GCSE
BIOLOGY
AQA - COMBINED SCIENCE
MARK SCHEME

B4
PHOTOSYNTHESIS & RESPIRATION
TEST 1
Mark schemes

(a) 

(b) any one from:
- not enough oxygen present (for aerobic respiration)
- more energy required for exercise (than can be transferred by aerobic respiration)

allow named example for exercise

(c) produces carbon dioxide

produces ethanol

plus any two from:
- (carbon dioxide) makes bread rise
- (carbon dioxide) makes beer / cider / (some) wines fizzy
  allow for alcoholic drinks / named drink
- (ethanol) is the alcohol in beer / cider / wine / spirits

(b) carbon dioxide

ignore formulae
ignore carbon oxide
do not accept carbon monoxide
(c) 46.2 (kg)  
\[\text{allow 46 (kg)}\]

(d) (fossil / hydrocarbon) fuels burn / combust  
\[\text{allow named fossil fuels}\]

in a limited supply of oxygen / air  
\[\text{allow lack of oxygen / air}\]

\textit{an answer of incomplete combustion gains 2 marks}

(e) red blood cells

(f) cell death

\text{decreased respiration rate}

(g) any one from:

\textit{ignore breathing problems}

- damages buildings / bridges / statues  
  \[\text{allow damages iron / metal / limestone structures}\]

- harms / kills plants / trees

- harms living organisms in ponds / rivers / lakes  
  \[\text{allow harms aquatic organisms}\]

(a) glucose  
\text{oxygen}

\textit{extra ticks negates marks}

(b) count the number of bubbles produced in 1 minute

measure the volume of gas produced in 30 seconds

\textit{extra ticks negates marks}
(c) any one from:
• to control the temperature
  allow so pondweed / solution did not warm up
• temperature affects the rate of photosynthesis
  allow correct description of effect of temperature on rate
  allow high temperatures denature enzymes
  ignore references to limiting factors
  ignore reference to 'it'

(d) 52

(e) all points plotted correctly
  allow ± ½ a square
  allow 1 mark for three points correctly plotted
  smooth curve drawn through all points
  ignore extensions of line / curve unless inconsistent with line / curve drawn
  (where a bar chart has been plotted)
  allow 1 mark for all bars plotted correctly
  if points are plotted as well as bars, ignore bars

(f) any one from:
• the nearer the light source to the pondweed the faster the rate of photosynthesis
  allow the nearer the light source to the pondweed the faster the bubbles produced
• the greater the light intensity the faster the rate of photosynthesis
  allow the greater the light intensity the faster the bubbles produced
  allow the closer the light source the more the plant photosynthesises
  ignore more bubbles are produced with no reference to rate
  allow oxygen for bubbles
  do not accept carbon dioxide
  allow converse statements for all marking points
(a) any two from:
- amino acids
- glycerol
- fatty acids

do not accept fat
allow salt / minerals
allow vitamins

(b) 11.79 (g)

allow 11.8 (g) or 12 (g)

(c) Level 3: Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.

Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.

Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.

No relevant content

Indicative content

- carbon dioxide enters the leaf through stomata
- glucose / sugars produced by photosynthesis (in leaves)
- some detail of photosynthesis
- transport / translocation (of glucose / sugars)
- in phloem
- glucose is converted to starch
- (starch is a) long chain of glucose / sugar molecules
- starch as storage (of glucose / sugars)

(a) temperature

carbon dioxide concentration

allow type of pondweed
allow mass of pondweed
(b) \( \frac{34 + 31 + 31}{3} = 32 \)

\( \text{allow 1 mark for} \)

\( \frac{22 + 34 + 31 + 31}{4} = 29.5 \)

\( \frac{32}{2(\text{min})} \)

= 16(.0) (bubbles per minute)

\( \text{allow ecf from incorrect mean} \)

(c) 2.3(333)

(d) place different coloured filters over the lamp bulb

or

use different coloured light bulbs

keep the lamp the same distance from the pondweed each time

(a) 36 000 (cm\(^3\))

(b) \( \frac{11600}{1200} \)

9.66666

\( \text{allow any number of decimals} \)

(c) muscles need more energy (for contraction)

(so) more oxygen / glucose needed

\( \text{need at least one reference to ‘more’ for full marks} \)

\( \text{allow so more carbon dioxide / thermal energy needs to be removed} \)

(for) increased respiration
Level 3: Relevant points (differences / functions) are identified, given in detail and linked logically to form a clear account.

Level 2: Relevant points (differences / functions) are identified and there are attempts at logical linking. The resulting account is not fully clear.

Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.

No relevant content

Indicative content

- artery has a thicker wall
- (because) artery has to withstand higher pressure
- artery has thicker layer of elastic tissue / fibres
- (so) it can stretch
- (so) artery returns to original size / shape
- artery has thicker layer of muscle
- to maintain a force on the blood
- vein has valves
- (valves) prevent backflow of blood
- artery carries blood away from the heart
- vein carries blood towards the heart

ignore references to oxygenated / deoxygenated blood

(a) any two from:

- synthesis of new molecules
  
  allow named molecule eg starch / glycogen / cellulose / lipids / fats / proteins / hormones / antibodies

- for active transport

- to keep warm (in mammals / birds)
  
  allow description
  
  allow to keep warm (in animals)
  
  allow for movement (in animals)
  
  allow for transmission of nerve impulses (in animals)
(b) mitochondria / mitochondrion

(c) both occur without oxygen

both release (a small amount of) energy

muscle cells produce lactic acid but plant cells produce ethanol

muscle cells do not produce carbon dioxide but plant cells do

marks can be awarded from correct word or balanced symbol equations

(d) the amount of oxygen needed to react with the lactic acid formed

allow the amount of oxygen needed to break down or oxidise the lactic acid

(a) \[6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2\]

(b) endothermic

(c) measure the volume of gas released

allow use a measuring cylinder / capillary tube / (gas) syringe

increase length of time

allow sensible length of time

allow video the investigation so you could re-count the bubbles later

allow repeat the measurement at each distance several times and calculate a mean

ignore references to using other distances
(d) temperature affects rate of photosynthesis
   or
temperature affects rate of bubble production
   
   allow correct description of effect of temperature on rate

   (because) reaction / photosynthesis is controlled by enzymes
   
   allow high temperatures denature enzymes
   enzymes being denatured must be linked to high temperature

(e) evidence of squaring for two distances that double:
   25 and 100
   or
   100 and 400

   calculate 1/d^2 for two distances that double:
   0.04 and 0.01
   or
   1/25 and 1/100
   or
   0.01 and 0.0025
   or
   1/100 and 1/400

   allow 2 marks for these calculations without working
   ignore calculations for a third distance as long as two
   where the distance doubles are correct

   (therefore as distance doubles) light intensity is quartered

(f) 2 (bubbles would be produced)

   (as) very little light / energy for photosynthesis to occur
   
   do not accept no light

   allow 2 marks for a quarter of the bubbles are produced
   as light distance doubles so 2 bubbles would be expected
(g) (independent variable)
use different concentrations of sodium hydrogencarbonate solution
  allow three concentration values
  ignore different concentrations of carbon dioxide

(control variables)
  max 2 marks for control variables

any two from:
  • distance from light source
    allow light intensity
    ignore light unqualified
    ignore same lamp
  • temperature of solution
  • same plant
    allow type / size of plant
  • time for plant to equilibrate
    allow time for plant to adjust to different solution
    ignore time unqualified

[14]