As part of CIE’s continual commitment to maintaining best practice in assessment, CIE has begun to use different variants of some question papers for our most popular assessments with extremely large and widespread candidature. The question papers are closely related and the relationships between them have been thoroughly established using our assessment expertise. All versions of the paper give assessment of equal standard.

The content assessed by the examination papers and the type of questions are unchanged.

This change means that for this component there are now two variant Question Papers, Mark Schemes and Principal Examiner’s Reports where previously there was only one. For any individual country, it is intended that only one variant is used. This document contains both variants which will give all Centres access to even more past examination material than is usually the case.

The diagram shows the relationship between the Question Papers, Mark Schemes and Principal Examiner’s Reports.

<table>
<thead>
<tr>
<th>Question Paper</th>
<th>Mark Scheme</th>
<th>Principal Examiner’s Report</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>Introduction</td>
<td>Introduction</td>
</tr>
<tr>
<td>First variant Question Paper</td>
<td>First variant Mark Scheme</td>
<td>First variant Principal Examiner's Report</td>
</tr>
<tr>
<td>Second variant Question Paper</td>
<td>Second variant Mark Scheme</td>
<td>Second variant Principal Examiner's Report</td>
</tr>
</tbody>
</table>

Who can I contact for further information on these changes?
Please direct any questions about this to CIE’s Customer Services team at: international@cie.org.uk
MARK SCHEME for the October/November 2008 question paper

9700 BIOLOGY
9700/02  Paper 2 (Theory 1), maximum raw mark 60

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1. (a) Check column A and B for correct ref. to feature if not clear in first column e.g. gives description.

<table>
<thead>
<tr>
<th>feature</th>
<th>phagocyte (A)</th>
<th>plasma cell (B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>rough endoplasmic reticulum / RER</td>
<td>small quantity / AW A few, less</td>
<td>large quantity / AW A many, more</td>
</tr>
<tr>
<td>allow ER if rough / RER stated in next column(s) R RER</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ribosomes</td>
<td>few</td>
<td>many ;</td>
</tr>
<tr>
<td></td>
<td>or ref. to free</td>
<td>or not free / fixed</td>
</tr>
<tr>
<td>lysosomes</td>
<td>some / present / ✓</td>
<td>none / absent / x ;</td>
</tr>
<tr>
<td>vacuoles / vesicles / phagosomes</td>
<td>some / present / ✓</td>
<td>none / absent / x ;</td>
</tr>
<tr>
<td>nucleus</td>
<td>lobed / AW A irregular, not round R curved, elongated, no definite shape</td>
<td>round / not lobed / not irregular / AW ; A spherical, circular</td>
</tr>
<tr>
<td>Golgi (body)</td>
<td>absent / x</td>
<td>present / ✓ ;</td>
</tr>
<tr>
<td>plasma / cell (surface), membrane</td>
<td>with, endocytotic / pinocytotic / phagocytic / exocytotic, vesicles / vacuoles A invaginations, infoldings R indentations</td>
<td>without, endocytotic / pinocytotic / phagocytic / exocytotic, vesicles / vacuoles A no invaginations, no infoldings R no indentations</td>
</tr>
<tr>
<td>mitochondria</td>
<td>less / few / 3</td>
<td>more / many / 7 ;</td>
</tr>
</tbody>
</table>

[3 max]

(b) (to nearest whole number) (x) 6000 ; A 5900 – 6100

Allow 1 mark for correct working if answer incorrect / not to whole number

E.g. length of scale bar in mm × 1000, divide by actual size

60 mm × 1000 / 10 A 59 – 61 mm

[2]
(c) **phagocyte**
move to sites of infection; 
- ingest / engulf / pseudopodia enveloping / phagocytosis of / endocytosis of, bacteria / microbes / pathogens / AW; 
- R antigens, virus 
(form) phagocytic / endocytotic, vacuoles; 
A vesicles, phagosomes 
ref to lysosomes; 
enzymes / named (hydrolytic) enzymes; 
digest / hydrolyse, (bacteria / AW); 
antigen presentation / description;  

**plasma cell**
produce / secrete / release / synthesise, antibodies; A make 
to, plasma / tissue fluid / lymph; A blood 
antibodies are proteins; 
ref to, RER / ribosomes; 
specificity qualified e.g. of, antibodies / lymphocyte / plasma cell 
    or description e.g. each type of plasma cell produces one type of antibody; 
Golgi (body) packages antibodies / ref to formation of (Golgi) vesicles;  

