AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 4.1.2.2

Mitosis and the cell cycle

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**4**
Available paper years	**2018–2024**

Using this booklet

1. Booklet answer numbers match the question booklet.
2. Use the original question number within marking tables.
3. Examiner comments are included where available.

Name: _____ **Date:** _____

Where a precise marking extract is unavailable, the full source document is included in an appendix. Any missing mark scheme is explicitly identified.

4.1.2.2 Mitosis and the cell cycle

Answer 01 · Mark scheme June 2018 | 8464/B/1H | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	any **one** from: • meristem(s) • **tip** of shoot • **tip** of root	ignore stem and embryo	1	AO1 4.1.2.3 4.2.3.1
06.2	to produce large numbers of identical plants		1	AO1 4.1.2.3
06.3	6×10^{-12} (grams)		1	AO2 4.1.2.1 4.1.2.2
06.4	$\frac{28}{360} \times 15$ **or** 1.166666666(r) 1.17 (hours)	an answer of 1.17 (hours) scores **2** marks allow $\frac{7}{90} \times 15$ allow correct rounding allow 1.16 allow **1** mark for 1 hour 10 minutes **or** 1 and 1/6 hours **or** 70 minutes **only** if units given	 1 1	AO2 4.1.2.2

4.1.2.2 Mitosis and the cell cycle

Answer 01 · Mark scheme

June 2018 | 8464/B/1H | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5		**max 4** if correct sequence but no reference to stage numbers **max 4** marks if no stage numbers given ignore names of phases marks can be awarded for labelled diagrams		AO1 4.1.2.1 4.1.2.2
	stage 1 cell growth **or** increase in number of organelles	allow increase in named organelle eg ribosomes / mitochondria	1	
	DNA replicates **or** two copies of each chromosome form	allow DNA duplicates / doubles ignore genetic information replicates if this statement given as part of stage 2 allow **max 4** marks	1	
	stage 2 / mitosis one set of chromosomes moves to each end of cell	allow chromosomes separate or are pulled apart	1	
	nucleus divides	allow nucleus splits into two	1	
	stage 3 cytoplasm / cell membrane divides to form two (genetically) identical cells	allow cytokinesis	1	

06.6	any **two** from: **advantages:** • may be used to cure / treat (current / future) diseases **or** cure medical conditions **or** produce replacement cells / tissues / organs • cells / tissues of any type could be produced • cells unlikely to be rejected by the patient • many cells produced • cells produced could be used for research • would reduce waiting time for organ transplants any **two** from: **disadvantages:** • potential life is killed / destroyed • shortage of donors / eggs • egg donation / collection has risks • do not yet know risks /side effects of the procedure on the patient • may transfer (viral) infection • poor success rate to produce viable eggs / embryo	ignore references to cost allow example eg diabetes / paralysis ignore used for medical treatments allow cells differentiate into many types ignore identical cells are produced unqualified ignore references to cost ignore unethical unqualified ignore references to religion / beliefs allow embryo is destroyed ignore cells destroyed or wasted allow may cause tumours / cancer	2 2	AO1 AO3 4.1.2.3 4.1.1.4 4.6.2.4
Total			**14**	

4.1.2.2 Mitosis and the cell cycle

Answer 02 · Mark scheme

June 2022 | 8464/B/1H | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	gene chromosome nucleus cell	must be in this order	1	AO1 4.1.1.1 4.1.1.2 4.1.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	differentiation	ignore specialisation	1	AO1 4.1.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	4	allow 15	1	AO2 4.1.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	46	allow 23 pairs (of chromosomes)	1	AO2 4.1.2.1 4.1.2.2

