CAMBRIDGE INTERNATIONAL EXAMINATIONS

Pre-U Certificate

MARK SCHEME for the May/June 2013 series

9790 BIOLOGY

9790/01 Paper 1 (Structured), maximum raw mark 100

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.

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CAMBRIDGE
International Examinations

Section A

Question Number	*Key*
1	**D**
2	**C**
3	**B**
4	**B**
5	**D**
6	**B**
7	**C**
8	**C**
9	**C**
10	**Q**
11	**B**
12	**5n**
13	**7**
14	**1**
15	**6**
16	**2**
17	**D**
18	**A**
19	**C**
20	**C**

Section B

21 (a) (i) **A =** pyruvate **;**

accept other names e.g. 2-oxopropanoic acid

B = reduced NAD / NADH
C = NAD($^+$) **;**

ignore attempts to balance equation **[2]**

(ii) cytosol / cytoplasm **;** **[1]**

(iii) 1 allows glycolysis to continue (during oxygen deficit) **;**
2 regenerates NAD (for use in glycolysis) **;**
3 allows ATP production (to continue) **;**
4 (ATP) for (muscle) contraction **;**
accept details of ATP involvement in contraction
5, AVP **; ;**
6 e.g. temporary storage of hydrogen / hydrogen transferred prevents accumulation of reduced NAD / AW
e.g. lactate transported areas with (more) oxygen (for oxidation)
e.g. lactate prevents damage to muscles by overexertion / AW **[max 4]**

(b) *allow points linked to named enzymes*
1 tertiary structure / folded chain, held in place by, bonds / interactions between R groups **;**
2 three correctly named bonds **;**
from:
hydrogen bond
accept H bond
ionic / electrovalent, bond
disulfide bond
hydrophobic interactions
van der Waal's (forces)
3 ref. specificity **;**
e.g. active site shape complementary to substrate shape
e.g. substrate binding to active site by lock and key mechanism
e.g. specific active site means enzyme catalyses only one specific, reaction / interconversion
accept active site in terms of tertiary and quaternary structure
4 *idea* that conformational changes occur to improve fit / induced fit, described **;**
5 (amino acids with) hydrophilic / polar, R-groups / side chains, on the outside / facing water / AW / ora hydrophobic, R-groups / central area **;**
6 solubility / interact with water / reactions occur in aqueous environment **;**
7, AVP **; ;**
8 e.g. reference to primary and secondary protein structure
e.g. further detail of R-groups involved in catalysis
e.g. details of how structure lowers activation energy for catalysis **[max 4]**

(c) 1 each (nucleated) cell has both genes **;**
accept *idea* that all cells have the same genetic information

2 ref. to differential expression / control of gene expression / tissue-specific expression **;**
accept in context of transcription

3 use of data from 21.1 to qualify **;**
in terms of genes, *LDH-A* and *LDH-B* transcribed

4 ref. transcription factors required to initiate transcription / ref. to binding of RNA polymerase to promoter / ref. to transcription complex **;**

5 AVP **;**
e.g. developmental control
e.g. control of assembly of transcribed polypeptides **[max 2]**

(d) **(i)** 1 ref. (events leading to heart attack take place in the) coronary arteries **;**

2 ref. presence of, atheroma / atheromatous plaque, and, uneven / turbulent blood flow **;**

3 (causes) clot / thrombus, formation (by platelets) **;**

4 decreased blood flow caused by, stenosis / narrow(ed) lumen **;**
accept no blood flow caused by blocked lumen
accept embolism / described, linked to reduced blood flow
accept thrombosis linked to reduced blood flow

5 less (blood with), glucose / oxygen, reaches the, heart / cardiac, muscle / heart / cardiac, muscle, deprived / AW, of oxygen / glucose **;**
accept myocardial infarction occurs

4/5 **accept** ischaemia in context of heart if no mp 4 and 5

6 heart attack caused by, damage to / death of, heart tissue **;** **[max 3]**

(ii) 1 different conditions (usually) affect different, tissues / body locations **;**

2 *idea* that, damage / injury (because of condition), to, tissues / cells, causes release of LDH / LDH to enter blood **;**
accept named examples, e.g. cardiac muscle

3 (as) different tissues have different isoenzymes / each tissue has particular isoenzyme(s) / heart tissue will have particular isoenzymes **;**
accept other named tissue