(d) (bacteria likely to be) resistant to (at least) one antibiotic (so useless); 
less likely to be resistant to all / chance that bacteria will develop resistance to all 
antibiotics used is very small; 
ref to mutation / change to DNA; 
(bacteria are) inside cells where protected from antibiotics; 
(mycobacteria) divide / grow, slowly; 
ensures all bacteria killed / reduces below critical level; 
otherwise, bacteria remain / reservoir of infection; 
(so) prevents development of antibiotic resistance;  

[Total: 15]
(ii) adaptations

(epidermal) hairs / trichomes; R spikes, spines
stomata in, pits / cavities / chambers; R sunken stomata

reduced air movement / still air;
holds water vapour / has high(er) humidity / AW; A holds moist air
(therefore) less steep, water potential / vapour pressure / diffusion, gradient;
A qualified ref to diffusion shells between air inside leaf and air in pits;

thick / waxy, cuticle (on upper, epidermis / surface);
multilayered, epidermis / hypodermis;
thick walled epidermal cells;
cuticle reflects sunlight;
stomata only on lower surface / no stomata on upper surface;[3 max]

[Total: 10]

3 (a) (i) tertiary (structure); A 3° [1]

(ii) secondary (structure); A 2°, alpha / α, helix [1]

(b) active site; A catalytic site [1]

(c) (i) mRNA CGU ; UGC / UGU GAA
DNA GCA ACG / ACA CTT ; [3]

(ii) many / several / more than one, triplet for each amino acid; A codon
an e.g. from Table 3.1:
degenerate code / description e.g. 64 possible triplets for 20 amino acids; A codons
AVP; e.g. may be an intron in this region, different nucleotides at the beginning
(signal sequence) [2 max]

(d) (i) reject references to time e.g. rapid, slowly
as the concentration of, enzyme / lysozyme, increases the percentage of
bacteria surviving decreases / AW; R if only 1 named
steep, decline / decrease, 0 to 10 / first two concentrations, for E. coli;
A large percentage difference in E. coli surviving at 0 to 10 / first two concentrations
less steep / more gradual, decline / decrease, from 10 to 150 for E. coli;
decline / decrease, shallower / less steep from 0 – 40 / 60 / 70 / 80, for S. aureus;
A small percentage difference in S. aureus surviving from 0 – , 60 / 70 / 80
decline / decrease, more significant / steeper / more abrupt, from 60 / 70 / 80, up to 150
for S. aureus; A large percentage difference in S. aureus surviving from 60 / 70 / 80,
up to 150
always more S. aureus than E. coli; ora
all bacteria survive with no lysozyme;
lysozyme is more effective, at killing / against, E. coli / AW; A ora
all E. coli killed, at 150 pmol dm⁻³ (of lysozyme) / at highest concentration;
comparative data quote; both axes, both curves
comparative data quote; penalise once for lack of units in both [4 max]

(ii) different, polysaccharides / peptidoglycans, in cell walls;
S. aureus, does not have / has less, polysaccharides / peptidoglycans, in cell wall;  
ref to shape of active site;  
ref to shape of, polysaccharide / peptidoglycan (to fit into active site);  
S. aureus has a capsule / ora;  
A protective lipids  
AVP; e.g. S. aureus produces inhibitor  

[2 max]

[Total: 14]

4 (a) blood passes through the heart twice during one (complete) circuit of the body;  
A one cycle / one circulation R cardiac cycle  
A systemic / body, and, pulmonary / lung, circulation  

[1]

(b) withstands high(er) blood pressure;  
maintains blood pressure;  
ref to more, elastin / collagen / (smooth) muscle;  
A thicker muscle  

[2 max]

(c) vasoconstriction / contract / constrict / close / narrow, to, stop / control / reduce, blood flowing through capillaries;  
blood, diverted / shunted, elsewhere;  
any suitable e.g.; diverted from, skin when cold / gut during exercise  
vasoconstriction / contract / constrict / close / narrow, to, stop / control / reduce, blood flowing through capillaries;  
blood, diverted / shunted, elsewhere;  
any suitable e.g.; diverted from, skin when cold / gut during exercise  
vasodilation / relax / dilate / open / widen, to allow blood to flow through capillaries;  
blood required in tissue to deliver, oxygen / glucose or to remove, lactate / carbon dioxide;  

[1 max]

