CAMBRIDGE INTERNATIONAL AS & A LEVEL BIOLOGY · 9700

BIOLOGY



EXAM QUESTION PACK

8 TRANSPORT IN MAMMALS

SCORE	PERCENTAGE
/	%

STEMUP

These questions belong to CIE, not to us.

The examination questions, mark schemes and examiner comments in this pack were written and published by Cambridge International (CIE). They are past assessment materials, reproduced here so that students can revise from them.

What we do not own

STEMUP is not affiliated with CIE and does not own, and makes no claim to own, any of the question, mark scheme or examiner report material in this pack. CIE has not endorsed, approved or been involved in the production of it. CIE and the qualification titles used here belong to their respective owners and appear for identification only.

Where to find the originals

CIE publishes its past papers, mark schemes and examiner reports. Always check the current syllabus at cambridgeinternational.org before you revise.

If you hold the rights to any material in this pack and would like it amended or removed, contact admin@stemup.co.uk and we will act on it.

132. 9700_s18_ms_21 Q: 4

(a)	**E** – haem / porphyrin (ring) ; **I** iron / iron-containing group **A** conjugated group / prosthetic group **F** – α helix ; **R** a helix **G** – tertiary structure ; **A** 3° structure **H** – primary structure ; **A 1°** structure **J** – quaternary structure / 4° structure / 2α and 2β globins ; **A** polypeptides for globins	**5**
(b)(i)	98 (%) ;	**1**
(b)(ii)	*four from:* 1 Bohr, shift / effect ; 2 (at any pO_2 on the left of graph) percentage saturation of haemoglobin decreases / haemoglobin releases more oxygen (to muscle tissue) / increases dissociation of oxyhaemoglobin ; **A** any comparative data quote for any one value of pO_2 between 1 and 5 kPa 3 (increase in carbon dioxide) increases production of carbonic acid ; 4 increase in hydrogen ions (in red blood cells) ; 5 haemoglobin accepts hydrogen ions / formation of haemoglobinic acid (HHb) ; **A** haemoglobin has an affinity for hydrogen ions 6 decreases the affinity between haemoglobin and oxygen ;	**4**

133. 9700_w18_ms_21 Q: 6

(a)(i)	*any three from* haem group containing iron (atom) ; four haem groups (per molecule of haemoglobin) ; each iron (atom) / haem / prosthetic group, binds one oxygen molecule ; **or** four oxygen molecule per haemoglobin molecule ; cooperative binding / allosteric effect described ; AVP ;	**3**
(a)(ii)	*any two from* *ref.* folding of polypeptide chain(s) / globin(s) fold (to give globular structure) ; **A** *ref.* to, tertiary structure / quaternary structure (so) hydrophilic R groups (of amino acids) are on the outside of the molecule / hydrophobic R groups (of amino acids) on the inside of the molecule ; **A** hydrophilic and hydrophobic amino acids hydrogen bonds form with water (molecules) ;	**2**
(b)(i)	llama = 90.5% human = 78.5% ;	**1**
(b)(ii)	*any two from* lower partial pressure of oxygen at high altitude ; at the same partial pressure the percentage saturation is (much) higher than for humans ; *ref.* to haemoglobin has a higher affinity for oxygen ; *idea that* sufficient oxygen delivered to tissues to satisfy demand ;	**2**

134. 9700_w18_ms_22 Q: 6

(a)	*rough endoplasmic reticulum* protein / polypeptide / named protein, synthesis / transport / modification ; **A** post-translational modification / examples *named protein e.g. haemoglobin, carbonic anhydrase, membrane proteins* *Golgi body* modification / processing, of, proteins / lipids **A** post-translational modification / examples / makes proteins functional **or** packaging (molecules) into vesicles **or** formation of, Golgi / secretory, vesicles **or** forms (primary) lysosomes ; *centrioles* formation of, spindle fibres / spindle **or** microtubule organisation ;	**3**
(b)	**A** iron / Fe ; **I** oxidation status of Fe **A** iron atom / iron ion **R** iron molecule **B** carbaminohaemoglobin ; **C** haemoglobinic acid ;	**3**

135. 9700_s17_ms_22 Q: 6

(a)	*row 1* globular + globular ; *row 2* 2, alpha / α, globin, and 2, beta / β, globin (chains) ; **A** 2 alpha and 2 beta chains *row 3* disulfide (bridges / bonds) ; covalent is neutral	3
(b)	*mRNA strand produced* UGU ; *tRNA anticodon sequence* UGU ;	2
	Total:	5

136. 9700_w17_ms_22 Q: 2

(a)	*two from* cell (surface) membrane / plasma membrane / phospholipid bilayer, damaged / AW ; **A** phospholipids are in cell surface membrane (and will be broken down by phospholipase) cell, bursts / lyses / lysis / ruptures ; *haemolysis is neutral* cell contents / AW / haemoglobin, leaks out / AW ; **I** water	2
(b)	*allow, fatty acids / fatty acid tails / hydrocarbon chains, for fatty acid residues* *both have / similarities (max 3)* glycerol (residue) ; fatty acids ; **I** *ref. to* saturation, **R** both have, two / three, fatty acids ester, bonds / linkages ; C and H and O ; double bonds ; **A** both have C=O *differences (max 3)* triglyceride / fat / oil / lipid **or** phosphatidylcholine / phospholipid no, choline / nitrogen **A** no / small / delta, charges **or** has, choline / nitrogen ; **A** choline / nitrogen, ion **A** charged / ionic three fatty acid residues **or** one extra fatty acid residue ; **A** triglyceride has three ester bonds **R** *if comparison includes phosphatidylcholine and the number of fatty acid residues is incorrect* no, phosphate (group) / phosphorus **A** no, phosphoester / phosphodiester bond **or** has phosphate ; **A** has phosphoester / phosphodiester bond	4
(c)	smooth endoplasmic reticulum ; **A** smooth ER **R** SER **R** if more than one organelle given **R** endoplastic *two from* membranous / membranes ; **A** *ref. to* vesicles, formed / bud off **R** envelope / double membrane tubular ; **A** cisternae but **R** if described as flattened fluid filled, channels / sacs ; not associated with ribosomes ;	3

137. 9700_m16_ms_22 Q: 3

(a) (i) a gene codes for a protein / gene coding for EPO ;

ref. transcription ; **A** gene 'switched on'
A increase gene expression

mRNA (required) for, EPO / protein, synthesis
or
mRNA involved in translation ;

[max 2]

(ii) vesicles move to, cell (surface) / plasma, membrane (via cytoskeleton) ;

(vesicles) fuse / merge, with cell (surface) membrane ;

exocytosis (occurs) ;

(movement of vesicle / exocytosis) requires, energy / ATP ;
A active (process)
R active transport

[max 2]

(b) (i) EPO, binds to / combines with / AW, receptors ;

receptors, complementary to / specific shape for, EPO ;
A EPO fits into receptors

cell signalling / EPO binding leads to (specific) responses within the (target) cells / AW ;
I cells respond to EPO

only, target / bone marrow, cells, have receptors, for EPO / specific to EPO ;
ora
A binding triggers responses only within, target / bone marrow, cells

[max 3]

(ii) too large ;

ref. to shape, cannot pass through ;

(protein) is, hydrophilic / water soluble, and cannot cross hydrophobic core (of phospholipid bilayer) / AW ;

no specific membrane transport protein ;

[max 1]

(c) stem cell ; **A** haematopoietic stem cell
treat as neutral adult / non-embryonic / multipotent / stromal [max 1]

STEMUP.CO.UK

(d) **max 3** *if all description (***D***) or all explanation (***E***)*
A Hb for haemoglobin and Hb concentration for mean Hb concentration
A g per kg / g kg^{-1}, for g per kg body mass

constant
D Hb concentration, remains constant / of 12.6 g kg^{-1}, for first two weeks (of investigation) / up to start of injections ;

E idea of regulation ;
e.g. sufficient oxygen so no requirement for increased EPO

increase then decrease description
D (then) increase in Hb concentration (from week 2) for 5 weeks / AW, then decrease (for last three weeks / to week 10) ;

D data quote / manipulated data, to support ;
e.g. increase from 12.6 g kg^{-1} (week 2) to15.3 g kg^{-1} (week 7)
increases by 2.7 g kg^{-1} (to week 7)
decrease from 15.3 g kg^{-1} (week 7) to 13.7 g kg^{-1} (week 10)
decreases by 1.6 g kg^{-1} (to week 10)

increase explanation
E EPO increases production of red blood cells that contain Hb / AW ;

decrease explanation
E red blood cells, short life span / die ;
E cell signalling stops / (target / bone marrow) cells no longer stimulated / AW ;
A EPO, degraded / AW

increase after injections stop
D Hb concentration increases for 1 week after injections have finished ;

E *idea of*, time delay for red blood cell production to stop / time for immature red blood cells to mature and be released into blood stream ;

AVP ; e.g. steady increase as time required for, mitosis / cell proliferation / differentiation into red blood cells / production of haemoglobin
contributory factor for increase may be, accumulation / increased concentration, of EPO with injections

[max 4]

(e) *high altitudes and low oxygen partial pressure so*
less oxygen in inhaled air / less oxygen (would be) transported to tissue / AW ;

lower oxygen saturation of haemoglobin / haemoglobin has lower oxygen affinity ;

body requires more red blood cells that contain haemoglobin / AW ;
A more red blood cells produced so more haemoglobin (to bind oxygen)

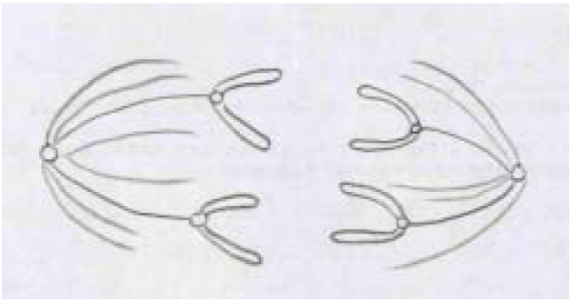
idea of compensation ; **R** *idea of* body getting more oxygen

[max 3]

[Total: 16]

138. 9700_s16_ms_21 Q: 5

(a) (i) *if draw other stages mark first one only – either left to right or top to bottom*



four chromatids / daughter chromosomes, drawn as single structures between equator and poles ;
V shaped, chromatids / daughter chromosomes, in correct orientation ;
spindle (fibres) attached to all four, centromeres / kinetochores / apex, and centrioles ; **R** if these extend between chromatids [max 3]

(ii) **1** attach to the, centromeres (at prophase) ; **A** kinetochores
I *if attach at metaphase*
2 attach to, centrioles ; **A** centrosome / MTOC
3 arrange the chromosomes on the, equator / metaphase plate ;
4 pull / move, (daughter) chromosomes, apart / to the poles ;
A separates *for moves apart* **A** (sister / identical) chromatids
I ends **R** homologous chromosomes [max 2]

(b) (i) **1** produces / makes / synthesises, haemoglobin ; **I** fills up
2 produces / makes / synthesises, carbonic anhydrase ; **I** fills up
3 loss / AW, of the nucleus ;
4 loss / AW, of (named) organelles ;
e.g. ribosomes / (R)ER / mitochondria
5 becomes biconcave / described ;
6 AVP ; e.g. cell surface / antigens / named antigens
ref. to cytoskeleton [max 3]

(ii) *cell Y*
1 remains / stays as a, stem cell ;
2 divides / undergoes mitosis ;
I *ref. to* becoming a type of blood cell / platelet
R if it becomes a cell other than a blood cell / platelet [max 1]

(c) (i) 13.5 ; [max 1]

(ii) **1** low(er) partial pressure of oxygen (at high altitude) ;
A pO_2 / ppO_2
2 less oxygen in, inhaled air / lungs / alveoli ;
3 so haemoglobin, is not fully saturated / has lower saturation (with oxygen) (than at sea level) / lower affinity for oxygen ;
4 *idea that* more red blood cells so, higher concentration of / more haemoglobin ;
5 allows, same / similar / enough, volume of oxygen to be transported in the blood as at sea level ;
6 volume of oxygen transported in the blood is less ;
7 less oxygen for (aerobic) respiration / lack leads to anaerobic respiration ;
8 any consequence, e.g. fatigue, altitude sickness ; [max 4]

[Total: 14]

139. 9700_w16_ms_22 Q: 4

(a) *allow middle coat / intermediate layer / middle layer, for tunica media*
allow adventitia for externa

one from
a thick tunica media ;
a thicker tunica media than tunica externa ; ora

a thick layer of, (smooth) muscle / muscle and elastic tissue ;
A thick muscular wall
R striated / skeletal, muscle
many (layers of) smooth muscle cells ;

a, well-defined / firm / oval / regular / AW, shape (in cross section) ;

narrow / AW, lumen in relation to thickness of wall ; **A** narrow lumen

convoluted / folded / AW, endothelium / tunica intima ; [1]

(b) *2 correct functions with no link to a structural feature – award one mark only*

R muscle / collagen, stretching and recoiling / recoiling
R elastic tissue contracting and relaxing

two from
1 (smooth) muscle / elastic tissue, maintains (blood) pressure ;
A increases blood pressure

2 thick (tunica media) / elastic tissue / (smooth) muscle / collagen (fibres), withstands high pressure / prevents rupture / AW ; **A** bursting

3 elastic tissue to smooth out (pulsatile) flow ; **R** smooths flow to give pulses

4 muscle / elastic tissue, helps to, maintain blood flow / move blood / keep blood moving forwards / AW ;
R *idea of* pumping / forcing blood forward / pushing blood

5 (smooth) muscle, contraction / relaxation, altering volume of blood delivered ;
A *idea of*, diverting blood / regulating blood flow
I muscle dilates [2]

STEMUP.CO.UK

(c) magnification = image diameter ÷ actual diameter ; **A** M = I ÷ A

allow one mark only if correct answer but units given

if calculation is shown measurement must be correct and working must lead to correct answer

× 3.5 ;; 18 (mm) / 5.2 (mm) = 3.46
A × 4 if correct working, and / or, 3.5 shown
A × 3 if 3.46 only shown from correct working

other acceptable answers using same criteria
× 3.3 ;; 17 / 5.2 = 3.27 **A** × 3

× 3.4 ;; 17.5 / 5.2 = 3.37 **A** × 3

× 3.6 ;; 18.5 / 5.2 = 3.56 **A** × 4

× 3.7 ;; 19 / 5.2 = 3.65 **A** × 4 [3]

(d) *three from*

1 (good) solvent ; **R** organic solvent

2 statement linking solvent properties to role of plasma ; e.g.
standalone statements do not need mp1
polar molecules / ions / ionic compounds / named substance(s),
dissolve in, water / plasma **R** blood cells
ions dissociate, in water / plasma
many / AW, substances dissolve in, water / plasma **R** blood cells
water is attracted to (many different) substances
water / plasma, is the transport medium for substances / transports substances
presence of solutes to maintain (constant) water potential

3 cohesion between water molecules / water is cohesive ;
A water molecules are sticky

4 so, continuous / uninterrupted / AW, blood flow ; *in context of mp3*

5 high specific heat (capacity) ;

6 statement linking high specific heat capacity to role of plasma ;
allow ecf for high heat capacity / specific heat capacity
e.g. helps, stabilise / (body to) regulate, temperatures
helps maintain constant (blood) temperature
water resists changes to temperature

7 high (latent) heat of, vaporisation / evaporation ;

8 in body temperatures, plasma stays liquid / water does not evaporate ; AW

other acceptable points – note that mps 10, 12, 14 are linked to water property

9 low compressibility ; **A** incompressible

10 maintains efficient blood flow / helps to push blood through vessels ; AW

11 low viscosity ;

12 allows efficient circulation of blood / AW ;

13 pH 7 / neutral ;

14 *ref. to* stability proteins ; **A** prevents denaturation [3]

[Total: 9]

---

140. 9700_w16_ms_22 Q: 6

(a) (i) **J** = mitosis ; **A** mitotic division **I** nuclear division
R mitotic cell division
K = cytokinesis; **A** cytoplasmic, division / cleavage **I** cell division
L = interphase; [3]

(ii) interphase ; **A** S-phase / synthesis phase / late interphase
R early interphase [1]

(b) (i) bone marrow ; [1]

(ii) lobed / irregular ; [1]

(iii) lysosomes / vesicles ; [1]

(c) (i) *two from*
ref. to loss of control over entry and exit substances ;
A membrane no longer partially / selectively, permeable
A becomes more permeable
lose, ions / nutrients ; **A** gains, ions / nutrients
lose water ; **R** gains water *(as cell wall still intact)*

metabolic reactions, prevented / impaired ; AW
enzymes no longer function ; AW

water potential affected ;
increase or decrease depends on rest of answer
e.g. gains ions so decreases water potential

cytoplasm shrinks ; AW **R** lysis / bursting
contents leak out ; [2]

(ii) breakdown / weaken / digests / AW, cell wall ; **A** destroyed / damaged
I breaks cross-links / cross-links cannot form

(water enters so) lysis occurs / bursts / AW ; [2]

[Total: 11]

---

141. 9700_w16_ms_23 Q: 5

(a) (i) 98.5 / 98 / 98.48 (%) ; **R** 98.4 [1]

(ii) (in solution / dissolved) in the plasma / cytoplasm of red blood cells ; [1]

(iii) *two from*
carbon monoxide, combines with haemoglobin / forms carboxyhaemoglobin ;
irreversible / permanent / stable compound / AW ;
reduces haemoglobin available to transport oxygen ;

alveolar walls / elastin, broken down (in emphysema/COPD) ;
less surface area for, absorption of oxygen / gas exchange ; [2]

(b) *accept steps of reaction if in reverse – as in the lungs*

1 catalyses / AW, the reaction (in red blood cells), between carbon dioxide and water / to form carbonic acid ; **A** correct equation
2 (carbonic acid dissociates to form) hydrogencarbonate ions / bicarbonate ions / HCO_3^- ;
3 very fast reaction ;
4 maintains (steep) concentration gradient for diffusion of carbon dioxide from tissues to blood ;
5 catalyses reverse reaction in the lungs ;
6 hydrogencarbonate ions / bicarbonate ions / HCO_3^- , diffuse / AW, into the plasma ; [3]

(c) 1 Bohr, effect / shift ;

AND

to max 2 ('more' only needs to be used once)
2 carbon dioxide decreases affinity of haemoglobin for oxygen ;
3 more oxyhaemoglobin dissociates (than at a lower concentration of carbon dioxide) ;
A oxyhaemoglobin dissociates more readily
A haemoglobin, releases / AW, more oxygen
4 more oxygen for (rapidly) respiring, tissues / cells ;
5 to meet the demand for increase in (aerobic) respiration ;
A to provide, enough / sufficient, oxygen for respiration
ora e.g. delays onset of / prevents, anaerobic respiration [3]

[Total: 10]

STEMUP.CO.UK

142. 9700_s15_ms_21 Q: 4

(a) enzyme **A** uses 'lock and key' **and** enzyme **B** uses induced fit **;**
A enzymes work by 'lock and key' and induced fit
enzyme **A** / lock and key, (shape of) active site is complementary / AW, to (shape of) substrate (molecule) **;**
enzyme **B** / induced fit, has an active site that, moulds around / AW, the substrate **;** [3]

(b) (i) 1 **P** is β-pleated sheet, **Q** is α-helix **;**
accept if P and Q are identified by a description

2 determined by, coiling / folding / sequence, of amino acids / polypeptide **;**
A primary structure for sequence of amino acids

3 stabilised / held / AW, by hydrogen bonds **;**

4 between C = O and H–N (of peptide bonds) **;**
A carbonyl / carboxyl group, and, amine / amino group

5 ref to, parallel / anti-parallel, nature of β-pleated sheet **;** [max 3]

(ii) 1 catalyses reaction between carbon dioxide and water to form carbonic acid **;**
A correct, formulae / equation

2 very fast reaction **;**

3 in (cytoplasm of) red blood cell / erythrocyte **;**

4 (so there are) hydrogen ions / protons, and hydrogencarbonate ions **;**

5 hydrogen ions promotes oxyhaemoglobin dissociation / AW **;**
e.g. reduces affinity of haemoglobin for oxygen / (oxy)haemoglobin gives up oxygen more readily

6 increases supply of oxygen to (respiring) tissues **;**

7 carbon dioxide is transported as hydrogencarbonate ions **;**

8 in the plasma **; A** carbon dioxide diffuses from red blood cell to plasma

9 AVP **;** e.g.
carbonic anhydrase catalyses reverse reaction in the lungs
ref to hydrogencarbonate ions as buffer in plasma (as a consequence of reaction)
R buffering action of haemoglobin in red blood cells [max 4]

[Total: 10]

STEMUP.CO.UK

143. 9700_s15_ms_22 Q: 3

(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 **;** **[max 1]**

[Total: 10]

144. 9700_s15_ms_23 Q: 4

(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 [max 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]

STEMUP.CO.UK

145. 9700_m20_ms_22 Q: 3

(a)	superior vena cava and inferior vena cava ; **A** venae cavae **A** vena cava	**1**
(b)	*any **four** from:* 1 pressure in ventricles decreases (in context of relaxation) ; 2 semilunar valves close ; 3 atria filling with blood / blood entering atria 4 bicuspid and tricuspid / left and right atrioventricular, valves open ; **A** mitral *for bicuspid* 5 blood enters ventricles (passively) ; allow once only (either marking point 5 or 8) 6 atria contract / atrial systole ; 7 pressure in atria exceeds pressure in ventricles ; 8 (so) blood enters ventricles (from atria) ; allow once only (either marking point 5 or 8) 9 AVP ; e.g. ref. to heart sounds (from valve closure)	**4**
(c)(i)	**P** C T C ; **Q** G T G ; **R** G U G ;	**3**
(c)(ii)	β-globin / beta globin ;	**1**
(d)	*any **three** from:* *in terms of sickle cell:* 1 low(er) affinity for oxygen / low(er) carrying ability of haemoglobin for oxygen / (more) difficult for oxygen to bind to haemoglobin / AW ; *uptake:* 2 lower uptake of oxygen / lower saturation of haemoglobin (at same partial pressures) ; *release* 3 oxygen is more easily released (at same partial pressures) ; 4 AVP ; e.g. requires higher partial pressure of oxygen to reach same level of saturation ref. to structure of abnormal haemoglobin, e.g. sticky fibres reduced allosteric effect of haemoglobin molecule for uptake ref. to allosteric release of oxygen in respiring tissues ref. to sketch curve on graph and numerical comparison increase in, 2,3-BPG / 2,3-DPG	**3**

146. 9700_s20_ms_22 Q: 2

(a)	sinoatrial node / SAN, sends out, wave of excitation / impulses / electrical impulses ; R nerve impulses wave of excitation / AW, spreads across atrial wall ;	**2**
(b)	*any two from* non-conducting fibres between atrial and ventricle walls ; impulse must pass down septum ; AVN (in interatrial septum) delays impulse ; (gives) time for atria to, complete contraction / empty ;	**2**
(c)(i)	one mark if **F** and **G** are semilunar and **E** and **H** are bicuspid ; one mark for **E** and **G** opens ; one mark for **F** and **H** closes ; ***E** bicuspid / (left) atrioventricular, valve, closes* ***F** semilunar / aortic, valve opens* ***G** semilunar / aortic, valve closes* ***H** bicuspid / (left) atrioventricular, valve opens*	**3**
(c)(ii)	(during contraction) left ventricle, generates / AW, higher pressure (than left atrium) ; **A** do not produce the same pressure when contracting *any one from* (because) wall of left ventricle thicker / more (cardiac) muscle, so reaches higher ; data from Fig. 2.1 to show difference in pressure ;	**2**

STEMUP.CO.UK

147. 9700_s19_ms_21 Q: 5

(a)	*closed* blood flows through, (blood) vessels; **A** three of heart, arteries, veins, capillaries *double* blood flows through the heart twice in one complete circulation (of the body) / AW ; **A** *ref. to* pulmonary and systemic circuits / to lungs and rest of body	**2**
(b)(i)	pulmonary vein ; semi-lunar / AW, valve ; **A** pulmonary valve **R** aortic valve right, atrium / auricle ;	**3**
(b)(ii)	*any three from:* **1** left ventricle / chamber **Y**, pumps blood into, systemic circulation / described ***or*** right ventricle / chamber **X** pumps blood into, pulmonary circulation / described ***or*** distance travelled by blood in systemic circulation is greater than distance travelled by blood in pulmonary circulation / AW; **2** to overcome great(er) resistance to flow in systemic circulation ; **ora** **3** high (blood) pressure is required for blood to travel around the systemic circulation ; **4** high pressure requires more muscular force ; **ora** **5** pulmonary capillaries, rupture easily / damaged by high pressure ; **I** more cardiac muscle	**3**
(c)	*any four from:* **1** impulse / wave of excitation / AW, passes from SAN to atria (muscles) ; **R** nervous impulse / signal *once only* **2** atria both contract, together / at the same time ; **A** atrial systole *if not contradicted by one contracting before the other* **3** atria contract before ventricles ; **4** fibrous / non-conducting, tissue prevents impulse travelling to ventricles ; **5** impulse delayed at AVN ; **6** AVN passes impulse to, bundle of His / Purkyne fibres ; **7** Purkyne fibres conduct impulses to muscle in wall of ventricles ; **8** ventricles contract together (if mp2 not awarded) ; **A** ventricular systole if not contradicted as for atria **9** ventricles contract from the bottom upwards ;	**4**

148. 9700_s19_ms_23 Q: 6

(a)	<table><tr><th>structure in the heart</th><th>letter</th></tr><tr><td>valves preventing back flow of blood into the ventricle</td><td>**S** ;</td></tr><tr><td>blood vessel carrying blood under highest pressure</td><td>**P** ;</td></tr><tr><td>chamber that pumps blood to the lungs</td><td>**N** ;</td></tr></table>	3
(b)	*treat as neutral effects of nicotine on the brain and ref. to adrenaline* *any three from:* increased heart rate ; **I** increased heart beat increased blood pressure ; increases risk of, blood clotting / thrombus formation ; **A** increases risk of thrombosis **A** increases stickiness of platelets damages the endothelium ; AVP ; e.g. stimulates vasoconstriction / reduces the diameter of blood vessels **A** named blood vessel types	3
(c)(i)	*any one from:* two nuclei vs one ; *ref. to*, DNA / chromosome, content ; cytokinesis has not occurred ; **A** cytoplasm has not divided (into two cells)	1
(c)(ii)	*any two from:* *in context of cardiac myocyte or overall heart function* unable to replace, damaged / worn out / old, cardiac myocytes ; **R** repair myocytes unable to repair (damaged) cardiac, muscle / tissue ; **A** heart tissue repair (to cardiac muscle may be) with, unspecialised cells / scar tissue ;	2

149. 9700_m18_ms_22 Q: 5

(a)	*any **three** across both sections:* SAN (max **two**): 1 pacemaker / sets rate of heart beat / responsible for rhythmic contraction ; 2 sends out, impulses / waves of excitation / waves of depolarisation ; 3 initiates / brings about / AW, heart beat / contraction of the heart / atrial contraction / atrial systole ; *AVN (max **two**)*: 4 acts to relay impulses / described ; 5 introduces delay to ventricular, systole / contraction(s) / prevents simultaneous contraction of atria and ventricles / AW ; **A** allows time for, atria to empty / ventricles to fill 6 conducts, waves of excitation / impulses, to, bundle of His / Purkyne fibres ;	3
(b)(i)	**D** = vein / veins **E** = artery / arteries **F** = capillary / capillaries } ;	1
(b)(ii)	*any **two** from:* single layer / one cell thick ; flattened / thin, cells ; **A** squamous / pavement, cells / epithelia smooth surface (facing lumen) ;	2

150. 9700_w18_ms_22 Q: 2

(a)	xerophyte / xerophytic ; **R** succulent / cactus / named	**1**
(b)(i)	phloem ; **A** sieve tube(s) **R** phloem sieve / phloem tube **A** sieve tube elements **R** phloem companion cell	**1**
(b)(ii)	*any two from* **1** for, transport / translocation, } *accept assimilates / products* **or** } *of metabolism, if in context of* movement / AW, from source to sink ; } *cardiac glycosides* **I** *ref. to* transport of, amino acids / sucrose **2** *ref. to* source, is place of synthesis / AW **or** sink is / movement to, area where not manufactured / storage area / area where they are required ; **3** as defence mechanism (e.g. against sap feeders) ;	**2**
(c)(i)	using / AW, water / H_2O ; to break bond (between phosphate groups) ; **R** if bond incorrectly named	**2**
(c)(ii)	active transport ;	**1**
(c)(iii)	*any four from* **1** (reversibly) binds / attaches / AW, to, allosteric site / site other than active site ; **2** (which) changes, shape / tertiary structure / 3-D structure, of active site ; **A** active site distorted **I** protein structure **3** substrate / ATP, cannot, enter / bind / fit / AW, to active site ; **A** active site no longer complementary to substrate **A** enzyme substrate / ES, complexes cannot form **A** ESCs cannot form **I** ATP / substrate, cannot bind to enzyme *without a link to active site* **4** no / less, hydrolysis of ATP **A** breakdown **or** no / less, energy released ; **I** no energy, synthesised / created / produced **5** Na^+ not moved, out and K^+ not moved in ; **I** active transport, stops / decreases	**4**
(d)(i)	*allow* *systole for contraction and diastole for relaxation* *bicuspid valve or mitral valve for (left) atrioventricular* *aortic valve for semi-lunar valves* *any four from (max 3 if whole response based on right side of heart)* *before atrial contraction / during relaxation of the left atrium and left ventricle* **1** atrioventricular valve, opens / is open **A** *following atrial contraction* **or** blood trickling into ventricle / some blood enters ventricle ; **2** atrial contraction, blood flow to ventricles / ventricles fill (with blood) **or** atrial contraction then ventricular contraction ; *ventricular contraction* **3** biscuspid valve closes and semi-lunar valve opens ; **R** *if occurs before ventricular contraction* **4** blood flows into aorta ; **R** if states 'from atrium' or 'then to lungs' **R** *if occurs before ventricular contraction* **5** *ref. to* atrium in relaxation during ventricular contraction ; *pressure changes* **6** contraction of, atrium / ventricle, increases pressure (of that chamber) **or** *ref. to* (blood) pressure differences to cause opening or closing of valves ; e.g. pressure in atrium greater than in ventricle so atrioventricular valve opens pressure in ventricle greater than aorta so semilunar valves open pressure in ventricle greater than atrium so bicuspid valve closes	**4**

(d)(ii)	**I** *ref. to* fibrillation / cardiac cycle rhythm *any three from* **1** more powerful contraction of (cardiac) muscle / increased ability for (cardiac) muscle (**A** cardiac cells) to contract ; **A** stronger contraction / contract strongly / increased contractility **I** contracts more / increased contraction **2** blood (pumped) at higher pressure ; **I** blood at high pressure **3** more force to overcome resistance (in blood vessels) ; **4** more blood reaches lungs to obtain oxygen (per unit time) / more oxygen reaches (rest of) body / tissues (per unit time) (in blood) ; *allow idea of efficient delivery of oxygen* **A** more oxygenated blood can be delivered to heart, muscle / tissue AW **5** less fatigue / increased energy / increased mobility / AW ;	**3**

151. 9700_w18_ms_23 Q: 4

(a)	*any four from* **I** signals **R** nerve impulse first time *SAN* **1** acts as a pacemaker / initiates heart beat / initiates cardiac cycle ; **A** regulates heartbeat **A** described, e.g. as rhythm / emits impulses at regular intervals **2** releases / AW, waves of excitation / (electrical) impulses ; **A** *ref.* to, action potentials / depolarisation **R** nerve impulses **3** spread across / AW, atria / atrial walls **or** leads to atrial, systole / contraction(s) ; *AVN* **4** allows a (short) delay / ~0.1 s ; **5** passes the impulse / wave of excitation, to the Purkyne fibres / down the septum ; **A** Bundle of His **R** nerve impulse **6** detail ; e.g. so atria contract before ventricles allows ventricles to fill / allow atria to empty completely so atria have, emptied / contracted, before ventricular contraction begins so atria and ventricles don't contract at the same time	**4**
(b)	*any two from* contraction / ventricular systole, begins at the base of the ventricles ; both ventricles contract at the same time ; blood is forced, upwards / into arteries / through (named) semi-lunar valves ; **A** pushed *idea that* so ventricles, empty / pump out most of the blood ; AVP ; e.g. so impulses / waves of excitation, travel upwards from the base	**2**
(c)	*any four from* **1** noradrenaline is, signalling, molecule / compound ; **A** noradrenaline is the signal **I** noradrenaline is a (neuro)transmitter **2** SAN cell is the target cell ; **3** noradrenaline / signalling molecule, binds to (cell surface) receptors (of target cell) ; **A** 'fits' **R** 'receptor cells' **4** receptors are specific to noradrenaline ; **A** *ref.* to complementary (shapes) **5** *ref.* to formation of cAMP / second messenger *or* activating enzyme ; **6** response is the opening of channel proteins (so calcium ions enter) ;	**4**