4 *idea* of comparing test LDH isoenzyme concentrations (in blood) against normal concentrations **;**
detail – use of Table 21.1 to max 2

5 results indicate tissue from where damage originates **;**

6 heart damage indicated by higher concentrations of, LDH-1 / LDH-2 **;**
accept HHHH / HHHM

7 presence of, LDH-3 / HHMM, indicates, brain / lung, damage /
LDH-4 / HMMM, indicates, kidney / placenta, damage /
LDH-5 / MMMM, indicates, liver / skeletal muscle, damage **;**

8 AVP **;**
e.g. ratio of isoenzymes may change with damage to different tissues
e.g. useful in differentiating between conditions with tissue damage and those without (where symptoms exist)
e.g. (suggestion of) use of electrophoresis to identify the different isoenzymes present **[max 4]**

(e) 1 base sequences are from the non-template / non-transcribed / AW, strand / polynucleotide **;**

2 (m)RNA is equivalent to DNA strand shown except U replaces T / is complementary copy of transcribed strand of DNA **;**

3 further detail from Fig. 21.2 and Table 21.2 **;**
e.g. met start amino acid = AUG mRNA codon, so transcribed DNA would be TAC, instead of ATG

4 *either*
stated similarity of nucleotide sequence **;**
e.g. first 11, nucleotides / bases, identical
e.g. first three triplets identical
e.g. triplet, 5 / 9, the same

or

stated differences in nucleotide sequence **;**
accept codon for triplet
e.g. fourth, sixth, seventh, eighth and tenth triplets different
e.g. fourth triplet CTA in *LDH-A* but CTT in *LDH-B*
e.g. sixth triplet GAT in *LDH-A* but GAA in *LDH-B*
e.g. seventh triplet CAG in *LDH-A* but AAA in *LDH-B*
e.g. eighth triplet CTG in *LDH-A* but CTC in *LDH-B*
e.g. tenth triplet TAT in *LDH-A* but AAA in *LDH-B*

5 *either*
stated similarity of amino acid sequence **;** *10 amino acids in sequence*
e.g. first five amino acids are, met-ala-thr-leu-lys / the same
e.g. eighth and ninth amino acids are, leu and ile / the same
e.g. 70% homology

or

stated differences in amino acid sequence **;**
e.g. sixth, asp v glu / seventh, gln v lys / tenth, tyr v ala

6 ref. same amino acid but different, nucleotide sequence / triplet **;**
e.g. first leu / fourth amino acid = CTA in *LDH-A* and CTT in *LDH-B*
e.g. second leu / eighth amino acid = CTG in *LDH-A* and CTC in *LDH-B*

7 explanation in terms of genetic code **;**
e.g. same amino acid can be specified by different codons / degeneracy of code / wobble on third nucleotide of codon

8 both have retained met, start amino acid **;**

9 AVP **;**
e.g. different amino acid sequences may allow for different polypeptide folding
e.g. different amino acid sequences may lead to changes in, active site / other named or described site
reject if suggestion made that this would alter the type of reaction catalysed
e.g. comment on evolutionary nature of the homology of the amino acid sequence
e.g. additional use of data from, Fig. 21.2 / Table 21.1, such as further examples of genetic wobble **[max 6]**

[Total: 26]

22 **(a)** for products, award mark if as table below OR correctly matched to cell

cell	name of cell	product
A	columnar epithelial / mucous neck ; **accept** epithelial cell / mucus-secreting cell	mucus ;
B	parietal / oxyntic ;	hydrochloric acid / intrinsic factor ; **accept** HC*l* / gastric acid
C	peptic / chief ; **accept** zymogenic	pepsinogen ; **accept** zymogen

[6]

(b) 1 faecal-oral route / described ;
e.g. present in faeces, into water sources
2 gastro-oral route / described ;
e.g. in vomit, unwitting ingestion
3 oral-oral route / described ;
e.g. saliva to saliva
4 oral-gastro route / described ;
e.g. sharing food (contaminated saliva ingested)
5 gastro-gastro route / described ;
e.g. endoscopy

If marking points 1 – 5 not awarded allow one mark for ingestion of contaminated food. **[max 2]**

(c) *antibodies:*

1 ref. to specificity antibody to antigen **;**
accept described

2 if anti-*H. pylori* antibody present, it will bind to, antigen (in well) / antigen-antibody complex formed in well **;**
accept serum antibody

