

**QUESTIONSHEET 1**

- (a) (i) mean increase in pulse rate = 35.4, mean pulse rate = 72;

$$= \frac{35.4 \times 100}{72} = 49.2 \% ;$$

2

- (ii) additional activity/use of muscle uses more energy;  
respiration increases to supply additional energy/ATP;  
increased circulation supplies additional oxygen/glucose;  
removes carbon dioxide/heat/lactic acid; **max 3**
- (b) (i) regular exercise improves heart performance/efficiency;  
increased heart force/stronger beat/greater stroke volume;  
more blood circulates per beat so rate falls;  
muscles work more efficiently so require less O<sub>2</sub>/glucose; **max 3**
- (ii) less force/contraction needed to circulate blood at lower pressure/reduces load on heart muscle; **1**

**TOTAL 9****QUESTIONSHEET 2**

- (a) (i) muscle contraction requires more ATP;  
produced by oxidative phosphorylation;  
aerobic respiration/respiratory chain/electron transport chain require more oxygen; **max 2**
- (ii) must restore oxygen debt;  
by re-oxidising accumulated lactic acid;  
oxygen content of haemoglobin/myoglobin is restored;  
ATP/creatine phosphate stores built up;  
increased temperature causes increased metabolic rate; **max 3**
- (b) increased diameter of fibres;  
increased number of fibres;  
increased number/size of mitochondria;  
increased stores of creatine phosphate/glycogen;  
increased myoglobin concentration;  
increased number of blood vessels/increased vascularisation; **max 3**

**TOTAL 8**

**QUESTIONSHEET 3**

- (a) (i) cardiac output = heart rate x stroke volume;  
both heart rate and stroke volume increase;  
vasodilatation of coronary arteries;  
allows increased contractability of cardiac muscle;  
increased return of blood from veins/means more blood must be pumped out/ref cardiac output = venous return  
/ref to law of the heart; **max 3**
- (ii) exercising muscles/contraction require more oxygen/glucose;  
for aerobic respiration/to produce ATP;  
blood carries oxygen/glucose to muscles; **max 2**
- (b) greater production/blood content of lactic acid/HCO<sub>3</sub><sup>-</sup> / CO<sub>2</sub>;  
due to increased muscle respiration;  
ref oxygen debt resulting in lactic acid formation; **max 2**
- TOTAL 7**
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**QUESTIONSHEET 4**

- (a) exercise caused increased temperature (which shifts curve to the right);  
increased CO<sub>2</sub> concentration at tissue level (due to greater respiration);  
decreased CO<sub>2</sub> concentration at alveolar level (due to faster/deeper breathing);  
causes shifts in blood pH/Bohr shift/to pH 7.6 in lungs/pH 7.2 in tissues;  
(thus) curve moves to the right in tissues/to the left in lungs; **max 3**
- (b) in the tissues/at any partial pressure O<sub>2</sub> haemoglobin now less saturated/blood releases more oxygen;  
enables tissues to resume/continue aerobic respiration/carries out faster respiration;  
to produce ATP quicker;  
to allow greater muscle activity/contraction;  
ref greater uptake of O<sub>2</sub> (by haemoglobin) at alveolar level; **max 4**
- TOTAL 7**
- 

**QUESTIONSHEET 5**

- (a) (i) the volume of blood (in cm<sup>3</sup>) pumped out of the heart/ventricles in one beat/ventricular contraction; **1**
- (ii) the volume of blood (in dm<sup>3</sup>) pumped out of the heart/ventricles per minute; **1**
- (b) (i) cardiac output = 90 x 109;  
= 9.81 dm<sup>3</sup> min<sup>-1</sup> ; **2**
- (ii) cardiac output must be equal to the venous return;  
otherwise heartbeat is inefficient/not pumping out all the blood received;  
or blood is being held up/dammed in the circulation; **max 2**
- (c) cardiac efficiency greater in athlete/converse;  
training develops more/stronger cardiac muscle/converse;  
coronary circulation becomes more efficient in athlete/no plaques/reductions in arteriole diameter due to lipid deposits/converse;  
more efficient ventilation/breathing in athlete means CO<sub>2</sub> chemoreceptors do not increase cardiac output as much (by  
negative feedback); **max 3**
- TOTAL 9**

