

**AQA, OCR, Edexcel**

**A Level**

# **A Level Biology**

**Gas Exchange, Transport, Circulation  
and Haemoglobin Answers**

Name:

**M**

**M**

**E**

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Total Marks:

- M1.(a)** Measure with eyepiece graticule / scale;  
Calibrate with stage micrometer / scale on slide / object of known size;  
Repeats and calculate the mean;  
**OR**  
Use a ruler to estimate the field diameter under microscope;  
How many droplets go across the field;  
Repeats and calculate mean;  
*Accept references to radius* 3
- (b) (i) Two mark for correct answer of 4 : 1;;  
One mark for incorrect answer but working shows that candidate has clearly attempted to compare values of  $r^2 / 6^2$  and  $3^2 / 36$  and 9;  
*Idea of comparing ratios*  
*A ratio of 1 : 4 should gain 1 mark* 2
- (ii) Small droplets have a larger surface area to volume ratio;  
More surface for lipase (to act), leading to faster digestion of triglycerides;  
Fatty acids are produced more quickly so pH will drop more quickly in curve Y / with bile salts / less fatty acids in curve Z / without bile salts so pH drop more slowly; 3
- M2.(a)** C. *Ignore name of organ* 1
- (b) E. *Ignore name of organ* 1
- (c) 1. Active site (of enzyme) has (specific) shape / tertiary structure / active site complementary to substrate / maltose;  
*Reject active site on substrate.*  
*Must have idea of shape*  
*Assume "it" = maltase*  
*Accept (specific) 3D active site*  
*Reject has same shape*
2. (Only) maltose can bind / fit;  
*Accept "substrate" for "maltose"*
3. To form enzyme substrate complex.  
*Accept E-S complex* 3 [5]
- M3.** (a) Two marks for correct answer of 64.285 / 64.3 / 64;  
*(allow 1 mark for (8100 / 100 x 30) / 37.8)* 2
- (b) dissolve in / add ethanol then mix with water;  
emulsion / white colour indicates triglycerides present; 2
- (c) (i) increase the surface area for absorption; *(ignore wrong ref. to name)* 1
- (ii) **R** = tissue fluid / interstitial fluid / extracellular fluid / intercellular space;  
**S** = lymph(atic) vessel / lymph capillary / lacteal; 2
- (iii) proteins are synthesised by **U**;  
involvement of ribosomes;  
protein isolation / transport (inside RER);  
vesicle formation; 2 max

[8]

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- (iv) exocytosis / description of;  
because of size / too large to leave by other methods; 2 [11]

**M4.(a)** High sucrose / starch diet leads to increase in lactase activity; 1

- (b) Not valid / cannot be certain because overlap in SD between high sucrose and high starch;

Study based on rats (not human) so may not apply to human; 2 **3]**

**M5.** (a) (i) Through alveolar epithelium;

Through capillary epithelium / endothelium;

*Accept: Through lining / wall of alveolus and capillary for 1 mark*

*Accept: squamous epithelial cells for 'epithelium'*

*Neutral: alveolar endothelium*

*Neutral: references to diffusion*

**Q** Correct use of terminology; 2

- (ii) (Thicker alveolar wall) – no mark

*Neutral: less diffusion*

(So) Longer diffusion pathway / slower diffusion;

*Neutral: references to surface area* 1

- (b) (i) (In alveolus)

*Need the idea of air moving and oxygen concentration*

Brings in air containing a high(er) oxygen concentration;

*Neutral: reference to carbon dioxide concentration*

Removes air with a low(er) oxygen concentration; 2

- (ii) Circulation of blood / moving blood;

*Neutral: blood Neutral: short diffusion pathway* 1

- (c) Long time between decrease in mining and increase in cases;

Graph shows fluctuations;

Correlation does not prove causation / there may be other causes of miner's lung;

Improved diagnosis methods;

Do not know number of cases / baseline before 1990;

Not all cases reported / not all individuals with miner's lung visit a doctor;

*Accept: correct use of figures from graph for the first marking*

*point: e.g. cases do not increase until after 2000 / 2001-2004 / 10 years later.*

2 max

[8]

- M6.(a)**
1. Other gases / nitrogen / water vapour in atmosphere / **A**;
  2. Only oxygen and carbon dioxide in gas mixtures / **C** and **D**;
  3. Composition of / gases in **A** not controlled / composition of gas mixtures / **C** and **D** controlled.