4.1.2.2 Mitosis and the cell cycle

Answer 02 · Mark scheme

June 2022 | 8464/B/1H | Original Q2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	**Stage 1** any **one** from: • (cell) growth • increase in number of sub-cellular structures • DNA replicates • chromosomes double / duplicate / replicate	allow increase in number of organelles / ribosomes / mitochondria allow genetic material for DNA allow DNA doubles / duplicates	1	AO1 4.1.2.2
	Stage 2 any **one** from: • (one set of) chromosomes pulled to each end of cell • two nuclei form	ignore mitosis occurs allow chromosomes line up across the centre of the cell allow chromosomes move to opposite ends of the cell allow nucleus divides / splits (into two)	1	
	Stage 3 any **one** from: • cytoplasm / membrane divides • two identical cells formed	allow cytokinesis	1	

Question	Answers	Mark	AO / Spec. Ref.
02.6	**Level 2:** Scientifically relevant features are identified; the way(s) in which they are similar / different is made clear and (where appropriate) the magnitude of the similarity / difference is noted.	4–6	AO3
	Level 1: Relevant features are identified and differences noted.	1–3	AO2
	No relevant content	0	

4.1.2.2 Mitosis and the cell cycle

Answer 02 · Mark scheme

June 2022 | 8464/B/1H | Original Q2

	Indicative content General comparisons: • boys height at birth (slightly) greater than girls height • boys are (slightly) taller than girls up to age 11 • correct height comparisons eg boys are approximately 4 / 5 cm taller than girls up to age 11 • girls and boys are the same height at age 11 • girls are taller than boys between age 11 and age 14 • girls and boys are the same height at age 14 • boys are taller than girls above age 14 • correct height comparisons eg boys are 5 to 18 cm taller than girls above age 14 • boys (eventually) grow taller than girls • boys carry on growing for a longer time than girls • girls stop growing age 13 / 14 / 15 **and** boys stop growing age 17 / 18 Rate comparisons: • rate of growth similar up to age 10 / 11 • girls grow faster than boys between 10 / 11 and 14 allow girls have a greater increase in height between 11 and 14 • growth spurt occurs at a younger age in girls • growth spurt starts age 10 / 11 in girls **and** age 13 / 14 in boys • increased rate of growth in girls aged 10 to 13 /14 **and** in boys aged 13 to 17 / 18 Key points for Level 2 are correct reference to 0-11 year period, 11-14 period and after age 14, with at least one correct reference to rate of growth or use of correct values of height and age to illustrate rate.		4.1.2.2

4.1.2.2 Mitosis and the cell cycle

Answer 02 · Mark scheme

June 2022 | 8464/B/1H | Original Q2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.7	repair of tissues **or** replacement of cells	ignore growth allow repair of organs ignore repair of cells allow replacement of tissues ignore replacement of organs	1	AO1 4.1.1.4

Total Question 2		**14**

4.1.2.2 Mitosis and the cell cycle

Answer 03 · Mark scheme

June 2022 | 8464/B/2H | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	negative feedback (control)	ignore homeostasis	1	AO2 4.5.3.6 4.5.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	A = glucagon B = insulin	both required in correct order correct or phonetic spelling only	1	AO2 4.5.3.2

4.1.2.2 Mitosis and the cell cycle

Answer 03 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3 indirect marking view with 5.2	(when blood glucose concentration is high after a meal) insulin / B is secreted (by the pancreas) causing glucose to enter cells		1	AO2
	(glucose is) converted to glycogen in the liver / muscle (cells for storage)		1	AO1
	(this causes) blood glucose concentration to return to normal so insulin / B secretion slows / stops / decreases		1	AO2
	when blood glucose concentration is low glucagon / A is secreted (by the pancreas)		1	AO2
	(which causes) breakdown of glycogen in the liver (into glucose)	allow (which causes) breakdown of glycogen in the muscle (cells)	1	AO1
	(this causes) blood glucose concentration to return to normal so glucagon / A secretion slows / stops / decreases		1	AO2 4.5.3.2