**QUESTIONSHEET 6**

- (a) fat; 1
- (b) (i) liver; 2  
 muscles;
- (ii) branched polymer of many glucose units;  
 breakdown/hydrolysis to many single glucose molecules is rapid;  
 especially of end chain glucoses;  
 rapid respiration of glucose to yield ATP; max 3
- (c) (i) percentage of energy supplied by fat increases with time; 1
- (ii) contains more H-C-H bonds/more high energy bonds;  
 glycogen has a core of indigestible (limit) dextrin which cannot be respired easily/complete fat  
 /triglyceride molecules can be respired; 2
- TOTAL 9**
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**QUESTIONSHEET 7**

- (a) energy use each day should balance energy intake;  
 excess carbohydrate intake, if not used for energy will be converted to fat and stored;  
 excess protein/amino acid intake will be deaminated and the CHO components/residues will be respired for energy/converted to fat  
 and stored;  
 excess fat intake, if not used for energy will be stored;  
 exercise should be used to ensure that daily energy use exceeds (or equals) intake/used to prevent development of obesity/heart  
 disease/equivalent statement; max 4
- (b) excess dietary fat will be stored and this could lead to obesity;  
 saturated fatty acids tend to stimulate (blood) cholesterol levels;  
 raised blood cholesterol levels are associated with the laying down of fat in arterioles/  
 development of (atheromatous) plaque;  
 vegetable fats/oils tend to contain less saturated fatty acids/fat compared to animal products;  
 ref HDL/high density lipids and LDL/low density lipids;  
 HDL (good cholesterol/unsaturated fats) will tend to reduce blood levels of LDL (bad cholesterol/saturated fat); max 4
- (c) excess sugar/glucose, if not respired for energy will be converted to fat and stored;  
 sugar/glucose has to be released from starch/glycogen by digestion (before it is available);  
 digestion is not 100% efficient/some glucose from complex carbohydrate remains unavailable;  
 cellulose/pectins cannot be digested and make up dietary fibre;  
 reduces risk of constipation/diverticulosis/ulcerative colitis/cancer of the colon/enhances formation/removal of faeces/  
 slows down fat absorption; max 4

**TOTAL 12**

**QUESTIONSHEET 8**

- (a) creatine phosphate releases energy immediately/most quickly;  
 releases most energy/correct ref to figures/but supply used up by 28 seconds(allow 28 –30);  
 anaerobic glycolysis releases energy next/energy release peaks at 10 seconds/ceases by 40 seconds;  
 only releases about half as much energy as creatine phosphate/correct ref to figures;  
 aerobic oxidative phosphorylation releases energy continuously;  
 increases release gradually/reaches a plateau at 70 seconds/peak rate of release less than the other mechanisms/correct ref to figures;  
**max 4**
- (b) (i) creatine phosphate accumulated from ATP /ATP + creatine → ADP + creatine phosphate;  
 during rest;  
 (at the start of contraction) stored creatine phosphate reacts with ADP to yield ATP;  
**max 2**
- (ii) (anaerobic) glycolysis yields ATP and lactic acid;  
 from oxidation of glucose/glycogen;  
 ATP produced directly, not via respiratory chain/electron transport chain/coenzymes;  
 when 1,3-diphosphoglyceric acid forms 3-phosphoglyceric acid;  
 only yields a net gain of 2ATP per glucose molecule;  
**max 3**
- (iii) oxidative phosphorylation is coupled to the respiratory chain/electron transport chain;  
 which is fed by reduced coenzymes from glycolysis/Krebs cycle;  
 coenzymes are reoxidised for reuse using oxygen;  
 at this stage energy is conserved/trapped in ATP;  
 glycolysis uses glucose/glycogen as substrate/Krebs cycle uses acetyl-coenzyme A produced by (aerobic) glycolysis;  
**max 3**
- (c) ref to long diffusion gradient for oxygen into muscle/syncytial structure of muscle fibre results in long diffusion gradient;  
 (thus) in continuous/severe exercise muscle cannot get oxygen quickly enough to maintain the respiratory/electron transport chain;  
 thus only glycolysis can continue, but anaerobically;  
 resulting in the production of much lactic acid;  
 this can make the pH of the fibre too acid to allow further metabolism/work/contraction/causes fatigue/pain;  
 oxygen debt is the volume of oxygen deficient/volume required to allow oxidation of lactic acid;  
**max 4**