2 max

- b)
1. Breathing rate *lowest* when no carbon dioxide / in (pure) oxygen / **B**;  
*Idea of 'lowest' must be stated.*
  2. (Generally) presence of carbon dioxide increases breathing rate / as concentration of carbon dioxide increases breathing rate increases / there is a positive correlation;  
*A general point incorporating all concentrations.*

3. Breathing rate increases when (carbon dioxide) higher than 0.1% / concentration in atmosphere / **A**;  
*This MP requires a specific comparison to 0.1% or the atmospheric concentration.*  
*Accept 'gas mixtures 1 and 2 / C and D' for 'higher carbon dioxide'.*
4. Breathing rate of **grasshopper 3** falls in **D** / 16% / gas mixture 2 (whereas others increase).  
*Restating data alone is insufficient for any mark point.*

3 max

- c) (i) 54;  
**OR**

1. Correct data / column **A** chosen;  
*A correct answer of 54 gets 2 marks.*  
*MP1 and MP2 allow a possible mark for an incorrect calculation or choice of wrong data.*
2. Correct calculation of mean from data chosen;  
*Check – the three values must be from same column.*      2 max

- (ii)
1. Small sample / only 3 (grasshoppers) so may not be representative (of all grasshoppers / insects);
  2. Grasshoppers are not the only insects / species; so genetic / behavioural / metabolic differences;
  3. (Insects) not all mature / are at different stages of development / different sizes; so different metabolic rates;
  4. Movement not restricted / not at rest in meadow; so (rate of) respiration higher;
  5. (Naturally-occurring) carbon dioxide concentration lower in meadow; so breathing rate lower;
- Explanations required, therefore both parts of answer required for credit in each marking point.*  
*Accept appropriate converse answers.*  
*Accept 'respiration' for 'metabolism' and vice versa.*

3 max

[10]

- M7.**
- (a) Diaphragm (muscle) contracts;  
Flattens / Increases volume of chest;  
Reduced pressure allows air to enter; 3
  - (b) Allows comparison;  
As organs differ in size / as larger organs will need more blood; 2
  - (c) 2 marks for 40.91 / 40.9 / 41  
1 mark for 59.09 / 59.1 / 59 2
  - (d) (i) Some oxygen still in lungs (which will enter the blood) /  
removal of carbon dioxide (from blood); 1
  - (ii) More blood available for other organs;  
Supplying oxygen / glucose / removing carbon dioxide;  
OR  
Diaphragm muscles not contracting (as not breathing);  
Will not require (as much) oxygen / glucose; 2 [10]
- M8.(a)** Fish keep moving / swimming / movement of gill covers too fast to count (at higher temperatures).  
*Accept converse.*  
*Reject personal errors e.g. with counting.*  
*Neutral – ‘water not clear’ or ‘difficult to see movement of gill covers’.* 1
- (b) 1. There is only one dependent variable / there are not two dependent variables /  
water temperature is the independent variable / breathing rate is dependent  
on water temperature;  
*Accept either approach for 1 mark.*  
*For ‘independent’ accept ‘manipulated’.*  
*Reject – ‘need two continuous variables’.*
2. Water temperature *plus* breathing rate are not both properties of  
fish  
or  
water temperature plus breathing rate are not both properties of water.  
*Accept reference to the ‘two variables’ (instead of water  
temperature plus breathing rate) 1 max*
- (c) (i) As (water) temperature increases, oxygen (concentration / solubility) falls and  
ventilation rate increases.  
*MP requires all 3 aspects before credit is possible. The correct  
context is required for each aspect so  
e.g. do not reward  
‘as oxygen concentration falls, water temperature increases’  
or  
‘as temperature increases, ventilation rate increases and oxygen  
concentration falls’.* 1
- (ii) 1. As concentration / solubility of oxygen falls  
less oxygen flows over gills / less oxygen enters gills / less oxygen  
enters fish; *For MP1 and MP2 accept converse.*  
*Both aspects needed for Page 5<sup>mark</sup>.*

