

Question 31 (Answer: B)

- Haemoglobin releases oxygen more readily when carbon dioxide is high and pH is low – the Bohr effect.
- Intense exercise produces the most CO₂ and the lowest pH.
- So the row with pH 7.2 and the highest CO₂ partial pressure gives the greatest dissociation.

Question 33 (Answer: A)

- A lymphocyte is small with a very large round nucleus filling almost the whole cell.
- A monocyte is larger with a bean-shaped nucleus, and a neutrophil has a lobed nucleus.
- A red blood cell has no nucleus at all.

Question 34 (Answer: A)

- Respiring tissue releases CO₂, which forms carbonic acid in the blood.
- The acid dissociates and the protons bind to haemoglobin, changing its shape.
- That lowers its affinity for oxygen, shifting the curve to the right – the Bohr shift.

Question 32 (Answer: C)

- Needing a *higher* oxygen partial pressure for 50% saturation means the curve has shifted right.
- A right shift means haemoglobin's affinity for oxygen has decreased.
- Lower affinity means oxygen is released more readily to the tissues.

Question 33 (Answer: A)

- The Bohr shift is the effect of carbon dioxide, and so of pH, on haemoglobin.
- More CO₂ means a lower pH.
- That lowers haemoglobin's affinity for oxygen, so oxygen is released more readily where it is needed.

2(a)	<i>any two from:</i> (each haem contains) an, iron ion / ferrous ion / Fe²⁺ ; A iron / iron atom (each haem) binds to / AW, an oxygen molecule / two oxygen atoms ; A forms a bond <i>only if</i>, iron ion / ferrous ion / Fe²⁺, stated
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2(b)	<i>any three from:</i> less carbon dioxide diffuses into red blood cells ; less carbon dioxide reacts with water ; less carbonic acid is formed ; less, dissociation of carbonic acid / formation of hydrogen ions and hydrogen carbonate ions ; less haemoglobin acid is formed ; A description e.g. H⁺ binds to haemoglobin less oxygen (released from haem) diffuses out of red blood cells (to respiring tissues) ; <i>ref. to carbaminohaemoglobin ;</i> <i>AVP ; e.g. ref. to change in shape of haemoglobin when H⁺ binds</i>
2(c)(i)	<i>idea that</i> blood vessel X carries (oxygenated blood) at high pressure (to body tissues) ; A <i>ref. to</i> systemic circulation <i>any two from:</i> <i>difference</i> high proportion of elastic fibres (and low proportion of smooth muscle) ; <i>explanation</i> (elastic fibres allow X to) expand / stretch, qualified ; e.g. to accommodate / AW, blood from ventricular, systole / contraction with, surges / pulses, of blood leaving heart to prevent, bursting / rupture recoil of elastic fibres, detail ; e.g. to allow surges / pulses, to continue <i>idea of</i> allowing continued flow of blood to tissues maintains, onward pressure / high pressure of blood <i>if no marks gained in this section allow one mark for:</i> <i>stretch and recoil with one detail</i> or <i>ref. to two correct details but stretch and recoil not stated</i>

2(c)(ii)	<i>allow, impulses / wave of excitation, for electrical impulses</i> R nerve impulses <i>once and allow ecf must attempt AVN and Purkyne tissue to gain max</i> <i>any four from:</i> both involved in, co-ordination / control, of, systole / contraction, of, heart / heart muscle / cardiac muscle / ventricles ; AVN only pathway for impulses to travel from atria to ventricles ; AW A impulses must pass through AVN for ventricular, contraction / systole allow, a delay / 0.1 s, for impulse to pass from atria to ventricles ; so, ventricles contract after atria contract / ventricular systole occurs after atrial systole ; allows atria to (fully) empty before, ventricles (begin to) contract / ventricular systole or allows blood to fill ventricles before ventricular, contraction / systole ; <i>Purkyne tissue</i> carries / transmits / AW, impulse(s), (down septum), to base of ventricles / through walls of the ventricles ; for ventricular systole / AW ; ventricular muscles contract / AW, together / at same time / simultaneously / from the base upwards / from apex of heart ;
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6(a)	- consider <u>all</u> mps to award if response clearly addresses events in the left side - mps 1,2,6,7,8 must be in the context of the left side of the heart - otherwise allow mp 3, 4, and 5 to max 3 – these mark points are inset to the right any five from: 1 blood enters (heart) via / in, pulmonary vein(s) ; 2 blood exits heart to aorta ; R aorta 3 blood flows from atrium to ventricle ; 4 atrial, systole / contraction, then, ventricular, systole / contraction ; A atrium contracts then ventricle contracts 5 pressure in ventricle, increases / gets higher ; I high pressure 6 bicuspid / (left) atrioventricular valve closes ; A mitral valve R if in context of events in the atrium 7 semilunar / aortic, valve opens ; ecf from aorta in mp 2 R if in context of events in the atrium 8 bicuspid / (left) atrioventricular, valve closes when (blood) pressure in ventricle higher than atrium or semilunar / aortic, valve opens when (blood) pressure in ventricle higher than aorta ; A aortic valve
6(b)(i)	if no marks gained allow one mark for four, polypeptides / polypeptide chains two, (identical) alpha / α, chains / globins, <u>and</u> two, (identical) beta / β, chains / globins ; A subunits / polypeptides, for chains R beta-pleated sheets / globulin plus one from; each, chain / globin / polypeptide, incorporates / contains / AW, a <u>haem</u> (group) ; A four haem groups A molecule for polypeptide if mp1 gained A ferrous ion / Fe^{2+} / iron (ion / atom), within porphyrin (ring) for haem group A prosthetic group with, ferrous ion / Fe^{2+} / iron (ion / atom) hydrogen bonds / hydrophobic interactions / ionic bonds, between, chains / polypeptides / globins ; context is <i>interactions between chains</i> R if disulfide bond also stated
6(b)(ii)	oxygen binds to, iron ion / ferrous ion / Fe^{2+} ; A oxygen bonds / oxygen forms a bond, <i>only if</i>, iron ion / ferrous ion / Fe^{2+} stated A oxygen binds to, iron / iron atom / haem (group) R if more than one oxygen molecule binds to one iron ion detail of saturated ; e.g. total of 4 oxygen molecules / 8 oxygen atoms (bind per haemoglobin molecule) each, chain / globin / polypeptide, binds one oxygen molecule R bonds <i>ref. to cooperative binding / allostery</i> A description <i>ref. to</i> (fully saturated molecule is) in, high partial pressures of oxygen / high concentration of oxygen ; <i>ref. to</i> T / tense, state to, R / relaxed, state