilise membrane **;** **[3]**

[Total: 12]

2 (a) *marking points are independent*

iodine in potassium iodide solution / I in KI solution / iodine solution **;**
R iodine / iodine test
A if 'solution' not used, but clear that it is a solution

positive result = (from yellow / red brown to) blue-black / blue / black **;**
R blue-black precipitate [2]

(b) no activity at pH 2.0 **and** pH 9.0, some activity at pH 3.0 **and** 8.0 **;**
optimum between pH 5.5 and 6.5 **;** [2]

(c) *description*
1 optimum / peak / described, at pH 6.0 **;** *allow ecf from graph*
A 'enzyme works best at' / 'most efficient at'
'rate of reaction / activity, is greatest at…'
2 low / no, hydrolysis / activity, with **at least one** correct pH **;**
3 data quote (from table) using time **;**
e.g. within 10 minutes / change within 2 minutes / 1/t

explanation to max 4 accept ora
4 at optimum pH, most successful collisions **;** **A** alternative wording

greater or less than optimum
5 high / low, hydrogen ion concentration **;**
6 enzyme denatured (fully) at / <pH2 *or* at / >pH9 **;**
7 partial denaturation / AW, at other stated value(s) of pH **;**

at any pH – optimum or sub-optimum
8 ref to, hydrogen bonds / ionic bonds **;** **R** if other bonds named
9 ref to tertiary structure **;** **A** ref to allosteric site
10 shape of active site **;**
11 detail of active site **;**
e.g. changes to charge on active site / no longer complementary to substrate forms, no / fewer, enzyme-substrate complexes [5 max]

[Total: 9]

3 (a) (i) anaphase / early telophase **;** [1]

(ii)
1 chromosomes / chromatids, move to / at, poles / centrosomes **;**
2 attached to, spindle / microtubules **;**
3 by, centromeres / kinetochores **;** **A** centromeres leading
4 pulled by, microtubules / spindle fibres / AW **;**
A contracting / shortening / disassembling [2 max]

(iii) *these points are independent*
1 cannot follow, movement of chromosomes / AW **;**
e.g. 'processes in mitosis'
2 can only view dead material **;**
3 sections have to be thin **;**
4 overstaining obscures details (of chromosomes) **;** **A** artefacts
5 cannot see, all of the chromosomes / whole chromosomes **;** [2 max]

(b) (i)
1 carcinogen / cancer-causing / named carcinogen (in tobacco smoke / tar) **;**
e.g. benzpyrene / phenol / nicotine *check any others*
2 mutation / change to DNA **;**
3 ref to named gene **;** e.g. oncogene / tumour suppressor
4 in (bronchial) epithelium **;**
5 uncontrolled, cell division / mitosis / cell cycle **;** **R** 'rapid'
6 grows into, mass of cells / lumen of airway(s) / lung tissue **;**
A squeezes against blood vessels / enters lymphatic vessels
7 growth of blood capillaries (into tumour) **;**
A angiogenesis / vascularisation / ref to thrombospondin
8 no programmed cell death **;** [3 max]

(ii) must be a sign or symptom
1 coughing up blood **;**
2 persistent cough / coughing a lot **;**
3 coughing up increased volume of sputum / AW **;**
4 chest / shoulder / back, pain **;**
5 wheezing / breathlessness / breathing difficulty **;**
6 weight loss **;**
7 AVP **;** e.g. fatigue **R** tiredness [2 max]

[Total: 10]

4 **(a)** loss of water vapour **;**
from leaves / aerial parts of plant **;** **R** stomata unqualified
ignore evaporation [2]

(b) **1** rate for species **A** is always higher / ora for **B ;**
similarity
2 the rates of both species, increase and then decrease / reach a peak **;**
3 peak is, around midday / around noon / 11.30 to 12.30 **;**
difference
4 rate for species **B** decreases earlier than that for species **A ;**
A species **B** at ~11.45 **and** species **A** at ~12.15 +/– 5 mins
5 steeper / faster, increase / decrease, for **A ;**
6 comparative data quote for rates of transpiration **;** +/– ½ a square
A µg min^{-1} for unit [4 max]