4.1.2.2 Mitosis and the cell cycle

Answer 03 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	FSH causes (several) ova / eggs to mature (in the ovary)	allow singular ovum / egg allow follicle for ovary	1	AO2 4.5.3.3 4.5.3.5
	(then) LH causes ovulation **or** LH causes release of the ova / eggs	allow singular ovum / egg	1	
	so more eggs / ova present therefore higher probability / chance of fertilisation **or** so more eggs / ova present therefore higher probability / chance of sperm fusing with an egg		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	collection of (mature) egg(s) from the ovary	allow follicle for ovary	1	AO1 4.5.3.5
	(which are) fertilised (in the laboratory)	do **not** accept if in fallopian tube allow egg and sperm fuse	1	
	develop into embryo(s) (in the laboratory)	allow develop / divide into small balls of cells (in the laboratory) do **not** accept foetus	1	
	embryo(s) inserted into uterus / womb		1	

4.1.2.2 Mitosis and the cell cycle

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	any **three** from: • meiosis forms sperm **and** mitosis forms liver (cells) • two cell divisions to form sperm **and** one cell division to form liver (cells) • four genetically different sperm cells **and** two genetically identical liver cells • sperm cells have 23 chromosomes **and** liver cells have 46 chromosomes	ignore reproduction max **2** marks if reference to sperm cells dividing allow four genetically different cells formed from meiosis **and** two genetically identical cells formed from mitosis allow sperm cells have 23 chromosomes **and** liver cells have 23 pairs of chromosomes allow haploid (sperm) and diploid (liver cells)	3	AO1 4.6.1.2 4.1.2.2

Total Question 5		**18**

4.1.2.2 Mitosis and the cell cycle

Answer 04 · Mark scheme

June 2024 | 8464/B/1H | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1		allow a maximum of **3** marks if the stages are out of order		AO2 4.1.2.2
	DNA replicates **or** two copies of each chromosome form	allow DNA duplicates / doubles allow genetic material doubles ignore genetic information replicates do **not** accept DNA reproduces	1	
	one set of chromosomes is pulled to each end of the cell	allow one set of chromosomes is moved to each end of the cell ignore half the chromosomes are moved to each end of the cell	1	
	nucleus divides	allow two (new) nuclei form	1	
	cytoplasm **or** cell membrane divides **and** two genetically identical cells form	allow cytokinesis **and** two genetically identical cells form ignore names of phases of mitosis if no other mark awarded allow **1** mark for mitosis	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	uncontrolled cell division / growth		1	AO1 4.2.2.7
	invade neighbouring tissues		1	
	(tumour) cells spread to different parts of the body / tissues in the blood / lymph	allow tumour metastasises	1	

4.1.2.2 Mitosis and the cell cycle

Answer 04 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	(need to breathe faster / deeper) to get more oxygen	allow the converse if clearly stated	1	AO2 4.2.2.6 4.2.2.2 4.4.2.1 4.4.2.2
	(because) smaller surface area		1	
	(so) less oxygen in the blood	allow (so) less oxygenation of haemoglobin	1	
	(so) less (oxygen for) respiration	allow (so) anaerobic respiration increases allow (so) lactic acid is produced allow (so) an oxygen debt is created do **not** accept energy produced / made / created	1	

Total Question 6	11

4.1.2.2 Mitosis and the cell cycle

Answer 01 · Examiner comments

June 2018 | 8464/B/1H | Original Q6

Question 6 (standard, standard / high & high demand)

06.1 26% of students achieved the mark for saying stem cells are found in meristems or the tips of roots or shoots. A variety of incorrect organs or tissues were named, the most common being root, stem, xylem and embryo. Some students named parts of a cell, such as chloroplast or cytoplasm.

06.2 49% of students correctly identified producing a large number of identical plants as one economic use of plant stem cells. There was some confusion of genetic engineering and stem cell technology, as most other students selected to create genetically modified crops as their answer.

06.3 This question was targeted at grades 8–9. 4% of students correctly converted 6 picograms into grams and wrote the answer in standard form.

Some students did not understand the term standard form and gave a number written in decimal form. This value was usually an incorrect conversion of picograms to grams. Common incorrect attempts at writing the value in standard form included 6×10^{-6} or 6×10^{-9}

4.1.2.2 Mitosis and the cell cycle

Answer 01 · Examiner comments

June 2018 | 8464/B/1H | Original Q6

06.4 15% of students achieved both marks for calculating the number of hours the cell spent in mitosis and giving the answer to three significant figures. 20% of students achieved one mark because they rounded the number incorrectly or gave their answer in hours and minutes. Many students referred to both 28 and 15 but used an incorrect calculation or did not realise there are 360° in a circle.