152. 9700_m17_ms_22 Q: 4

(a)	(closed) double circulation ; capillary ; pulmonary vein ; right atrium ; **A** auricle septum ;	**5**
(b)(i)	*two from:* 1 *idea* that (to be transported) many substances need to, dissolve / be in solution ; 2 ionic compounds / named, can, dissociate / dissolve ; 3 polar compounds / named, e.g. glucose / amino acids, can dissolve ; 4 globular proteins / named, e.g. antibodies, can dissolve ;	**2**
(b)(ii)	*three from:* 1 water molecules attracted to each other ; **A** sticky / stickiness *cohesion:* 2 (hydrogen bonding provides) cohesion between water molecules ; **A** water is cohesive 3 reference to water leaving xylem (at top), pulling water (molecules below) ; **A** there is a transpiration pull *adhesion:* 4 adhesion to cellulose lining (of xylem) ; **A** cellulose wall 5 maintains / prevents falling of, column of water ; 6 AVP e.g. reference to cellulose hydrophilic / adhesion to hydrophilic parts of lignin ;	**3**

153. 9700_w17_ms_21 Q: 2

(a)	capillary ; *two from* single celled wall / AW ; **A** thin wall *ref. to* wall composed only of one, squamous epithelial / endothelial, cell ; *ref. to* lumen diameter approx 7 μm ; **A** 5–8 μm **A** *ref. to* similarity to dimension of red blood cell in direct contact with tissue fluid ; *if vein named, allow one mark for, thin wall (relative to lumen)* ***or*** *wide / AW, lumen (relative to wall thickness)*	**3**
(b)(i)	0.24 s / 0.25 s ;	**1**
(b)(ii)	0.08 s / 0.09 s ; **A** range	**1**
(b)(iii)	*four from* *similarity* *ref. to* increases and decreases in pressure at same time ; **A** description for part of the graph e.g.starts to rise at same point as RV, returns to minimum at same point as RV *idea that* events in cardiac cycle occur are coordinated ; **A** described e.g. impulses pass up both ventricles at the same time, ventricles both contract at same time *difference* reaches higher, blood pressure / peak, (than RV) ; systolic pressure higher in LV (than RV) left ventricle pumps blood to (whole) body / RV only to lungs) overcome greater resistance / ora for RV walls of left ventricle, thicker / more muscular more force exerted by LV *any two* ;;	**max 4**

154. 9700_w17_ms_22 Q: 6

(a)(i)	**S** ;	1
(a)(ii)	pulmonary vein ; **R** ;	2
(a)(iii)	wall of right atrium ; **A** muscle of right atrium	1
(b)	*two from* passes the, impulse / wave of excitation, to the Purkyne fibres / down the septum ; **A** Bundle of His **R** nerve impulse allows a (short) delay ; detail ; e.g. so atria contract before ventricles allows ventricles to fill so atria have, emptied / contracted, before ventricular contraction begins so atria and ventricles don't contract at the same time	2

155. 9700_w17_ms_23 Q: 2

(a)	*two from* 1 to generate a high(er) blood pressure (during systole) ; **A** force **I** withstands / AW, high blood pressure 2 to overcome high(er) resistance (in systemic circuit than in pulmonary circuit) ; 3 to transport blood a greater distance / greater distance in systemic circuit ; 4 *ref. to* right ventricle generating low pressure to avoid damaging (capillaries in the) lungs / AW ;	2
(b)(i)	**F** (inferior / posterior) vena cava ; **I** superior **G** pulmonary artery ;	2
(b)(ii)	diastole ; **I** ventricular / atrial	1
(c)	*five from* 1 wave of excitation / wave of depolarisation / impulses, from, atrioventricular node / AVN ; 2 pass(es) down Purkyne fibres (to ventricles) ; **A** Bundle of His 3 (both) ventricles contract / ventricular systole ; 4 from the base (upwards) / AW ; 5 blood pressure in ventricles, increases / becomes higher ; 6 blood pressure in ventricles greater than in atria ; 7 atrioventricular / AV / tricuspid and bicuspid, valves close ; 8 blood pressure in ventricles greater than in, artery / aorta / pulmonary artery ; 9 semi-lunar / pulmonary and aortic, valves open ; **A** blood flows through 10 blood flows, into arteries / to lungs and rest of the body ; *at end of description only* 11 atria relaxing / atrial diastole / blood flows into atria ;	5

156. 9700_s16_ms_23 Q: 6

(a) (superior / inferior) vena cava ; [1]

(b) left (ventricle) pumps blood to the body / right ventricle pumps blood to lungs ;
A further distance
(left ventricle) requires higher pressure ; ora
ref. to overcoming greater resistance / lungs less resistance ;
pulmonary capillaries damaged by higher pressure ;
higher pressure requires more muscular force / AW ; ora [max 3]

(c) sinoatrial node ; [1]

[Total: 5]

157. 9700_s15_ms_22 Q: 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]

---

158. 9700_w15_ms_22 Q: 6

(a) **1** *idea of* different distances **;** *must be comparative*
e.g. atria pump blood shorter distance **ora**
atria pump blood a short distance and ventricles pump blood a long distance
atria pump blood to ventricles and ventricles pump blood to, (other parts of) body

2 (so) resistance to overcome by atria is low(er)
or
(so) ventricles need to overcome, great(er) / AW, resistance **;**

3 (so) atria generates lower pressure
ventricles generate higher pressure **;** AW
A force for pressure
R ventricles withstand high pressures
A low pressure / high pressure *if mp1 or mp2 gained* [max 2]

(b) septum **; R** atrioventricular septum [1]

(c) **(i)** **I** *ref. to* xylem / transpiration stream

transpiration
involves only water (molecules) **;**
involves, evaporation / diffusion / evaporation and diffusion **;**
I *ref. to* evaporating surface
movement out to (external) environment / loss from leaves **; A** aerial parts
affected by, external factors / humidity / light / wind speed / temperature **;**
occurs in one direction / from air spaces through stomata **;**
ATP not required **;**

translocation
involves, assimilates / photosynthates / sucrose / other named **; A** cell sap
involves (hydrostatic) pressure gradients **; A** mass flow
involves transport in phloem (sieve tubes) **;**
flow from source to sink / AW **;**
ATP used (to enable loading of sucrose into phloem sieve tube) **; A** active [max 1]

(ii) both involve, transport / movement of substances **; R** if transport in xylem stated
both involve water **;**
both require energy **;** *(transpiration – evaporation requires heat energy and translocation – hydrogen ions pumping out of companion cells)* [max 1]

[Total: 5]

STEMUP.CO.UK

Q1.

Use

5 Haemoglobin is a globular protein with quaternary structure.

Fig. 5.1 is a diagram of the haemoglobin molecule.

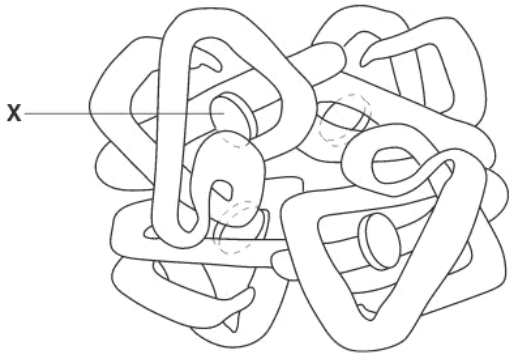


Fig. 5.1

(a) With reference to Fig. 5.1,

(i) name **X** and state its function;

.....

.....[2]

(ii) explain why haemoglobin is described as a *globular protein* with *quaternary structure*.

.....

.....

.....[2]

(b) Explain why people who have a deficiency of iron in their diet are often lacking in energy and feel tired.

.....

.....

.....

.....[3]

STEMUP.CO.UK

Examiner's Use

Fig. 5.2 shows the oxygen dissociation curves for myoglobin, **M**, and haemoglobin, **H**.

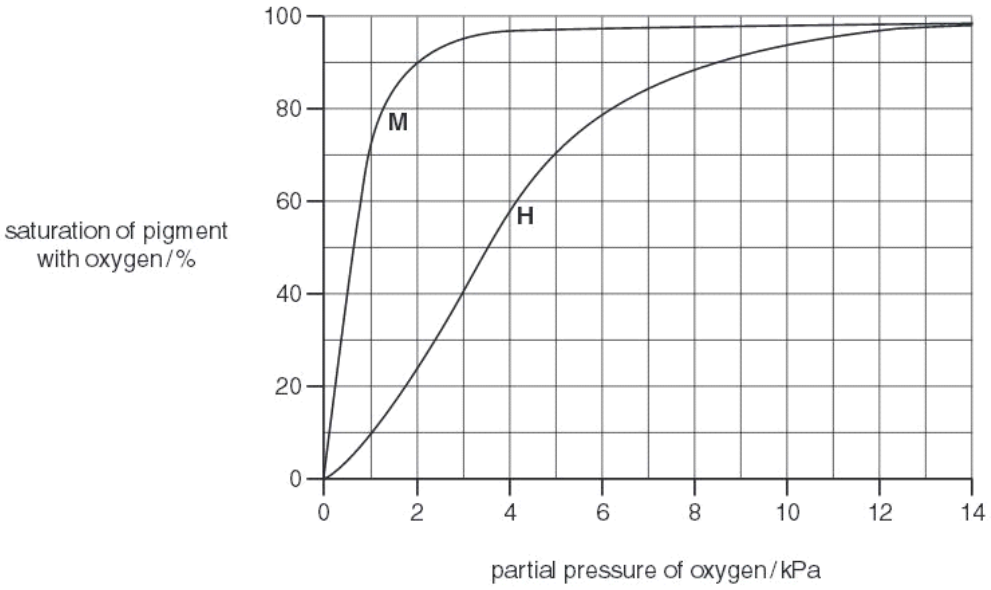


Fig. 5.2

(c) State the tissue where myoglobin is found.

.....[1]

(d) With reference to Fig. 5.2,

(i) state the percentage saturation of myoglobin and haemoglobin when the partial pressure of oxygen is 2 kPa;

myoglobin .....

haemoglobin .....[1]

(ii) explain the significance of the difference in percentage saturation that you have shown in **(i)**.

.....

.....

.....

.....

.....[3]

STEMUP.CO.UK

(e) When a person exercises vigorously, the partial pressure of carbon dioxide in the blood increases.

Draw on Fig. 5.2 a dissociation curve for haemoglobin when the partial pressure of carbon dioxide has increased. [1]

[Total : 13]

Q2.

1 Fig. 1.1 is a vertical section of the heart to show the regions concerned with initiating and conducting impulses.

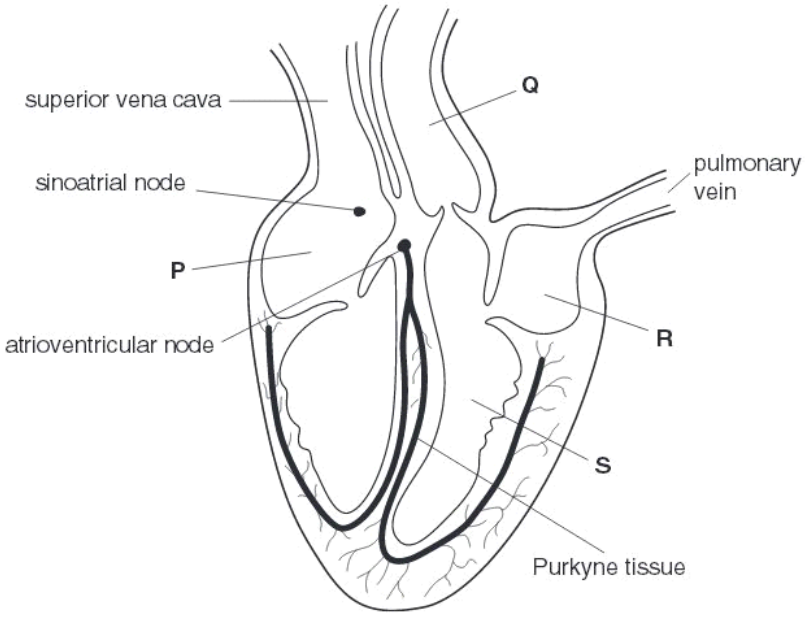


Fig. 1.1

STEMUP.CO.UK

(a) Name chamber **P** and blood vessel **Q**.

P .....

Q .....[2]

(b) Explain why the wall of chamber **S** is much thicker than the wall of chamber **R**.

.....

.....

.....

.....

.....[2]

(c) Describe how the following three structures shown on Fig. 1.1 initiate and coordinate the contraction of the heart:

- sinoatrial node (SAN)
- atrioventricular node (AVN)
- Purkyne tissue.

.....

.....

.....

.....

.....

.....

.....

.....[4]

STEMUP.CO.UK

(d) Outline the effects of atherosclerosis in coronary arteries on the blood flow through these coronary arteries and the resulting effects on the heart itself.

.....

.....

.....

.....

.....

.....

.....

.....[4]

[Total: 12]

Q3.

(c) State three ways in which the **structure** of a red blood cell differs from the structure of the cell shown in Fig. 4.1.

1 .....

2 .....

3 .....

[3]

Table 4.1 shows the red blood cell counts for two people from Peru – one who lived at sea level and the other who lived at 5 000 metres above sea level.

Table 4.1

	red blood cell count / cells mm^{-3}
sea level	5.0×10^6
5 000 metres above sea level	6.3×10^6

STEMUP.CO.UK

(d) Explain why the red blood cell count is much higher in the person who lived at high altitude.

.....

.....

.....

.....

.....[2]

[Total:11]

Q4.

3 **(a)** As blood passes through the capillaries in the lungs it becomes oxygenated.

Explain how the structure of haemoglobin aids the uptake of oxygen in the lungs.

.....

.....

.....

.....

.....

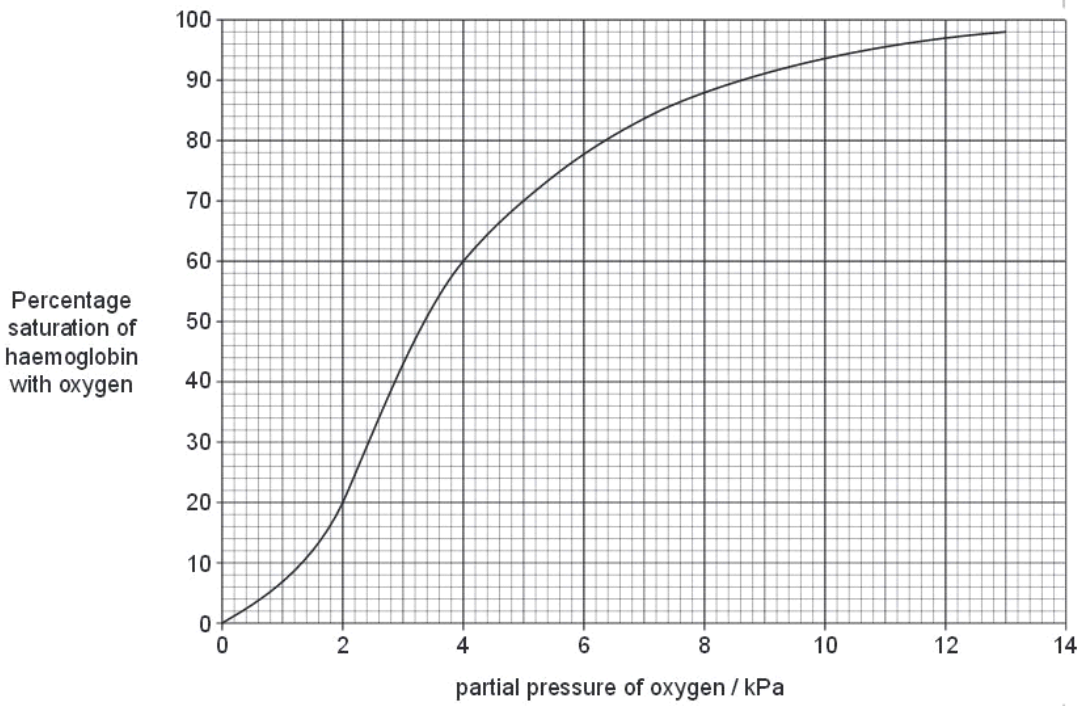
.....

.....

..... **[4]**

STEMUP.CO.UK

Fig. 3.1 shows the dissociation curve of adult haemoglobin.



(b) Use the information given in Fig. 3.1 to complete the table below.

part of the circulation	partial pressure of oxygen / kPa	percentage saturation of haemoglobin
capillaries in the lungs		98
capillaries in muscle tissue at rest		70
capillaries in muscle tissue during strenuous exercise	2.0	

[3]

STEMUP.CO.UK

(c) During exercise the concentration of carbon dioxide in muscle tissue increases. This stimulates an increase in the release of oxygen from the blood.

Explain how carbon dioxide stimulates the release of oxygen from the blood.

.....

.....

.....

.....

.....

..... [3]

[Total: 10]

Q5.

1 Fig. 1.1 is a drawing made from an electron micrograph of a longitudinal section of a capillary in muscle tissue.

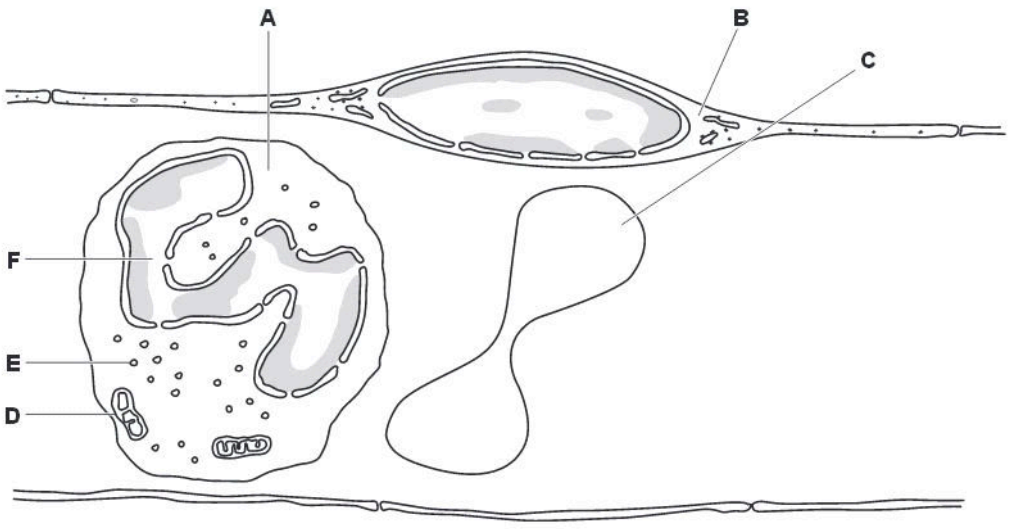


Fig. 1.1

STEMUP.CO.UK

(a) Complete the table below using the information in Fig. 1.1 to help you.

	cell **A**	cell **B**	cell **C**
name of cell			red blood cell
function of cell	ingest bacteria	permit exchange of gases	
diameter / µm		20	7

[4]

(b) Name the organelles **D**, **E** and **F**.

D .....

E .....

F .....[3]

(c) Explain how oxygen and glucose move from the blood inside the capillary to the tissue fluid in the muscle.

oxygen .....

.....

.....

glucose .....

.....

.....[3]

(d) Describe how the **structure** of the **wall** of a vein differs from that of a capillary.

.....

.....

.....

.....

.....

.....[3]

[Total: 13]

STEMUP.CO.UK

Q6.

1 Fig. 1.1 shows the heart and associated blood vessels.

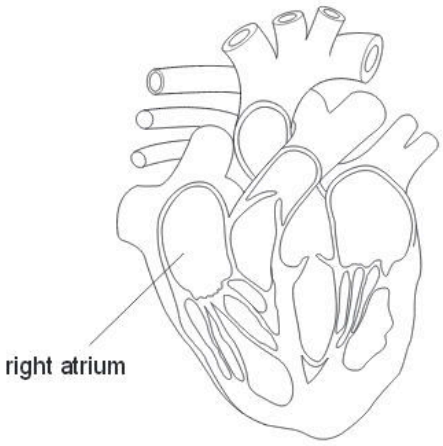


Fig. 1.1

(a) On Fig. 1.1, draw label lines and use the letters **P**, **Q** and **R** to indicate the following structures:

P a blood vessel that carries deoxygenated blood

Q a structure that prevents backflow into a ventricle

R a blood vessel that carries blood at high pressure [3]

(b) The changes in blood pressure in the right atrium are the same as those in the left atrium. The changes in blood pressure in the right ventricle are different from those in the left ventricle.

Explain why this is so.

.....

.....

.....

.....

.....

.....

.....

..... [4]

STEMUP.CO.UK

(c) Some components of tobacco smoke are absorbed into the blood stream and affect the cardiovascular system.

Describe the effects of nicotine and carbon monoxide on the cardiovascular system.

nicotine .....

.....

.....

.....

carbon monoxide .....

.....

.....

..... [4]

[Total: 11]

Q7.

3 **(a)** Fig. 3.1 shows a cross-section of the heart at the level of the valves.

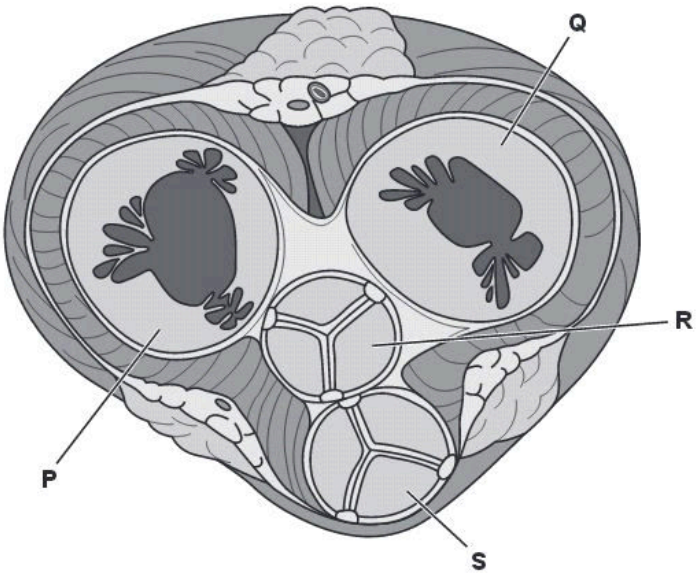
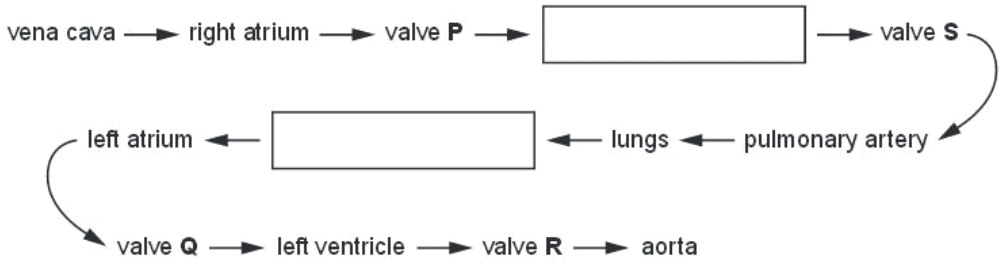


Fig. 3.1

STEMUP.CO.UK

(i) Complete the following flow chart to show the pathway of blood through the heart.



[2]

(ii) Explain how the valves **P** and **Q** ensure one-way flow of blood through the heart.

.....

.....

.....

.....[2]

(b) The cardiac cycle describes the events that occur during one heart beat.

Fig. 3.2 shows the changes in blood pressure that occur within the left atrium, left ventricle and aorta during one heart beat.

STEMUP.CO.UK

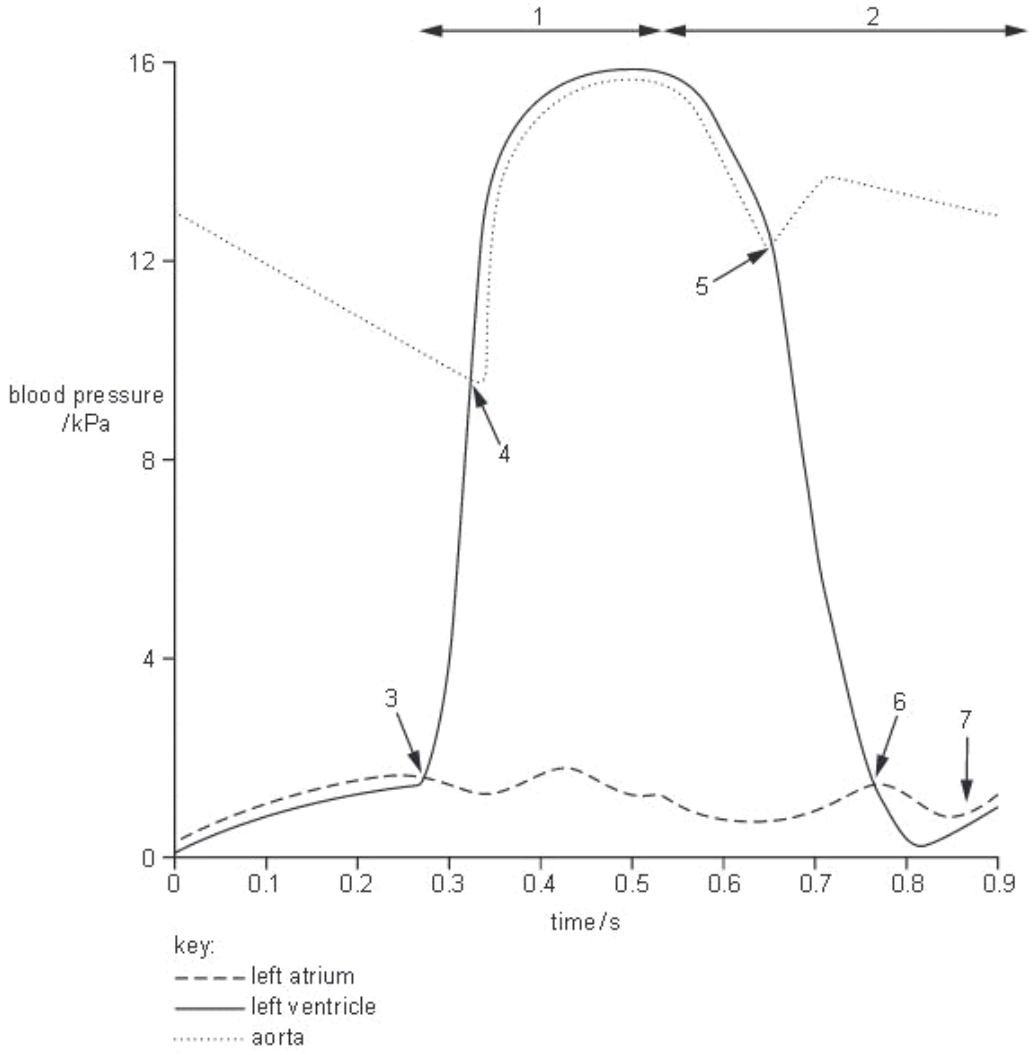


Fig. 3.2

STEMUP.CO.UK

In the table below, match up each event during the cardiac cycle with an appropriate number **1** to **7** on Fig. 3.2.

For Examiner Use

You should put only one number in each box. You may use each number once, more than once or not at all.

The first answer has been completed for you.

event during the cardiac cycle	number
atrioventricular (bicuspid) valve opens	**6**
ventricular systole	
semilunar (aortic) valve closes	
left ventricle and left atrium both relaxing	
semilunar (aortic) valve opens	

[4]

(c) Explain the roles of the sinoatrial node (SAN), atrioventricular node (AVN) and the Purkyne tissue during one heart beat.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....[5]

[Total: 13]

Q8.

STEMUP.CO.UK

2 Fig. 2.1 is a diagram of a vertical section through a healthy mammalian heart.

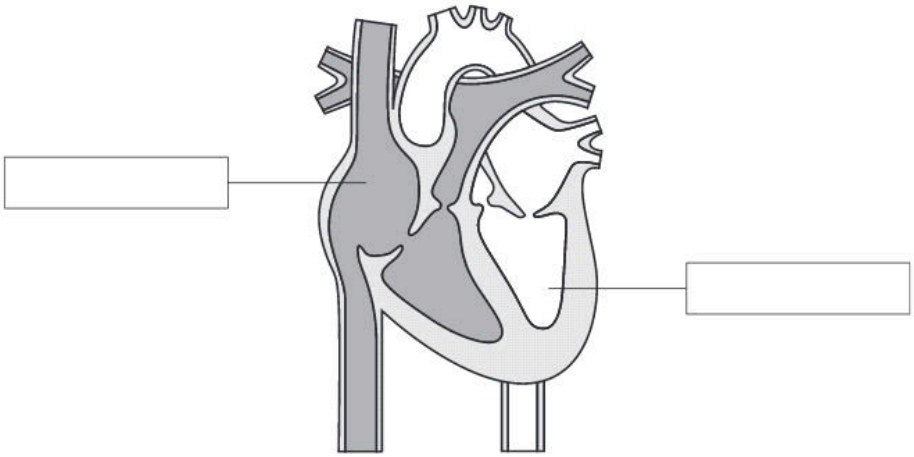


Fig. 2.1

(a) (i) Label the **two** chambers of the heart by writing in the boxes provided on Fig. 2.1. [1]

(ii) State two ways in which the **composition** of blood entering the right atrium is different to blood entering the left atrium.

1. .....

.....

2. .....

.....[2]

STEMUP.CO.UK

Some people are born with structural defects of the heart and its associated blood vessels. This is known as congenital heart disease. The dotted circles labelled **A** to **G** on Fig. 2.2 show some areas that are affected by different types of congenital heart disease.

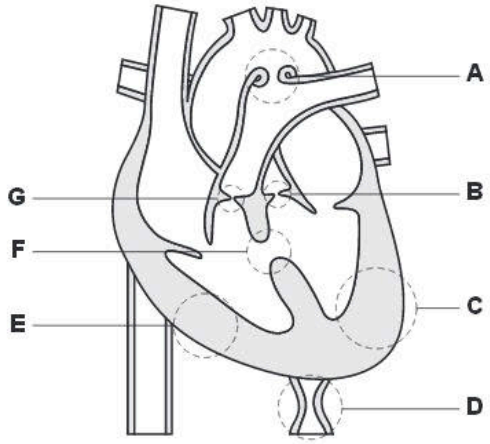


Fig. 2.2

The structural defects causing four types of congenital heart disease are described below:

- **patent ductus arteriosus** – a link between the pulmonary artery and aorta fails to close after birth
- **pulmonary stenosis** – a narrowing of the semilunar valve of the pulmonary artery
- **coarctation of the aorta** – a localised narrowing of the aorta
- **ventricular septal defect** – a hole in the septum between the ventricles.

(b) Match the **one** correct area from **A** to **G** on Fig. 2.2 with each of the congenital heart diseases.

The first one has been completed for you.

patent ductus arteriosus ..... **A** .....

pulmonary stenosis .....

coarctation of the aorta .....

ventricular septal defect ..... [3]

STEMUP.CO.UK

(c) Suggest and explain how the flow of blood in a person with patent ductus arteriosus differs from that of a person with a healthy heart.

.....

.....

.....

.....

.....

.....[3]

[Total: 9]

Q9.

