The circulatory system

Mark Scheme 1

Level	International A Level
Subject	Biology
Exam Board	CIE
Topic	Transport in mammals
Sub Topic	The circulatory system
Booklet	Theory
Paper Type	Mark Scheme 1

Time Allowed : **63 minutes**

Score : **/ 52**

Percentage : **/100**

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 **(a** **A** right ventricle **;** **A** r. ventricle **R** RV

B vena cava **;** **A** vena cavae
I superior / upper / inferior / lower / posterior
R if other terms used

C atrioventricular node **;** **A** AVN

D coronary arteries **;** **A** coronary artery **A** coronary capillaries
I coronary vessels

E bicuspid / left atrioventricular / mitral (valve) **;** **[5]**

[Total: 5]

2 **(a** same, water potential / Ψ(inside + outside) / no water potential gradient **;**
A same solute potential **I** osmotic potential
(so) no, net / overall, movement of water (molecules) **;**
A osmosis does not occur **[2]**

(b) *for two marks match correct plasma component and, mechanism / membrane component if no mechanism given*

plasma component ;	**mechanism ;**	**membrane component ;**
oxygen carbon dioxide steroids / steroid hormones	(passive) diffusion **A** movement from high to low concentration	(phospho)lipid bilayer / hydrophobic core (of membrane)
glucose amino acid(s) named amino acid mineral / inorganic, ions named ion e.g. sodium ions / Na^+, magnesium ions / Mg^{2+} chloride ions / Cl^-, hydrogen ions hydrogen carbonate ions / HCO_3^- phosphate ions / HPO_4^{2-} potassium ions (K^+)	facilitated diffusion **;** **A** active transport **A** cotransport	transport(er) / carrier / integral / intrinsic / transmembrane, protein **;** **A** channel protein for facilitated diffusion **A** pump protein for active transport

A urea, with any of the three mechanisms and relevant membrane component to match the mechanism stated **[3]**

(c) (x) 1000 **;; A** (x) 947 / 947.4 or 1053 / 1052.6
if units given = one mark only

if incorrect allow one mark for correct length measured 9 / 9.5 / 10 mm and knowledge of formula is correct (magnification = image length / actual length – this can also be seen by workings e.g. 9.5 mm ÷ 9.5 μm) but incorrect conversion factor used for final calculation **[2]**

(d) *feature = one mark, with appropriate explanation = one mark*

F red blood cells / haemoglobin, close to body cells **;**
F (capillary) endothelium / capillary wall, one cell thick / thin **; A** epithelium
E short distance / AW (for oxygen to move to cells) **;**

F ref. to, diameter / size, red blood cell and capillary (lumen) similar **;**
E slows down flow (to allow sufficient oxygen to move out) / short distance (for oxygen to move to cells) **;** **[max 2]**

(e) no / fewer, gaps / fenestrations / pores, in endothelium / capillary wall **;**
A spaces
ref. tight junctions between (endothelial) cells **; A** epithelial cells
idea that cells wrap round / fewer cells make up capillary wall, so reduces (endothelial) cell-cell contact **;**
idea of layer around capillary / basement membrane, impermeable **;** **[ma 1]**

[Total: 10]

3 **(a) (i)** ***A*** *bp for blood pressure throughout*

1 bp decreases with distance (from, heart / LV) **;**
A named vessels to indicate distance

2 difference between minimum and maximum bp decreases (with distance) **;**

3 maximum and minimum bp are the same, at the capilaries / after arterioles **;**

4 (BP) reaches zero kPa, at large veins / vena cava(e) **; A** after small veins
A no blood pressure

5 steepest decrease in bp between aterioles and capillaries **;**

6 correct data quotes **;**
e.g. mp 1 from 16 kPa to 0 kPa for maximum bp
mp 1 from 10.6–10.8 kPa to 0 kPa for minimum bp
mp 2 11.6 / 11.8 kPa, in aorta / nearest to left ventricle and 0 kPa at capillaries
mp 3 (same bp of) 5 kPa [3]

(ii) (presence of) valves **; R** bicuspid / tricuspid, valves
to stop backflow / allows one-way flow / flow only towards heart **;** [max 2]

(b) hydrolysis **; A** breaking bond using water
(of / breaking of) peptide bond **;**
between Phe and His / Phe-His bond **;**
removal of, two amino acids / His and Leu / dipeptide **;** [max 3]