2. (As a result) blood oxygen (concentration) falls / is lower;
3. An increase in ventilation rate increases / maintains the flow of oxygen / carbon dioxide across gills / into (or out of) fish;  
*Accept idea in relation to either gas or 'gas exchange'.*
4. Maintains diffusion / concentration gradient(s) (in gills);  
*Gradient(s) relates to either / both gas(es).*
5. To maintain oxygen supply to cells / tissues / organs / to maintain respiration.  
*Accept a named example of 'tissues' e.g. muscle. 3 max [6]*

- M9.(a)**
1. Trachea and bronchi and bronchioles;
  2. Down pressure gradient;
  3. Down diffusion gradient;
  4. Across alveolar epithelium.  
*Capillary wall neutral*
  5. Across capillary endothelium / epithelium. 4 max
- (b) (About) 80.0%. 1
- (c)
1. (Group **B** because) breathe out as quickly as healthy / have similar FEV to group **A**;
  2. So bronchioles not affected;
  3. FVC reduced / total volume breathed out reduced.  
*Allow this marking point for group C* 3 **8]**

- M10.(a)**
1. (Carry) oxygen / glucose;  
*Accept: oxygenated blood*  
*Ignore references to removing waste products*  
*Ignore references to arteries 'pumping' blood*
  2. (To) heart muscle / tissue / cells / myocytes.  
*Must be supply to heart or cardiac* 2
- (b)
- (i) **A**;  
*Accept: A on its own even if outside box*  
*Reject if two (or more) letters given* 1
  - (ii) **H**;  
*Accept: H on its own even if outside box*  
*Reject if two (or more) letters given* 1
- (c) (Aorta)
1. (is) close / directly linked to the heart / ventricle / pressure is higher / is very high;
  2. (Aorta has) elastic tissue;  
*Accept elasticity Ignore reference to muscle*
  3. (Aorta has) stretch / recoil. **Q** *Reject: contracts / relaxes / pumps*  
*Accept: for mp 2 and mp 3, converse for small arteries if qualified by little / less 3 [7]*

- M11.** (a) (i) **C and D;** 1
- (ii) left ventricle with thicker wall / more muscle / (muscle in) left ventricle contracts more forcefully / beats more strongly; 1
- (b) higher in atria / lower in ventricles; atrioventricular valves / valves between atria and ventricles open; (*position of valves must be identified.*)  
Do not accept an unqualified reference to valves. Assume pronouns refer to atria.) 2
- (c) (i) allows blood to pass into ventricles / from atria / so that atria can empty; before ventricles contract; 2
- (ii) ventricle contracts from base / upwards; blood pushed through **B** and **C** / arteries / all blood ejected; 2 [8]
- M12.(a)** 1. Many / more capillaries (than arterioles);  
2. (Cross-sectional) area of capillaries (much) greater (than of arterioles).  
*Note: maximum of 1 mark for this question* 1 max
- (b) 1. Short pathway / short distance between blood and outside of capillary;  
*Reference to blood and cells required*
2. Large surface area (of blood) in contact with walls of capillaries;  
*Idea is per unit volume of blood but candidates need not say this*
3. Fast exchange / fast diffusion / fast osmosis.  
*Must relate to increased speed* 2 max
- (c) Width / size / diameter of blood cell.  
*Accept named blood cell* *Reject platelet*  
*Accept idea that below a certain diameter friction becomes too great for blood to flow* 1
- (d) (Fluid) in tissue fluid / (fluid) in lymph. 1 5]

**M13.**

Statement	Haemo- globin	Cellulose	Starch
Has a quaternary structure	✓		
Formed by condensation reactions	✓	✓	✓
Contains nitrogen	✓		