2 Fig. 2.1 shows a diagram of a section through a human heart.

For Examiner Use

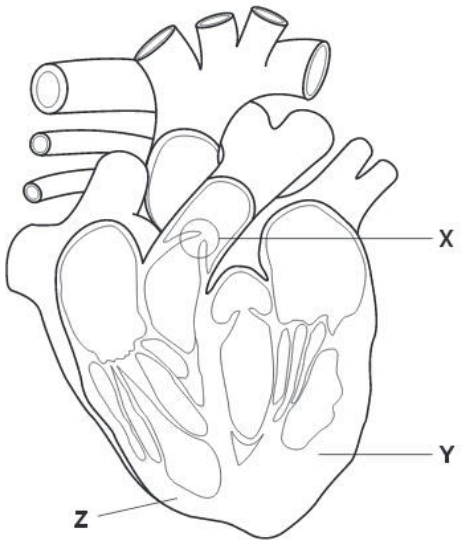


Fig. 2.1

STEMUP.CO.UK

(a) State the name and function of the circled structure labelled **X**.

name .....

function .....

.....

.....[3]

(b) Explain why the region labelled **Y** is thicker than the region labelled **Z**.

.....

.....

.....

.....

.....

.....[3]

(c) Cardiac muscle is described as myogenic as it naturally contracts and relaxes. With reference to the structures and tissues within the heart, describe how the cardiac cycle is initiated and coordinated.

Ex

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....[5]

[Total: 11]

Q10.

STEMUP.CO.UK

2 **(a)** Carbon dioxide is transported in the blood in various forms.

Describe how carbon dioxide molecules reach red blood cells from respiring cells.

.....

.....

.....

.....[2]

Fig. 2.1 shows part of a capillary network and some cells of the surrounding tissue.

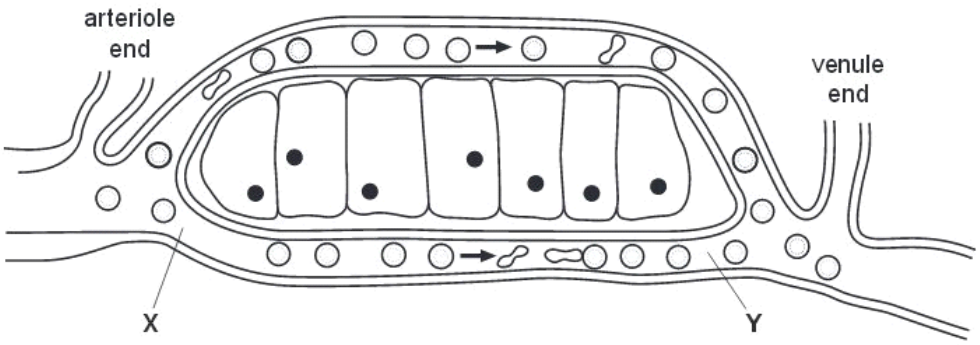


Fig. 2.1

(b) State three ways in which the blood at **Y** differs from the blood at **X** **other than** in the concentration of carbon dioxide.

1. .....

2. .....

3. .....[3]

STEMUP.CO.UK

An enzyme in red blood cells catalyses the reaction between carbon dioxide and water as blood flows through respiring tissues.

For Examiner Use

$$CO_2 + H_2O \xrightarrow{\text{enzyme}} H_2CO_3 \longrightarrow H^+ + HCO_3^-$$

(c) (i) Name the enzyme that catalyses this reaction.

.....[1]

(ii) Explain the significance of this reaction in the transport of carbon dioxide.

.....

.....

.....

.....

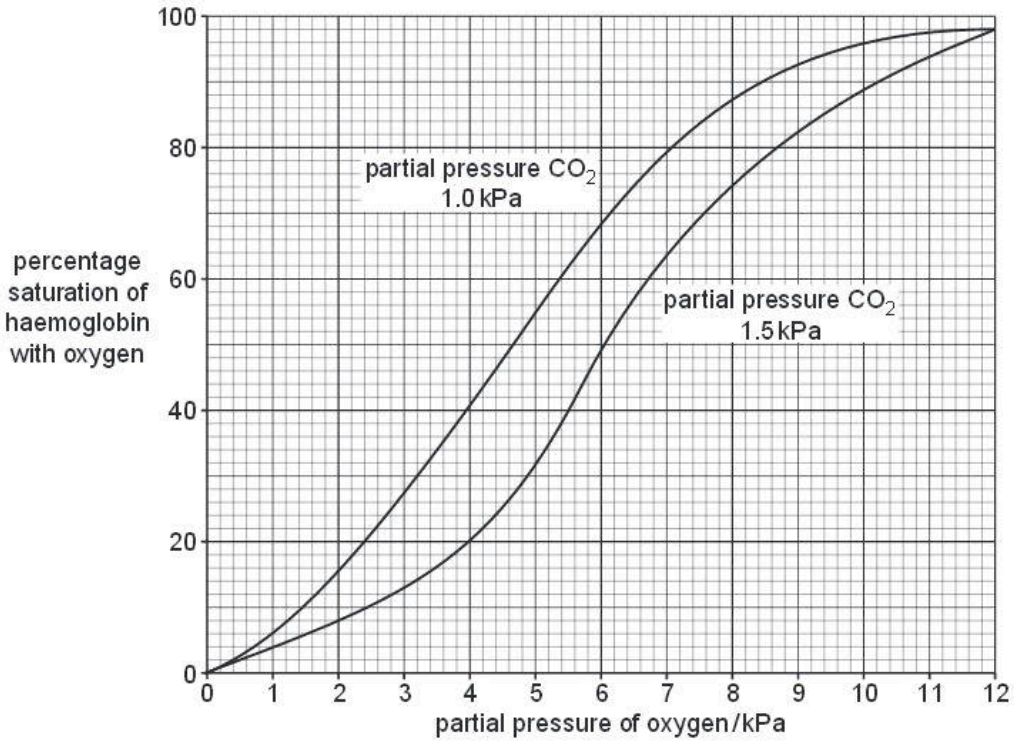
.....

.....

.....[3]

STEMUP.CO.UK

(d) Fig. 2.2 shows the effect of increasing the carbon dioxide concentration on the oxygen haemoglobin dissociation curve.



(i) State the percentage saturation of haemoglobin with oxygen at a partial pressure of 5 kPa of oxygen when the partial pressure of carbon dioxide is:

1.0 kPa .....

1.5 kPa .....[1]

(ii) The percentage saturation of haemoglobin with oxygen **decreases** as the partial pressure of carbon dioxide increases.

Explain how this happens.

.....

.....

.....

.....[2]

STEMUP.CO.UK

(iii) Name the effect of increasing carbon dioxide concentration on the oxygen dissociation curve.

For Examiner Use

.....[1]

(iv) Explain the importance of the effect of carbon dioxide on haemoglobin as shown in Fig. 2.2.

.....

.....

.....

.....

.....

.....[3]

[Total: 16]

Q11.

3 **(a)** Explain how the structure of red blood cells is suited to their function of transporting oxygen to body tissues.

Ex

.....

.....

.....

.....

.....

.....[3]

STEMUP.CO.UK

(b) The circulating red blood cell is metabolically active but only lives for about 120 days. During this time, some important enzymes are gradually broken down and this may contribute to the death of the cell.

Explain why the red blood cell is **not** able to replace important enzymes that have been broken down.

.....

.....

.....

.....

.....[2]

(c) Red blood cells are broken down by phagocytic cells in the liver and spleen. The haemoglobin is broken down into haem and globin before further processing. Some of the components of haemoglobin are re-used in the body.

(i) Name the mineral ion released from the breakdown of haem.

.....[1]

(ii) State the products of globin hydrolysis.

.....[1]

Haemoglobin plays an important role in carrying oxygen and carbon dioxide.

Fig. 3.1 summarises some of the events that occur as blood enters a capillary located in an area of actively respiring cells.

STEMUP.CO.UK

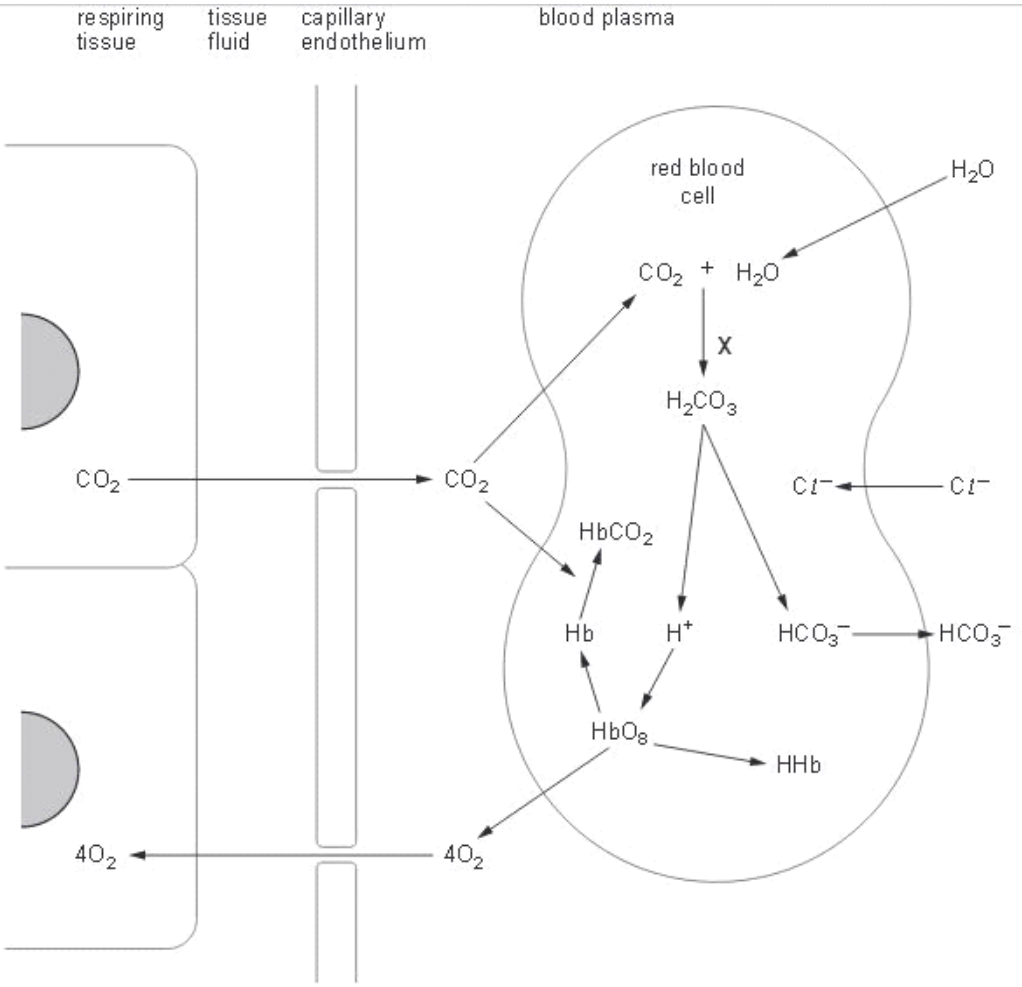


Fig. 3.1

(d) State the name of the enzyme that catalyses the reaction occurring at **X**.

.....[1]

STEMUP.CO.UK

(e) With reference to Fig. 3.1, describe **and** explain how carbon dioxide (CO_2) and hydrogen ions (H^+) play a role in the unloading of oxygen from haemoglobin.

Exa

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....[5]

[Total: 13]

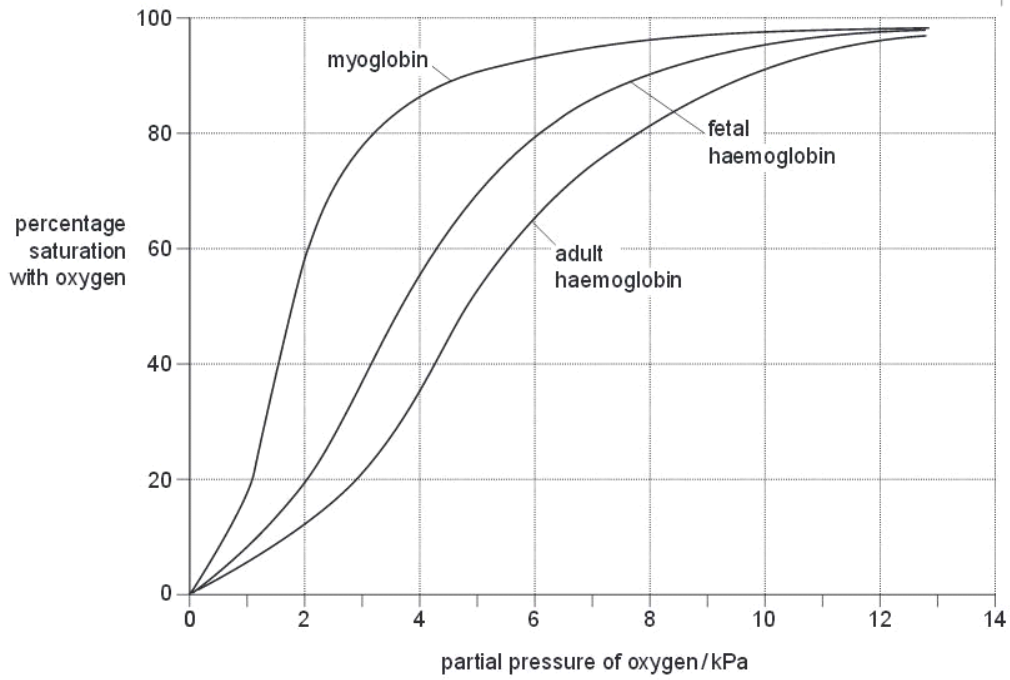
Q12.

4 **In mammals, haemoglobin is used to transport oxygen and myoglobin is used to store oxygen in muscles.**

Fig. 4.1 shows the oxygen dissociation curves for myoglobin, fetal haemoglobin and adult haemoglobin.

For Examin Use

STEMUP.CO.UK



(a) (i) Name the cells in which haemoglobin is found.

..... [1]

(ii) Use Fig. 4.1 to determine the percentage saturation of **myoglobin** and **adult haemoglobin** when the partial pressure of oxygen is 3 kPa.

myoglobin .....

adult haemoglobin ..... [1]

(iii) There is a large difference between the percentage saturation of myoglobin and that of adult haemoglobin at **low** partial pressures of oxygen. Suggest reasons for this.

For Examiner's Use

.....

.....

.....

..... [2]

STEMUP.CO.UK

(b) Fetal haemoglobin has a different oxygen binding affinity to that of adult haemoglobin, as shown in Fig. 4.1. Normally, after birth, the production of the fetal form stops and the adult form is produced.

In a rare condition known as Hereditary Persistence of Fetal Haemoglobin (HPFH), fetal haemoglobin continues to be produced well into adulthood in addition to adult haemoglobin. This condition, however, usually lacks any symptoms.

(i) Explain, with reference to Fig. 4.1, the significance of the difference in oxygen binding affinity between fetal and adult haemoglobin.

.....

.....

.....

..... [2]

(ii) Suggest why HPFH usually lacks symptoms.

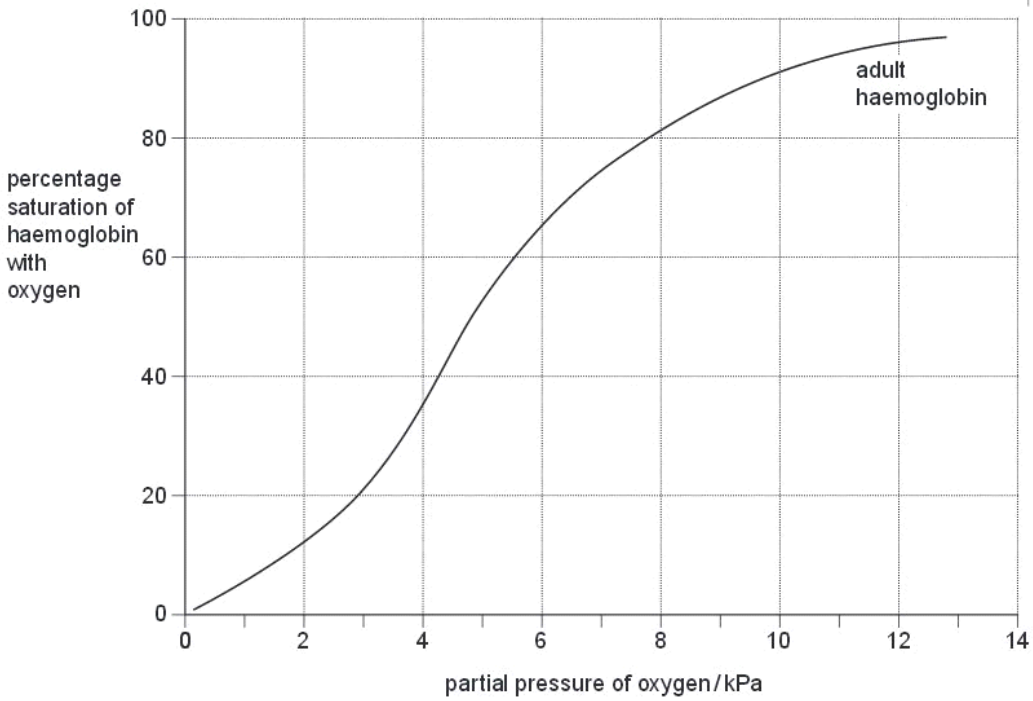
.....

.....

..... [1]

(c) Sketch on Fig. 4.2 the dissociation curve you would expect for adult haemoglobin if the concentration of carbon dioxide is increased. [2]

For Examiner's Use



STEMUP.CO.UK

Q13.

3 Haemoglobinopathies are inherited conditions linked to the structure and function of haemoglobin. Sickle cell anaemia is one of these conditions in which the transport and delivery of oxygen to tissues is less than normal.

An investigation was carried out to discover the effect of sickle cell anaemia on the ability of blood to carry oxygen. Blood samples were taken from two people:

- person **L** without sickle cell anaemia
- person **M** with sickle cell anaemia.

The percentage saturation of haemoglobin with oxygen was determined over a range of partial pressures of oxygen.

Fig. 3.1 shows oxygen haemoglobin dissociation curves for the two blood samples.

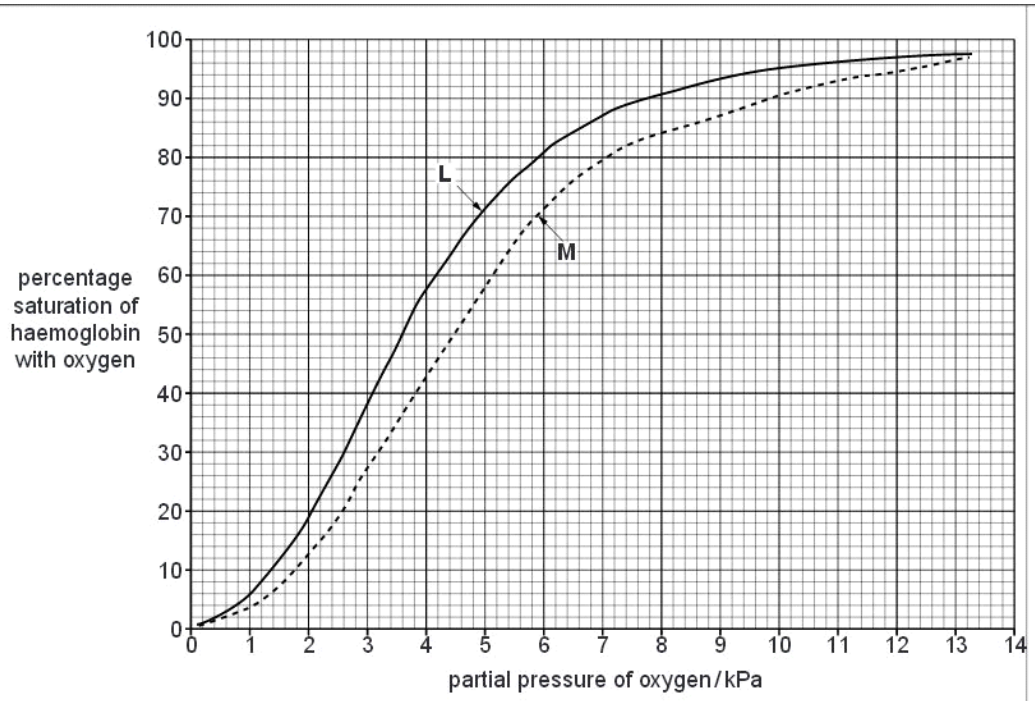


Fig. 3.1

(a) P50 is the partial pressure of oxygen at which haemoglobin is 50% saturated with oxygen. It is taken as a measurement of the affinity of haemoglobin for oxygen.

(i) State the P50 for the two blood samples, **L** and **M**.

L .....

M .....[1]

STEMUP.CO.UK

(ii) With reference to Fig. 3.1, describe how the dissociation curve for person **M differs** from the dissociation curve for person **L**.

.....

.....

.....

.....

.....

..... [3]

(b) Explain the advantage of the position of the dissociation curve for people with sickle cell anaemia.

.....

.....

.....

.....

.....

..... [3]

STEMUP.CO.UK

(c) The partial pressure of oxygen in the lungs at sea level is about 13.5 kPa. At an altitude of 3000 metres the partial pressure of oxygen in the lungs is about 7.5 kPa.

When people move from sea level to high altitude they become adapted to the low partial pressure of oxygen.

Describe **and** explain how humans become adapted to the low partial pressure of oxygen at high altitude.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....[4]

(d) Vaccination is used to control the spread of diseases, such as measles.

Explain why vaccination cannot be used to prevent sickle cell anaemia.

.....

.....

.....

.....[2]

[Total: 13]

Q14.

STEMUP.CO.UK

1 Fig. 1.1 is an electron micrograph of a cross section through a blood vessel.

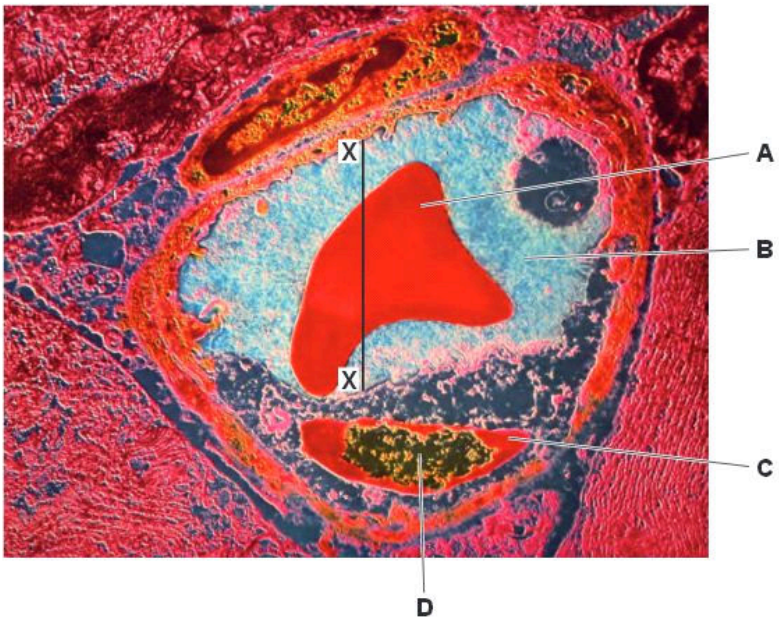


Fig. 1.1

(a) Name the type of blood vessel shown in Fig. 1.1 and describe one **visible** feature which is characteristic of this type of vessel.

type of vessel.....

characteristic feature .....

.....[2]

(b) Name:

(i) structure **A** .....

(ii) the main component of substance **B**. .....
[2]

(iii) Cell **C** in Fig. 1.1 is an endothelial cell.

Name structure **D**.

.....[1]

STEMUP.CO.UK

(c) The magnification of Fig. 1.1 is × 6000.

Calculate the diameter of the lumen along the line X–X.

Show your working and give your answer in micrometres (μm) to the nearest whole number.

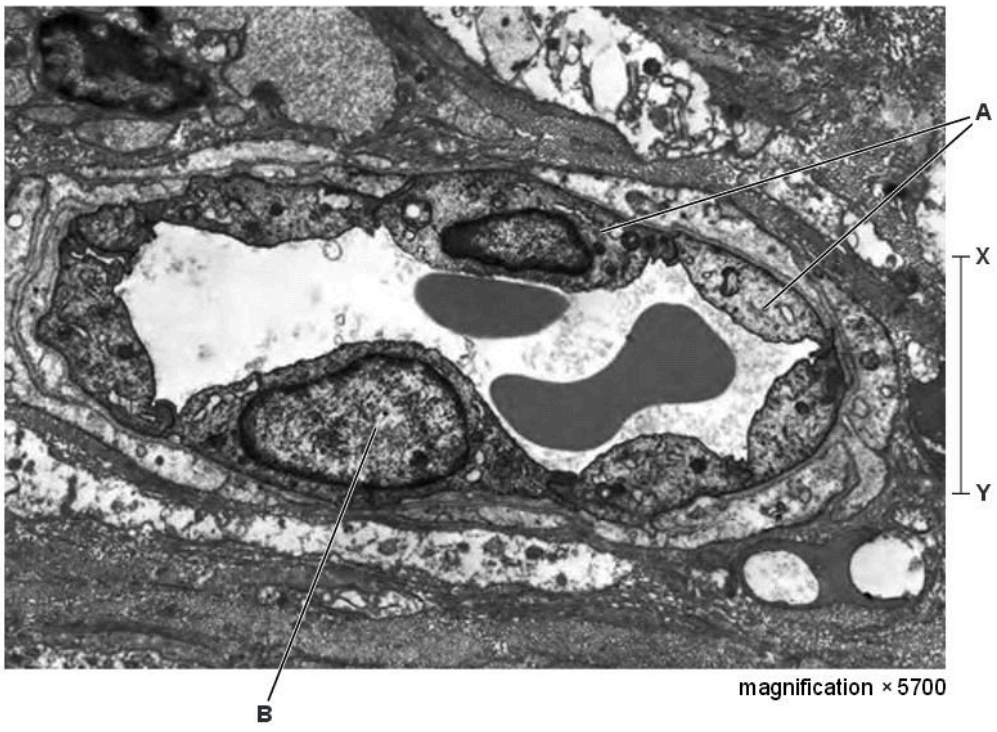
answer ..... μm [2]

[Total: 7]

Q15.

1 Capillaries are known as exchange vessels. Substances are exchanged between blood and tissue fluid as the blood flows through the capillaries.

Fig. 1.1 is an electron micrograph of a section through a capillary with two red blood cells.



magnification × 5700

STEMUP.CO.UK

(a) (i) Name the cells labelled **A** and the structure labelled **B**.

A .....

B ..... [2]

(ii) Calculate the actual distance **X – Y** on Fig. 1.1.

Show your working and give your answer to the nearest micrometre (μm).

answer ..... μm [2]

(iii) Explain how capillaries are adapted for their function as exchange vessels.

For Examiner's Use

.....

.....

.....

.....

..... [2]

(b) Table 1.1 shows the composition of blood, tissue fluid and lymph.

Table 1.1

component	blood	tissue fluid	lymph
red blood cells / cells $mm^{-3} \times 10^6$	5.1	0.0	0.0
white blood cells / cells mm^{-3}	9000	75	1000000
glucose / g dm^{-3}	800	800	775
protein / g dm^{-3}	71	1	26

STEMUP.CO.UK

Explain the differences between the composition of blood, tissue fluid and lymph as shown in Table 1.1, for white blood cells, glucose and protein.

white blood cells .....

.....

.....

.....

glucose .....

.....

.....

.....

protein .....

.....

.....

..... [5]

(c) Outline how **red blood cells** are involved in the transport of carbon dioxide.

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 14]

Q16.

STEMUP.CO.UK

6 **(a)** The statements below are some of the events that occur in the initiation and control of heart action during one cardiac cycle.

Place the events in the correct sequence, using **1** as the first event in the sequence.

event	correct sequence
Purkyne tissue conducts the wave of excitation	
atrioventricular node sends out a wave of excitation	
atria contract	
ventricles contract	
sinoatrial node sends out a wave of excitation	

[3]

(b) The wall of the left ventricle contains more cardiac muscle than the wall of the right ventricle.

Explain the difference in the thickness of the walls of the left and right ventricles of the heart, in terms of their functions.

.....

.....

.....

.....

..... [2]

[Total: 5]

Q.17.

STEMUP.CO.UK

1 Fig. 1.1 is a photomicrograph of a transverse section of an artery and a vein from a mammal.



Fig. 1.1

(a) State three ways, **visible in Fig. 1.1**, in which the artery differs from the vein.

1 .....

.....

2 .....

.....

3 .....

.....[3]

STEMUP.CO.UK

(b) The lungs contain arteries, veins and capillaries.

Explain the role of capillaries in the lungs.

.....

.....

.....

.....

.....[3]

(c) Describe the effect of tar from cigarettes on the lining of the gaseous exchange system.

.....

.....

.....

.....

.....

.....[3]

[Total: 9]

Q18.

STEMUP.CO.UK

4 **(a)** Explain why the mammalian circulatory system is described as a closed double circulation.

.....

.....

.....

.....[2]

(b) Mature mammalian red blood cells have no nuclei. State **one** advantage and **one** disadvantage of this.

advantage .....

.....

.....

disadvantage .....

.....

.....[2]

Q19.

5 Table 5.1 shows blood cell counts for three different people.

Table 5.1

	number of cells per mm^3 of blood		
	healthy person at sea level	healthy person acclimatised to high altitude	person with a bacterial infection
red blood cells	5 400 000	6 100 000	5 300 000
T helper lymphocytes	1 000	1 050	850
phagocytes	5 400	5 600	8 750

STEMUP.CO.UK

(a) (i) Calculate the percentage increase in the number of red blood cells in the person acclimatised to high altitude compared with the person at sea level. Show your working and express your answer to the nearest whole number.

Answer = ... [2]

(ii) Explain the advantage of this increase in red blood cells to people who live at high altitude.

.....

.....

.....

.....

.....[2]

Q20.

14

6 Fig. 6.1 shows three stages in the cardiac cycle.

STEMUP.CO.UK

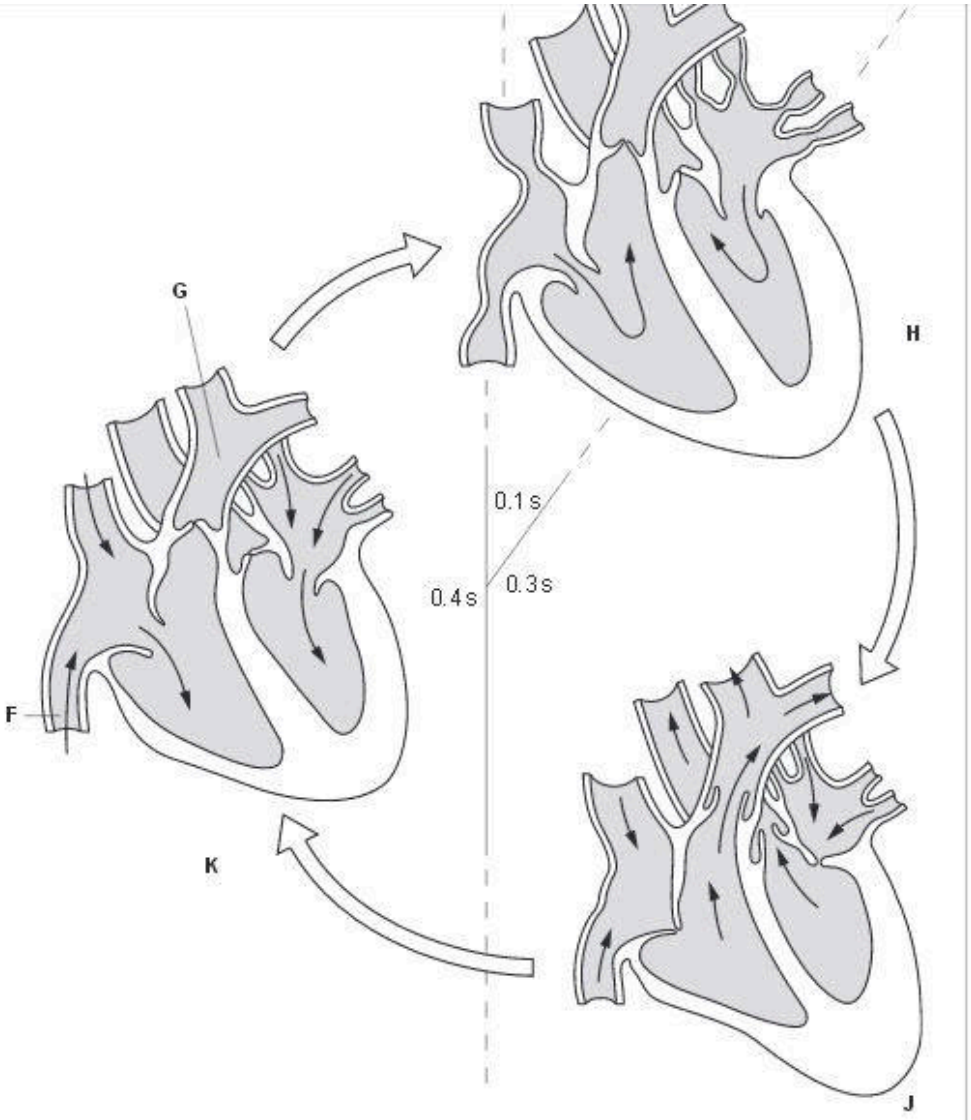


Fig. 6.1

(a) (i) Name the blood vessels labelled **F** and **G**.