(d) pores / gaps / perforations, in / between, (endothelial) cells;  
A pores in capillary wall R spaces, holes  
water / ions / glucose, move out;  
A named small soluble substances  
R list which contains incorrect substance / red blood cells  
hydrostatic pressure of blood is greater than (hydrostatic) pressure of tissue fluid;  
(causing) pressure filtration / AW e.g. forced out under pressure / ultrafiltration;  
R leaking pinocytosis across capillary wall;  

[3 max]

(i) any three of the following  
more / plasma, proteins;  
more glucose;  
more fat / fatty acids / glycerol;  
lower, water / solute, potential;  
R water concentration  
lower carbon dioxide concentration / lower concentration of HCO₃⁻;  
higher oxygen concentration;  
AVP;  
e.g. cell secretes substance that is in higher concentration in tissue fluid,  
another named solute, higher pressure  

[3 max]

(ii) lymph / lymphatic fluid;  

[1]

[Total: 11]
5  (a)  one mark for each row

<table>
<thead>
<tr>
<th>statement</th>
<th>haemoglobin</th>
<th>DNA</th>
<th>phospholipids</th>
<th>antibodies</th>
</tr>
</thead>
<tbody>
<tr>
<td>contains iron</td>
<td>✓</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>contains phosphate</td>
<td>x</td>
<td>✓</td>
<td>✓</td>
<td>x</td>
</tr>
<tr>
<td>able to self-replicate</td>
<td>x</td>
<td>✓</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>hydrogen bonds stabilise the molecule</td>
<td>✓</td>
<td>✓</td>
<td>x</td>
<td>✓</td>
</tr>
<tr>
<td>contains nitrogen</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

(b)  AVP answers must be in context to a watery external environment

ref to molecules held together / strong attraction / AW ;

  A cohesion between water molecules
detail of hydrogen bonding, e.g. slight –ve charge on O, slight +ve charge on H ;

  A water molecules are polar
high boiling point / boils at 100°C ;
high latent heat of vaporisation ;
so water is liquid over wide range of temperatures ;
(liquid so) provides, support / buoyancy ;
high (specific) heat capacity ;
stable temperature / temperature of water does not change quickly ;
large amount of energy needed to be transferred from water for it to freeze / high latent heat of fusion ;
maximum density at 4°C / less dense at 0°C ;
provides surface tension ;
ref solvent ;
AVP ;
AVP ;
e.g. ref to surface dwellers, less need for support tissue, stable habitat qualified, ref upwelling currents
ice floats / insulates

[5 max]

[Total: 10]
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1 (a) (i) bracket extends across whole bilayer ;

(ii) fluid
phospholipids move (within their monolayer) / proteins, move / float ;
A phospholipids are liquid
mosaic
proteins, scattered / dispersed, within, phospholipids / bilayer ;
R membrane unqualified

(iii) both made of, protein / polypeptide(s) / amino acids ;
both have
disulphide bond ;
antigen binding site ;
variable region ;
constant region ; A non-variable

(b) helper cells
secrete / release / produce, cytokines / lymphokines / hormones ;
to stimulate B cells to, divide / develop into plasma cells ;
(which) produce antibodies ;
stimulate macrophages to carry out phagocytosis ;
cytotoxic / killer T cells
seek out / find / bind to, (foreign) antigens, on host cells / pathogens ;
destroy, virally infected host cells / intracellular parasites / viruses ;
attach to surface of cells / ‘punch holes’ into cells / disrupt cell surface (plasma) membrane ;
(release) toxic substances / hydrogen peroxide (into cells) / interferons ;
R enzymes

(c) control of entry and exit of substances ;
barrier to, polar molecules / water soluble molecules ;
adhesion ;
idea of retaining, large molecules / cell contents ;
allow substances across, passively / by diffusion ;
ref to channel proteins ; A pore allow transport protein once
move substances through carrier proteins ;
active transport ;
ref to facilitated diffusion ;
endocytosis / exocytosis / phagocytosis / pinocytosis ;
recognise, hormones / neurotransmitters / chemical signals ;
sites of chemical reactions / sites for enzymes ;
[Total: 12]
2 (a) (i) assume answer is about glycogen

- branched;
- 1–6, glycosidic, links / bonds;
- not, coiled / helical;  

(ii) compact so large quantity can be stored;
- insoluble so no osmotic effect;
- glucose would lower water potential; A decrease, more negative
- (so) water would enter and cell volume would increase;
- (so) plant cells would need thicker cell walls / animal cells might burst;
- glucose reactive molecule;  