06.5 14% of students achieved more than two marks. The majority of students gained a mark for stating that the cell would grow during stage 1, or two copies of each chromosome form. The latter of these events was often included in stage 2, rather than stage 1. This error, or if stage numbers were omitted, limited the response to a maximum of four marks.

Some very good descriptions of mitosis, including spindle formation, were seen. However, a lot of students did not mention the nucleus dividing. A few students gained the final mark for saying cytokinesis occurred in stage 3. Few gave the full description of the cytoplasm or membrane dividing to form two identical cells.

42% of students did not achieve any marks. This was usually because they described the process of IVF. Some confused the cell cycle with meiosis and fertilisation.

06.6 31% of students achieved two or more marks.

Marks were generally awarded for advantages, rather than disadvantages. Common correct advantages given included:

- how stem cells can be used in patients
- diseases stem cells can be used to treat, for example paralysis
- that the cells would not be rejected by patients.

The most common disadvantage mentioned was that an embryo or potential life was destroyed. Saying the cells were wasted was insufficient.

A lot of students confused the process with that of IVF.

Use of statistics

Statistics used in this report may be taken from incomplete processing data. However, this data still gives a true account on how students have performed for each question.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

4.1.2.2 Mitosis and the cell cycle

Answer 02 · Examiner comments

June 2022 | 8464/B/1H | Original Q2

Question 2 (standard demand)

02.1 54% of the students put gene, chromosome, nucleus and cell in order of increasing size.

02.2 Half of the students gave the correct answer, differentiation. Some said specialisation, whilst most students thought the process to produce specialised cells was mitosis, cell division or therapeutic cloning.

02.3 44% of the students correctly calculated the number of cell divisions to form a 16-cell embryo.

02.4 65% of students knew that the cells of a human embryo have 46 chromosomes.

02.5 A quarter of students scored full marks, with 69% scoring at least one mark. Many students scored a mark for Stage 1 by saying that the cell grows or that there is an increase in the number of sub-cellular structures. Some students thought Stage 1 was fertilisation, and they went on to describe the development of an embryo.

A mark for Stage 2 was less often awarded. Many students said mitosis happens, but as this was written on the cell cycle diagram it did not gain credit.

For Stage 3 all the changes listed on the mark scheme were seen, but many students only referred to two daughter cells forming, when reference to two identical cells was required. Reference to specialised cells being formed was seen quite a lot, and was ignored.

Answer 02 · Examiner comments

02.6 The question asked students to compare the growth of boys with the growth of girls, using data from growth curves.

There are three main sections in the graph:

- a section from birth to age 10 or 11, where the height and growth rate of boys and girls is very similar
- a section from age 10 or 11 up to age 14, where girls grow faster than boys
- the section from 14 to 18 years, where boys continue to grow rapidly whilst girls have stopped growing.

Within each section there were several comparisons that could be made.

To score the highest marks reference to all three sections of the graph was required, in addition to at least one comparison of the rate of growth. 30% of students scored four or more marks. More than two thirds of students scored three or more marks.

As the command word was 'Compare' it was important that comparative statements about boys and girls were made. All the statements given in the indicative content are comparisons.

Many responses gave descriptions of what they had learnt about puberty and growth spurts, but if they did not match the data given in the graph they were not credited. Any data given had to be correct.

Common errors in interpreting the graph included:

- boys grow faster than girls up to age 11
- boys grow shorter, or stop growing, at age 11
- girls stop growing at age 18.

02.7 The question asked for one way that mitosis is important in fully grown animals, so saying 'to grow' was not credited. Many students said for growth and repair, which was insufficient. Repair of tissues, organs or wounds all gained credit. Many students said to repair damaged cells, which is incorrect. Replacement of cells or tissues was another acceptable response. Many said mitosis was important for reproduction, which was ignored.