F .....

G .....[2]

STEMUP.CO.UK

Use

(ii) Fig. 6.1 indicates that one heart beat takes 0.8 second.
State the heart rate in beats per minute.

Answer = ... [1]

(iii) Explain why the walls of the atria have thinner muscle than the walls of the ventricles.

.....

.....

.....

.....[2]

(b) Complete the table to show what is happening to the following parts of the **left** side of the heart at each of the stages, **H**, **J** and **K** as shown in Fig. 6.1:

- left atrium
- left ventricle
- aortic valve.

stage	left atrium	left ventricle	atrioventricular valve	aortic valve
H	contracts to force blood into left ventricle	....	open	closed
J	....	....	closed	.....
K	....	relaxes and fills with blood from left atrium	open	.....

[6]

[Total: 11]

Q21.

STEMUP.CO.UK

2 Scientists have developed a variety of ways to represent the three dimensional structure of proteins. Fig. 2.1 shows one way of representing the structure of the protein, haemoglobin.

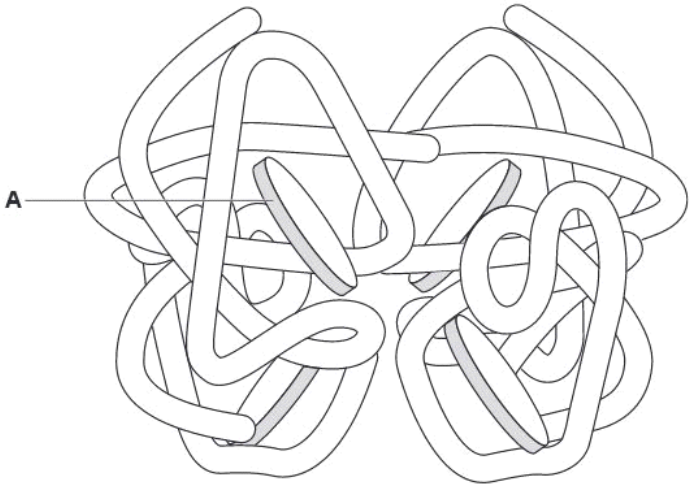


Fig. 2.1

(a) (i) Name **A** and state its role.

name .....

role .....

.....

.....[3]

(ii) With reference to Fig. 2.1, explain why a molecule of haemoglobin is said to show **both** tertiary structure and quaternary structure.

.....

.....

.....

.....

.....[2]

Fig. 2.2 shows the oxygen haemoglobin dissociation curve when the partial pressure of carbon dioxide is very low.

STEMUP.CO.UK

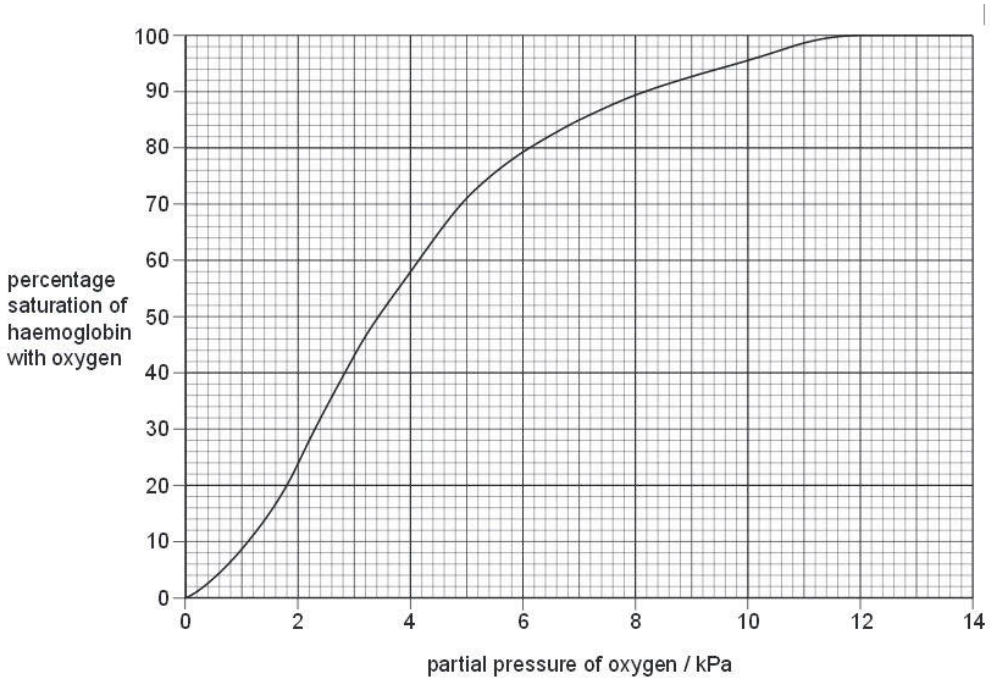


Fig. 2.2

(b) With reference to Fig. 2.2,

(i) state the percentage saturation of haemoglobin with oxygen at

4 kPa ..... %

12 kPa ..... % [2]

(ii) explain how the shape of the curve between 6 kPa and 2 kPa helps in the delivery of oxygen to respiring tissues.

.....

.....

.....

.....

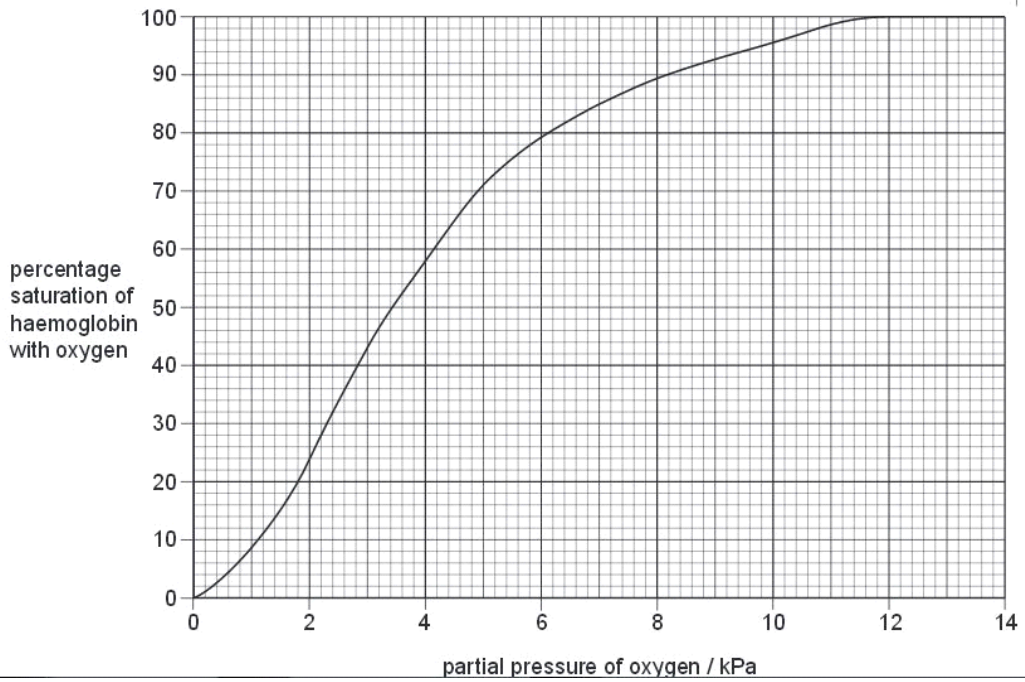
.....

.....

.....[4]

STEMUP.CO.UK

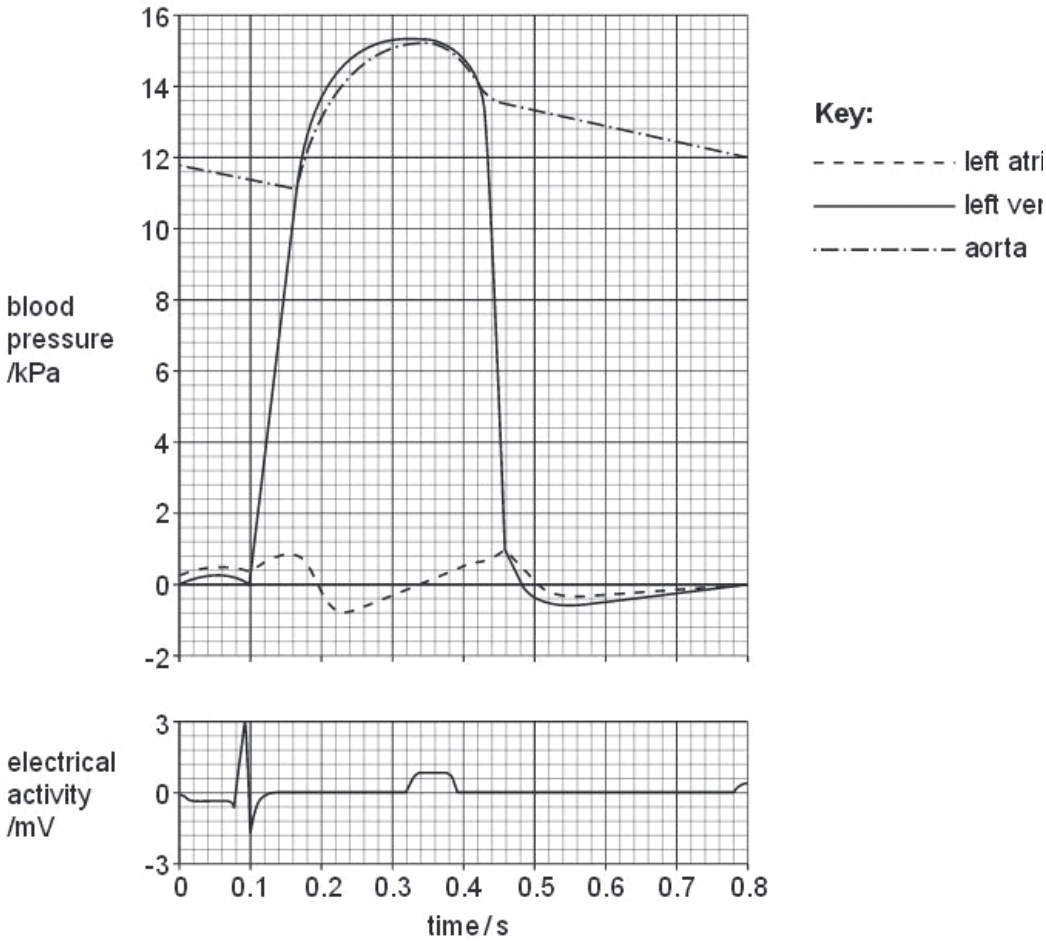
(c) **Sketch on** Fig. 2.3 below the dissociation curve that you would expect if the concentration of carbon dioxide is increased. [2]



Q22.

4 Fig. 4.1 shows the changes in blood pressure in the left atrium, left ventricle and aorta during one complete contraction of the heart. It also shows a recording of the electrical activity of the heart.

STEMUP.CO.UK



(a) Name the source of the electrical activity in the heart.

.....[1]

STEMUP.CO.UK

(b) Explain how the heart is coordinated so that the ventricle contracts after the atrium has contracted.

.....

.....

.....

.....

.....

.....

.....

..... **[4]**

(c) With reference to Fig. 4.1, calculate the heart rate in beats per minute. Show your working and express your answer to the nearest whole number.

Answer = ... beats min^{-1} [2]

(d) The pressure in the **right ventricle** is rarely higher than 4.0 kPa.

Explain why the pressure in the right ventricle is much lower than that in the left ventricle.

.....

.....

.....

.....[2]

[Total: 9]

Q23.

STEMUP.CO.UK

4 **(a)** Mammals have a closed, double circulation.

State what is meant by the term *double circulation*.

.....

..... [1]

Fig. 4.1 shows part of the circulation in a mammalian tissue. The central part is enlarged to show a capillary, a cell supplied by the capillary, and vessel **Z.**

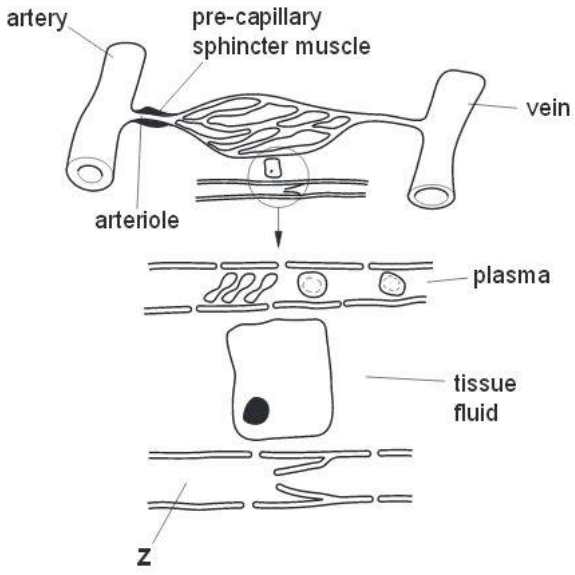


Fig. 4.1

(b) Explain why the wall of the artery is thicker than the wall of the vein.

.....

.....

.....

..... [2]

(c) Suggest one role for the pre-capillary sphincter muscle shown in Fig. 4.1.

.....

..... [1]

STEMUP.CO.UK

(d) With reference to Fig. 4.1, describe the role of capillaries in forming tissue fluid.

For Examiner's Use

.....

.....

.....

.....

.....

..... [3]

(e) **(i)** Describe three ways in which plasma differs from tissue fluid.

1. .....

.....

2. .....

.....

3. .....

..... [3]

(ii) Name the fluid in vessel **Z**.

..... [1]

[Total: 11]

Q24.

STEMUP.CO.UK

(c) Fig. 2.1 shows a cross section of a coronary artery partially blocked by plaque causing atherosclerosis.

For Examiner's Use

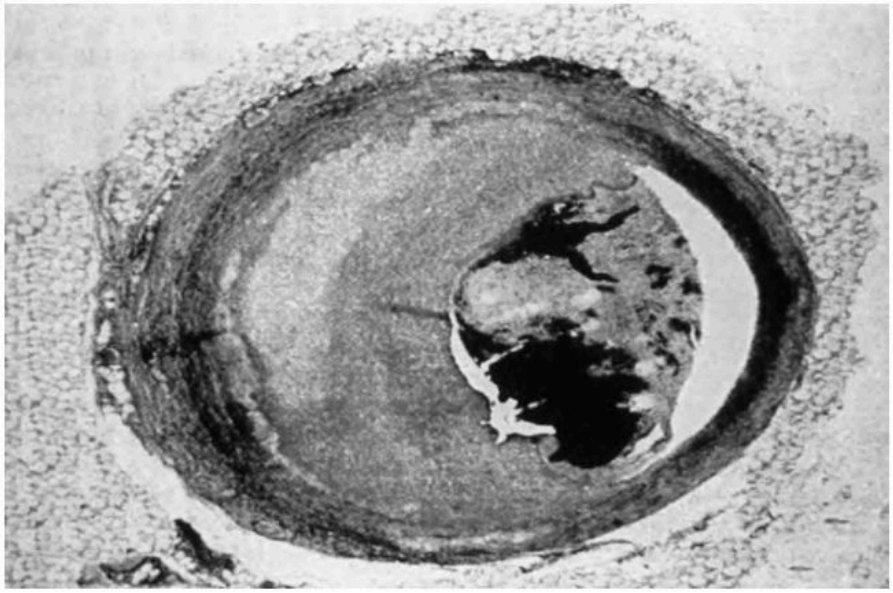


Fig. 2.1

Explain why atherosclerosis in coronary arteries may limit the ability of people to take vigorous exercise.

.....

.....

.....

.....

.....

.....[3]

STEMUP.CO.UK

(d) Describe the effects of nicotine and carbon monoxide in cigarette smoke on the cardiovascular system.

For Examiner's Use

nicotine .....

.....

.....

.....

.....

.....

carbon monoxide .....

.....

.....

.....

.....

.....[3]

[Total: 13]

Q25.

Red blood cells each contain about 240 million molecules of haemoglobin that transport oxygen and carbon dioxide.

E

(c) Describe the role of haemoglobin in the **transport** of oxygen and carbon dioxide.

oxygen .....

.....

.....

.....

carbon dioxide .....

.....

.....

.....[4]

STEMUP.CO.UK

(d) The haematocrit is the proportion of the blood that is composed of red blood cells. Samples of blood were taken from an athlete who lived at sea level since birth and moved to live and train at an altitude of 5000 m for three weeks. The haematocrit and the number of red blood cells per mm^3 were determined before moving to high altitude and after three weeks at that altitude. The results are shown in Table 3.2.

Table 3.2

altitude	haematocrit	number of red blood cells × 10^6 per mm^3
sea level	0.45	6.1
5000 m (after three weeks)	0.53	7.3

(i) Calculate the percentage increase in the number of red blood cells per mm^3 after three weeks at 5000 m. Show your working.

Answer = ... % [2]

(ii) Explain why the haematocrit increases at altitude.

E

.....

.....

.....

.....

.....

.....[3]

Q26.

STEMUP.CO.UK

2 **(a)** Describe the function of each of the following structures in the human heart:

(i) sinoatrial node (SAN)

.....

.....

..... [2]

(ii) atrioventricular node (AVN)

.....

.....

..... [2]

(iii) left atrioventricular (bicuspid) valve.

.....

.....

.....

..... [2]

(b) Fig. 2.1 shows the changes in blood pressure in the left atrium, left ventricle and aorta during one complete cardiac cycle.

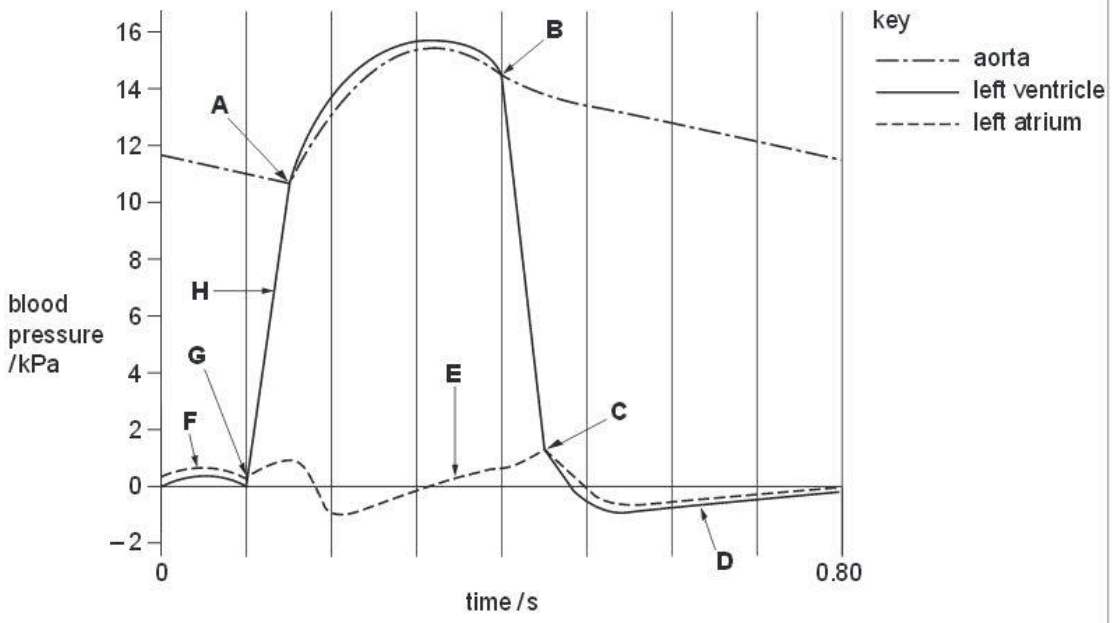


Fig. 2.1

STEMUP.CO.UK

Complete the table below using the appropriate letter, **A** to **H**, to match the points from the graph to the correct statement.

You must only put one letter in each box. You may use each letter once, more than once or not at all.

statement	letter
left atrioventricular (bicuspid) valve starting to open	
left atrioventricular (bicuspid) valve starting to close	
left ventricle starting to contract	
minimum blood remaining in left ventricle	

[4]

[Total: 10]

Q27.

5 Mammals have closed, double circulatory systems.

(a) Explain what are meant by the terms *closed* and *double* as applied to mammalian circulatory systems.

closed .....

.....

.....

double .....

.....

.....[2]

STEMUP.CO.UK

Fig. 5.1 shows a longitudinal section through a mammalian heart.

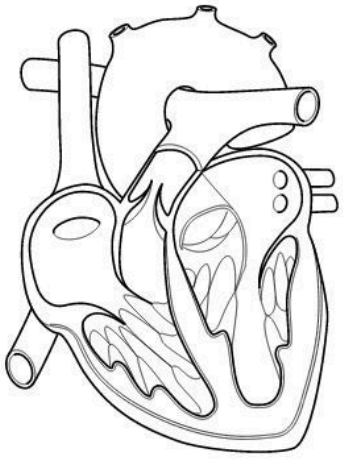


Fig. 5.1

(b) Use label lines and the letters **P**, **Q**, **R** and **S** to label the following on Fig. 5.1:

P the right atrium

Q a semilunar valve

R a blood vessel that carries deoxygenated blood

S the position of Purkyne tissue [4]

STEMUP.CO.UK

Catheters are small tubes that are inserted into blood vessels. A catheter was inserted into an artery in the arm and then moved into the aorta and then into the left ventricle during a diagnostic investigation. The catheter contained a device to measure the blood pressure in the aorta and in the left ventricle. The results are shown in Fig. 5.2.

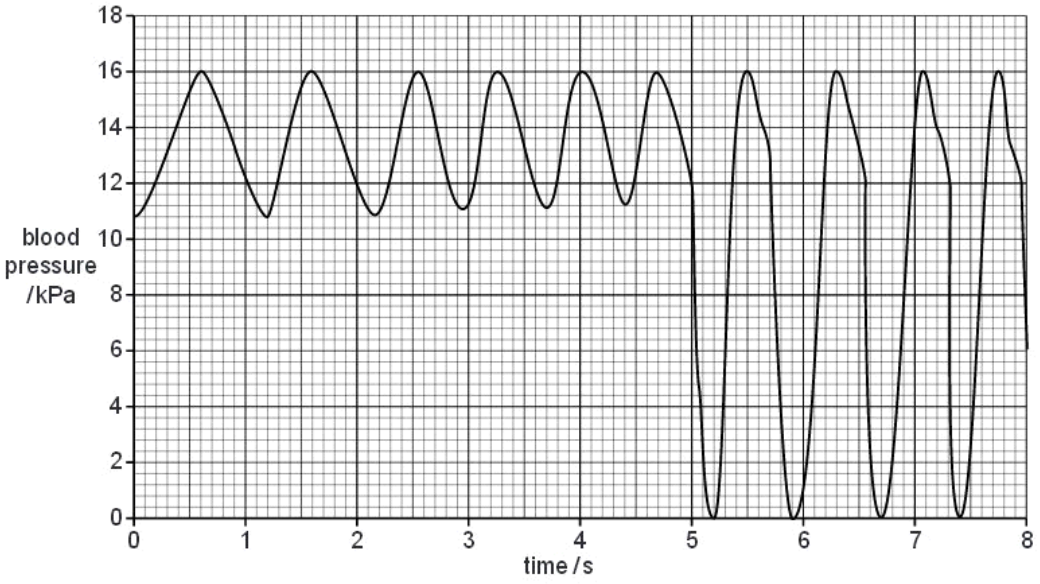


Fig. 5.2

(c) (i) Calculate the heart rate during the period of the investigation.

Show your working.

answer .....[2]

(ii) Describe **and** explain the differences in pressure as the catheter moves from the aorta into the left ventricle.

.....

.....

.....

.....

.....

.....

.....

.....[4]

STEMUP.CO.UK

Fig. 5.3 is an X-ray showing narrowing in the blood vessels supplying muscles in the heart. A catheter is used to insert a dye into the blood vessels so that they appear clearly in the X-ray. The arrows indicate where there is narrowing of the blood vessels.

For Examiner Use



Fig. 5.3

(d) (i) Name the blood vessels shown in Fig. 5.3.

.....[1]

(ii) State the likely effect of narrowing of these blood vessels.

.....[1]

(e) Suggest ways in which the condition shown in Fig. 5.3 may be treated.

.....

.....

.....

.....[2]

[Total: 16]

Q28.

STEMUP.CO.UK

6 Coronary artery bypass grafting is the most common heart operation in the world.

For Examin Use

Fig. 6.1 is a diagram of a coronary bypass. The graft is a section of a healthy blood vessel. The blood vessel used in Fig. 6.1 is the internal mammary artery. It is a common choice for surgeons as it is quite resistant to arteriosclerosis.

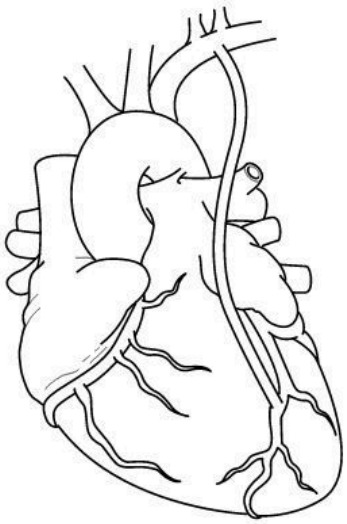


Fig. 6.1

(a) Use label lines and the following letters to label the following on Fig. 6.1:

A aorta
B coronary artery
C internal mammary artery
D pulmonary artery
E right atrium
F vena cava [3]

(b) On Fig. 6.1, mark with an **X**, the diseased area of the coronary artery for which the surgery has been performed. [1]

STEMUP.CO.UK

(c) With reference to coronary heart bypass surgery, discuss the difficulties in achieving a balance between prevention and cure.

.....

.....

.....

.....

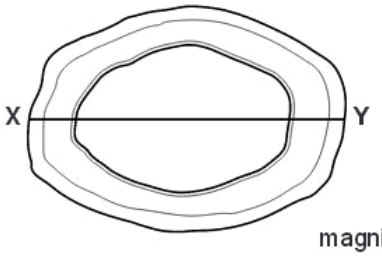
.....

..... [3]

[Total: 7]

Q29.

1 Fig. 1.1 is a diagram of a transverse section through a vein.



magnification × 35

Fig. 1.1

(a) Calculate the actual diameter of the vein marked by the line **X–Y**.

Show your working and give your answer in millimetres (mm).

answer ..... mm [2]

STEMUP.CO.UK

(b) The presence of a valve would help to confirm that the blood vessel in Fig. 1.1 is a vein and not an artery.

Describe three structural features of the blood vessel shown in Fig. 1.1 that would help to identify it as a vein and **not** as an artery.

1. .....

.....

.....

2. .....

.....

.....

3. .....

.....

.....[3]

(c) Explain how the following structural features of a capillary are related to its function.

(i) The capillary wall is composed of a single layer of squamous epithelial cells.

.....

.....[1]

(ii) The diameter of the capillary lumen is approximately 8 μm.

.....

.....[1]

Q30.

STEMUP.CO.UK

4 Fig. 4.1 is a diagram of a section through a mammalian heart.

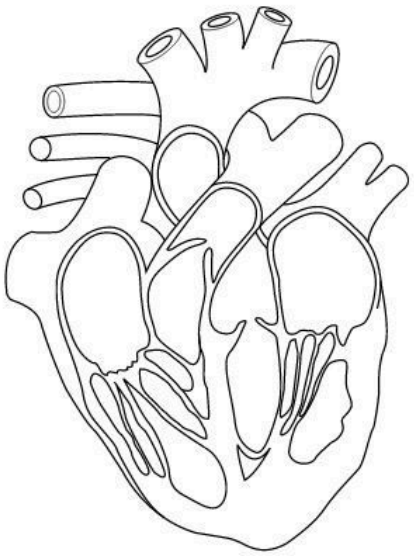


Fig. 4.1

(a) Use a label line and the appropriate letter to label each of the following on Fig. 4.1:

W right atrium

X tricuspid valve

Y aorta.

[3]

(b) Starting from the left ventricle, describe the route taken by the blood as it travels to the lungs.

.....

.....

.....

.....

.....

.....

..... [3]

STEMUP.CO.UK

(c) Describe **and** explain how the structure of the human **gas exchange surface** is adapted for maximum efficiency.

For Examiner's Use

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

[Total: 10]

Q31.

(b) Nicotine has an effect on the cardiovascular system, such as making platelets sticky, so causing blood to clot. This increases the risk of thrombosis and reduces blood flow.

Outline **other** effects of nicotine on the cardiovascular system.

.....

.....

.....

.....

.....

.....[3]

STEMUP.CO.UK

Q1.

5 (a) **(i)** haem; R. incorrect spelling
combines/binds with/carries/holds/takes up/transports oxygen; **2**

(ii) soluble/polar/hydrophilic (on outside)/compact/spherical/curled/coiled/folded (into a ball)/metabolically active;
4 polypeptides; **2**

(b) iron needed for haem/haem contains iron;
less haemoglobin (made); R. less RBCs
less oxygen transported/supplied/delivered (to cells/tissues);
less respiration/respiration rate decreased;
R.respiration less efficient/effective **max 3**

(c) muscle; A. cardiac/skeletal/involuntary muscle **1**
R. named muscle, e.g. biceps muscle

(d) **(i)** 90%;
25%; A. within range 23-25% R. 23-26%, 22-25%
(N.B. Both % need to be correct for one mark) **1**

(ii) haemoglobin unloads/releases oxygen/dissociates,
easily/readily/at higher ppO_2 (in tissues/cells);
(whilst) myoglobin holds on to oxygen/is very stable/does not dissociate easily/has a higher affinity for oxygen;
(so) providing a store/reservoir/reserve of oxygen;
(so will not) release oxygen until the pp/conc./tension of oxygen is low/during strenuous exercise;
so delaying anaerobic respiration; **max 3**

(e) S-shaped curve to the right of **H**;
(N.B. curve should be S-shaped, start at 0, plateau out at between 90-98% saturation, show 50% plus saturation at pp of 6kpa) **1**

[Total 13]

Q2.

STEMUP.CO.UK

Question	Expected Answers	Marks
1 (a)	P - right atrium / auricle; **R** atrial Q - aorta;	2
(b)	more muscle in wall of S; ora S / left ventricle, (pumps) blood, around whole body / further; R / left atrium, (pumps) blood to ventricle / short distance; (wall must resist) high(er) pressure in S / needs to overcome greater resistance to flow;	2 max
(c)	myogenic; SAN, is pacemaker / sends out impulses / waves of excitation / initiates, heart beat / action potential / contraction; **R** electrical, messages / waves / signals AVN delays, impulse / contraction (of ventricles); detail e.g. specific time ref (0.1 - 0.2 secs) *or* to allow ventricles to fill / atria to empty; relays impulse to Purkyne tissue / bundle of His; Purkyne tissue conducts (impulse) to base / apex of heart / septum / ventricles; ref to papillary muscles contracting; ventricle (muscle) contracts / ventricular, contraction / systole, from base upwards; (blood) into arteries / named artery;	4 max
(d)	fat / cholesterol / deposited in, plaque / atheroma formed in, wall / endothelium / epithelium / lining, of artery; **R** dead cells • (so) narrows lumen of artery; • (so) blood flow reduced / restricted (in coronary arteries); **R** constricted / stop (this) creates higher blood pressure; less oxygen / glucose, supplied to heart muscle; **R** no oxygen **A** blood sugar less wastes removed; anaerobic respiration; build up of lactic acid; fibrillation / heart muscle contracts less strongly; angina / CHD / heart attack / MI / heart failure; • (risk of), thrombosis / clot / thrombus; cardiac, cell / tissue / muscle, death; • *(award only if linked to deposition of fat / plaque formation not sticky platelets)*	4 max **[Total: 12]**

Q3.