(c) 1 (ACE) inhibitor / drug, has similar shape as, substrate / polypeptide **;**

2 complementary (shape) to active site (shape) **;**

3 binds to / fits into / enters, active site (of ACE enzyme) **;**
A forms enzyme-substrate complex

4 substrate cannot, enter / bind **;**
A competes with substrate for active site
A no / few / prevents formation of, ES complexes

5 reduces rate of, reaction / formation of angiotensin / product formation **;** [max 3]

[Total: 11]

4 **(a** *accept Hb for haemoglobin throughout*

low(er), partial pressure / **AW**, of oxygen / O_2 **;**

high(er), partial pressure / **AW**, of, carbon dioxide / CO_2 **;**

formation of carbaminohaemoglobin **;**

carbonic acid disocciation to form, hydrogen ions / H^+ (and hydrogen carbonate ions) **;**

formation of haemoglobinic acid / binding (of Hb) with, hydrogen ions / H^+, causes release of oxygen **;** *allow HHb*

ref. to Hb affinity for oxygen **;** e.g.
Hb has higher affinity for, hydrogen ions / H^+, than oxygen **;**
reduces / lowers, affinity of Hb for oxygen

Bohr effect **;**

AVP **;** e.g. *ref. to* allosteric effects [max 3]

(b) lower, partial pressure / **AW**, of oxygen (at high altitudes) ***or*** less oxygen in inhaled air / **AW ;**

(so) percentage saturation of haemoglobin is lower **;**
A haemoglobin is less saturated
A fewer molecules of / less, oxygen combine with haemoglobin

more haemoglobin needed (so more red blood cells) **;**
A (more red blood cells) so more haemoglobin / more oxyhaemoglobin can be formed

idea of compensation **;** e.g. (to transport) same amount of oxygen to, cells / tissues **;**

ref. to (increased) secretion of, erythropoietin / EPO **;** [max 3]

(c) (i) making a (complementary) copy of, DNA**;** **A** a gene
ref. information / **AW**, for production of a polypeptide **;**

one (DNA) strand acts as a template **; AW**
production of (pre) mRNA **;**
detail of process **;** e.g. assembly of nucleotides
RNA polymerase [max 3]

(ii) nucleotide / base, sequence of, DNA / gene, changed / **AW ;**
A new allele (formed)

ref. to altered mRNA / **AW ;**
this may be in context of a named type of mutation consequence on tRNA

tRNA / anticodon, with different amino acid (to ribosome) **;**
A tRNA with different anticodon

change in amino acid(s) / different amino acid sequence / change in primary structure **;**

affects, secondary structure / tertiary structure / 3D shape / function, of protein ;

ref. to one type of mutation **;**
e.g. base substitution means
deletion / insertion, leads to frameshift
ref. to premature stop codon [max 3]

(iii) *may prevent*
breaking of hydrogen bonds between, base pairs / bases / nucleotides, (and access of RNA polymerase) **;**

attachment of, RNA polymerase (to DNA) **;**

progress / functioning, of RNA polymerase (along gene) **;**

synthesis / elongation of (pre) mRNA **;**

AVP **;** e.g. interfere with action of helicase [max 2]

[Total: 14]

5 **(a** pulmonary artery ; **A** pulmonary arteries [1]

(b) phagocyte / macrophage ;
A neutrophil / polymorphonuclear leucocyte **R** PMN
R leucocyte / white blood cell unqualified
R any incorrect qualification [1]

(c) B-lymphocyte / (effector) B (cell) / plasma (cell) ; **R** lymphocyte alone
R effector cell unqualified [1]

(d) goblet (cell) ; [1]

(e) cartilage ; ignore plates / rings [1]

[Total: 5]

6 **(a** capillary **;**

plus one of
ref. to size relative to size of red blood cell (in lumen) **;** **A** small diameter / narrow lumen *if capillary correctly identified*
(wall is) one cell thick **;** **A** ref. to, only one layer / only endothelium / thin endothelium
[max 2]

(b) **(i)** red blood cell / erythrocyte **;** **A** red blood corpuscle [1]

(ii) water **;** **A** plasma [1]

(iii) nucleolus **;** **A** nucleus [1]

(c) *if working shown, award one mark only if measurement is incorrect*
7 (μm) **;;**

one mark if correct working is shown but answer not to whole number or incorrect conversion used
39 mm / 6000 **A** ± 1 mm in measurement [2]

[Total: 7]