*One mark for each correct row*

- (b) 16; 1
- (c) 1. Higher affinity / loads more oxygen at low / same / high partial pressure / pO<sub>2</sub>;  
 2. (Therefore) oxygen moves from mother / to fetus; 2
- (d) 1. Low affinity / oxygen dissociates;  
*Assume 'it' is adult haemoglobin*  
 1. *Accept: converse if 'fetal haemoglobin' is clearly stated*
2. (Oxygen) to respiring tissues / muscles / cells;  
 2. **Q: Neutral 'respire'** 2
- (e) Enough adult Hb produced / enough oxygen released / idea that curves / affinities / Hb are similar / more red blood cells produced;  
*Neutral: 'adult Hb is also produced' as in the question stem*  
*Reject: curves / affinities / Hb are the same* 1 [9]

**M14.(a)** 53–70 / 70-53 / 17 (beats per minute). 1

- (b) 13.6 / 13.58 / 14;  
*If answer is incorrect, 1 mark for the principle of difference (11) divided by initial heart rate (81).*  

$$\frac{70-81}{81} \text{ or } \frac{81-70}{81} \text{ for 1 mark}$$

*Ignore + or – signs* 2

- (c) 1. Allows comparison;  
 2. (Initial / resting) heart rates different (between males and females). 2
- (d) 1. Cardiac output = stroke volume × heart rate  
 1. *Accept CO = SV × HR*
2. (So) stroke volume increases / increased size or volume of ventricles.  
 2. *Neutral: more blood leaves heart*  
 2. *If the term stroke volume is not used, it must be defined* 2 **max [7]**

**M15.(a)** (i) Left ventricle; 1

- (ii) Thick muscle / thick walls;  
*Accept more muscle / more muscular.*  
*Ignore stronger muscle.* 1

- (b) (i) 85.7 / 86;  
*Accept 85*  
*Ignore additional decimal places.* 1

- (ii) Two marks for correct answer of 7905 - 7998;  
*Accept either formula or illustration with figures from table.*

One mark for incorrect answer in which candidate provides evidence of multiplying heart rate by stroke volume; 2

- (c) 1. Closed open;
2. Open closed; 2 [7]

- M16.(a)** 1. (Overall) outward pressure of 3.2 kPa;
2. Forces small molecules out of capillary. 2

(b) Loss of water / loss of fluid / friction (against capillary lining). 1

- (c) 1. High blood pressure = high hydrostatic pressure;
2. Increases outward pressure from (arterial) end of capillary / reduces inward pressure at (venule) end of capillary;
3. (So) more tissue fluid formed / less tissue fluid is reabsorbed.
- Allow lymph system not able to drain tissues fast enough 3*

- (d) 1. Water has left the capillary;
2. Proteins (in blood) too large to leave capillary;
3. Increasing / giving higher concentration of blood proteins (and thus wp). 3 [9]

**M17.** (a) More red blood cells;

More haemoglobin; 2

(b) Given (only) salt solution;

(Otherwise) treated the same way;

*Accept: 'Placebo' in salt solution.*

*Reference to salt solution is essential for first marking point. 2*

(c) Allows comparison to be made;

Different masses / weights (of volunteers) / different weeks / lengths of treatment;

*Accept: 'Both were different' for one mark.*

*Neutral: Size for second marking point. 2*

(d) To determine (most effective) dose / length of treatment / to find the most cost effective treatment;

Investigate long term effect / toxicity / side effects;

*Do not credit marks for descriptions of the information in the table in terms of dose and length of treatment. 2*

(e) More haemoglobin / more red blood cells;

(More) oxygen can be absorbed / transported (for) respiration / to respiring tissues / cells;

(More) energy released / more ATP for muscle contraction;

Delays anaerobic respiration / delays build up of lactate / lactic acid;

*Reject: 'Energy produced or made' but allow 'energy made in form of ATP'. 4*

(f) Large sample / wide range (of individuals tested);  
Random (sampling);

Tested at different times / more than Page 9once;

Mean / average value determined;