STEMUP.CO.UK

(c) *assume answer is about red blood cells unless indicated otherwise*

no nucleus;
no cell wall;
no vacuole; **R** smaller vacuoles
no, organelles / named organelle visible in fig. 4.1;
A only chloroplasts / mitochondria / ribosomes
R refs to shape **3 max**

(d) partial pressure of oxygen is low; **A** low concentration / lack / less of oxygen / ora
more haemoglobin (is produced);
idea of compensating / making up for / counteracting the smaller volume of oxygen absorbed / lower saturation of haemoglobin / haemoglobin only 70% saturated / less oxygen carried around body; **2 max**

Q4.

3 (a) 4 polypeptides/4 globins/4 amino acid chains;

outwardly pointing hydrophilic (R) groups, maintain solubility/AW;

each with a haem group;

ref to iron/Fe^{2+} (ion); **R** Fe^{3+}/iron atom

temporary attachment to oxygen; **A** readily attaches/binds combines with
R oxygen binds to haem

4 molecules of oxygen; **A** 4 O_2/8 oxygen atoms **R** 4 oxygens unqualified

oxyhaemoglobin; **A** HbO_8

ref to cooperative binding; **[max 4]**

(b)

part of the circulation	partial pressure of oxygen/kPa	% saturation of haemoglobin
capillaries in the lungs	accept answers between 12 and 14;	
capillaries in muscle tissue at rest	5;	
capillaries in muscle tissue during strenuous exercise	20;	

[3]

STEMUP.CO.UK

(c) carbon dioxide reacts with water to form carbonic acid;

catalysed by carbonic anhydrase;

dissociates to hydrogen carbonate and hydrogen ions;

hydrogen ions combine with haemoglobin; **R** hydrogen ions replace oxygen in haemoglobin

forms haemoglobinic acid/HHb;

so releasing oxygen;

ignore ref to Bohr shift (question says 'explain')

A from equations. **[max 3]**

[Total: 10]

Q5.

1 (a)

	cell **A**	cell **B**	cell **C**
name of cell	phagocyte / neutrophil / AW;	squamous epithelial (cell) / endothelial (cell);	
function of cell			transports, oxygen / carbon dioxide;
diameter / µm	*to be added*		

[4]

(b) **D** mitochondrion;
E lysosome / (Golgi) vesicle; **R** vacuole
F nucleus; **[3]**

(c) *oxygen*
diffuses, down concentration gradient / from high concentration to low concentration;
through, phospholipid bilayer; **R** protein channels

glucose
(pressure) filtration / AW; e.g. 'forced out by blood pressure'
through pores, in capillaries / between capillaries;

facilitated diffusion;
through channel proteins / idea;
through cytoplasm; **[max 3]**

STEMUP.CO.UK

(d) *assume answer is about vein unless told otherwise*

thicker wall / more cells / more than one cell thick;
A more, squamous epithelium / endothelium
valve(s);

three layers / described;

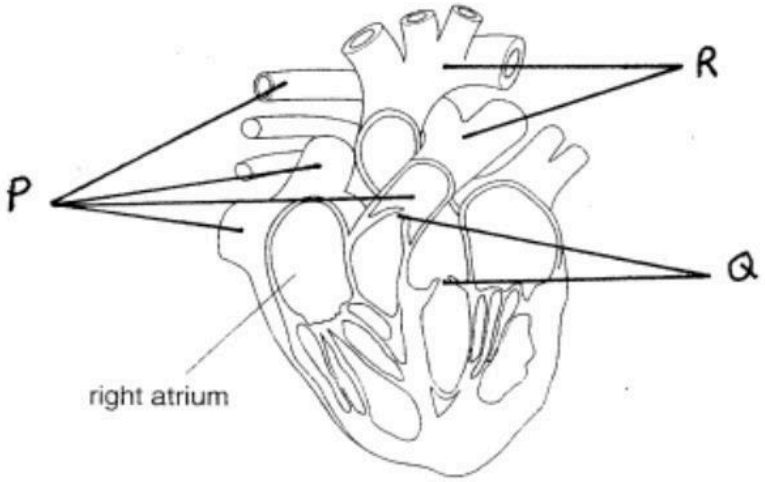
to max 2
(smooth) muscle;
collagen;
elastic tissue / elastin;

R references to size, width, size of lumen, amount of blood etc. **[max 3]**

[Total: 13]

Q6.

1 **(a)** *accept without label lines if not ambiguous e.g. if written correctly on diagram*
*only accept more than one line for each if **all** are correct*



[3]

(b) (both) atria pump blood to ventricles ;
same / short, distance ;

right ventricle pumps blood to lungs ;
short distance / at low(er) pressure / at approx 3.2 kPa / at approx 24 mmHg ; ora i.e. (left ventricle) greater distance / high(er) pressure / at approx 15.8 kPa / at approx 120 mmHg
less resistance, in lungs *or* pulmonary circulation / greater resistance in the systemic circulation ;
left ventricle pumps to, whole body / AW ;
correct ref. to (muscular) walls ; e.g. same (thickness) in atria
thicker / thinner, in ventricles
more / less, muscular, in ventricles
right ventricle pumps with lower / less, force ; **ora** [4 max]

STEMUP.CO.UK

(c) *accept once only for either nicotine or carbon monoxide*
damages lining of arteries ;
promotes, atheroma / atheromatous plaques / fatty plaques / arteriosclerosis / atherosclerosis ;

nicotine
increases heart rate ;
increases blood pressure ;
makes platelets 'sticky' ;
increases chance of blood clotting / promotes thrombosis ;
decreases flow of blood to, extremities / AW ;
constriction of blood vessels ; **R** contraction **R** capillaries (2 max)

carbon monoxide
combines with haemoglobin / forms carboxyhaemoglobin / higher affinity for haemoglobin (than oxygen); **R** absorbed, reacts with, bonds to
reduces oxygen carrying capacity (in context of, haemoglobin / blood) ;
promotes release of damaging free radicals / peroxides / super oxides / oxidising agents ;
causes platelets and neutrophils to stick together / platelets to stick to endothelium ;
hypoxia can damage heart muscle ; (2 max) [4 max]

[Total: 11]

Q7.

3 **(a)** **(i)** right ventricle ;
pulmonary vein ; [2]

(ii) *ignore close to prevent backflow – allow ref to one side only*
valve opens to allow blood from atria to ventricles ;
when ventricles contract, valves close (to stop backflow) ;
A valves close when blood is pumped out of the ventricles
ref. to pressure difference between chambers ; [2 max]

(b) 1 ;
5 ;
2 ;
4 ; [4]

STEMUP.CO.UK

(c) 1 SAN sends out, wave of excitation / impulses ; **A** electrical (im)pulses
R once only - nervous impulse(s) / pulse(s) / signal(s) / wave(s)
R if brain stimulates SAN to send out impulses
2 spreads across atria ;
3 atria contract / atrial systole ;
4 fibrous ring / non-conducting tissue / insulating tissue ;
5 prevents, it reaching the ventricles / ventricles contracting at the same time (as atria) ;
6 AVN sends on wave of excitation to ventricles ;
A *in context – impulse reaches AVN and is passed on to ventricles*
7 (therefore) time delay to allow, atria to empty / atria to complete contraction / ventricles to fill / atria and ventricles do not contract at the same time ;
8 time ref. 0.1–0.2 seconds ;
9 Purkyne tissue conducts, excitation / impulses, to base of, septum / ventricles ;
A apex of heart
10 spreads upwards in ventricle (walls) ;
11 (so) ventricles contract from base upwards / ventricles force blood up from base ;
[5 max]

[Total: 13]

Q8.

2 **(a)** **(i)** right, atrium/auricle **and** left ventricle ; *correctly labelled*
left hand side box *right hand side box* [1]

(ii) *right atrium has* *(ora for left atrium)*

lower, concentration/partial pressure/AW, of, oxygen ; **R** no oxygen
A (right) deoxygenated blood (versus oxygenated blood)
A higher saturation of haemoglobin with oxygen

higher concentration/AW of, hydrogen carbonate ions/carbon dioxide ;
A more carbaminohaemoglobin

higher concentration of water molecules/high(er) water potential/less negative water potential ;

higher concentration/AW, of glucose ; [2 max]

(b) *reject if more than one letter for each disease*
pulmonary stenosis = **G** ;
coarctation of the aorta = **D** ;
ventricular septal defect = **F** ; [3]

STEMUP.CO.UK

(c) *accept ora where relevant*

suggest

1 blood flows from aorta to pulmonary artery ;
2 increased volume of / more, blood to lungs ;
A blood to lungs at higher pressure
3 oxygenated and deoxygenated mix ;
4 oxygenated blood / blood from aorta, to lungs ;

explain (why blood flows from aorta to pulmonary artery)

5 left ventricle thicker wall (than right ventricle) ;
6 (so) contraction generates greater force (than right ventricle)/AW ;
7 higher pressure in aorta (than pulmonary artery) ; [3 max]

[Total: 9]

Q9.

2 **(a)** semilunar valve ; **A** pulmonary valve

prevents backflow (of blood) ;
from the pulmonary artery/into the right ventricle ;
or
ensures one-way flow of blood ;
from the right ventricle/into the pulmonary artery ; [3]

(b) (**Y**/wall of left ventricle) contains more (cardiac) muscle ; ora
left ventricle/ventricle beside **Y**, pumps blood to, whole body / further ; ora
at higher pressure with more force (than right) ; ora
resistance to blood flow is greater in systemic circulation ; ora [3 max]

STEMUP.CO.UK

(c) *any two of* SAN, AVN, Purkyne tissue/Bundle of His *in correct context* ;

SAN/(primary) pacemaker, sends out, waves of excitation/impulses ;
A electrical (im)pulses
R once only nervous impulse(s)/pulse(s)/signal(s)
R if brain stimulates SAN to send out impulses
spreads across atria ;
atria contract/atrial systole ;

fibrous ring/non-conducting tissue/insulating tissue ;
prevents, it reaching the ventricles/ventricles contracting at the same time (as atria);

atrio-ventricular node/AVN, acts as 'relay station'/sends wave of excitation to ventricles;
A in correct context – impulse reaches AVN and is passed on
(therefore) time delay to allow, atria to empty/atria to complete contraction/ventricles to fill//
atria and ventricles do not contract at the same time ;
time ref. 0.1 – 0.2 seconds ;

Purkyne tissue bundle of His, conducts, excitation/impulses, to base of, septum/ventricles ;
A apex of heart
spreads upwards in ventricle (walls) ;
(so) ventricles contract from base upwards/ventricles force blood up from base ; [5 max]

[Total: 11]

Q10.

2 **(a)** diffusion / diffuses ;
down concentration gradient / from high concentration to low concentration / from high to low partial pressure ;
description of pathway ;
two of the following
cell (surface) membrane of (respiring) cell, tissue fluid, (pore in) capillary wall / endothelium / endothelial cell, basement membrane / plasma [max 2]

(b) *assume answer refers to Y unless told that it refers to X*
less pressure ; **A** low pressure
less oxygen ; **A** deoxygenated
less glucose ; *only accept more glucose if identified as liver*
fewer / more, amino acids / fatty acids ;
less water / lower water potential / lower solute potential / higher osmotic pressure / higher concentration of solutes *and / or* rbcs ;
A 'blood is more concentrated'
fewer ions ;
more of **named** cell product ; e.g. insulin / glucagon / albumen / AW

(more), urea / excretory waste ; **R** waste unqualified [max 3]

STEMUP.CO.UK

(c) (i) carbonic anhydrase ; [1]

(ii) (catalyses very) fast / AW, reaction ;
(carbon dioxide as) hydrogen carbonate ions / bicarbonate ions ;
diffuse / move / leaves, out of the (red blood) cell ;
in(to) the plasma ; **R** 'into blood'
(so that) blood can transport more than could be transported as carbon dioxide (in solution) / 80 – 90% CO_2 transported this way ;
idea that
reaction maintains concentration gradient for CO_2 from, tissues / tissue fluid, to blood ;
if carbon dioxide transported then pH would decrease ;
(therefore) maintains pH / prevents pH decreasing / acts as a buffer ; [max 3]

(d) (i) 55 (%) **A** 54 - 56 (%),
32 (%) **A** 31 / 31.5 (%) ; [1]

(ii) hydrogen ions / protons ; **A** H^+
either
react *or* combine with haemoglobin / form haemoglobinic acid / form HHb ;
A 'picks up' / absorb
or
carbon dioxide combines with haemoglobin / forms carboxyhaemoglobin ;
(so) stimulate haemoglobin to release more oxygen (in areas of low pO_2) ;
ref. to, allosteric effect / change in tertiary *or* quaternary structure *or* shape ;
A conformational change
either
haemoglobin has a higher affinity for hydrogen ions than oxygen = 2 marks
or
haemoglobin has a higher affinity for carbon dioxide than oxygen = 2 marks [max 2]

(iii) Bohr (effect / shift) ; [1]

(iv) **1** carbon dioxide influences percentage saturation of haemoglobin with oxygen / AW ;
2 tissues / cells, with high rate of (aerobic) respiration ;
3 high demand for oxygen ;
4 haemoglobin / blood, releases more oxygen ; **R** faster
5 than it would in absence of carbon dioxide ;
6 at same partial pressure of oxygen ; [max 3]

[Total: 16]

Q11.

STEMUP.CO.UK

3 **(a)** **1** small size / 6-8 μm (diameter), to squeeze through capillaries (7 μm) ;
2 small size / 6-8 μm (diameter), so, haemoglobin (molecules) near to surface (of plasma membrane) / reduces distance for diffusion (in / out of rbc) ;
3 no nucleus / lack of organelles, so more room for haemoglobin (so more oxygen transported) ; **R** more room for oxygen
4 biconcave shape / diagram drawn, increases surface area for, diffusion / uptake / release (of oxygen) ;
5 flexible / AW (membrane), to squeeze through capillaries ; [max 3]

(b) **1** enzymes are proteins, protein synthesis does not occur ;
2 no, nucleus / DNA / genes, so no, transcription / mRNA ; } *
3 no mRNA, so no, translation / protein synthesis ; }
***A** no nucleus, so no protein synthesis *for one mark*
4 no, RER / ribosomes, site of protein synthesis / AW ;
5 no mitochondria, insufficient ATP (for synthesis) ;
6 no RER for modification (of protein) ; **A** Golgi apparatus [max 2]

(c) **(i)** iron ; **A** Fe^{2+} / Fe^{3+} / ferrous / ferric [1]

(ii) amino acids / peptides ; [1]

(d) carbonic anhydrase ; [1]

(e) **1** diffusion of, carbon dioxide / CO_2;
2 into red blood cell from correct source ;

3 description of carbonic acid formation followed by H^+ production ;
4 ref. carbonic anhydrase) fast reaction; **A** ecf from **(d)**

5 haemoglobin has a higher affinity for hydrogen ions than oxygen ;
A haemoglobin releases oxygen more easily in acidic conditions
accept idea of H^+ binding to haemoglobin bringing out oxygen release
6 ref. to, allosteric effect / change in tertiary structure / AW, in (oxy)haemoglobin, causes, release / AW, of oxygen ;
7 formation of haemoglobinic acid ; *must refer to, H^+ binding / decreased pH*
8 ref. higher partial pressures / AW, CO_2, linked to (oxy)haemoglobin releasing, more oxygen / oxygen more readily ; *Bohr shift*
9 formation of carbamino-haemoglobin ; **R** carboxyhaemoglobin

10 chloride shift, qualified ;
e.g. as hydrogen carbonate ions move out of cell, chloride ions move in e.g. to maintain, electroneutrality / a balance of charge / ions ; [max 5]

[Total: 13]

Q12.

STEMUP.CO.UK

4 **(a)** **(i)** red blood cells / erythrocytes / red blood corpuscles ; [1]

(ii) *myoglobin* 78% **A** 77% } ;
haemoglobin 21% } *must have both correct for 1 mark* [1]

(iii) myoglobin has higher affinity for oxygen / myoglobin binds oxygen while haemoglobin releases oxygen ; ora
(myoglobin) acts as a store of oxygen ;
myoglobin will only release oxygen, at (very) low oxygen partial pressures / AW when oxygen demand (in muscles) exceeds supply ; **A** during exercise
AVP ; e.g. myoglobin has, one / fewer haem groups, so no cooperative binding effects
e.g. allows aerobic respiration to continue (in muscle) [max 2]

(b) **(i)** fetal haemoglobin has higher oxygen affinity (than adult / maternal haemoglobin) / AW ;
(higher oxygen affinity) over all ppO_2 / use of data at more than one ppO_2 (from Fig. 4.1) ;

oxygen uptake from, adult / maternal, blood / AW ;
or
gas exchange taking place between fetal and, adult / maternal, blood ;

ref. to fetal reliance on mother to supply oxygen / mother only source of oxygen for fetus ; [2]

(ii) at lower ppO_2 both, unload / AW, oxygen ;
sufficient / more, adult haemoglobin present or adult haemoglobin provides sufficient oxygen / AW ;
ref. to compensating by producing additional red blood cells ;
AVP ; e.g. ref. to similarity of position of both curves [max 1]

(c) (all) to the right of given curve, same overall shape as adult haemoglobin curve ;
to the right of given curve, begins at 0.2 kPa, ends at 97% ;
A *within range of* 0–0.4kPa and 95–99% [2]

[Total: 9]

Q13.

STEMUP.CO.UK

3 (a) (i) *no mark if no units used at all*
L – 3.6 kPa ; *award the mark if units only used once*
M – 4.5 kPa ; **A** in range 4.45 to 4.55 [1]

(ii) *ignore any similarities*
1 to the right / lower (affinity) / qualified ; e.g. lower percentage saturation
2 at, higher / lower, partial pressures, small(er) difference in percentage saturation (than others) ; **A** ora
3 comparative data quote ; *must refer to **L** and **M***
allow ecf from (i) [3]

(b) 1 at partial pressures in the tissues ; *where oxygen is unloaded from Hb*
2 haemoglobin is less saturated (than **L**) ;
3 because, haemoglobin / Hb, dissociates more readily ;
A idea of unloading oxygen more readily *even if Hb not mentioned*
4 to compensate for, fewer / less effective, red blood cells / Hb ; [max 3]

(c) 1 haemoglobin less well saturated (in lungs at high altitude) ;
2 data quote from Fig. 3.1 ; **A** 80–90% saturated at 'about 7.5 kPa'
3 produce more red blood cells / increase in number of RBCs ;
4 more haemoglobin ;
5 *idea* of compensates for, smaller volume of oxygen absorbed / lower saturation (of haemoglobin) ;

also accept the following adaptations
6 increase in haematocrit / AW / decrease in plasma volume ;
A increase in RBCs per unit volume
R decrease in blood volume
7 increase in, breathing rate / tidal volume / heart rate / stroke volume ;
8 increase in, capillary density / number of mitochondria / myoglobin / respiratory enzymes, in muscle ;
9 ref. to (increased) secretion of, erythropoietin / EPO ;
10 increase in (2,3), BPG / DPG, in red blood cells ; **A** rightward shift in curve [max 4]

(d) 1 not caused by (named type of) pathogen / non-infectious / non-transmissible / non-communicable / AW ;
2 genetic / inherited / AW, disease ; **A** caused by a mutation / AW
A 'passed down from parent(s)'
R idea of congenital diseases
R 'you get it from your mother'
3 ref. to, no immune response / no antigen(s) ;
4 affects all red blood cells so vaccine would lead to their destruction ; [max 2]

[Total: 13]

Q14.

STEMUP.CO.UK

1 **(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]

Q15.

1 **(a) (i)** **A –** endothelial / squamous / epithelial (cell) ;
B – nucleus ; [2]

(ii) 7 (μm) ;;
award two marks if correct answer given
award one mark if not rounded to nearest whole number
award one mark if given incorrect unit
if no answer given, award one mark if correct measurement (38–41 / 3.8–4.1 / 38000–41000) is divided by 5700 [2]

(iii) *for two marks - one structure and one function*
only two functions = 1 mark
only two structures = 1 mark

1 (capillary) <u>wall</u> is, thin / single layer of cells / one cell thick ;
A endothelium / epithelium for wall
2 short <u>diffusion</u>, pathway / distance / AW ;
R 'easy' diffusion
3 (many have) endothelial pores / fenestrations / gaps / spaces / openings ;
4 to allow named, substance / cell, to leave the blood ;
A *idea* of separation / selection, of named substance(s) by size
5 small diameter / small lumen / diameter of red blood cells ;
6 slows down flow of red blood cells / (capillary / blood) close to cells ;
7 (capillaries have) large, surface area / surface area to volume ratio ;
8 *idea that* allows more exchange ;
Ignore faster exchange [max 2]

STEMUP.CO.UK

(b) *white blood cells*

1 (named) white blood cells can, leave capillaries / enter tissue fluid ;
A diapedesis / (suggestion that some) too large to leave the, blood / capillaries

2 high number in, lymph nodes / thymus / bone marrow / spleen ;
A stored / produced

glucose

3 small (molecule) ;

4 filtered / diffuses / leaves / leaks, from blood / from capillaries / into tissue fluid ;

5 taken up / used, by cells in respiration ;
Ignore supply

protein

6 too large to, leave capillaries / enter lymph / enter tissue fluid ;

7 (in lymph / tissue fluid) antibodies / proteins, from / secreted by, lymphocytes / other cells ; [max 5]

(c) *accept hydrogen carbonate (ions) / bicarbonate (ions) / HCO_3^- penalise HCO_3 once only*

1 carbon dioxide, reacts / combines, with (terminal amine / **N** terminal, of) haemoglobin ;
R carried by / reacts with, haem

2 to form carbaminohaemoglobin ;

3 carbonic anhydrase catalyses, formation of carbonic acid (H_2CO_3) / reverse reaction described (in the lungs) ;

4 (carbonic acid dissociates to) HCO_3^- / CHO_3^- / hydrogen carbonate (and H^+) ;

5 hydrogen carbonate / HCO_3^-, diffuses / moves / AW, out (into plasma) ; [max 3]

[Total: 14]

Q16.

STEMUP.CO.UK

6 **(a)** *all correct* ;;;

event	*sequence*
Purkyne tissue conducts the wave of excitation	4
atrioventricular node sends out a wave of excitation	3
atria contract	2
ventricles contract	5
sinoatrial node sends out a wave of excitation	1

if not correct sequence, mark to max 2
SAN = 1 ;
atria contract before ventricles ; [max 3]

(b) left ventricle pumps blood to the body, right ventricle pumps blood to the lungs ;
(left) round the body further distance / (right) to lungs shorter distance ; AW
(left) greater force required / (right) less force required ; **A** (left) blood needs to be pumped at a higher pressure / (right) blood needs to be pumped at a lower pressure
A needs to overcome greater resistance
less force / lower pressure, to lungs, to prevent damage to capillaries ; [max 2]

[Total: 5]

Q17.

STEMUP.CO.UK

1 (a) thicker wall;
smaller / narrower lumen;
more muscle / more elastic tissue / more / thicker tunica media;
ref to 'crinkly' / crenulated / wavy / folded, lining / endothelium / tunica intima; R. epithelium
ref to wall to diameter ratio e.g. thicker wall to diameter ratio;
more collagen fibres / more tunica adventitia / externa;
circular / rounded shape compared to irregular shape;
A. converse points for vein

max 3

(b) provide a large surface area / surface area to volume ratio;
for gas exchange / carbon dioxide out and oxygen in;
short diffusion distance across capillary wall / one cell thick capillary wall / 1-2µm c. wall / thin endothelium;
R. epithelium R. thin wall unqualified
small size enables blood to be as close as possible to lung cells / air in alveolus / capillaries in close contact with alveolus (wall);

(so) diffusion is efficient / takes place easily / maximises efficiency of diffusion;

max 3

(c) destroys / paralyses / inhibits / weakens cilia; R. kill
mucus glands / goblet cells produce more mucus;
tar contains carcinogens / chemicals which damage DNA / genes / oncogenes;
ref cancer / tumour;
epithelium / lining replaced by scar tissue;

max 3

[Total 9]

Q18.

STEMUP.CO.UK

4 **(a)** *Double* – blood passes through the heart twice during one circulation;
Closed – blood travels inside blood vessels. **[2]**

(b) *One mark for an advantage and one mark for a disadvantage.*

Advantage
More space, for haemoglobin/to carry oxygen;
Idea that rbcs can change shape, to fit through capillaries.

Disadvantage
Cannot carry out, protein synthesis/replication/repair;
Short life span;
Cannot, divide/replace themselves. **[2]**

Q19.

5 **(a)** **(i)** 700 000/5 400 000 x 100; AW e.g. 6,100,000/5,400,000 = 112.96% – 100 (= 12.96%)

13; **R** 12.96
1 mark for working, 1 mark for correct answer **[2]**

(ii) (more red cells =) more haemoglobin;
more oxygen can be carried (per unit volume of blood);
at altitude the partial pressure of oxygen is, low/lower than at sea level;
A less oxygen at altitude **R** ref to lower Hb saturation
more red cells/more haemoglobin, compensates for lower saturation, of haemoglobin; **A** affinity **[max 2]**

Q20.

6 **(a)** **(i)** **F** vena cava;
G pulmonary artery; **[2]**

(ii) 75; **R** inappropriate units e.g.dm^3/min **[1]**

(iii) ventricles pump blood, to lungs/to whole body/further;
atria pump blood, to ventricles/shorter distance;
correct reference to pressure; e.g. ventricles have to push blood further so blood under higher press or create higher press
R atria at lower press or ventricles receive blood at higher press **[max 2]**

STEMUP.CO.UK

(b)

	left atrium	left ventricle	atrio-ventricular valve	aortic valve
H	*contracts to force blood into left ventricle*	Diastole/relaxes, filling with blood/receives blood, from left atrium;	*open*	*closed*
J	Diastole/relaxes, fills with blood/receives blood, from pulmonary veins;	Systole/contracts, forcing blood into aorta;	*closed*	open
K	Diastole/relaxes, fills with blood/receives blood, from pulmonary veins;	*relaxes and fills with blood from left atrium*	*open*	closed;

[6]

[Total: 11]

Q21.

2 (a) (i) haem / prosthetic group ; **A** porphyrin

site of attachment of / binds with / carries / combines with / joins with / takes up / transports, oxygen ;
R absorbs / reacts with / stores
(oxygen binds to) iron ion / Fe^{2+} / FeII (in haem) ;
A atom, of iron / ferum [3]

(ii) *tertiary*
(each) polypeptide / protein, with complex 3D shape ;
folding of secondary structure / folded alpha helices ;
polypeptide / protein, coiled / folded / curled up / compact ;
1 max

quaternary
more than one polypeptide / AW ; [2]

STEMUP.CO.UK

(b) (i) 58 ;
100 ; [2]

(ii) partial pressure of oxygen in tissues is low ; **A** concentration
percentage saturation decreases sharply ;
A appropriate ref to 'steepest part of the curve'
small decrease in partial pressure of oxygen / 6 to 2 kPa, causes very large change in % saturation with oxygen ;
78–80 to 22–24% saturated ; **A** appropriate figure(s)
this = range of partial pressures of oxygen in (respiring) tissues ;
(oxy)haemoglobin, dissociates / 'gives up its oxygen', at low partial pressures of oxygen ;
ref to, distortion of haemoglobin molecule and ability to release oxygen / allosteric effect / cooperative binding ; [4 max]

(c) *accept curve drawn on Fig. 2.3*
same shape as existing curve – begins at origin, ends at 95%–100% ;
to the **right** of existing curve ; [2]

[Total: 13]

Q22.

4 (a) sino-atrial node / sinu-atrial node / sinoatrial node / SAN ; [1]

(b) myogenic, explained (e.g. contracts and relaxes without stimulation) ;
SAN / pacemaker, sends out, waves of excitation / impulses ;
spreads across atria (and causes atria to contract) ;
fibrous ring / non-conducting tissue / insulating tissue, prevents it reaching the ventricles ;
time delay to allow, atria to empty / ventricles to fill *or* time ref. (0.1–0.2 seconds) ;
atrio-ventricular node / AVN, acts as 'relay station' ;
relays impulse to Purkyne tissue / bundle of His ;
Purkyne tissue conducts impulse to, base / apex of heart / septum / ventricles; [4 max]

(c) 60 / 0.8 ;
75 ; [2]

(d) lower / less, resistance (within pulmonary tissue) ; *ora*
lower / less force needed ; *ora*
short distance / only has to pump blood to lungs ; *ora* ;
because RV wall is, thinner / less muscular ; *ora* [2 max]

[Total: 9]

Q23.

STEMUP.CO.UK

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

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 ; **R** sugars
more, fat / fatty acids / glycerol ;
lower, water / solute, potential ; **R** water concentration
lower carbon dioxide concentration / lower concentration of HCO_3^- ;
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]

Q24.

(c) reduced supply of blood to, heart / cardiac, muscle ;
reduced supply of glucose (to cardiac muscle) ; **R** no
reduced supply of oxygen (to cardiac muscle) ; **R** no
less aerobic respiration / (more) anaerobic respiration (of cardiac muscle) ;
build up of, lactate / carbon dioxide ;
ref. limited cardiac output ;
AVP ; e.g. ref. to consequences to (muscles of) body with reduced blood supply, ref. to pain caused by angina **R** heart attack / AW [3]

STEMUP.CO.UK

(d) damages, lining of arteries / endothelium ; *accept once*
speeds up (atheromatous / fibrous) plaque development ; *accept once*
increases chance of blood clotting / promotes thrombosis ; *accept once*

nicotine
increases heart rate / AW ;
increases blood pressure ;
makes platelets 'sticky' ;
decreases blood flow to, extremities / AW ;
constriction of blood vessels ; (max 2)

carbon monoxide
combines with haemoglobin / forms carboxyhaemoglobin / higher affinity for haemoglobin (than oxygen) ;
reduces oxygen-carrying capacity / AW (in context of, haemoglobin / blood) ;
promotes release of damaging free radicals / peroxides / superoxides / oxidising agents ;
causes, platelets and neutrophils to stick together / platelets to stick to endothelium ;
ref. hypoxia damage to cardiovascular system ; (max 2) [max 3]

Q25.

(c) 4, oxygen molecules / O_2, per (molecule of) haemoglobin ;
(forms) oxyhaemoglobin (in lungs) ; **A** marking points 1 and 2 as equation
ref. oxygen remains bound until blood in area of low pO_2 / high pCO_2 / high(er) temperature ; **A** in area of respiring tissues (max 3)
carbon dioxide combines with haemoglobin ;
terminal, amine / amino, group of haemoglobin ; **A** $-NH_2$
carbamino-haemoglobin ; **R** carboxyhaemoglobin
ref. to hydrogen ions from carbonic acid ;
ref. carbon dioxide remains bound until blood in area of low pCO_2 / high pO_2 ; [max 4]

(d) **(i)** 19.7 / 20 (%) ;;

allow 1 mark if incorrect answer but correct working shown
7.3 – 6.1 / 6.1 × 100 / 1.2 / 6.1 × 100 [2]

(ii) partial pressure / AW, of oxygen is, low / lower than at sea level ;
haemoglobin less well saturated ;
more red blood cells / more haemoglobin ;
compensates for, smaller volume of oxygen absorbed (per red blood cell) / lower saturation of haemoglobin ;
A ref. to tissues receiving sufficient oxygen
AVP ; e.g. ref to erythropoietin (EPO) [max 3]

Q26.

STEMUP.CO.UK

2 **(a)** **(i)** acts as a pacemaker / regulates heartbeat ;
A ref. to myogenic / described e.g. as rythmn / AW

releases / AW, waves of excitation / depolarisation / (electrical) impulses / action potentials ;

R nerve impulses / signals / messages / waves unqualified

atrial systole / atrial contraction(s) ; **A** initiates, heart beat / cardiac cycle
ref. to nervous innervation allowing changes ; [max 2]

(ii) delays, impulse / AW ;
R nerve impulses / signals / messages / waves unqualified
A *ecf* from **(i)**

sends impulse to, Purkyne fibres / Bundle of His / ventricles / septum ;

allows atrial systole to complete before ventricular, systole / contraction(s) ;
A *idea that* allows ventricles to fill (before they contract)
A *idea that* allows atria to, empty completely / complete contraction [max 2]

(iii) *either*
stops backflow (of blood) ;
(stops backflow) from ventricle to atrium ; **R** if ref. to right

or
allows one-way flow of blood ;
allows flow from atrium to ventricle ; **R** if ref. to right [max 2]

(b) C ;
G ;
G ;
B / C ; [4]

[Total: 10]

Q27.

