**AS Circulation test – mark scheme**

**1.** **(a)** Carriage of oxygen;
production of antibodies/killer cells (cell-mediated immunity);
engulfing of foreign material/phagocytosis;
blood clotting; [4]

**(b)** **Any two from**
- transport of cell suspension
- transport of carbon dioxide
- transport of urea
- transport of products of digestion
- transport of ions
- transport of hormones
- transport of antibodies
- distribution of heat around the body
- contains chemicals involved in blood clotting process
- formation of tissue fluid
- carries plasma proteins [2]

**2.** **(a)** 0.1 second;
at that point the pressure in the ventricle exceeds that in the atrium; [2]

**(b)** 0.4 second;
at that point the pressure in the aorta exceeds that in the ventricle; [2]

**(c)** **Any two from**
- immediate increase in pressure as the bicuspid valve bulges into atrium (reducing volume)
- atrial pressure drops as blood is forced out of the heart (ventricle)/ continued atrial diastole
- atrial pressure increases (after 0.2 s) as blood is returned to the atrium (from veins) [2]

**(d)** Low pressure required in pulmonary circulation to prevent fluid accumulating in the alveoli (and the individual drowning);
high pressure required in the body circulation to ensure the formation of tissue fluid (and ultrafiltration in the kidneys);
**or**
**Any two from**
- the left ventricle is much more muscular than the right ventricle
- since it must pump blood to the body
- while the right ventricle pumps blood to the neighbouring lungs [2]

**3.** **(a)** Myogenic means that contraction is initiated within the heart muscle itself/ takes place without nervous/hormonal stimulation; [1]

**(b)** **(i)** Zero (or just after) to 0.12 s/initial tenth of a second (estimated); [1]

**(ii)** The valves are non-conducting/connective tissue between the atria and the ventricles is insulating; [1]

**(iii)** Impulses pass down the septum (in the bundle of His) and then up the Purkinje (Purkyne) fibres in the walls of the ventricles; [1]

**(iv)** The ventricles contract from the bottom up and so force blood more readily into the major arteries; [1]

**4.** **(a)** Shrew: 4.8 kPa;
Human: 2.4 kPa; [2]

**(b)** The shrew haemoglobin releases oxygen (dissociates) more readily/at a higher $ppO_2$;
satisfies the large oxygen requirement for high rate of respiration; [2]

**(c)** When respiration increases;
the $ppO_2$ decreases/$ppCO_2$ increases/pH decreases/temperature increases; [2]

**5.** **(a)** Atrioventricular valves are open/atria are not contracting/semi-lunar valves are closed; [1]

**(b)** X positioned at top-left of the diagram; [1]

**(c)** A: AVN/atrio-ventricular node;
B: bundle of His/Purkinje tissue; [2]

**(d)** The atria must contract before the ventricles;
to ensure that blood leaves the atria/enters the ventricles; [2]

**(e)** **Any two from**
- ventricular contraction will drive the blood up
- towards the major arteries for blood to exit the heart
- ensure complete emptying [2]

6. **(a)** Small intestine/ileum/gut; [1]

**(b)** Aorta; [1]

**(c)** The right atrium; [1]

7. **8 Ten points (with at least three from each part)**

**Haemoglobin:**

- haemoglobin is a conjugated/quaternary protein (with haem/iron groups capable of carrying oxygen)
- each haemoglobin molecule can carry four oxygen molecules
- red blood cells are packed with haemoglobin
- haemoglobin exhibits co-operative binding of oxygen/when first oxygen binds the polypeptide chains open up exposing other three haem groups/sigmoid shaped oxygen dissociation curve
- in the lungs, where the partial pressure of oxygen is high, almost all the haemoglobin is carrying oxygen/is in the form of oxyhaemoglobin
- (in actively metabolising tissues) where oxygen is consumed, oxyhaemoglobin dissociates, releasing oxygen
- the first oxygen is not readily released, but once it is other oxygen molecules unload more readily
- at higher carbon dioxide partial pressures, more oxygen will be released by oxyhaemoglobin/less oxygen will remain attached to the haemoglobin, the Bohr effect/oxygen dissociation moves to the right
- its significance is that actively respiring tissue (such as exercising muscle) will increase the carbon dioxide partial pressure which, in turn, will promote the release of more oxygen
- the Bohr effect is caused by carbon dioxide combining with the haemoglobin and bringing about a change in structure which means that it loses some affinity for oxygen
- localised increase in temperature, also a product of actively respiring tissue (such as exercising muscle), will cause the oxygen dissociation curve to move to the right

**Myoglobin:**

- myoglobin is a conjugated protein with haem groups capable of carrying oxygen
- each myoglobin molecule can carry one oxygen molecule
- red muscle contains myoglobin
- myoglobin has a much higher affinity for oxygen/taking oxygen from oxyhaemoglobin
- at low oxygen partial pressures (while haemoglobin might be mostly dissociated), myoglobin is still well saturated/the dissociation curve lies well to the left
- myoglobin only dissociates when the oxygen partial pressure reaches very low levels
- such as happens during strenuous exercise
- essentially myoglobin acts as an oxygen reserve in muscle tissue
- maintians aerobic respiration for longer [10]