Idea of establishing a range for the normal concentration / reference to use of standard deviation; **2 max**

- (g) Blood thicker / denser / more viscous / more 'concentrated' / heart contraction greater / increases volume of blood;

*Accept: More blood cells in same volume / 'space'.*

*Neutral: 'more red blood cells' / 'more blood' on its own.*

*Neutral: 'Heart pumps / beats more / harder'.*

1  
[15]

**M18.(a)** Open / use tap / add water from reservoir; **1**

- (b) 1. Seal joints / ensure airtight / ensure watertight;  
*Answer must refer to precautions when setting up the apparatus*  
*Ignore: references to keeping other factors constant*

2. Cut shoot under water;

3. Cut shoot at a slant;

4. Dry off leaves;

5. Insert into apparatus under water;

6. Ensure no air bubbles are present;

7. Shut tap;

8. Note where bubble is at start / move bubble to the start position; **2 max**

- (c) 1. Water used for support / turgidity;  
*Accept: water used in (the cell's) hydrolysis or condensation (reactions) for one mark. Allow a named example of these reactions*

2. Water used in photosynthesis;

3. Water produced in respiration;

4. Apparatus not sealed / 'leaks'; **2 max**

- (d) As number of leaves are reduced (no mark),  
*Accept: converse arguments*

1. Less surface area / fewer stomata;

3. Less evaporation / transpiration;

4. Less cohesion / tension / pulling (force); **3 [8]**

**M19.** (a) (i) unrestricted / free / quick / easy water flow / continuous column / maintains transpiration stream; **1**

- (ii) resists tension in water (column) / provides support / strength / maintains column of water / **adhesion / prevents water loss**

*(allow waterproofing in correct context i.e. not absorbing); 1*

- (b) (i) as total area of stomata decreases the rate of water flow decreases / decrease is proportional;  
*(reject proportional, 'as one goes up the other goes up' and 'same shape')* 1
- (ii) increasing / higher temperature causes increasing / higher rate of evaporation / transpiration;  
*(not water loss)* 1
- (iii) lower plateau (start and finish at same point);  
*(allow if curve sketched on original graph, reject 'curve is lower')* 1
- (c) conserves water / reduces water loss / reduces transpiration / reduces evaporation;  
high humidity (in pit) / reduced water potential gradient / less water blown away /  
increased diffusion pathway; 2 [7]

**M20.(a)** (Scientists) used fully grown leaves / used five plants of each (species).  
*Ignore other references to methodology. Reward only information provided in the Resource.*  
*Do not accept reference to number of leaves – different plants were used.* 1

- (b) Either
1. Draw around leaf on graph paper;  
*Mark as a trio – MP1, MP2 and MP3 OR MP4, MP5 and MP6. Do not mix and match.*  
*Both aspects needed for mark – drawing and type of paper.*
  2. Count squares (however described);  
*There is no reward for additional detail e.g. dealing with part squares.*
  3. Multiply by 2 (for upper and lower leaf surface);  
OR
  4. Draw around a leaf on paper of known mass (per unit area);  
*Both aspects needed for mark – drawing and mass of paper.*
  5. Cut out *and* weigh;
  6. Multiply by 2 (for upper and lower leaf surface). 3

- (c) (i) Species **B** (no mark)
1. Smaller surface area  
so  
less evaporation / less heat absorbed;  
*Correctly selected feature and the explanation required for 1 mark.*  
*In all marking points – 'less water loss' is insufficient as an explanation but accept transpiration for evaporation or diffusion.*
  2. Thicker leaves  
so  
greater diffusion distance (for water);  
*Accept 'thicker leaves so more water storage'.*

3. Fewer stomata / lower stomatal density  
so  
less diffusion / evaporation (of water);

4. Smaller surface area to volume ratio  
so  
less evaporation. **1 max**

(ii) 1. Thick(er) cuticle  
so

increase in diffusion  
distance / slower (rate of) diffusion;  
*Feature and explanation needed for each mark.*

*Reject other features not related to leaves.*

*Reject features related to water storage.*

*'Cuticle' alone is insufficient (all leaves have a cuticle). Reject suggestion of 'less' diffusion, for idea of 'slower diffusion', an idea of rate is required.*

2. Hairs on leaves  
so

reduction in air movements / increase in humidity / decrease in water potential gradient;

3. Curled leaves  
so

reduction in air movements / increase in humidity / decrease in water potential gradient;

4. Sunken stomata  
so

reduction in air movements / increase in humidity / decrease in water potential gradient.

