**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]