5 **(a)** *closed* blood travels, inside blood vessels / AW ;
double blood travels through the heart twice during one, complete circuit / circulation of the body ; AW
A pulmonary and systemic, systems / circuits [2]

(b) **P** to right atrium ;
Q to (semilunar) pulmonary or aortic valve ;
R to, vena cava / pulmonary artery ;
S to, septum / wall(s) of ventricles ; [4]

(c) **(i)** 75 (beats per minute) ;;

if incorrect answer or no answer allow one mark for extraction from Fig. 5.2 or for correct working
e.g.10 beats in 8 seconds
10/8 × 60 [2]

STEMUP.CO.UK

(ii) *max 3 if only description or only explanation given*
lowest pressure in aorta, is 10.8 kPa / varies between 10.8-11.2 kPa v in left ventricle is 0 KPa ;
difference between highest and lowest is greater in the ventricle / AW ;
4.8 – 5.2 kPa for aorta, 16.0 kPa in left ventricle ;

reference pressure differences (in left ventricle) as a direct result of ventricular systole and diastole ;
semilunar / aortic, valve prevents backflow from aorta into ventricle ;
(so) no / little, blood in ventricle, when fully contracted / AW ;
elastic recoil of artery maintains (diastolic) blood pressure ;
AVP ; [max 4]

(d) (i) coronary arteries ; [1]

(ii) insufficient, glucose / oxygen (to, cardiac / heart, muscle) ;
angina ;
heart attack / myocardial infarction / cardiac arrest ;
description of anaerobic conditions in muscle ; [max 1]

(e) coronary (artery) by-pass (graft) operation ;
R by-pass *unless qualified*
A described
insertion of a (coronary) stent ; **A** described
heart transplant ;
angioplasty ; **A** described
AVP ; e.g. calcium-channel blockers / named
further detail of treatments e.g. anticoagulants after angioplasty [max 2]

[Total: 16]

Q28.

6 **(a)** *one mark each correct label to max 3;;;* [max 3]

(b) **X** marked over coronary artery section before graft joins; [1]

STEMUP.CO.UK

(c) cure for, coronary artery disease / atherosclerosis in artery;
A arteriosclerosis
so less risk of, myocardial infarction / heart attack / AW;

prevention of coronary artery disease to avoid bypass surgery
one example; e.g. no smoking
increase exercise
low, (saturated) fat / cholesterol, diet
reduce alcohol consumption
reduce salt intake
statins
avoid, excessive / AW, sugar
avoid obesity

ref. to difficulties in getting people to change lifestyle to prevent;

disadvantage of, surgical procedure / cure;
accept ora prevention
e.g. invasive / painful
costly medical
lost time / money, by absence from work
risk of complications / graft rejection / infection
risk / graft becoming diseased / collapsing

AVP; e.g. *idea that* as cure is available, more difficult to encourage prevention [max 3]

[Total: 7]

Q29.

1 **(a)** 1.4 mm ; ;
two marks for the correct answer
A 1.3 / 1.34 / 1.37 / 1.43 / 1.46 / 1.5

tolerance on measurement of 49 mm = ± 2 mm (i.e. 47 to 51 mm)

*if answer not given or incorrect allow one mark for correct measurement and correct use of formula (measurement divided by the magnification of 35 **or** showing the rearranged formula)* [2]

STEMUP.CO.UK

(b) 1 large / wide, lumen (relative to thickness of wall) ;
A artery narrow lumen

2 irregular shape ; AW
A flattened / oval / not round(ed) (shape) ;
A artery, round(ed) / regular (shape)
I ref. to (vein) not spherical / artery spherical

3 thin / AW, tunica media / middle layer / (smooth) muscle and elastic layer
or
(proportionately) less, elastic / (smooth) muscle, in, tunica media / middle layer ;

4 (relatively) thin, tunica externa / tunica adventicia / outer layer / fibrous coat / fibrous layer ;
R small(er)

5 tunica intima / tunica interna / inner layer / endothelium, smooth / not 'crinkly' / not wavy / AW ;

alt *if mp 3 not awarded, award 1 mark only for*
thin (smooth) muscle layer / less (smooth) muscle
thin elastic layer / less elastic tissue [max 3]

(c) **(i)** short distance for diffusion (of molecules / ions / named) ;
A reduced distance / thin / short pathway / AW

increased rate / AW, of diffusion (of molecules / ions / named) ;
A fast(er) / (more) efficient
I easy / better [max 1]

(ii) 1 small size allows contact with (many body) cells / AW ;
A *idea of* extending into small spaces

2 red blood cell, close to, (body) cells / tissue for (efficient), diffusion / AW ;
A in contact with / close to, capillary wall / endothelium, for diffusion

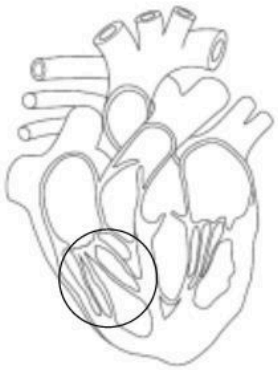
3 red blood cells / blood flow, slow(s) down / *idea of* more time,
for (efficient) diffusion / cells to obtain sufficient nutrients / AW ;
treat ref. to lower pressure as neutral

4 (plasma / blood, containing), glucose / nutrients / named nutrient / oxygen,
close to / AW, body cells ; [max 1]

Q30.

STEMUP.CO.UK

4 **(a)** **W** right atrium labelled in lumen / wall ;
X tricuspid valve labelled ; **A** valve flap / chordae tendinae *see encircled area on diagram*
Y aorta labelled ; [3]



(b) *needs to be a sequence, not events in the cardiac cycle e.g.* ***I*** *valves*

aorta, body (tissues / blood vessels) / capillaries / systemic circulation, vena cava ;
A body cells
right atrium and right ventricle ;
pulmonary artery (to lungs) ; **R** if blood comes from left ventricle [3]

(c) *max 2 for structural features*
I *fast diffusion, efficient diffusion, reduces diffusion distance*
mps 4, 6, 8 and 10 – can be awarded if related structure is not given but is implied

1 many alveoli ;
2 large surface area ; **I** high SA:V ratio / increase SA
3 many capillaries / network of capillaries ; **I** good blood supply
4 (so) maintain, diffusion / concentration / partial pressure, gradient(s) ;
5 lining / epithelium / wall, of, alveoli / gas exchange surface, is thin / one cell thick / squamous ; **I** thin interstitium
R 'cell walls of' **R** lungs **R** alveoli are one cell thick **R** endothelium / membrane
6 (so) short diffusion distance / only diffuse through two cells ;
7 ref. to, elastin / elastic fibres ; **I** alveoli are elastic
8 (so) allows alveoli to, increase in volume / expand / stretch / stop bursting / recoil ;
R contract
9 (alveolar type II cells secrete) surfactant ;
10 (so) reduces surface tension ; [max 4]

[Total: 10]

Q31.

STEMUP.CO.UK

(b) **1** increases heart rate ;
A heart, pumps / beats faster

2 increased blood pressure / hypertension ;

3 damage to, endothelial / arterial, lining ;
A damage to, tunica intima / lining of veins

4 (so) contributes to plaque / atheroma ;
A atherosclerosis

5 vasoconstriction
or
constricts / reduces diameter of, arterioles / blood vessels ;
A more resistance to blood flow *must be in context*

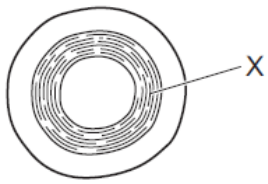
6 reduced blood flow to extremities / AW ; [max 3]

STEMUP.CO.UK

Transport in mammals – AS 9700 Biology June 2022

1. June/2022/Paper_11/No.30

The diagram shows a transverse section through an artery.



Which tissues are present in layer X?

A collagen and smooth muscle only

B elastic fibres and collagen only

C elastic fibres and smooth muscle only

D elastic fibres, collagen and smooth muscle

2. une/2022/Paper_11/No.31

What is systolic blood pressure?

A the blood pressure in the arteries when the heart is relaxing

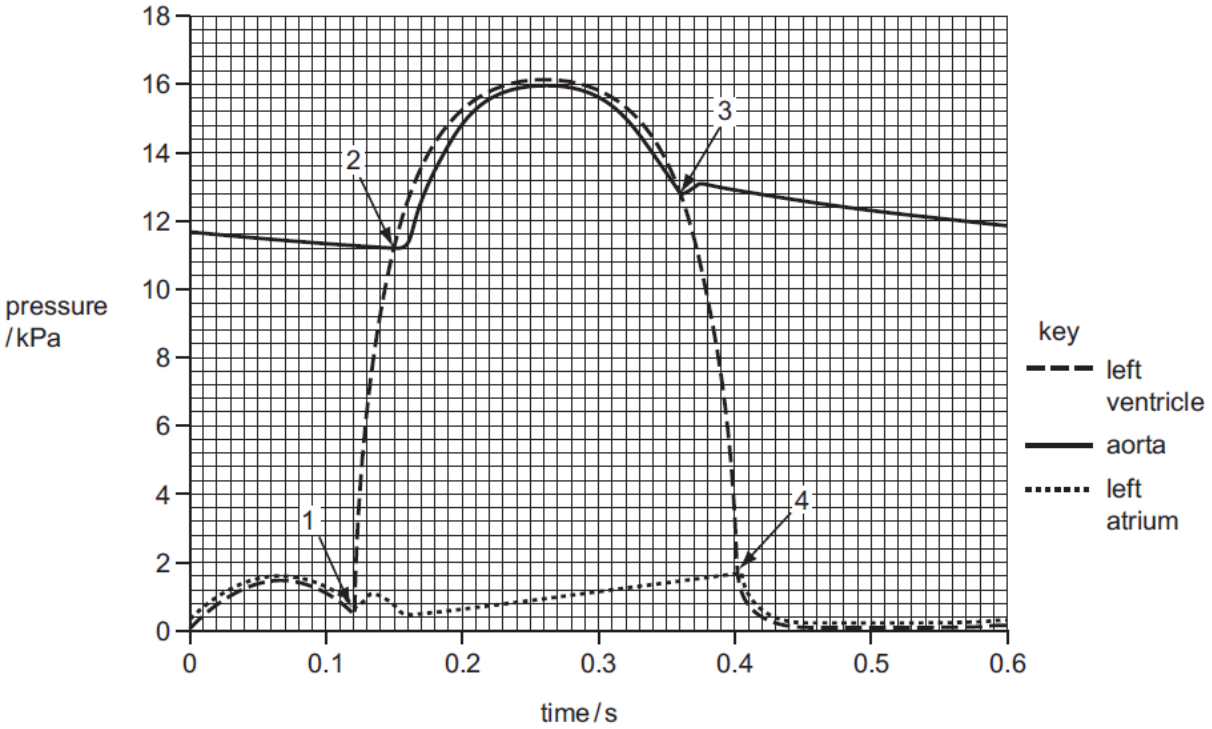
B the blood pressure in the left ventricle at the start of a contraction

C the maximum blood pressure in the arteries

D the maximum blood pressure in the right ventricle

3. June/2022/Paper_11/No.32

The diagram shows pressure changes in the left side of the heart and aorta over time. The length of this cardiac cycle is 0.6 s. Points 1, 2, 3 and 4 indicate when atrioventricular valves and semilunar valves either open or close.



What is the total time during one cardiac cycle that the atrioventricular valves and the semilunar valves are both closed at the same time?

A 0.03 s **B** 0.04 s **C** 0.07 s **D** 0.21 s

STEMUP.CO.UK

4. June/2022/Paper_11/No.39

A person's blood group is determined by antigens present on the red blood cells.

The table shows the antigens and antibodies in the blood of people with different blood groups.

blood group	presence of A or B antigens on red blood cells	presence of antibodies to A or B in plasma
A	A only	anti-B only
B	B only	anti-A only
AB	A and B	neither
O	neither	anti-A and anti-B

During a blood transfusion, it is essential that the person receiving the blood does not have antibodies to the donor's blood.

Which blood groups can be given to a person with blood group AB?

A AB only

B O only

C A and B only

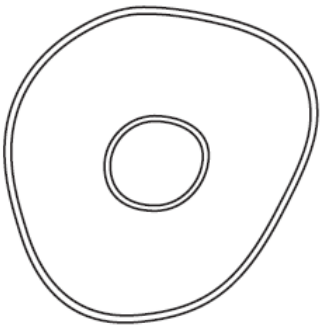
D A, B, AB and O

STEMUP.CO.UK

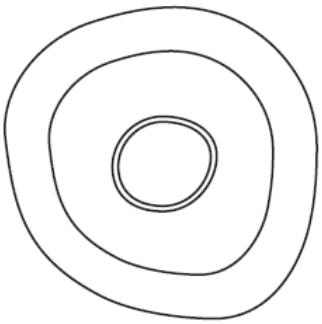
5. June/2022/Paper_12/No.31

Which plan diagram represents the tissues in a major vein?

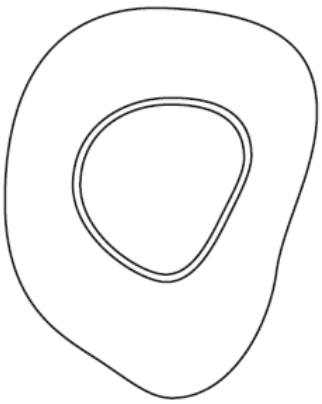
A



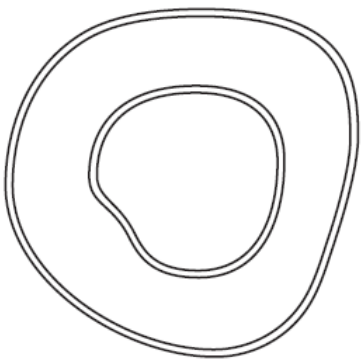
B



C



D

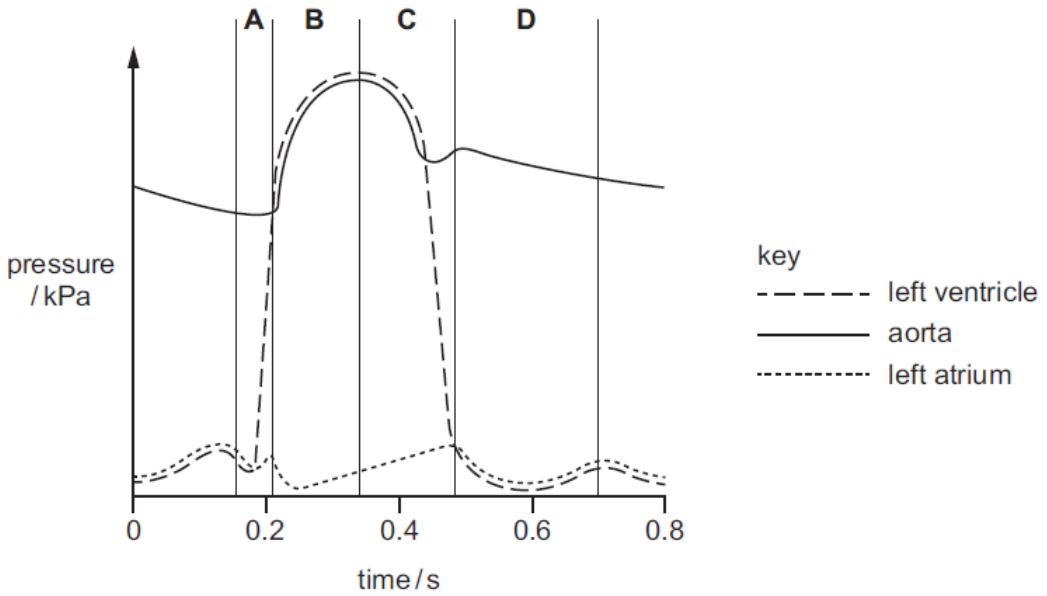


STEMUP.CO.UK

6. June/2022/Paper_12/No.32

The diagram shows the pressure changes in various structures of the left side of the heart during the cardiac cycle.

At the end of which period is the ventricle full of blood?



7. June/2022/Paper_12/No.33

Which description of movement of substances during tissue fluid formation is correct?

A Low hydrostatic pressure forces substances out of the capillary at the arterial end allowing small substances to enter the fluid that bathes the cells.

B Tissue fluid moves back into the venule due to a net hydrostatic pressure change in the capillary.

C Movement of water in tissue fluid into the capillary by osmosis is due to the low water potential and low hydrostatic pressure inside the capillary.

D A high water potential of the surrounding tissue fluid causes substances to leave the capillaries at the arterial end.

8. June/2022/Paper_12/No.34

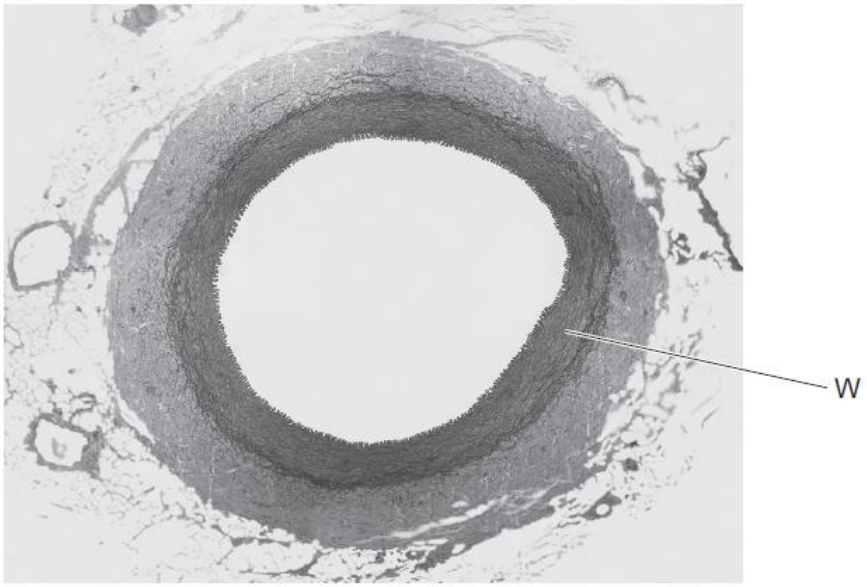
Which row shows the change in concentration of some substances in red blood cells when carbon dioxide diffuses from active cells?

	carbonic anhydrase	hydrogencarbonate ions	hydrogen ions
A	decreases	no change	no change
B	increases	increases	increases
C	no change	decreases	increases
D	no change	increases	increases

STEMUP.CO.UK

9. June/2022/Paper_13/No.30

The photomicrograph shows a section through a structure found in mammals viewed using a light microscope.



×60

What are the main components of layer W?

A collagen fibres only

B elastic fibres and collagen fibres

C smooth muscle and elastic fibres

D squamous epithelial cells forming an endothelium

10. June/2022/Paper_13/No.31

Which statement correctly links muscular or elastic arteries to their function?

A The aorta is an example of a muscular artery as it transports blood from the left ventricle of the heart.

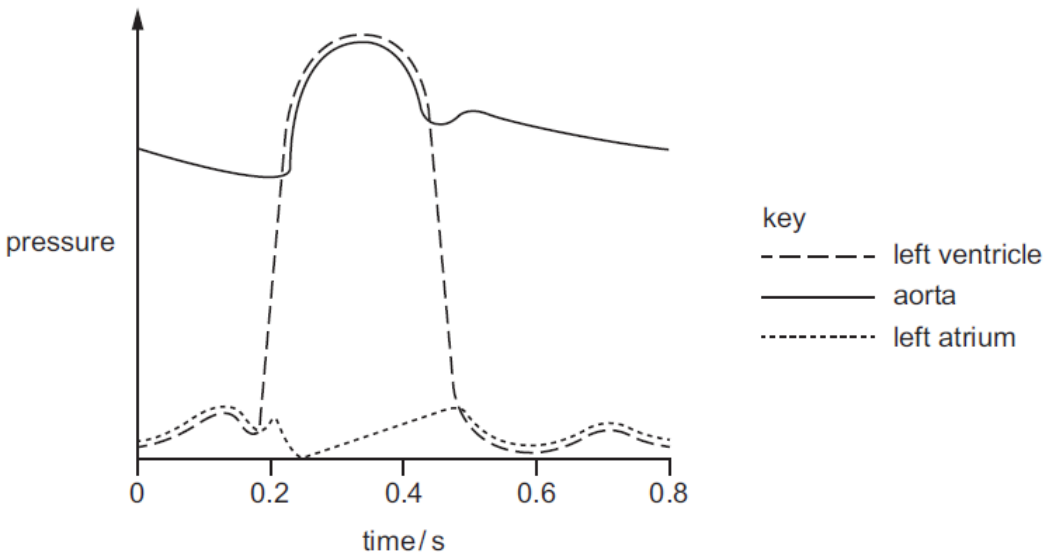
B Arteries further away from the heart are muscular arteries as they transport blood at high pressure.

C Elastic arteries expand when the heart contracts and then recoil as the heart relaxes to maintain pressure.

D Muscular arteries facilitate smoother blood flow than elastic arteries as their walls expand and recoil.

11. June/2022/Paper_13/No.32

The graph shows the changes in pressure that occur in the left side of the heart during one cardiac cycle.



What is the heart rate in beats per minute?

A 75 **B** 80 **C** 120 **D** 150

12. June/2022/Paper_13/No.33

Which events occur during ventricular systole?

1 Atrioventricular valves close.

2 Muscle in ventricle walls relaxes.

3 Semilunar valves open.

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

STEMUP.CO.UK

13. June/2022/Paper_13/No.39

A person's blood group is determined by antigens present on the red blood cells. Antibodies in the plasma of the person who receives the blood can make some blood transfusions unsafe.

The table shows the antigens and antibodies in the blood of people with different blood groups.

blood group	presence of A or B antigens on red blood cells	presence of antibodies to A or B in plasma
A	A only	anti-B only
B	B only	anti-A only
AB	A and B	neither
O	neither	anti-A and anti-B

Which blood groups can be given to a person with blood group A?

A A and AB **B** A and O **C** B and O **D** AB only

STEMUP.CO.UK

Transport in mammals – AS 9700 Biology Nov 2022

1. Nov/2022/Paper_11/No.32

Which statements about arteries are correct?

1 Artery walls can resist high pressure.

2 Arteries pump blood out of the heart.

3 Blood in arteries has the same flow rate as in veins.

4 The pulse in arteries is the result of a surge in blood that causes expansion of the artery wall.

5 There are semilunar valves at the junction of arteries with the heart.

A 1, 2 and 4 **B** 1, 3 and 5 **C** 1, 4 and 5 **D** 2, 3 and 4

2. Nov/2022/Paper_11/No.33

What happens during ventricular systole in a mammalian heart?

1 The atrioventricular node transmits an electrical signal to the apex of the heart.

2 The pressure in the ventricles drops below the pressure in the atria.

3 The atrioventricular valves close and the semilunar valves open.

A 1 and 2 **B** 1 and 3 **C** 2 only **D** 3 only

3. Nov/2022/Paper_11/No.34

A shortage of protein in the diet of children can lead to a disease that causes excess tissue fluid to build up in the abdomen.

What explains why a build-up of excess tissue fluid can occur in this disease?

A A shortage of plasma proteins decreases blood water potential; less tissue fluid returns to the blood.

B A shortage of plasma proteins increases blood water potential; less tissue fluid returns to the blood.

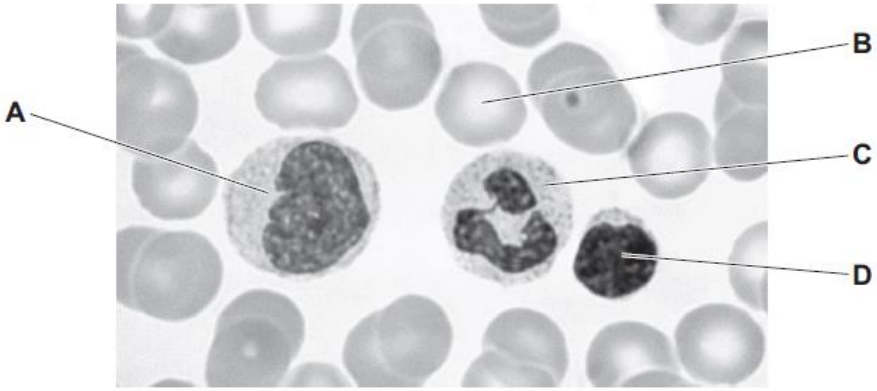
C A shortage of protein in the diet causes weak cardiac muscle, reducing hydrostatic pressure.

D A shortage of protein in the tissue fluid decreases its water potential; more water leaves the blood.

4. Nov/2022/Paper_12/No.32

The photomicrograph shows a blood smear.

Which cell is a monocyte?



5. Nov/2022/Paper_12/No.33

The table shows some information about three blood vessels, P, Q and R, from a mammal.

	diameter / mm	wall thickness / mm	percentage composition of wall		
			muscle	collagen	elastic tissue
P	25	2	22	33	40
Q	20	1	25	40	25
R	4	1	35	25	30

Which row identifies blood vessels P, Q and R?

	P	Q	R
A	artery	vein	artery
B	artery	vein	capillary
C	vein	artery	capillary
D	vein	artery	vein

STEMUP.CO.UK

6. Nov/2022/Paper_12/No.34

Ventricular septal defect (VSD) is a heart defect that people can have from birth. People with VSD have a hole in the wall (septum) that separates the left and right ventricles.

What could happen in a person with VSD?

1 Blood will leak through the hole, mostly from right to left.

2 The volume of blood circulating through the lungs will be higher than in a person without VSD.

3 Less oxygen will be delivered to the body tissues.

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

7. Nov/2022/Paper_12/No.35

Which statement about the structure of the heart is correct?

A The semilunar valves close when the pressure in the ventricles falls lower than the pressure in the arteries.

B A muscle called the septum separates the atria from the ventricles.

C There is a small patch of tissue in the right atrium that acts to delay the electrical impulse.

D Closure of valves in the veins prevents backflow of blood into the ventricles.

8. Nov/2022/Paper_12/No.37

What are the functions of cilia in the gas exchange system?

1 to move mucus

2 to trap pathogens and dust

3 to increase the surface area

	1	2	3
A	✓	✗	✗
B	✓	✓	✗
C	✗	✓	✓
D	✗	✗	✓

key

✓ = a function

✗ = not a function

STEMUP.CO.UK

9. Nov/2022/Paper_13/No.32

Which blood vessels carry blood into the atria?

1 coronary artery

2 vena cava

3 pulmonary artery

4 pulmonary vein

A 1 and 2 **B** 1 and 3 **C** 2 and 3 **D** 2 and 4

10. Nov/2022/Paper_13/No.33

Which statements about the cardiac cycle are correct?

1 The atrioventricular valves close during atrial systole.

2 The left and right ventricles contract together.

3 There is a time delay as the electrical impulse passes from the atrioventricular node to the sinoatrial node.

4 Electrical impulses pass along the Purkyne tissue to the ventricles.

A 1, 2 and 3 **B** 1, 3 and 4 **C** 2 and 4 **D** 3 and 4 only

11. Nov/2022/Paper_13/No.34

At one point in the cardiac cycle, the pressure in the right ventricle is lower than that in the right atrium and lower than that in the pulmonary artery.

Which row is correct?

	atrioventricular valve	semilunar valve
A	closed	closed
B	closed	open
C	open	closed
D	open	open

STEMUP.CO.UK

12. Nov/2022/Paper_21/No.2

Fig. 2.1 is a simplified diagram of the human circulatory system.

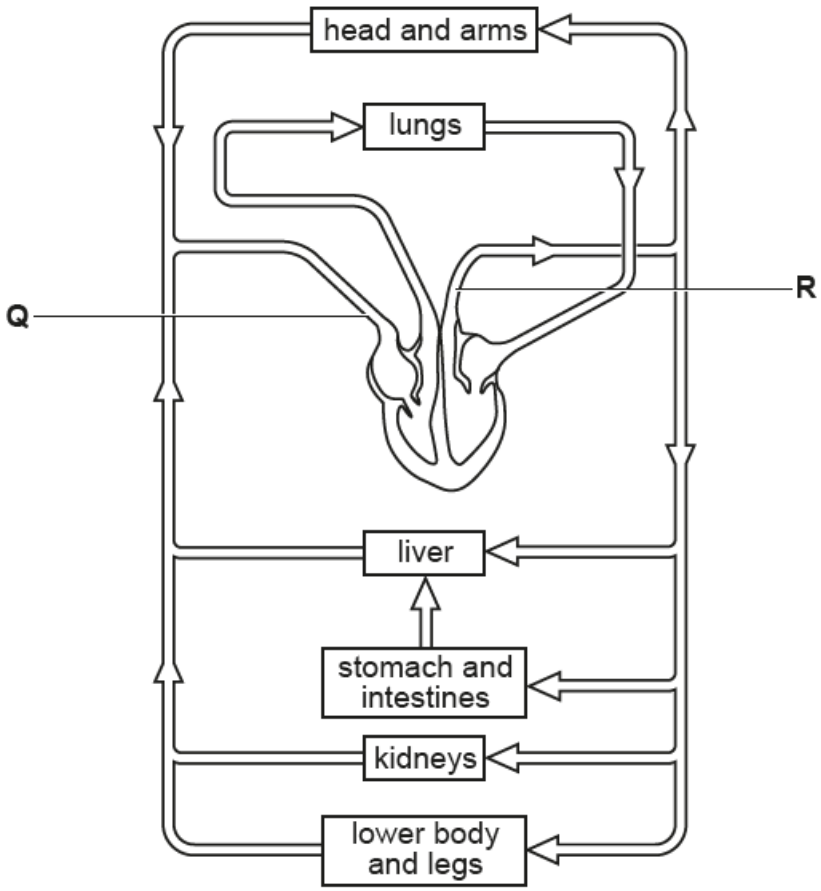


Fig. 2.1

(a) (i) State why the human circulatory system is described as a closed, double circulation.

.....

.....

.....

.....

..... [2]

(ii) Identify blood vessel **Q** and blood vessel **R**, shown in Fig. 2.1.

Q .....

R .....

[1]

STEMUP.CO.UK

(iii) Blood leaving the heart passes through valves before it enters blood vessel **R**.

Describe the differences between the structure of blood vessel **Q** and the structure of blood vessel **R**. Do **not** refer to valves in your answer.

.....

.....

.....

.....

.....

.....

..... [3]

(b) Blood plasma plays an important role in the transport of molecules such as antibodies.

Scientists discovered that some of the antibodies in the blood plasma of sharks have a different structure to the antibodies found in human blood plasma.

Fig. 2.2 shows the structure of an antibody molecule found in the blood plasma of a shark.

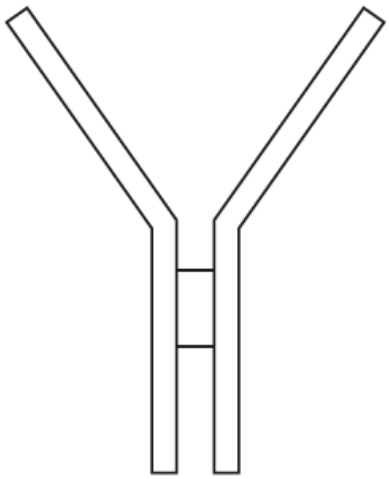


Fig. 2.2

(i) State how the quaternary structure of a human antibody molecule differs from the quaternary structure of the shark antibody molecule shown in Fig. 2.2.

.....

.....

..... [1]

STEMUP.CO.UK

(ii) Human antibodies are used in the treatment of some forms of cancer. However, the antibodies injected into the bloodstream can only reach a small percentage of the cancer cells that form the cancerous tumour.

Shark antibodies are smaller than human antibodies. Scientists are researching the possibility of injecting shark antibodies into the bloodstream to treat cancerous tumours in humans.

Suggest how using the smaller shark antibodies may be more effective in reaching a greater percentage of cancer cells than human antibodies and lead to greater success at treating cancer.

.....

.....

.....

.....

..... [2]

(iii) Antibodies can also be used in the prevention of infectious diseases.

Explain how injection of antibodies into the bloodstream can protect a person from disease after infection by a pathogen.

.....

