

8 (a) Give an account of the role of surface area and volume in the metabolism of an organism and the effect of increasing body size on the relationship between these two factors. [5]

(b) Using the lungs and the blood system as examples, explain how mammals have compensated for increasing body size. [8]

Quality of written communication [2]

8 (a) **Any five points**

- the volume of a body represents the bulk of its metabolically active tissue
- the greater the volume, the greater the need for metabolites/the greater the production of wastes (allow converse)
- metabolites are usually supplied by the surrounding environment
- the surface of a body is the interface with its surrounding environment
- the greater the surface area of a body the more metabolites can be absorbed/wastes can be excreted
- as an organism increases in size its volume increases proportionally more than its surface area/its SA to vol. ratios decreases (allow converse)
- illustration of this with 'cube measurements'
- for a larger organism, the absorptive ability needs to be increased to meet the increased demand [5]

(b) **Eight points (with a maximum five points from each area)**

Maximising absorption in lungs

- in the lungs the bronchi subdivide repeatedly into smaller bronchioles (each ending in a cluster of alveoli)
- the alveoli provide a large surface area for gas exchange
- the alveolar walls/capillary walls are composed of squamous epithelium
- which makes a short diffusion distance
- capillary walls are closely associated with alveolar walls
- ventilation/blood flow ensures there is always a diffusion gradient
- moisture inside the alveoli allows oxygen to dissolve prior to diffusion
- a dense network (large surface) of blood capillaries (surrounding each alveolus) provides a large surface area

Maximising delivery to tissues

- arteries deliver blood carrying oxygen/nutrients to the metabolically active cells
- arteries divide into a dense network of blood capillaries that permeate all tissues
- so that no body cell is more than a couple of cells away from a capillary
- capillary walls are very thin so that diffusion is easy
- there is a large surface area over which metabolites can diffuse rapidly into all cells/over which wastes can be removed from tissues
- red blood cells are biconcave discs increasing surface area (exposed to haemoglobin)
- haemoglobin is an efficient carrier of oxygen/has a high affinity for O₂
- the heart pumps blood to all tissues (parts of body)
- benefits of double circulation
- vasoconstriction/vasodilation controls blood flow to different organs [8]