**1.** C

[1]

**2.** D

[1]

**3.** *ventilation (is):* ***[2 max]***movement of air;  
movement in and out of the lungs;  
caused by muscles;  
an active process;  
involves mass flow / involves flow along air passages;

*gas exchange (is):* ***[2 max]***movement of carbon dioxide and oxygen;  
(occurs when) oxygen moves from lungs /   
alveoli to red blood cells / carbon dioxide  
moves to lungs / alveoli from red blood cells;  
(occurs when) oxygen moves from red blood cells to tissues /   
carbon dioxide moves to red blood cells from tissues;  
a passive process / diffusion;  
takes place across a surface;

[4]

**4.** (a) carbon dioxide is carried in three forms in the blood;  
carbon dioxide can be dissolved in the blood / plasma;  
carried as dissociated carbonic acid / H2CO3 / H+H2 CO3–;  
carried as carbaminohemoglobin / bound to hemoglobin;  
carbonic anhydrase found in red blood cells / erythrocytes;  
carbonic anhydrase speeds up production of hydrogen carbonate /   
bicarbonate / H CO3–;  
chloride shift / movement of chloride ions into red  
blood cell / erythrocyte occurs to balance movement of hydrogen carbonate /   
bicarbonate / H CO3– ion movement out;

[4]

**5.** *Diagrams are acceptable provided they are adequately annotated*.  
initial uptake of one oxygen molecule by hemoglobin  
facilitates the further uptake  
of oxygen molecules / hemoglobin has an increasing affinity  
for oxygen / and vice versa;  
shows how the saturation of hemoglobin with oxygen  
varies with partial pressure of oxygen /   
dissociation curve for (oxy)hemoglobin is S / sigmoid-shaped;  
low partial pressure of oxygen corresponds to the situation in the tissue;  
when partial pressure of oxygen is low, oxygen released;  
high partial pressure of oxygen corresponds to the situation in the lungs;  
when partial pressure of oxygen is high, oxygen taken up by hemoglobin;  
Bohr effect occurs when there is lower pH / increased carbon dioxide /   
increased lactic acid;  
shifts the curve to the right;  
oxygen more readily releases to (respiring) tissue;

[6]

**6.** (a) 93% ± 1% 1

(b) (i) increases by 0.63 mmol l–1 of blood /   
rises from 15.59 to 16.22 mmol l–1 1

(ii) dissolved CO2 1

(c) CO2 makes the blood more acidic and the pH drops;  
pH of venous blood at rest has decreased compared to arterial blood;  
because the blood is carrying waste CO2  
(from cellular respiration) back to lungs for removal;  
pH of venous blood after exercise has decreased  
compared to arterial blood;  
and dropped even further than venous blood at rest;  
because the blood is carrying more waste CO2  
than normal due to exercise; 3 max

[6]

**7.** oxygen is becoming limited;  
CO2 concentration builds up in blood;  
lactic acid builds up in blood;  
lowers blood pH;  
chemosensors detect lowered pH;  
sensors in carotid artery / aorta;  
send impulses to breathing centre / brain stem;  
impulse sent to diaphragm;  
impulse sent to intercostal muscles;  
increases / decreases rate of breathing /   
contraction / relaxation of muscles;  
involuntary control;  
breathing rate increases to remove more CO2 from blood / lungs;

[9]