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 12]

STEMUP.CO.UK

13. Nov/2022/Paper_22/No.1(a_ c)

The mammalian circulatory system is adapted for the long-distance transport of the respiratory gases, oxygen and carbon dioxide.

The system is described as a closed double circulation.

(a) Name:

- the two different circulations of the double circulatory system of mammals

  .....

  .....

- the main vein returning deoxygenated blood to the heart.

  .....

[3]

(b) In a closed circulation, blood is kept within vessels at all times.

Name the type of blood vessel that connects capillaries and veins.

..... [1]

STEMUP.CO.UK

(c) Fig. 1.1 is a diagram of a section through the heart.

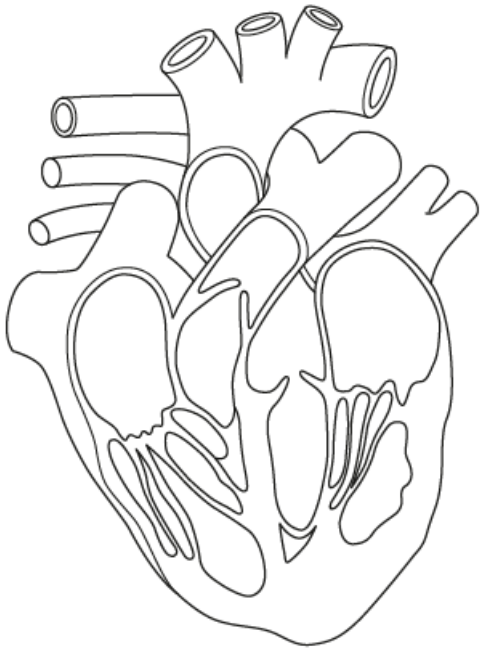


Fig. 1.1

On Fig. 1.1:

- add a label line and the letter **L** to show the artery that takes blood from the heart to the lungs
- add a label line and the letter **R** to show the valve that closes when the right ventricle is in systole. [2]

STEMUP.CO.UK

Transport in mammals – AS 9700 June 2022

1. June/2023/Paper_9700/11/No.11

Which statement correctly explains why blood plasma can be maintained at a stable temperature?

A It has a low specific heat capacity.

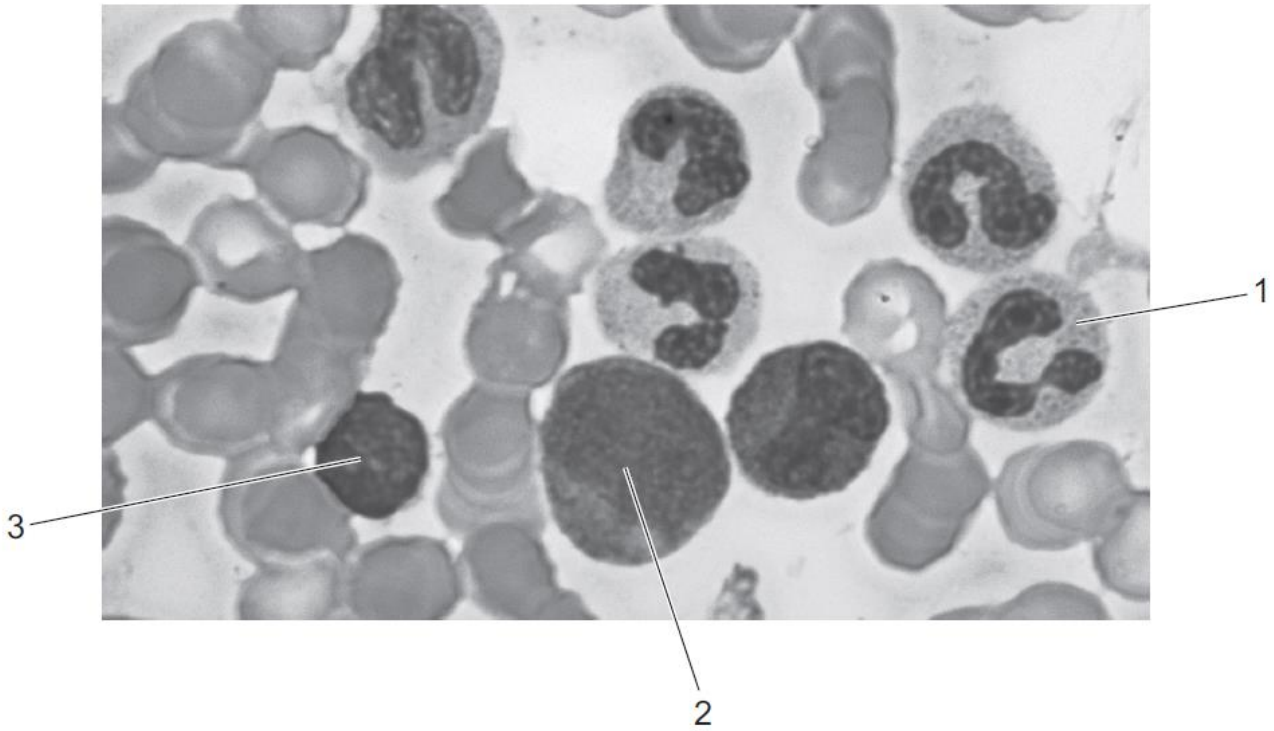
B It has a high specific heat capacity.

C It has a low latent heat of vaporisation.

D It has a high latent heat of vaporisation.

2. June/2023/Paper_9700/11/No.28

The photomicrograph shows blood cells as seen using a high-power light microscope.



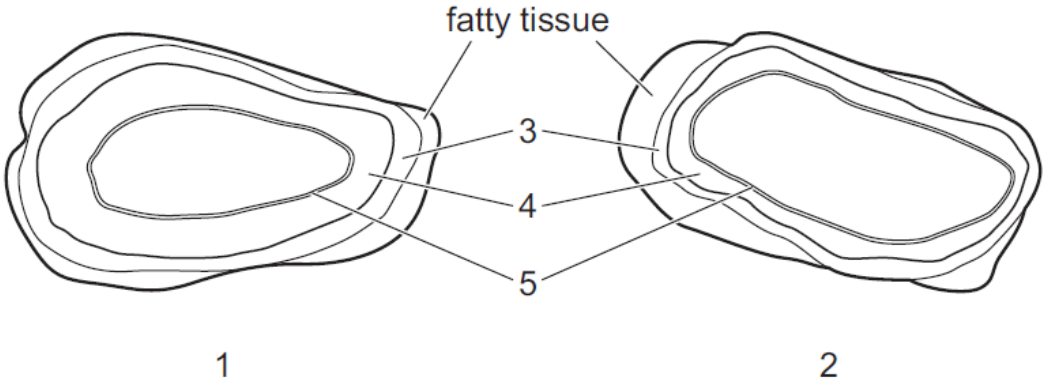
Which row correctly identifies the different types of white blood cell?

	1	2	3
A	lymphocyte	monocyte	neutrophil
B	monocyte	neutrophil	macrophage
C	neutrophil	monocyte	lymphocyte
D	phagocyte	lymphocyte	monocyte

STEMUP.CO.UK

3. June/2023/Paper_9700/11/No.29

Plan diagrams of two blood vessels are shown.



Which labels are correct?

	1	2	3	4	5
A	aorta	vena cava	elastic fibres	smooth muscle	epithelium
B	artery	vein	collagen fibres	smooth muscle and elastic tissue	endothelium
C	vein	artery	collagen fibres	elastic fibres	squamous cells
D	coronary artery	coronary vein	elastic fibres	smooth muscle and elastic tissue	epithelium

STEMUP.CO.UK

4. June/2023/Paper_9700/11/No.30

What are found in blood and tissue fluid?

1 carbon dioxide

2 fatty acids

3 white blood cells

4 proteins

A 1, 2, 3 and 4

B 1, 2 and 3 only

C 1, 2 and 4 only

D 3 and 4 only

5. June/2023/Paper_9700/11/No.31

Which reactions would be slowed down by an inhibitor of carbonic anhydrase?

1 CO_2 + haemoglobin $\rightarrow$ carbaminohaemoglobin

2 $CO_2 + H_2O \rightarrow H_2CO_3$

3 $H_2CO_3 \rightarrow H^+ + HCO_3^-$

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

STEMUP.CO.UK

6. June/2023/Paper_9700/11/No.32

Which sequence of letters correctly identifies the order of events during the cardiac cycle?

T atrial walls contract

U impulse is delayed by a fraction of a second

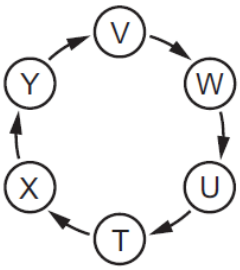
V wave of excitation enters the atrioventricular node

W wave of excitation passes down the Purkyne tissue

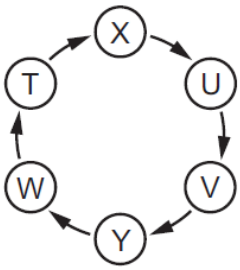
X wave of excitation spreads from the sinoatrial node

Y ventricles contract

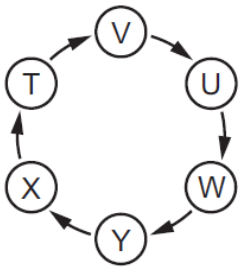
A



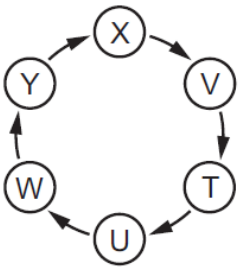
B



C



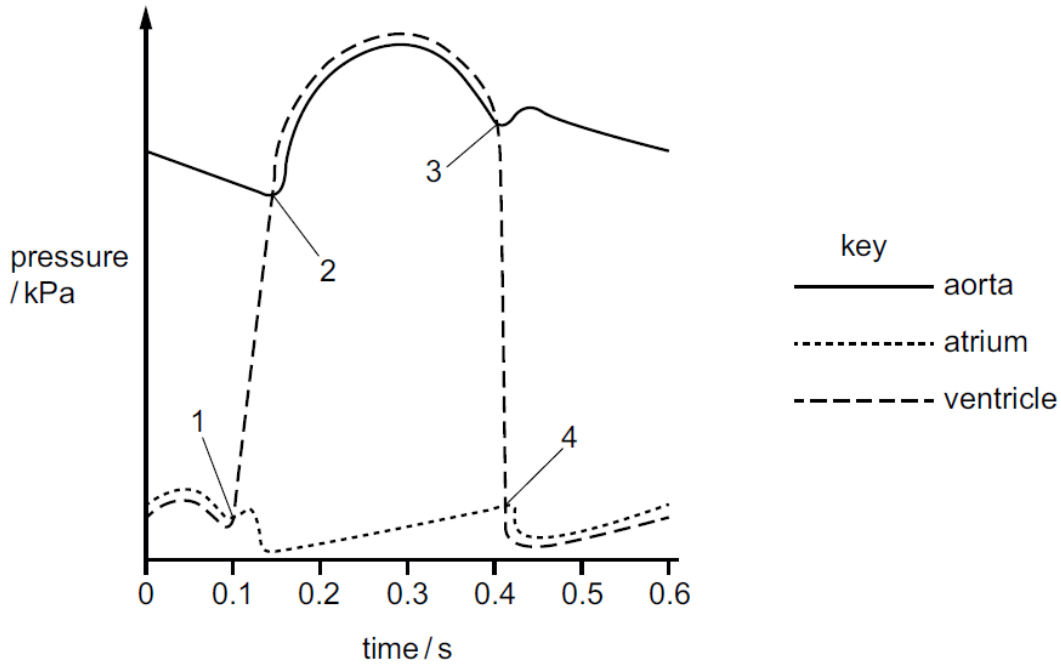
D



STEMUP.CO.UK

7. June/2023/Paper_9700/11/No.33

The diagram gives information about blood pressure in the left side of the heart during the cardiac cycle.



Valves open and close at the points numbered.

Which row identifies the valves opening or closing at the points numbered?

	atrioventricular valve opens	semilunar valve opens	atrioventricular valve closes	semilunar valve closes
A	1	3	4	2
B	2	4	3	1
C	3	1	2	4
D	4	2	1	3

STEMUP.CO.UK

8. June/2023/Paper_9700/12/No.32

Which properties of water are essential for its role in the transport of blood in mammals?

	high latent heat of vaporisation	solvent for polar substances
A	✓	✗
B	✗	✓
C	✓	✓
D	✗	✗

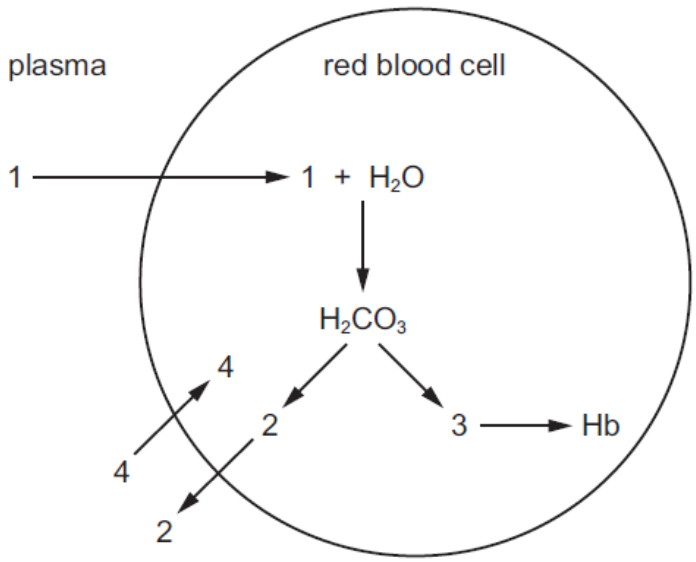
key

✓ = essential

✗ = not essential

9. June/2023/Paper_9700/12/No.33

The diagram shows some of the events that happen between the plasma and the red blood cells in the circulatory system.



What do the numbers 1, 2, 3 and 4 represent?

	1	2	3	4
A	Cl^-	HCO_3^-	H^+	CO_2
B	CO_2	HCO_3^-	H^+	Cl^-
C	HCO_3^-	Cl^-	CO_2	H^+
D	CO_2	H^+	HCO_3^-	Cl^-

STEMUP.CO.UK

10. June/2023/Paper_9700/12/No.34

The diagrams show the valves in the heart when viewed in cross-section from above at different stages in the cardiac cycle.

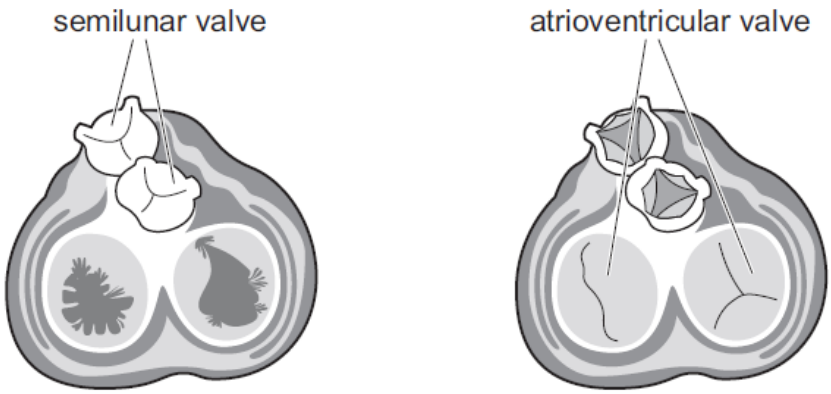


diagram 1 diagram 2

Which stages in the cardiac cycle are shown?

	diagram 1	diagram 2
A	diastole	ventricular systole
B	atrial systole	diastole
C	ventricular systole	diastole
D	diastole	atrial systole

11. June/2023/Paper_9700/13/No.33

What is present in the blood in human veins?

1 chloride ions

2 carbonic anhydrase

3 oxyhaemoglobin

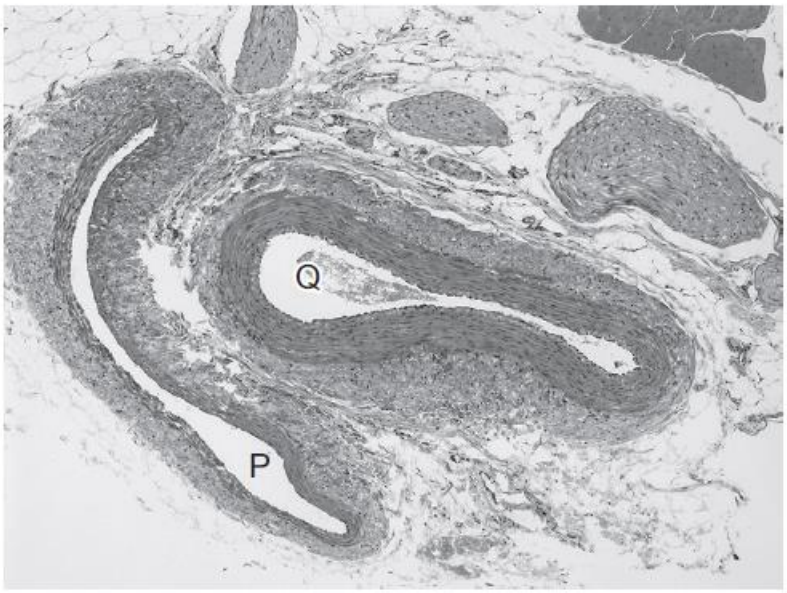
A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

STEMUP.CO.UK

12. June/2023/Paper_9700/13/No.34

The photomicrograph shows two blood vessels P and Q.

Both these blood vessels are part of a network which transports blood around the body.



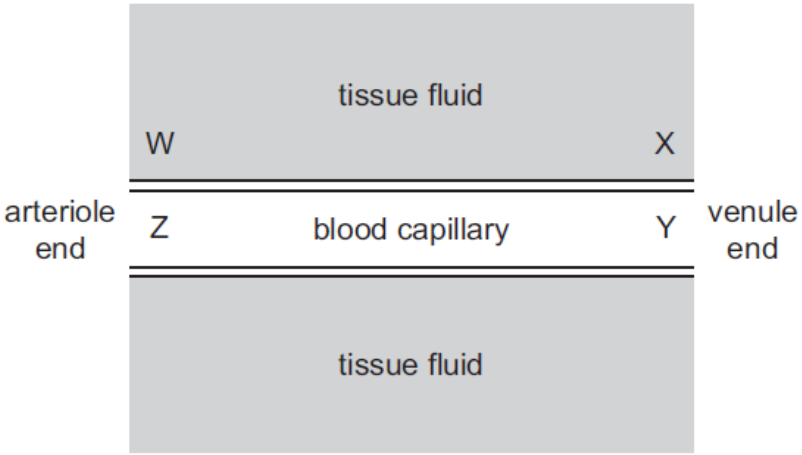
Which row is correct for blood vessel P and blood vessel Q?

	blood vessel P	blood vessel Q
A	carries blood into arterioles	carries blood into arterioles
B	carries blood into arterioles	carries blood from venules
C	carries blood from venules	carries blood into arterioles
D	carries blood from venules	carries blood from venules

STEMUP.CO.UK

13. June/2023/Paper_9700/13/No.35

The diagram shows a blood capillary and the tissue fluid which surrounds it.



Tissue fluid is formed when fluid and solutes from blood plasma pass through tiny gaps in the capillary wall. Most tissue fluid is then returned to the blood in the capillary.

Which pressures will be needed at points W, X, Y and Z so that this system can function?

	pressure at W / mm Hg	pressure at X / mm Hg	pressure at Y / mm Hg	pressure at Z / mm Hg
A	18	26	36	26
B	26	26	18	36
C	26	36	26	18
D	36	18	26	26

14. June/2023/Paper_9700/13/No.36

What happens during ventricular systole in a mammalian heart?

A Aortic pressure increases.

B Atrioventricular valves open.

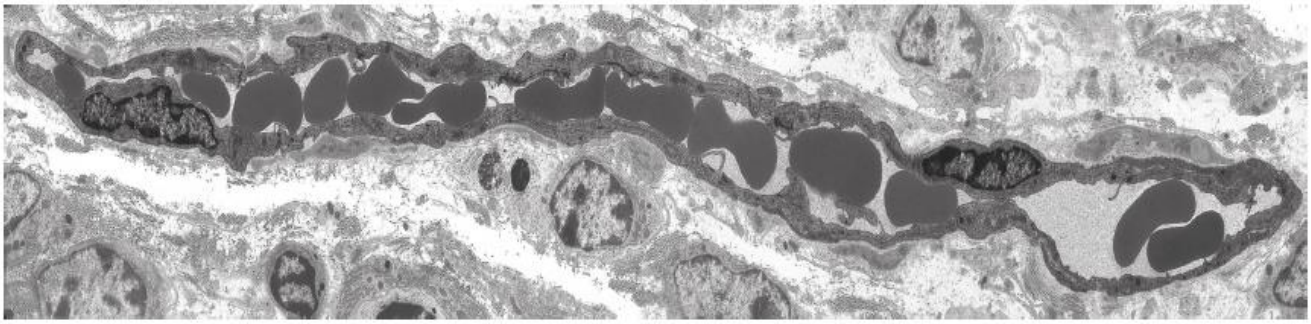
C Semilunar valves close.

D Ventricular pressure decreases.

STEMUP.CO.UK

15. June/2023/Paper_9700/21/No.5

Fig. 5.1 is a longitudinal section of a capillary in muscle tissue as viewed with a transmission electron microscope.



magnification ×2000

Fig. 5.1

(a) State the evidence, **visible in Fig. 5.1**, that identifies the cells inside the capillary as red blood cells.

.....

.....

.....

.....

..... [2]

(b) Explain how the structure of the capillary wall is related to its functions.

.....

.....

.....

.....

.....

.....

..... [3]

STEMUP.CO.UK

(c) Fig. 5.2 is a diagram showing some of the events that occur as blood flows through a capillary in a respiring tissue.

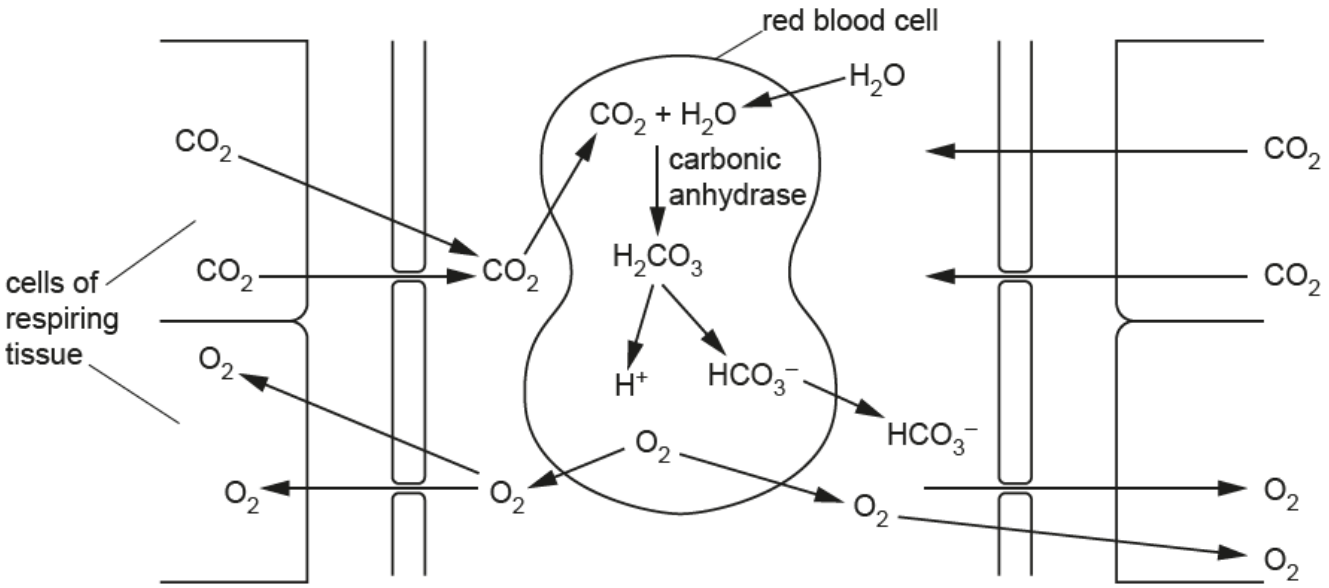


Fig. 5.2

(i) An increase in respiration results in an increase in the carbon dioxide concentration in the blood and the release of more oxygen from red blood cells to tissues.

Explain how an increase in carbon dioxide in the blood leads to the release of more oxygen from red blood cells.

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

STEMUP.CO.UK

(ii) Chloride ions are a constituent of blood plasma. The concentration of chloride ions in the plasma of deoxygenated blood is between 2–4 mmol dm^{-3} lower than in the plasma of oxygenated blood.

Explain why the concentration of chloride ions in the blood plasma of deoxygenated blood is lower than in the plasma of oxygenated blood.

.....

.....

.....

.....

..... [2]

[Total: 11]

STEMUP.CO.UK

16. June/2023/Paper_9700/22/No.1

The sinoatrial node (SAN) and the atrioventricular node (AVN) have an important role in the control of the cardiac cycle. The timing of atrial and ventricular systole and diastole must be controlled so that blood passes through the heart efficiently.

(a) Fig. 1.1 is a summary of blood flow through the **right** side of the heart during one cardiac cycle. Three boxes in Fig. 1.1 are **not** complete.

Complete boxes **3**, **5** and **7** in Fig. 1.1 using **only** the terms **systole** and **diastole**.

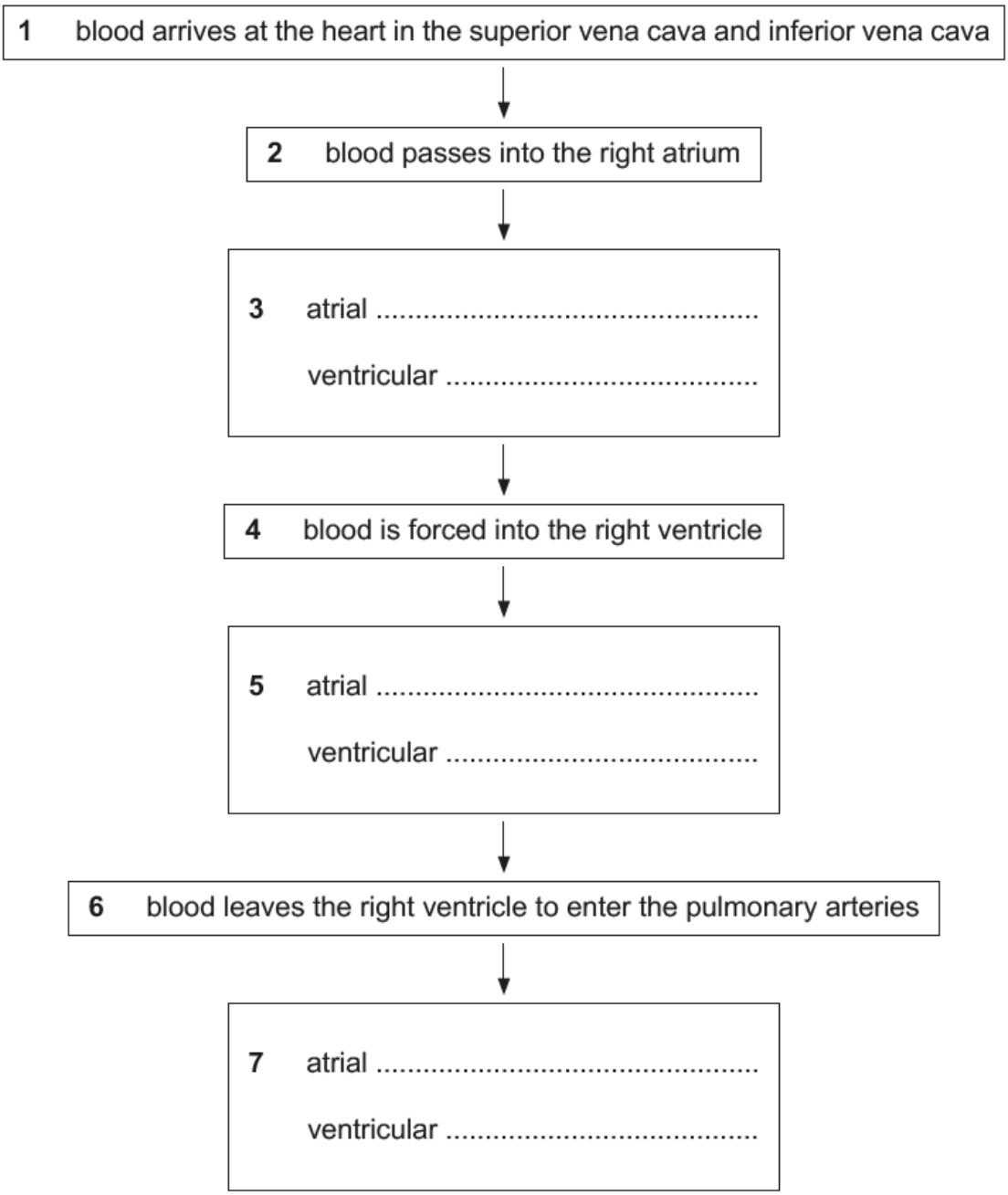


Fig. 1.1

[2]

STEMUP.CO.UK

(b) Impulses sent out by the SAN pass to the AVN, where there is a short delay.

With reference to Fig. 1.1, explain why it is important for the control of the cardiac cycle that there is a short delay at the AVN after impulses have been sent out by the SAN.

.....

.....

.....

.....

.....

..... [2]

(c) Changes in blood pressure occur in the heart during the cardiac cycle. These changes cause the opening and closing of the bicuspid and tricuspid (atrioventricular) valves and the aortic and pulmonary (semilunar) valves.

Explain how blood pressure changes:

- cause the **opening** of the **tricuspid** valve
- cause the **opening** of the **pulmonary** valve
- help the flow of blood through the heart.

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 7]

STEMUP.CO.UK

17. June/2023/Paper_9700/23/No.3

Blood contains white blood cells and red blood cells.

(a) Fig. 3.1 is a photomicrograph showing different types of blood cell.

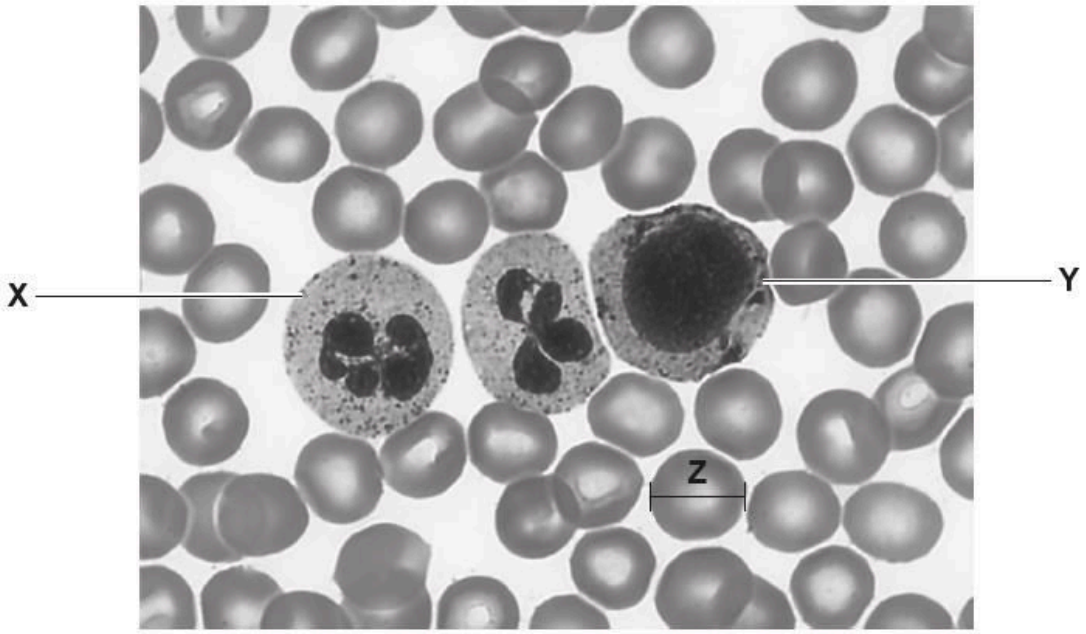


Fig. 3.1

(i) Identify cell **X** and cell **Y** in Fig. 3.1.