(c) *two adaptations plus explanation – explanation may be the same for each answer*
*accept ora for species **A***

f1 sunken stomata **;** **A** stomata in, pits / chambers / grooves
f2 hairs / trichomes (on epidermis) **;** **R** needles
f3 rolled / curled / AW, leaves **;** *ignore curved unqualified*
e1 high humidity / retains moist air / high concentration of water vapour, to reduce diffusion gradient *or* water potential gradient / AW **;**
R 'moisture'

f4 small leaves / leaves are spines / leaves are needles **;** **R** spikes
R 'no leaves'
e2 reduce surface area (for transpiration) **;**
reduce SA explained but unqualified by size of leaf = 1 mark (see F9)

f5 thick leaves **;** **A** succulent
e3 reduce surface area : volume ratio **;**

f6 thick (waxy) cuticle **;**
e4 decreases permeability / is impermeable / provides **a** barrier / ora **;** **A** e5

f7 reflective cuticle **;**
f8 several layers of hypodermis **;** **A** layers of epidermis / described
f9 epidermis with thick walled cells **;**
f10 few stomata / low stomatal density **;**
e5 reduce (rate of) diffusion of water **;** **R** close of stomata [4 max]

[Total: 10]

5 **(a)** meiosis in lowest box **;**
mitosis in the other two boxes **;** [2]

(b) larger / 80S, ribosomes **;**
mitochondria **;**
Golgi (body / apparatus) **;**
(smooth / rough) endoplasmic reticulum **;** **A** (smooth / rough) ER
vacuole(s) / vesicle(s) / lysosomes **;**
centriole / centrosome **;**
A membrane-bound organelles if no examples given
R chloroplast/ chromosomes / nucleus [2 max]

(c) *ignore any other methods of transmission given*
(spores) in droplets / moist air, coughed / sneezed / breathed, out **;** **A** aerosol
breathed in (by other person) **;** [2 max]

(d) **1** no (effective) vaccine **;**
2 HIV has a high mutation rate **;**
3 antigens change / different antigens / different strains **;**
4 no cure **;**
5 drugs, are expensive / not widely available / not effective / AW **;**
6 vertical transmission / mother to child **;**
problems with:
7 symptomless carriers (spreading the virus) **;**
8 testing people for HIV status **;**
9 providing, condoms / femidoms **;**
10 promiscuity **;**
11 educating about risks / AW **;**
12 reuse of needles **;**
13 tracing contacts (of infected people) **;**
14 testing / screening, blood donations **;**
15 treating, blood / blood products, to, destroy / inactive / 'kill', HIV **;**
16 ref to cultural issues **;** *accept relevant examples*
17 ref to poverty **;**
18 AVP **;** e.g. war / civil disturbance, out of date drugs, ref to transport links
ignore resistance of HIV [4 max]

[Total: 10]

6 (a) 'self contained' / 'self-sustaining' / determined by same physical feature / defined area **;**

community / all organisms / biotic factors, **and**, physical factors / abiotic factors / non-living factors / environment **;**

ref. to interaction between, organisms (and physical environment) **;** [2 max]

(b) *award two marks for the correct answer (5.5%)*
if no answer or incorrect answer or answer to too many decimal places, award one mark for working (88 / 1609)
88 / 1609 (× 100)
5.5 (%) **;;** [2]

(c) *these are points for producers to primary consumers – accept ora for secondary consumers to tertiary consumers*
1 some parts inedible **;**
2 indigestible / cannot digest cellulose or lignin **;**
3 more material goes to decomposers (rather than consumers) **;**
4 plant material is less energy rich / animal flesh is more energy rich **;**
5 manipulated data in support **;** e.g. ×2 to decomposers from producers
0.8% (energy available to primary consumers divided by the energy available to plants)
[3 max]

(d) *decomposers in recycling nitrogen*
protein → ammonia / ammonium ions = 1 mark
1 convert protein → amino acids **;**
2 deamination **;**
3 urea / amino acids → ammonia / ammonium ions **;** **A** ammonification
4 make, ammonia / ammonium ions, available to nitrifying bacteria **;**
A role of nitrifying bacteria / correctly named [2 max]

[Total: 9]