**Q1.** (a)     1.      Phosphorylation of glucose using ATP;

2.      Oxidation of triose phosphate to pyruvate;

*Accept removal of hydrogen from triose phosphate for oxidation.*

3.      Net gain of ATP;

*Accept any description that indicates a net gain e.g., 4 produced, 2 used.*

4.      NAD reduced;

*Accept NADH/NADH2/NADH + H+ produced.*

*Accept all mark points in diagrams.* **4 max**

(b)     1.      Less/no reduced NAD/coenzymes

**OR**

Fewer/no hydrogens/electrons removed (and passed to electron transfer chain);

*Accept less/no FAD reduced.*

2.      Oxygen is the final/terminal (electron) acceptor; **2** **[6]**

**Q2.** (a)     Electrons transferred down electron transport chain;

Provide energy to take protons / H+ into space between membranes;

Protons / H+ pass back, through membrane / into matrix / through  
ATPase;

Energy used to combine ADP and phosphate / to produce ATP;

*Accept: alternatives for electron transport chain.* **3 max**

(b)     (i)      Prevent damage to mitochondria caused by  
water / osmosis / differences in water potential;

*Accept: other terms that imply damage e.g. shrink / burst*

**1**

(ii)     Glucose is used / broken down during glycolysis in cytoplasm / not in mitochondria;

*Accept: ‘glucose is converted to pyruvate’ for description of breakdown*

Glucose cannot cross mitochondrial membrane / does not  
enter mitochondria;

*Accept: only pyruvate can*

**2**

(iii)    Terminal / final acceptor (in electron transport chain) / used to  
make water;

*Could be shown by symbols*

**1**

**[7]**

**Q3.** (a)     (i)      Cytoplasm/cytosol;

**1**

(ii)     1.      Regenerates/produces NAD / oxidises reduced NAD;

2.       NAD reduced in stage 1/glycolysis / NAD accepts hydrogen in stage 1/glycolysis;

*Note: penalise use of NADP for first marking point obtained.*

*Do not accept NAD accepts only protons but allow accepts protons and electrons.*

**2**

(b)     (i)     1/one/1.0;

**1**

(ii)     1.      Aerobic and anaerobic respiration occurring;

*Accept: some/mainly anaerobic respiration occurring.*

2.      More carbon dioxide produced than oxygen uptake;

**2**

(c)     1.      Oxygen is final/terminal (electron) acceptor / oxygen combines with electrons and protons;

2.      (Aerobic respiration) oxidative phosphorylation / electron transfer chain;

3.      Anaerobic (respiration) only glycolysis occurs / no Krebs / no link reaction;

*Ignore: number of ATP produced.*

*3. Accept: without oxygen.*

*3. Ignore: converse.* **2 max****[8]**

**Q4.** (a)

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Glycolysis** | **Link reaction** | **Krebs cycle** |
| Occurs in mitochondria |  | √ | √ |
| Carbon dioxide produced |  | √ | √ |
| NAD is reduced | √ | √ | √ |

Mark horizontally

**3**

(b)     (i)      1.      Glucose is used / broken down during glycolysis / in cytoplasm;

*1. Accept: glucose to pyruvate or glucose not converted to pyruvate for one mark*

2.      Glucose cannot cross mitochondrial membrane(s) / pyruvate can cross mitochondrial membrane(s);

**2**

(ii)     1.      Is a competitive inhibitor / attaches to active site;

*1 Accept: inhibitor / malonate attaches to active site to form an enzyme-substrate complex*

2.      Reduces / prevents enzyme-substrate / E-S complex forming;

*2 Accept: substrate / succinate cannot bind to enzyme*

*2 Accept mark point 2, but not mp1 in context of non-competitive inhibition*

**2**

(iii)    1.      Krebs cycle inhibited as NAD / Coenzyme / FAD not / less reduced;

2.      Hydrogens not passed to ETC therefore oxygen not used as (much as a) final / terminal (electron) acceptor;

**2**

**[9]**

**Q5.** (a)     1.      No aerobic respiration / electron transfer / oxidative phosphorylation;

*Reject reference to anaerobic respiration.*

2.      (Because) no (respiratory) substrate / nothing to respire;