X .....

Y .....

[2]

(ii) The width of one of the cells in Fig. 3.1 is represented by the line **Z**.

The actual width of cell **Z** is 8 μm.

Calculate the magnification used to produce the image shown in Fig. 3.1.

Write down the formula you will use to make your calculation.

formula

magnification = x ..... [2]

STEMUP.CO.UK

(b) Carbonic anhydrase is an enzyme found in red blood cells.

(i) Describe how carbonic anhydrase is involved in the release of oxygen from red blood cells at respiring tissues.

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

(ii) Sulfonamide is a competitive inhibitor of carbonic anhydrase.

Fig. 3.2 shows the effect of increasing substrate concentration on the rate of the reaction catalysed by carbonic anhydrase.

Sketch a curve **on Fig. 3.2** to show the effect of sulfonamide on the rate of reaction catalysed by carbonic anhydrase.

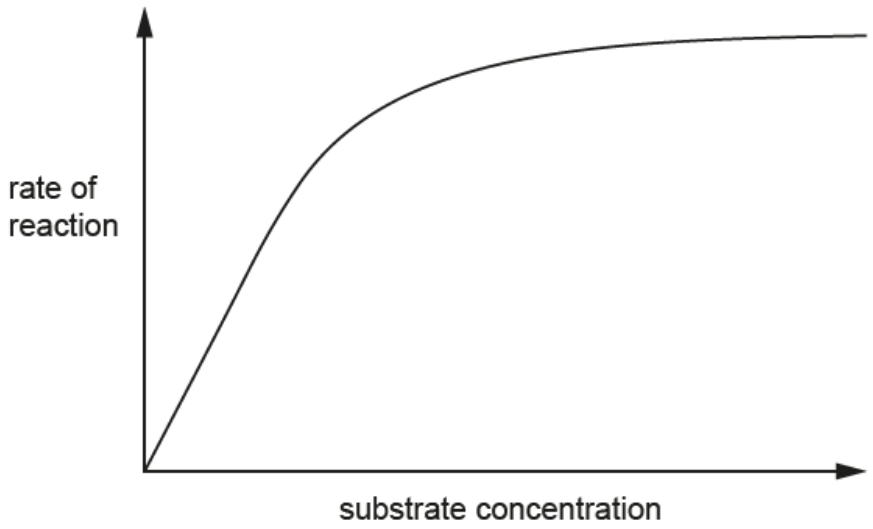


Fig. 3.2

[2]

[Total: 10]

STEMUP.CO.UK

18. March/2023/Paper_9700/12/No.20

The estimated total number of red blood cells in the human body is 2.5×10^{13}.

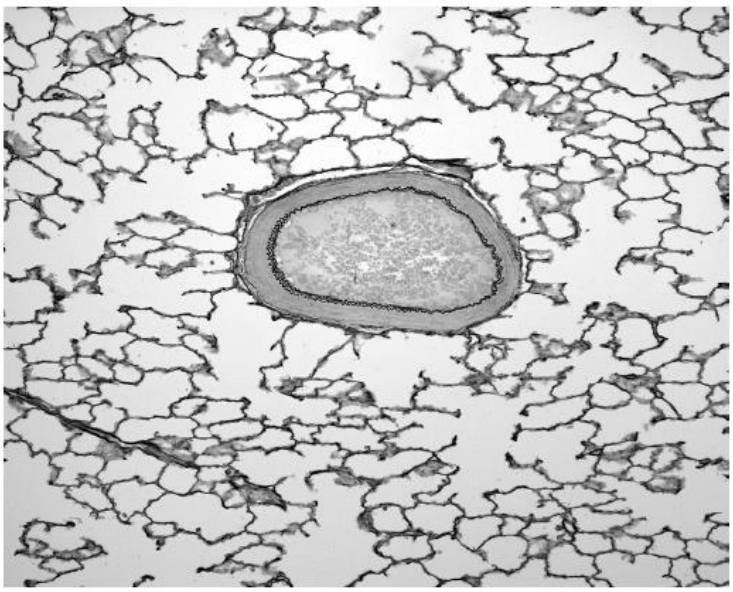
It is estimated that, each day, 2.5×10^{11} red blood cells are removed from the circulation and are replaced by stem cells in the bone marrow.

Which percentage of the total number of red blood cells is replaced each day?

A 0.01% **B** 0.1% **C** 1% **D** 10%

19. March/2023/Paper_9700/12/No.31

The photomicrograph shows a section through a tissue with an artery.



Which row correctly shows the type of artery and whether the blood inside the artery is oxygenated or deoxygenated?

	type of artery	blood
A	muscular	deoxygenated
B	muscular	oxygenated
C	elastic	deoxygenated
D	elastic	oxygenated

STEMUP.CO.UK

20. March/2023/Paper_9700/12/No.32

Heart surgery may cause a decrease in the transmission of impulses in the Purkyne tissue to the right side of the heart.

What is a possible effect of this decrease?

A Impulses would be delayed by the atrioventricular node.

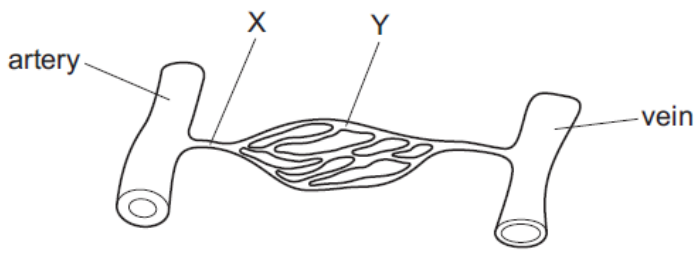
B The muscle of the right ventricle would contract slightly more slowly than the muscle of the left ventricle.

C The muscle of the right atrium would not contract as fully as the muscle of the left atrium.

D The sinoatrial node would transmit fewer impulses.

21. March/2023/Paper_9700/12/No.33

The diagram shows a network of blood vessels that supply blood to muscle tissue in the human body.



What is a correct comparison between the blood at X and the blood at Y when the muscle tissue is at rest?

	blood pressure at X compared with blood pressure at Y	water potential of blood at X compared with water potential of blood at Y
A	equal	higher
B	equal	lower
C	higher	higher
D	higher	lower

STEMUP.CO.UK

22. March/2023/Paper_9700/22/No.5

Pneumonia is a severe lung disease that can interfere with gas exchange. A person with pneumonia can be connected to an ECMO machine. This machine performs the gas exchange functions of the lungs.

A cannula (tube) is inserted into the right atrium and this takes blood to the ECMO machine. In the ECMO machine, blood is passed firstly to an artificial pump and then to an oxygenator, where gas exchange occurs. The blood is then warmed and returns by another cannula to the vena cava.

(a) Complete Fig. 5.1 to show how the ECMO machine is connected to the right atrium and to the vena cava. Use a single line to represent each cannula.

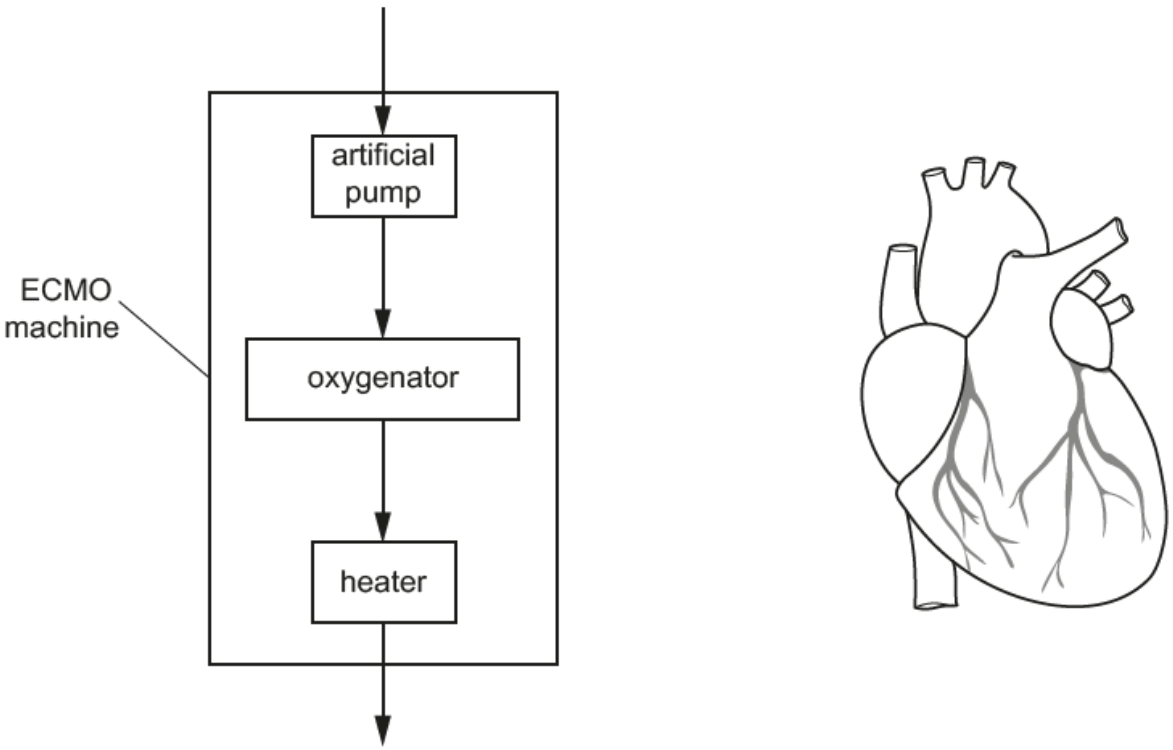


Fig. 5.1

[1]

(b) In the oxygenator, a partially permeable membrane separates the blood from air that has been enriched with extra oxygen.

(i) State the name of a structure in the gas exchange system that has the same function as the partially permeable membrane of the oxygenator.

..... [1]

STEMUP.CO.UK

(ii) In the oxygenator, blood and oxygen-enriched air flow in opposite directions.

Suggest **and** explain how the oxygenator carries out the functions of gas exchange that normally occur in the lungs.

.....

.....

.....

.....

.....

.....

..... [3]

(c) Fig. 5.2 is a photomicrograph showing a transverse section of part of the human aorta.

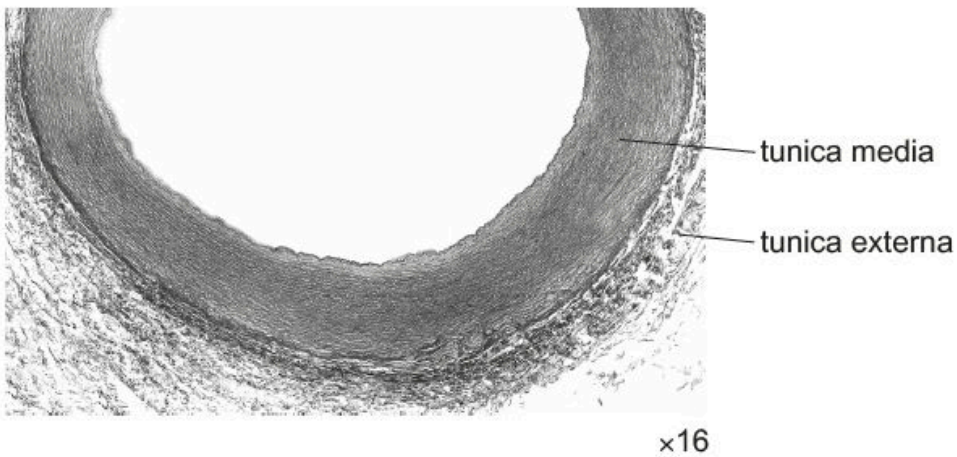


Fig. 5.2

Explain how the structure of the tunica media in Fig. 5.2 is different from the structure of the tunica media in a muscular artery **and** relate the difference to the function of the aorta.

.....

.....

.....

.....

.....

.....

..... [3]

STEMUP.CO.UK

(d) Some biologists investigated the transport of carbon dioxide in the blood of *Caiman latirostris*, a type of reptile.

The biologists found that when *C. latirostris* respires:

- most of the carbon dioxide is converted into hydrogencarbonate ions in red blood cells
- the hydrogencarbonate ions combine with haemoglobin inside the red blood cells
- the hydrogencarbonate ions remain combined with haemoglobin until the blood reaches the lungs.

(i) Explain why the physiology of *C. latirostris* requires carbonic anhydrase.

.....

.....

..... [1]

(ii) Explain why the physiology of *C. latirostris* does **not** require the chloride shift.

.....

.....

..... [1]

[Total: 10]

STEMUP.CO.UK

Transport in mammals – AS 9700 November 2023

1. Nov/2023/Paper_ 9700/11/No.30

Which factors affect blood pressure?

1 the diameter of the blood vessels

2 the systolic pressure of the heart ventricles

3 the volume of blood returning to the heart in each cardiac cycle

A 1, 2 and 3 **B** 1 and 3 only **C** 1 only **D** 2 and 3 only

2. Nov/2023/Paper_ 9700/11/No.32

The partial pressure of oxygen in blood vessels in different parts of the body affects the percentage saturation of each haemoglobin molecule with oxygen.

blood vessel	partial pressure of oxygen / kPa	saturation of each haemoglobin molecule with oxygen / %
vein in active muscle	4	25
vein in resting muscle	7	75
arteriole in lungs	12	100

Which statement explains the difference in saturation between a resting and an active muscle?

A A small decrease in partial pressure causes two atoms of oxygen to leave each haemoglobin molecule because the oxygen dissociation curve is sigmoid shaped.

B A small decrease in partial pressure between 4 kPa and 7 kPa causes two molecules of oxygen to leave each haemoglobin molecule because the oxygen dissociation curve is steep.

C Loading of oxygen is slower between 4 kPa and 7 kPa due to binding of one oxygen molecule to each haemoglobin molecule making the next one harder to bind.

D Loading of oxygen is faster between 4 kPa and 7 kPa due to binding of one oxygen molecule to each haemoglobin molecule making the next one easier to bind.

3. Nov/2023/Paper_ 9700/11/No.34

Some of the events during a cardiac cycle are listed.

1 Left and right atria contract.

2 Left and right ventricles contract.

3 A wave of electrical activity is conducted by the Purkyne tissue.

4 A wave of electrical activity passes through the atrioventricular node.

What is the correct sequence of events after the sinoatrial node sends out a wave of electrical activity?

A $1 \rightarrow 3 \rightarrow 4 \rightarrow 2$

B $1 \rightarrow 4 \rightarrow 3 \rightarrow 2$

C $2 \rightarrow 4 \rightarrow 3 \rightarrow 1$

D $4 \rightarrow 1 \rightarrow 3 \rightarrow 2$

4. Nov/2023/Paper_ 9700/12/No.26

Which processes are required for the transfer of assimilates from a source cell into a phloem sieve tube?

A active transport, facilitated diffusion and simple diffusion

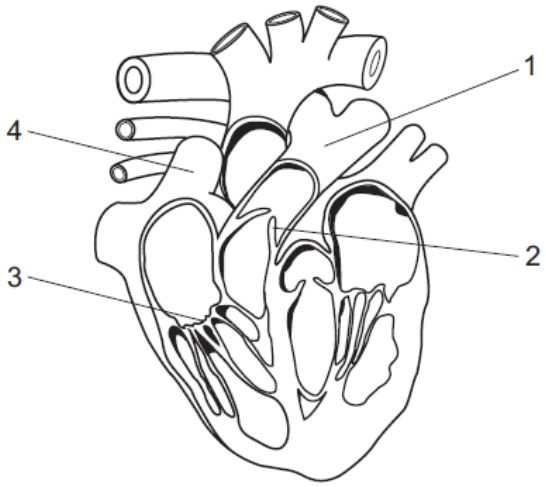
B active transport and exocytosis

C active transport and simple diffusion only

D active transport only

5. Nov/2023/Paper_ 9700/12/No.29

The diagram shows an anterior view of a vertical section through the human heart.



Which row shows the correct labels for the diagram?

	1	2	3	4
A	aorta	atrioventricular valve	semilunar valve	pulmonary artery
B	pulmonary vein	semilunar valve	atrioventricular valve	pulmonary vein
C	pulmonary artery	semilunar valve	atrioventricular valve	vena cava
D	pulmonary vein	atrioventricular valve	semilunar valve	vena cava

6. Nov/2023/Paper_ 9700/12/No.30

What does the inner layer of veins **and** capillaries contain?

A collagen fibres

B elastic fibres

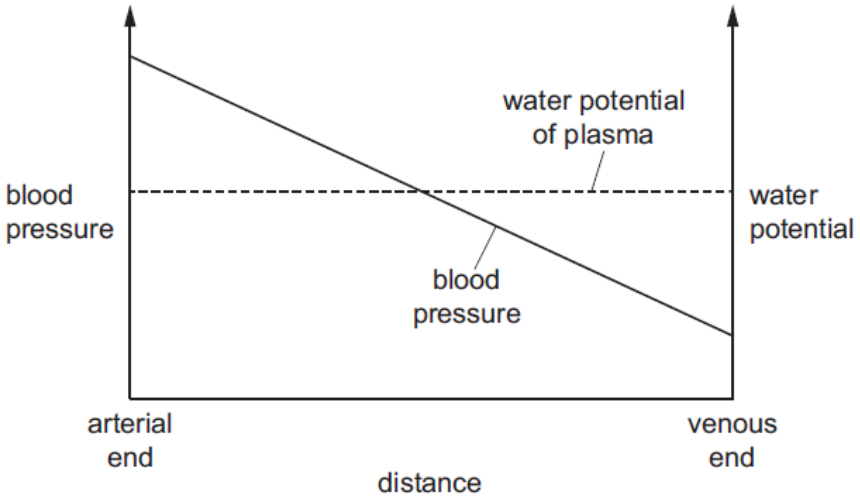
C endothelium

D smooth muscle

STEMUP.CO.UK

7. Nov/2023/Paper_ 9700/12/No.31

The graph shows the changes in blood pressure and water potential across a blood capillary from the arterial end of the capillary to the venous end of the capillary.



What could result in an accumulation of excess tissue fluid?

A an increase in concentration of large proteins in the blood plasma

B an increase in blood pressure

C a decrease in the concentration of small proteins in tissue fluid

D a decrease in blood pressure

8. Nov/2023/Paper_ 9700/12/No.32

Which statement is correct about a red blood cell that has just entered a capillary in a respiring muscle?

A There is a net decrease in chloride ions.

B There is a net decrease in haemoglobinic acid.

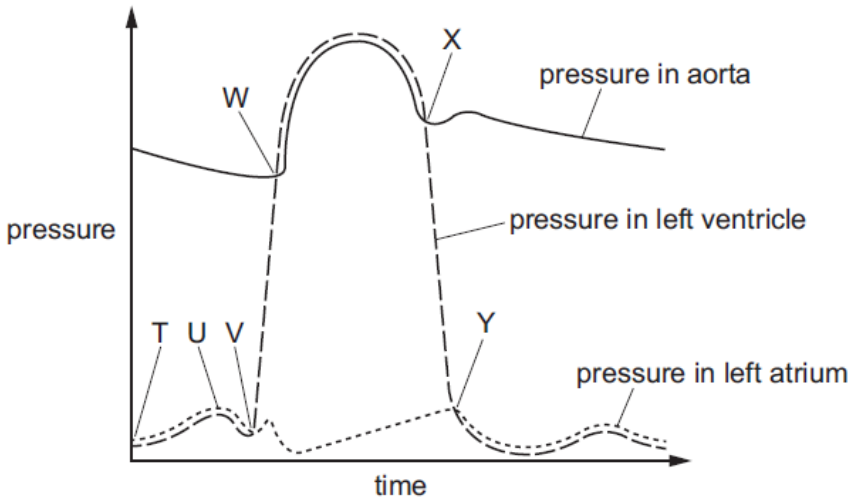
C There is a net increase in carbonic anhydrase.

D There is a net increase in carbaminohaemoglobin.

STEMUP.CO.UK

9. Nov/2023/Paper_ 9700/12/No.33

The graph shows some blood pressure changes that occur in a human during one cardiac cycle.



When does systole start and end in the right atrium and in the right ventricle?

	in right atrium		in right ventricle	
	systole starts	systole ends	systole starts	systole ends
A	T	V	V	X
B	T	U	V	Y
C	U	V	W	X
D	V	W	W	Y

10. Nov/2023/Paper_ 9700/13/No.28

Which process can be carried out by a mature red blood cell?

A active transport

B cell division

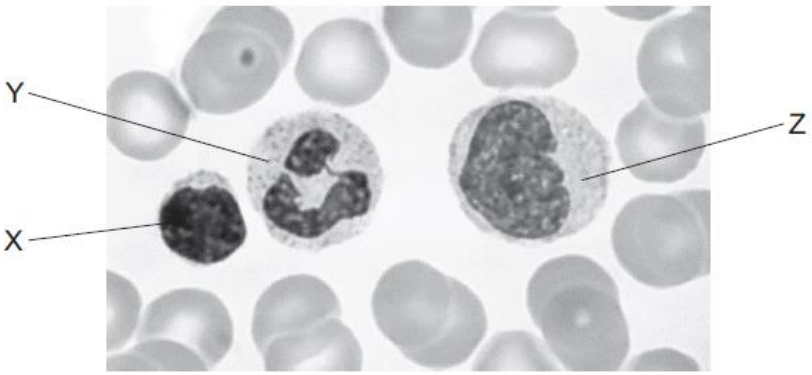
C phagocytosis

D protein synthesis

STEMUP.CO.UK

11. Nov/2023/Paper_ 9700/13/No.29

The photomicrograph shows three white blood cells labelled X, Y and Z.



Which row correctly identifies these cells?

	cell X	cell Y	cell Z
A	lymphocyte	monocyte	neutrophil
B	lymphocyte	neutrophil	monocyte
C	monocyte	neutrophil	lymphocyte
D	neutrophil	monocyte	lymphocyte

12. Nov/2023/Paper_ 9700/13/No.30

When a blood vessel is damaged it can result in problems in the body.

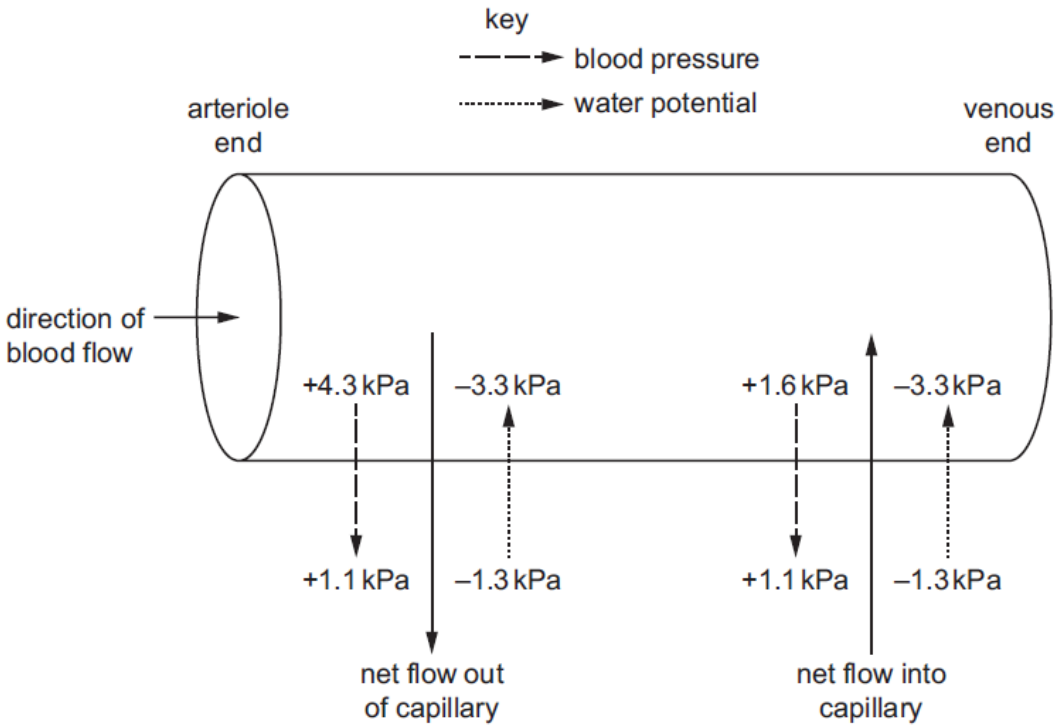
Which row identifies the blood vessel that could have been damaged?

	blood is not being distributed to organs that need it	blood is not returning to the heart and is collecting in organs	blood surges mean that relatively constant blood pressure is not maintained
A	elastic artery	muscular artery	vein
B	elastic artery	vein	muscular artery
C	muscular artery	elastic artery	vein
D	muscular artery	vein	elastic artery

STEMUP.CO.UK

13. Nov/2023/Paper_ 9700/13/No.31

The diagram shows how tissue fluid is formed.



What is the net pressure causing tissue fluid to flow out of the capillary at the arteriole end?

A –1.5 kPa **B** +1.0 kPa **C** +1.2 kPa **D** +5.2 kPa

14. Nov/2023/Paper_ 9700/13/No.32

What happens when carbon dioxide is transported by red blood cells?

A Hydrogencarbonate ions move into the red blood cells and chloride ions move into the plasma.

B Chloride ions move into the red blood cells and bind to haemoglobin.

C Chloride ions move into the red blood cells and hydrogen ions move into the plasma.

D Chloride ions move into the red blood cells and hydrogencarbonate ions move into the plasma.

STEMUP.CO.UK

15. Nov/2023/Paper_ 9700/22/No.3

The liver receives blood from the hepatic artery and from the hepatic portal vein. The hepatic portal vein transports blood from the digestive system.

Hepatocytes are the main cell type of the liver. They have a wide range of functions, including:

- the synthesis of triglycerides and plasma proteins
- detoxifying waste
- energy storage.

(a) The hepatic artery branches from the main artery that transports blood from the heart.

Name the main artery that transports blood to the hepatic artery.

..... [1]

(b) Blood arriving at the liver enters specialised blood vessels known as sinusoids.

Fig. 3.1 is a diagram of part of a sinusoid and surrounding hepatocytes. A second type of cell found in the liver, a Kupffer cell, is also shown.

Kupffer cells are phagocytic cells of the immune system.

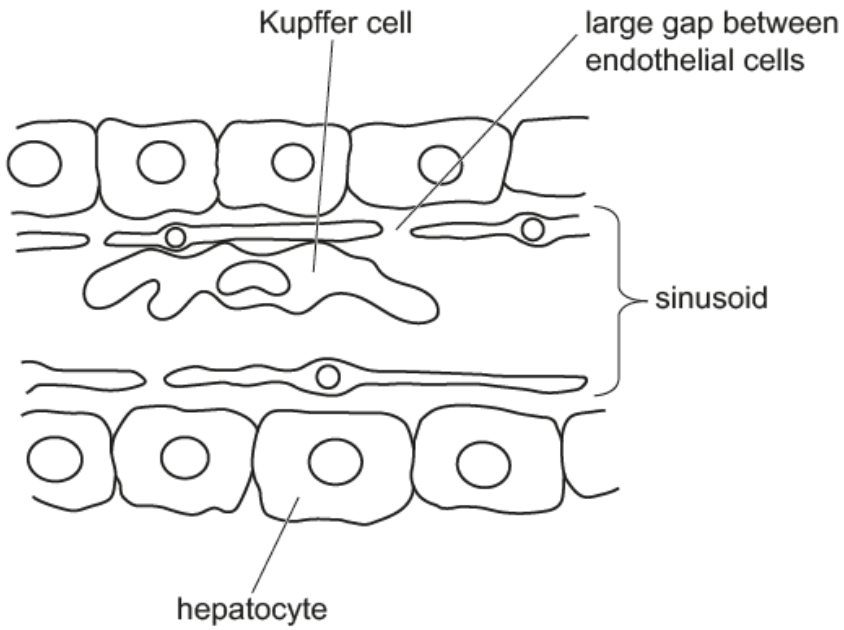


Fig. 3.1

(i) Suggest **one** advantage of having large gaps between the endothelial cells of the sinusoid, as shown in Fig. 3.1.

.....

.....

..... [1]

STEMUP.CO.UK

(ii) In addition to removing bacteria present in the blood inside the sinusoid, Kupffer cells are also able to remove old or damaged red blood cells.

Describe the mode of action of a Kupffer cell in removing and breaking down a damaged red blood cell.

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

STEMUP.CO.UK

(c) Fig. 3.2 is a transmission electron micrograph of part of a hepatocyte showing some cell structures.

The peroxisome shown in Fig. 3.2 is a spherical organelle bound by a single membrane. It carries out a variety of enzyme-catalysed metabolic reactions, including detoxification. Some of these reactions require oxygen.

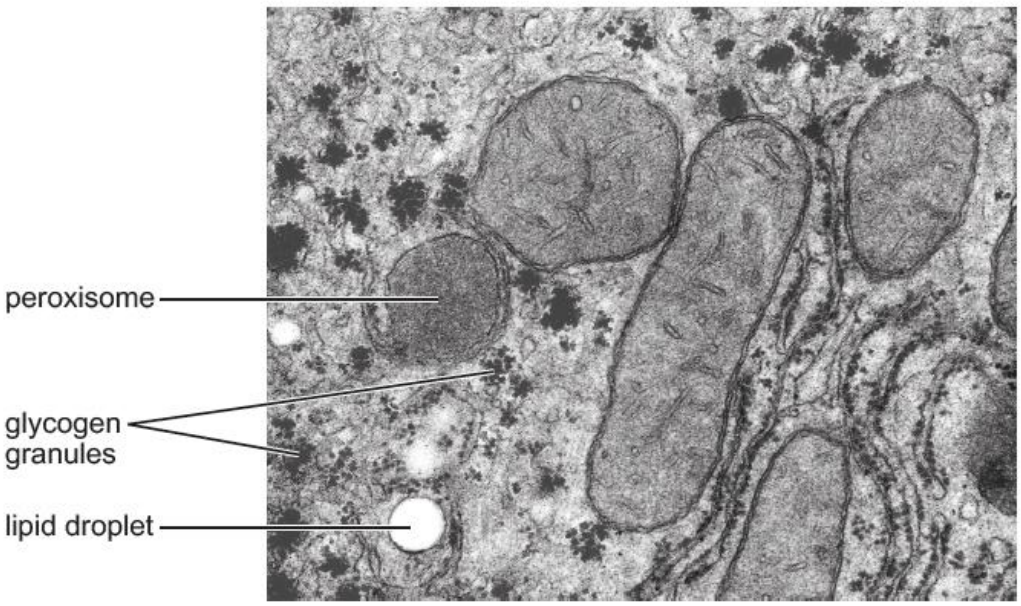


Fig. 3.2

(i) Describe the evidence **visible** in Fig. 3.2, apart from the presence of a peroxisome, that indicates some of the functions of a hepatocyte.

Add labels to Fig. 3.2 to identify the location of any cell structures, if not already labelled, that are part of your evidence.

.....

.....

.....

.....

.....

.....

.....

..... [3]

STEMUP.CO.UK

(ii) The mitochondria in Fig. 3.2 are larger than the peroxisome.

State **one other** difference, **visible** in Fig. 3.2, between a peroxisome and a mitochondrion.

.....

.....

.....

..... [1]

(iii) Some of the enzymes used within mitochondria can be synthesised by the organelle. Peroxisomes cannot synthesise any of the enzymes that they contain.

Suggest why a mitochondrion can synthesise enzymes, but a peroxisome cannot synthesise enzymes.

.....

.....

.....

.....

..... [2]

(iv) One of the enzymes present in peroxisomes is catalase. This enzyme catalyses the breakdown of hydrogen peroxide to harmless products.

Suggest why it is useful to the cell for this reaction to take place within peroxisomes.

.....

.....

.....

.....

.....

..... [2]

[Total: 14]

STEMUP.CO.UK

16. Nov/2023/Paper_ 9700/23/No.6

The mammalian heart consists of four chambers.

(a) Explain why the ventricles have thicker walls than the atria.

.....

.....

.....

.....

..... [2]

(b) Complete Table 6.1 to identify the structure in the heart responsible for each function listed.

Table 6.1

function	structure in the heart
initiates the heartbeat	
delays the wave of depolarisation between the atria and the ventricles	
transmits the wave of depolarisation through muscles of the ventricle	
closes when the left ventricle contracts	

[4]

[Total: 6]

STEMUP.CO.UK