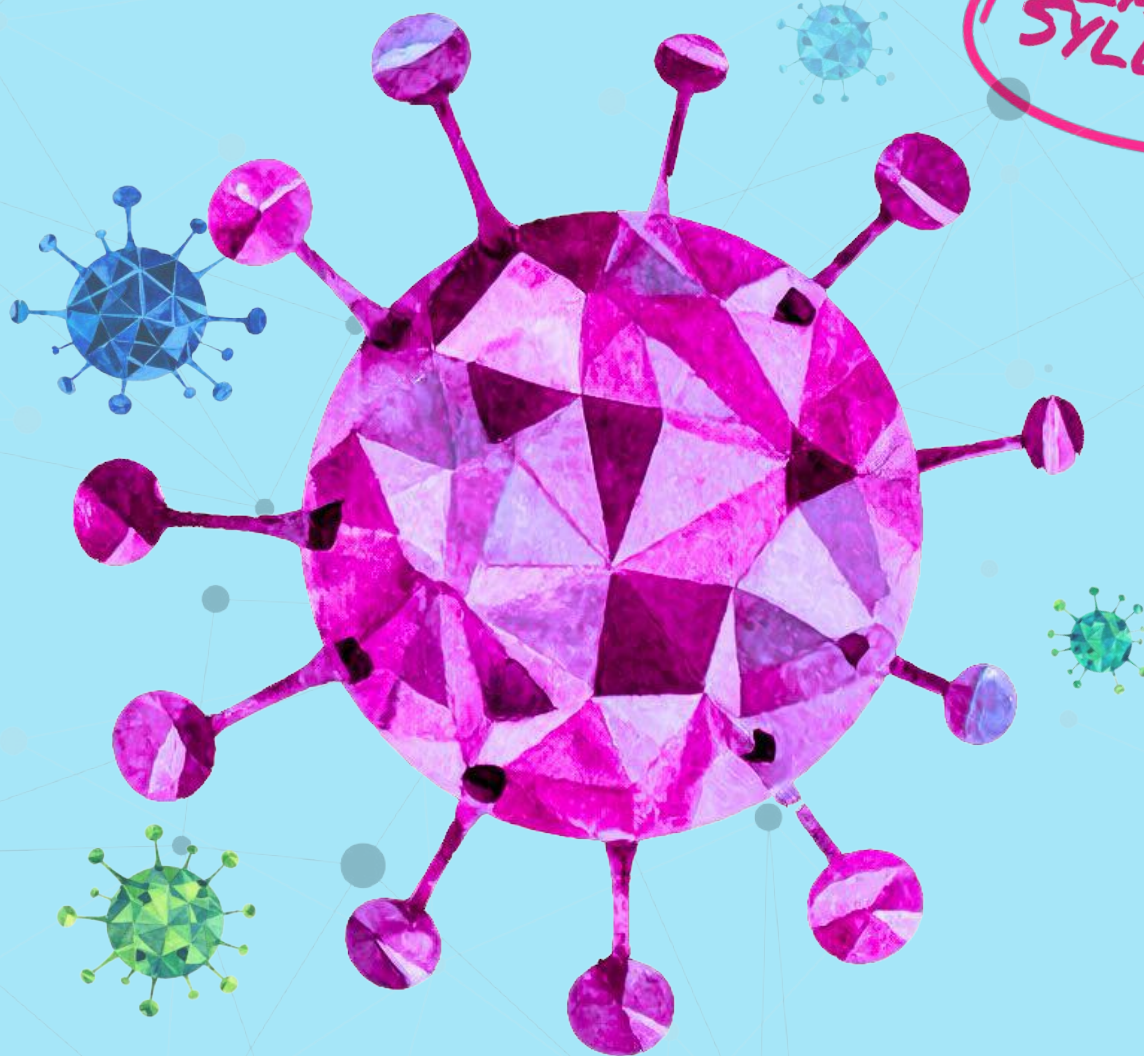


edexcel 

A2

Biology

**LATEST
SYLLABUS**



Unit 5 Solved Past Papers



Edexcel IAL Biology · Unit 5 (WBI15/01)

Solved ANSWERS by Topic

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● 5 (b)(iv)

Multiple choice · [1 mark]

Which part of the brain has learning and memory as one of its main functions?

Model answer

✓ The answer is A — cerebral hemispheres. ✓ The cerebral hemispheres (cerebrum) handle learning, memory and higher thought.

Mark scheme 1 mark

✓ A · cerebral hemispheres (1)

Do not accept: B, C or D · the hypothalamus, medulla and pituitary are not the main sites of learning and memory.

● 5 (b)(v)

Suggest · [1 mark]

Suggest one reason for the difference in response of children and adults.

Model answer

✓ The cerebral hemispheres are less well developed in children (fewer synapses/neurone connections), so they respond differently from adults.

Mark scheme 1 mark

✓ cerebral hemispheres are less well developed / fewer synapses in children (1)

Accept: the converse for adults; children have a less developed brain/nervous system; fewer neurone connections / different neurotransmitter levels; ageing weakens the eye muscles; children give up with very difficult tasks.

Jan 2026 · Question 7 · Rod cells & phytochromes

● 7 (a)

Describe · [3 marks]

Describe how the absorption of light by molecules in rod cells results in hyperpolarisation of these cells.

The table shows the sequences of treatment that each group received and whether the lettuce seeds germinated or not.

Group	Length of treatment			Seeds germinated
1	red light			yes
2	darkness			no
3	red light	darkness		yes
4	red light	far red light	darkness	no
5	far red light	red light	darkness	yes

Model answer

✓ Light is absorbed by rhodopsin, ✓ which is bleached – it splits into opsin and trans-retinal, ✓ and the opsin causes the sodium ion channels to be blocked / closed, so more sodium ions are pumped out of the rod cell than diffuse back in, and the inside becomes more negative (hyperpolarised).