**TOTAL 16****QUESTIONSHEET 9**

- (a) true;  
 creatine phosphate will all have been changed to creatine, yielding ATP;  
**2**
- (b) true;  
 lactic acid is produced in muscle during anaerobic glycolysis/oxygen debt;  
 some lactic acid leaks out of the muscle into blood thus increasing blood acidity;  
**3**
- (c) false;  
 it would reach a plateau and result in an oxygen debt ;  
**2**
- (d) false;  
 glycogen cannot be transported, but liver glycogen may yield glucose which could be used (in the muscle);  
**2**
- (e) true;  
 (HCO<sub>3</sub><sup>-</sup>) chemoreceptors in carotid/aortic bodies/medulla sense that HCO<sub>3</sub><sup>-</sup> tension is still raised/high;  
 (thus) continue to stimulate ventilation/heart until levels return to norm/mean/resting values;  
**max 3**

**TOTAL 12**



**QUESTIONSHEET 12**

- (a) (i) oxygen carried by haemoglobin/red blood cells;  
 volume of oxygen carried could be reduced by anaemia/reduced red cell counts;  
 volume of oxygen carried could be reduced by acidosis/ref Bohr shift of haemoglobin dissociation curve to the right/acidosis due to lactic acid build up;  
 volume of oxygen carried could be increased by raised red blood cell counts/raised haemoglobin content;  
 ref effect of altitude/increased erythropoietin raising red cell counts;  
 renal disease causing reduced erythropoietin resulting in anaemia; **max 4**
- (ii) cardiac output in litres per minute/dm<sup>3</sup> min<sup>-1</sup>;  
 = pulse rate in beats per minute multiplied by stroke volume in cm<sup>3</sup> per beat;  
 increased cardiac output pumps more blood to lungs for oxygenation/more blood to tissues to supply oxygen;  
 regular exercise/training will increase (the upper limit of ) cardiac output (allowing more oxygen to be carried to the tissues per minute);  
 well trained athletes can achieve higher cardiac outputs than sedentary individuals; **max 4**
- (iii) the larger the mass of exercising muscle the greater the (possible) use of oxygen;  
 ref to regular exercise causing an increased mass of active skeletal muscle;  
 ref to different muscle fibre types/type 1 or slow twitch type/type 2 or fast twitch type;  
 slow twitch fibres have many mitochondria/oxidative enzymes/associated capillaries and extract much oxygen from blood (for aerobic respiration);  
 fast twitch fibres are more adapted for ATP synthesis by anaerobic glycolysis (and so use less oxygen);  
 (give credit to answers which also distinguish the different types of fast twitch fibres) **max 4**
- (b) (i) women generally have less muscle mass than men and so consume less oxygen;  
 women have lower mean red blood cell counts than men and so their blood transports less oxygen; **2**
- (ii) athlete will develop a greater (working) muscle mass than a non-exercising man and so will consume more oxygen;  
 blood supply to athlete's muscles will be more developed/more efficient/have more capillaries; **2**

**TOTAL 16**