*Reject idea of ‘little’ or ‘less’ − this would result in a change in oxygen concentration.*

*Accept the idea of no residual respiratory substrate in the mitochondria.*

**2**

(b)     (i)      (Oxygen concentration falls because)

1.      Aerobic respiration (uses oxygen);

*Accept ‘oxidative phosphorylation / electron transfer takes place’.*

2.      Oxygen is terminal / electron acceptor;

3.      (oxygen combines with) protons / H+ **and** electrons / e- **to form** water / H2O;

*All aspects are required to gain mark.*

**2 max**

(ii)     Phosphate (ions) / inorganic phosphate / PI;

*Reject ‘phosphorus’ or ‘P’.*

*Accept ‘PO4’.*

**1**

(c)     1.      Oxygen concentration continues to fall in plants but stays constant  
         in animals;

*For ‘plants’ accept ‘line R to T’, for ‘animals’ accept ‘line R to S’.*

*MP1 and MP2. Accept answers in terms of ‘use’ of oxygen rather than change in concentration.*

2.      (Oxygen concentration) falls more slowly in plants than before  
          cyanide added;

3.      (Because aerobic) respiration continues in plant (mitochondria);

*Accept (because aerobic) respiration stops in animal (mitochondria).*

4.      (Because) electron transfer / oxidative phosphorylation continues in plant (mitochondria);

*Accept (because) electron transfer stops in animal (mitochondria).*

*Accept for* ***one additional mark***

*(up to 4 max) use of Resource A i.e: idea that plant cytochrome oxidase is (more) resistant to cyanide*

*OR*

*idea that animal cytochrome oxidase not resistant to cyanide.*

**4**

**[9]**

**Q6.** (a)     (So the) oxygen is used/absorbed/respired;

**1**

(b)     1.      Anaerobic respiration produces carbon dioxide;

2.      Increase in pressure/volume (of gas);

*Reference to either volume or pressure required for the mark*

**2**

(c)     1.      Correct answer in range of

4.9 × 10–4 to 4.91 × 10–4 = **2 marks**;;

*Accept any equivalent mathematical representation of this answer*

2.      Incorrect answer buts shows division by 24 = **1 mark**

**OR**

Incorrect answer but shows a number from 1175 to 1178 (ignore position of decimal point, standard form and any numbers that follow) = **1 mark**;

**OR**

Incorrect answer but show the number 49 (ignore position of decimal point, standard form and any numbers after 49) = **1 mark**;

**2**

(d)     Large range/difference/increase in numbers;

*Accept reference to exponential (increase)*

*Ignore if the answer only refers to numbers being high*

*Ignore to ‘fit on the scale’*

**1**

(e)     Decrease/no glucose/substrate

**OR**

Increase in ethanol/carbon dioxide/acidity;

*Accept decrease/no oxygen as* ***Figure 2*** *is not linked to* ***Figure 1****.*

*Accept competition for glucose/oxygen.*

*Accept any named sugar*

*Accept decrease in pH*

*Accept increase in toxins*

*Ignore food/nutrients*

**1**

(f)      1.      Correct answer of 298000 or 297766 or 297765.59 or 296826 = **2 marks**;;

*Accept: any equivalent answer with appropriate rounding*

*e.g. 2.98 × 105,*

*29.78 × 104 etc.*

2.      Incorrect answer but working shows 2000 × 2.72 = **1 mark**;

**OR**

Incorrect answer but working shows 2.720.5 × 10 / 2.725 / e0.5 × 10 / = **1 mark**

**2**

**[9]**

**Q7.** (a)     1.      Equilibrium reached.

*Accept equilibrate*

2.      Allow for expansion / pressure change in apparatus;

3.      Allow respiration rate of seeds to stabilise.

*Ignore seeds acclimatise*

**3**

(b)     1.      Optimum temperature / temperature for normal growth of seeds;

2.      (Optimum temperature) for enzymes involved in respiration.

**2**

(c)     1.      Oxygen taken up / used by seeds;

2.      CO2 given out is absorbed by KOH (solution);

3.      Volume / pressure (in **B**) decreases.

**3**

(d)     0.975 / 0.98.

*If incorrect,*

*0.26 × 6 / or incorrect numbers divided by 1.6 for 1 mark*

**2**

**[10]**