4.1.2.2 Mitosis and the cell cycle

Answer 03 · Examiner comments

June 2022 | 8464/B/2H | Original Q5

Question 5 (standard, standard/high & high demand)

05.1 A quarter of students could identify this type of hormonal control as negative feedback. Common incorrect answers were homeostasis, diabetes and endocrine.

05.2 39% of students could interpret the figure to identify hormone A and hormone B as glucagon and insulin respectively. Both hormones were allowed to be spelt phonetically, however hybrid terms that indicated a possible confusion between glucagon and other terms such as glycogen, glucose and glycerol where not acceptable. Examples such as glycogen were seen.

Common mistakes were to confuse glucagon and insulin, or to name other hormones.

05.3 Explanations usually started with the first marking point but it was equally acceptable to start at the fourth marking point. The most frequently seen mark was for release of glucagon when blood glucose concentration is low.

Confusion was common between the terms glucagon and glycogen, plus glycerol was also regularly seen.

The third and sixth marking points were very challenging. These required an understanding of how negative feedback causes the reduction in the release of each hormone.

A fifth of students scored either three or four marks.

05.4 40% of students could identify the roles of FSH and LH. Few students gained the third marking point, to fully explain why the probability of pregnancy would be greater following FSH and LH injections.

05.5 Most students knew that IVF involves fertilisation in laboratory conditions. Some inaccuracies of language were seen, such as sperm and egg mix, with no reference to or description of fertilisation, and eggs being inserted into the body, with no reference to uterus or womb.

05.6 Students found this question challenging, with 4% achieving full marks. Confusion between meiosis and mitosis was common. Responses generally lacked the detail required for the points on the mark scheme. Some students only described one process or the other, rather than describing differences.

Responses could not gain full marks if there was an implication that sperm cells go through meiosis.

The third marking point was sometimes attempted, but not expressed clearly, such as four sperm cells are made that are different, but the two liver cells are the same. Reference to *genetically* different or *genetically* identical was required.

Answer 04 · Examiner comments

June 2024 | 8464/B/1H | Original Q6

Question 6 (standard/high & high demand)

06.1 Many students were only able to gain the single fall-back mark of 'mitosis' for this high-demand question: 62% were only awarded 1 mark, and less than 1% gained all 4 marks.

Use of appropriate terminology proved challenging. It was common to see references to:

- DNA being copied
- genetic information duplicating
- chromosomes duplicating
- 'everything' replicating
- chromosomes doubling
- nucleus replicating.

None of these were sufficient for the first marking point.

Students rarely made any reference to one *set* of chromosomes in their answers, so this mark was rarely awarded.

There were some good descriptions beyond the specification of spindle fibre formation, although it was also common for any description attempted to infer that the chromosomes moved themselves to the poles rather than being pulled.

Students often referred to the nucleus being split, rather than using the term 'divide'; this was not enough to gain the third mark.

Although some good descriptions of cytokinesis were seen, as well as the term itself, marking point 4 was often not credited due to lack of reference to the cells being 'genetically' identical.