**2 max**

(d) Small leaves / surface area so (total) number of stomata is low.

*Both aspects needed for mark. 1 [8]*

**M21.** (a) (i) 1. Stomata open;  
*Allow converse*

2. Transpiration highest around mid-day as middle of day warmer / lighter;  
*2. Allow 'Sun is at its hottest'*

3. (Increased) tension / water potential gradient;  
*Ignore 'pull, suck' 3*

(ii) (Inside xylem) lower than atmospheric pressure / (water is under) tension;  
*Accept cohesion tension. Ignore vacuum 1*

(b) (i) High pressure / smoothes out blood flow / artery wall contains more collagen / muscle / elastic (fibres) / connective tissue;  
*Accept converse for pulmonary vein*  
*Incorrect function of artery disqualifies mark 1*

(ii) 1. (Aorta wall) stretches because ventricle / heart contracts / systole /

pressure increases;

1. *Allow expand*

2. (Aorta wall) recoils because ventricle relaxes / heart relaxes / diastole / pressure falls;

2. *Allow spring back*

*Reject any reference to contract / relax in MP1 and 2*

3. Maintain smooth flow / pressure; 3

(iii) Aorta 1.2 / largest SD;

*Allow pulmonary vein provided candidate relates standard deviation to mean* 1

(c) Formation

1. High blood / hydrostatic pressure / pressure filtration;

2. Forces water / fluid out;

2. *Reject plasma, ignore tissue*

3. Large proteins remain in capillary;

Return

4. Low water potential in capillary / blood;

5. Due to (plasma) proteins;

6. Water enters capillary / blood;

7. (By) osmosis;

7. *Osmosis must be in correct context*

8. Correct reference to lymph; 6 max [15]

M22.(a) (i) **(Both)**

1. Are polymers / polysaccharides / are made of monomers / of monosaccharides;

2. Contain glucose / carbon, hydrogen and oxygen;

3. Contain glycosidic bonds;

4. Have 1-4 links;

*Neutral: references to 'unbranched', insoluble, formed by condensation, flexible and rigid*

*Are made of the monomer glucose = MP 1 and 2 = 2 marks*

5. Hydrogen bonding (within structure).

*Ignore reference to H bonds between cellulose molecules 2 max*

(ii) (Starch)

1. Contains  $\alpha$  / alpha glucose;

*Assume 'it' refers to starch*

*Accept: converse arguments only if linked directly to cellulose*

*Accept: forms  $\alpha$  glycosidic bonds*

2. Helical / coiled / compact / branched / not straight;

3. 1,6 bonds / 1,6 branching;

4. Glucoses / monomers same way up;

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5. No H-bonds between molecules;
6. No (micro / macro) fibres / fibrils.

2 max

- (b) (i)
1. No / few organelles / very little cytoplasm / cytoplasm at edge / more room / hollow / large vacuole / large space / thick walls;  
*Accept strong walls for thick walls*
  2. (So) easier / more flow / (thick / strong walls) resist pressure.  
*Easier flow may be expressed in other ways e.g. lower resistance to flow*

2

- (ii)
1. Mitochondria release energy / ATP / site of respiration;  
**Q Reject:** 'produce energy'  
*but accept produce energy in form of ATP*
  2. For active transport / uptake against concentration gradient.  
*Note: no mark is awarded for simply naming an organelle*

**OR:**

3. Ribosomes / rough endoplasmic reticulum produce(s) proteins;  
*Concept of making proteins needed*
4. (Proteins) linked to transport e.g. carrier proteins / enzymes.

2

[8]