3 *either*
anti-human antibody (linked to enzyme X) binds to, anti-*H. pylori* / serum, antibody **;**
accept binds to antigen-antibody complex
or
anti-*H. pylori* / serum, antibody acts as antigen to anti-human antibody **;**

rinsing in step 3:

4 rinsing washes away any unbound, anti-human antibody / enzyme (X) **;**
5 only want to identify, anti-human antibody that binds to antigen-antibody complex / enzyme (X) attached to antigen-antibody complex **;**
6 presence of, anti-human antibody / enzyme (X), will give colour change on addition of substrate **;**
7 to avoid false colour changes / false positive result / AW **;**

*use of enzyme **X**:* **accept** points if occurring as part of rinsing in **step 3**

8 produces coloured product **;**
9 quickly **;**

10 no colour obtained = no anti-*H. pylori* antibodies present (in serum) / ora **;**
11 person not infected / has not had recent infection / ora **;**
12 intensity of colour is proportional to concentration of antibodies **;** **[max 7]**

(d) 1 test only detects presence of antibodies, not actual organism / AW **;**
2 antibodies can remain in body for some time (after *H. pylori* eradicated) **;**
accept ref. to (B) memory cells
3 would give, false positive result / a positive result even if *H. pylori* not present **;** **[max 2]**

(e) (i) 1 suggestion of how mutation confers resistance **;**
e.g. production of enzyme that inhibits action of antibiotic
e.g. production of membrane efflux pump
e.g. alteration to ribosome structure
2 antibiotic(s) acts as a selection pressure / described **;**
3 explained **;**
e.g. resistant bacteria survive to pass on, mutation / AW
4 directional selection **;**
5 (vertical transmission by) binary fission / described **;**

horizontal / lateral, (gene) transmission:
6 by transformation, transduction and conjugation **;**
7 transformation described **;**
e.g. bacteria die, DNA / plasmid, released and antibiotic resistance genes directly taken up
8 transduction described **;**
e.g. virus incorporates bacterial gene coding for resistance, virus pass on when infecting cell, cell gains resistance if survives
9 conjugation, with other bacteria / further detail **;**
e.g. sex pilus formation induced, by transposons or plasmids
10 AVP **;**
e.g. *idea* of previously evolved genes coding for resistance that are induced to express in presence of antibiotic **[max 4]**

(ii) *allow any acceptable suggestions to max 3*
allow ora where relevant
assume ref to protoctists unless told otherwise

1 eukaryotes / eukaryotic **;**
2 do not have, murein / peptidoglycan, cell walls **;**
accept (some) do not have cell walls
reject eukaryotes do not have cell walls
3 do not have, transpeptidases / enzymes that are susceptible to inhibition **;**
4 have (structurally) different ribosomes **;**
accept 80S / larger, ribosomes
5 different targets in, transcription / translation **;**
6 do not build up antibiotics within their cytoplasm, bacteria do **;**
7 have different cell surface membrane, which prevents entry of antibiotics **;**
8 have efflux pumps (specific to antibiotics used to treat) **;**
9 have cytoplasmic enzymes that degrade antibiotics **;**
10 AVP **;**
e.g. may secrete protective layer **[max 3]**

[Total: 24]

23 (a) *any two suitable features e.g.*

1 ability to target, epithelial cells / epithelial tissue / cells of the respiratory tract / AW ;
accept idea of, specificity / target cells

2 ability to penetrate mucus ;

3 ability to get DNA into target cells ;

4 mechanism of integration into target genome ;

5 harmless to, target cells / person ;

6 immune system not stimulated / no allergic reaction / AW ;

7 can accommodate, healthy / replacement, gene / AW ; **[max 2]**

(b) 1 cells have (relatively) short life span so cannot rely on one-off treatment ;
accept repeated treatments required

2 target cell uptake of gene not 100% successful / AW ;

3 integration of gene into genome not always successful / AW ;

4 problems with continued gene expression ;

5 possibility of gene insertion affecting expression of other genes ;

6 ref. to not (overall) cure / other areas of body affected / large numbers of cells to be treated / only localised areas treated ;

7 further detail ;
e.g. pancreatic ducts and digestive problems

8 may produce bad side effects / AW ;
accept in context of past trials

9 (repeated treatments may lead to) immune response problems ;
accept in context of past trials **[max 3]**

(c) *CFTR* = cystic fibrosis transmembrane conductance regulator

1 membrane, glycoprotein / protein (of epithelial cells) ;