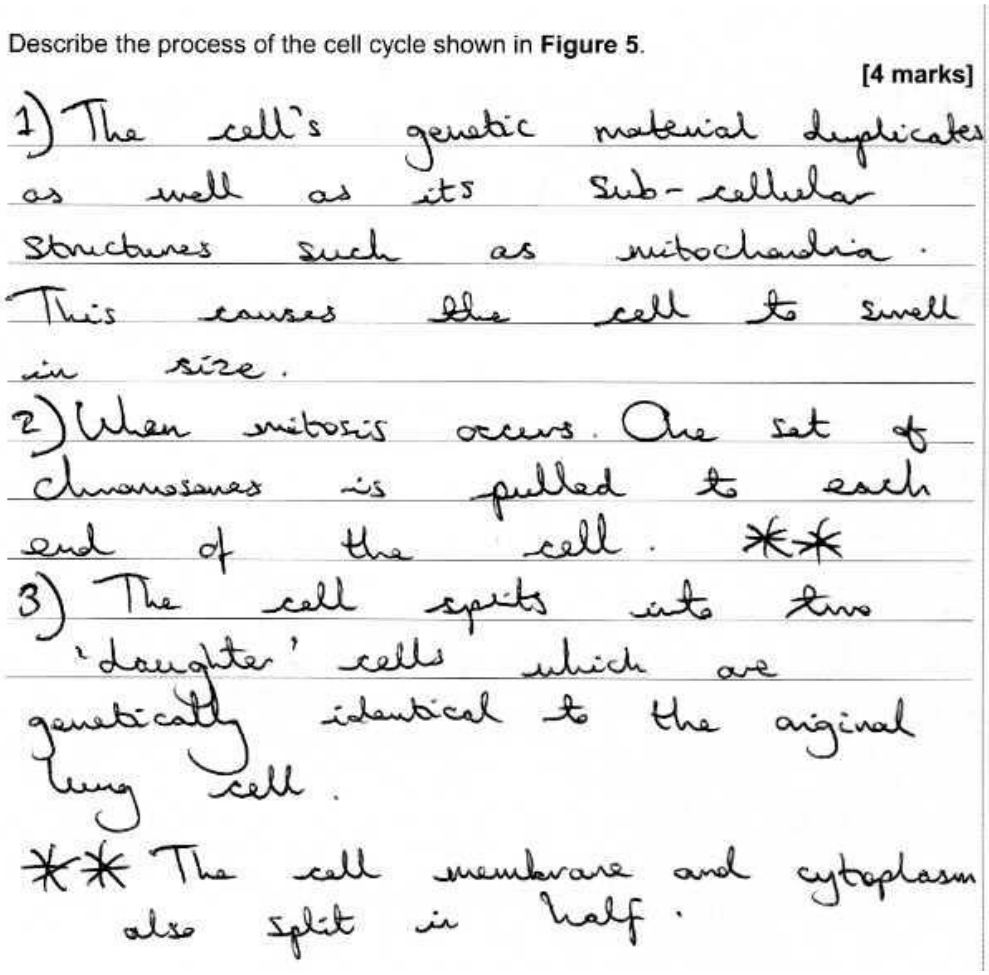
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4.1.2.2 Mitosis and the cell cycle

Answer 04 · Examiner comments June 2024 | 8464/B/1H | Original Q6

Describe the process of the cell cycle shown in **Figure 5**.

[4 marks]



This response gained 3 marks: 1 mark for 'genetic material duplicates' ('genetic information' would not have gained credit), 1 mark for the set of chromosomes being pulled to each end of the cell, and 1 mark for cytoplasm splitting in half (synonymous with dividing) and forming two genetically identical cells. There is no mention of the nucleus dividing.

06.2 Students occasionally referred to uncontrolled division or growth in their answer, which gained them 1 mark. However, many students simply repeated the stem of the question, talking about cancer being malignant, which gained no credit. Many responses stated that the tumour itself spreads through the blood rather than the *cells* spreading or did not make a reference to how the cells were spreading (ie through the blood). It was common to see responses stating that the tumour invades cells rather than tissues. It was rare to see students using the term metastasise. 67% gained no credit on this question.

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4.1.2.2 Mitosis and the cell cycle

Answer 04 · Examiner comments June 2024 | 8464/B/1H | Original Q6

06.3 28% of students were not able to access this question, often giving simple statements rather than being comparative. Some responses did not relate to the question at all: they simply referred to the adaptations of the alveoli for efficient gas exchange.

Marks were most commonly awarded for comparison of surface area, and why the person breathes faster to gain more oxygen.

A very common misconception was that B had a larger surface area than A. Although the general idea of the smaller surface area allowing less oxygen was often seen, many students did not qualify this with there being less oxygen in the blood so could not gain the mark.

Where students correctly identified B as having a smaller surface area, accurate descriptions of how this affected breathing in terms of lactic acid production and oxygen debt were more commonly seen than less respiration.

Many responses still refer to the 'production of' energy.