(b) use annotations to help award these points

1 oxygen bridge / glycosidic bond, broken;
2 at left hand end of chain;
3 water shown to be involved; A hydrolysis
4 free glucose molecule with –OH drawn on C1;
5 chain now ends with –OH on C4;  

[Total: 8]

3 (a) max 2 if no reference to data

up to substrate concentration of 24 / 25 g dm⁻³, substrate concentration is limiting;
24 / 25 to 30 g dm⁻³, another factor is limiting;
- enzyme concentration / temperature / pH;
- active sites, not filled up to 24 / 25 g dm⁻³ / all filled above 24 / 25 g dm⁻³;
- A enzyme working at maximum rate
- ref to collisions between substrate molecules and enzyme;  

(b) same shape starting at the origin and with plateau starting at 24 / 25 g dm⁻³;
- lower; A plateau that starts between 7–12 au  

[2]

(c) either

- competitive inhibitor / effect described in terms of competition;
- same shape as protein / substrate / elastin; A complementary shape
to active site R same / similar, structure to active site
- fits into active site;
- blocking entry of substrate / prevents formation of ES complex;

or

- non-competitive inhibitor / described in terms of not competing;
- fits into, a site other than active site / allosteric site;
- shape of enzyme changes / shape of active site changes;
- active site no longer complementary shape to substrate;

or

- combines permanently with, active site / other site on enzyme;
- e.g. by covalent bonding;
- blocks access to active site / causes tertiary structure to change;
- prevents formation of ES complex;  

[3 max]
(d) set up different concentrations of substrate;
   same concentration of inhibitor;
   measure rate of reaction;

   *if competitive*
   lower rate at low substrate concentrations, but at high substrate concentration will reach the
   same plateau;
   increasing substrate concentration reverses inhibition;

   *if non-competitive / irreversible*
   lower rate / no activity / does not reach the same rate at high substrate concentrations;
   increase substrate concentration does not reverse inhibition;

   accept sketch graphs to show results [4 max]

(e) expands / stretches, during inhalation;
   recoils during exhalation;
   forces air out of alveoli;
   prevents bursting of alveoli [2 max]

(f) emphysema; A chronic obstructive, pulmonary / lung disease
   A COPD or COLD [1]

[Total: 15]

4 (a) H⁺ pumped out;
   creates an H⁺ gradient;
   sucrose moves in with H⁺
   co-transport / through co-transporter;
   energy / ATP, provided by mitochondria;
   sucrose diffuses down concentration gradient;
   through plasmodesmata; [4 max]

(b) large surface area: volume ratio / to increase surface area;
   gives large surface area of membrane;
   (so) many, pumps or co-transporters; [2 max]

(c) (i) higher / greater resolution / resolving power; ora
   A 0.5 nm (0.0005 µm) compared with 200 nm (0.02 µm)
   because of shorter wavelength; A smaller
   more detail can be seen / much clearer (at the same magnification)
   / can see two points that are close together;
   can see cell structures that are not visible in the LM;
   A e.g. ribosomes / membranes
   can see detail of structures just visible in LM with e.g.:
   A mitochondrion / chloroplast [2 max]
5 (a) transmitted by, Anopheles / mosquito / (insect) vector ;
P. falciparum / parasite, needs, warm / hot, temperatures / >20°C,
to complete its life cycle (in the mosquito) ;
requirement for areas of still water (ref. mosquito life cycle);
eradicated in areas outside tropics (e.g. North America) ; [2 max]

(b) (i) A  28 ;
     B  14 ; [2]

(ii) reduce / halve, chromosome number ;
     retain diploid number at fertilisation ;
     prevent chromosome number doubling each generation ;
     ref to variation ; A ref. to meiosis crossing over / independent assortment [2]

(c) genetic complexity of Plasmodium ;
     A ref to Plasmodium, being eukaryotic / having many genes
     many antigens / antigenic variation ;
     many stages in life cycle (within human) ;
     antigens change in different stages ;
     idea that variation generated during meiosis ;
     mutations / recessive alleles, are expressed in haploid stage(s) ; ora
     Plasmodium / parasite, lives within cells ; A only briefly free in the blood stream
     A antigenic concealment
     T-lymphocyte / B-lymphocyte, receptors not stimulated ;
     antibodies cannot work against stages within cells ; [4 max]

[Total: 10]