2 transport / channel / gated, (protein) / transporter ;
accept carrier protein

3 (transports) chloride ions out of cells ;

4 so water moves out of cell, down water potential gradient / by osmosis ;
accept watery mucus produced

5 AVP ;
e.g. ATP, activated / driven
ignore active transport
e.g. regulates other channels so positively charged ions leave / sodium ions follow chloride ions (so decreasing water potential)
e.g. examples of location of cells including digestive system / pancreas, reproductive system, airways / lungs
e.g. sweat duct cells reabsorb chloride ions **[max 3]**

(d) (i) restriction, endonuclease / enzyme ; **[1]**

(ii) electrophoresis ; **[1]**

(iii) (DNA) ligase ; **[1]**

(e) (complementary) gene / DNA, probes / descriptions ; **[1]**

(f) 1 ref. heating to 90°C (for a short time) ;
accept 75°C – 95°C
2 (to) separate (DNA) strands / H bonds broken / ref. denaturing DNA ;
3 cool (to 55°C) ;
4 primers added / primers anneal ;
5 (DNA) nucleotides added ;
reject RNA nucleotides
reject oligonucleotides
6 *Taq* polymerase added ;
accept *Pfu* polymerase (and others)
7 new strands synthesised (in context of PCR) ; **[max 4]**

[Total: 16]

24 (a) (i) 1 no reliance on light / ora ;
2 (reef-building corals) algae / zooxanthellae, photosynthesise ;
3 depth limit to penetration by light / light absorbed as penetrates water ;
4 AVP ;
e.g. different feeding methods / deeper waters (may be) nutrient rich **[max 2]**

(ii) 1 physical support to obtain light ;
2 carbon dioxide for photosynthesis ;
3 N from nitrogenous wastes of, coral polyps ;
4 ref. coral and, food caught / suspension feeding / catching prey, provides nutrients / needed for growth of algae ;
5 protection from predation ;
6 protection from extreme conditions ;
7 AVP ;
e.g. low concentrations of nitrate ions and phosphate ions in seas **[max 2]**

(b) 1 decreased source of food ;
accept nutrients if qualified by ref. to photosynthesis or production by zooxanthellae
2 lack of organic compounds / named compound ;
accept no carbon fixation
3 loss of (main) source of (chemical) energy ;
4 loss of inorganic ions for deposition of skeleton that algae obtain from sea ;
5 loss of protective algal layer from harmful effects of sunlight ; **[max 1]**

(c) (i) *idea* that shallow bodies of water, heat up quicker / more susceptible to extreme temperature fluctuations, than deeper bodies ; **[1]**

(ii) 1 increased bacterial multiplication (provides larger numbers) / AW ;
2 bacterial infectivity increases in warmer temperatures ;
3 stress conditions for coral increases susceptibility to disease ; **[max 1]**

24 (d) 1 levels of biodiversity affected are, genetic, species, community, ecosystem ;
accept any three

genetic biodiversity:
2 loss of genomes ;
accept loss of genes if clear species becomes extinct
3 loss of, genetic diversity / alleles, within a species ;

reduced species biodiversity:
4 loss of different coral species ;
5 loss of species within the genus *Symbiodinium* ;
6 loss of species, reliant / AW, on coral ;

7 reduced community biodiversity is loss of more than one species (from coral reef) ;

reduced ecosystem biodiversity:
8 loss of, primary producers / autotrophs ;
9 effect on, energy flow / food web ;
accept example
10 loss of habitat for, other species / fish / marine invertebrates ;
11 reduced / affected, interactions ;
12 recycling of matter altered ;

13 AVP ; **[max 4]**

(e) 1 species, exerts disproportionate influence / has a crucial role, (on ecosystem) / AW ;
2 out of proportion to its (relative), abundance / biomass ;
3 represents (ecosystem) / maintains, stability (of ecosystem) / AW *or* removal / loss, has a destabilising effect (on ecosystem) / AW ;
4 loss of the species can lead to loss of the ecosystem / ora ;
5 loss of the species can cause the loss of other species (in the ecosystem) ;
6 loss of the species can lead to invasion by non-native species ;
7 addition, can (greatly) alter character of ecosystem / AW ;
8 loss / addition, (greatly) alters, energy flow / food webs *or* presence maintains stability of food web ;
9 biodiversity maintained by continued presence ;
10 AVP ;
e.g. described example
e.g. example of contribution made **[3]**

[Total: 14]