Mark scheme

any three · 3 marks

- ✓ light absorbed by rhodopsin (1)
- ✓ which splits into opsin and (trans) retinal (1)
- ✓ opsin causes sodium ion channels to be blocked / closed (1)
- ✓ more sodium ions pumped out of the rod cells than diffuse in (1)

Accept: positive ions for sodium ions.

Examiner's insight

Reach the ION MOVEMENT / active transport point (Na^+ pumped out with channels closed) · many stopped at the rhodopsin breakdown and missed the higher mark.

● 7 (b)

Explain (levels) · [6 marks]

*Lettuce seeds were given sequences of red light (R), far-red light (FR) and darkness. Group 1: R · germinated. Group 2: darkness · not. Group 3: R then darkness · germinated. Group 4: R then FR then darkness · not. Group 5: FR then R then darkness · germinated. Explain the role of phytochromes in germination in this investigation. Use the table and your own knowledge.

Model answer

✓ Phytochrome exists in two interconvertible forms: red light (660 nm) converts PR into PFR, and far-red light (730 nm) converts PFR back into PR; in darkness PFR slowly reverts

to PR. PFR is the active form that stimulates germination – germination needs more PFR than PR. ✓ Group 1 (red light): red light converts PR into PFR, and the PFR causes germination – so the seeds germinate. ✓ Group 2 (darkness only): no red light, so no PR is converted to PFR; with no PFR there is no germination (PR inhibits germination). ✓ Group 3 (red then dark): red light raises PFR; the dark period is not long enough to convert the PFR back to PR, so enough PFR remains and germination occurs. ✓ Group 4 (red, far-red, dark): the final far-red flash converts the PFR back into PR, and the darkness converts any remaining PFR to PR, leaving more PR than PFR – not enough PFR, so no germination. ✓ Group 5 (far-red, red, dark): the far-red is reversed by the following red flash (PR → PFR again), and the short dark period leaves enough PFR, so the seeds germinate. ✓ It is the LAST light flash that matters, because each treatment reverses the previous one; PFR then initiates the transcription of the germination genes (activating the amylase gene, so starch is hydrolysed to maltose/glucose for respiration and growth).

Mark scheme levels • 6 marks

- ✓ basic (B): PR • PFR by red/far-red light; PFR slowly • PR in the dark; PFR is the active form that stimulates germination (PR inhibits)
- ✓ group 1: red light converts PR • PFR, PFR causes germination
- ✓ group 2: PFR slowly reverts to PR in darkness; no PFR so no germination
- ✓ group 3: red light raises PFR; darkness too short to revert it, so germination occurs
- ✓ group 4: far-red (and darkness) converts PFR back to PR; less PFR than PR, so no germination
- ✓ group 5: far-red reversed by the later red flash • PFR; short darkness leaves PFR, so germination occurs
- ✓ additional (A): PFR initiates transcription of germination genes / activates the amylase gene • starch hydrolysed to maltose/glucose for respiration / growth

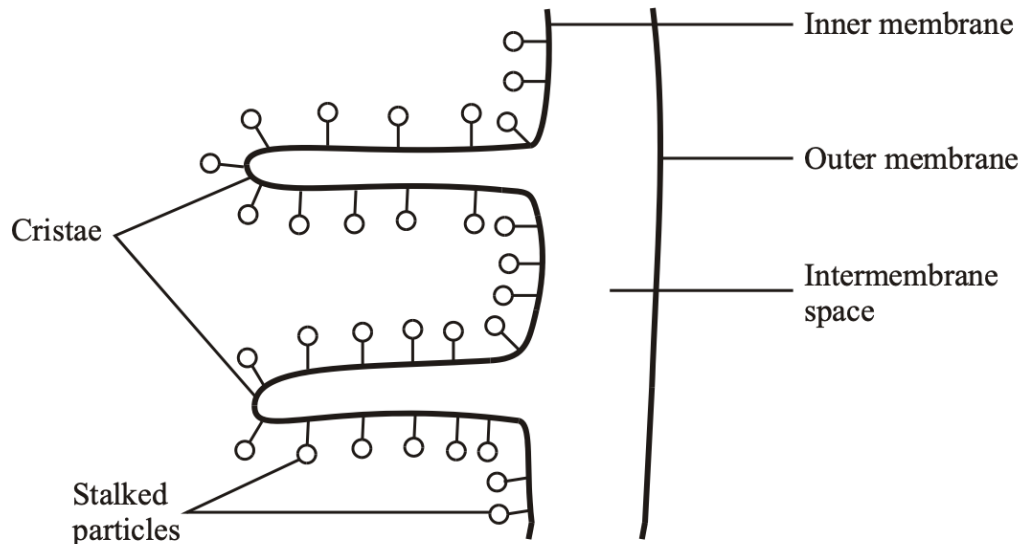
How to reach full marks

Level 3 (5–6): explain the phytochrome mechanism for at least two groups (E), PLUS additional explanation of why germination occurs. 6 marks = two group explanations + two additional points (e.g. amylase / transcription of germination genes); 5 marks = two group explanations + one additional. Level 2 (3–4) = one or two group explanations only. Level 1 (1–2) describes the outcomes without linking to the phytochrome form. DO NOT ACCEPT 'PFR acts as a transcription factor'.

Examiner's insight

This was the strongest discriminator • EXPLAIN each group by the phytochrome form (PR/PFR), not just whether germination happened; watch the DIRECTION of conversion (red: PR → PFR; far-red: PFR → PR) and consider the cumulative sequence, not only the final flash in isolation.

5. The diagram below shows a section through the membranes of a mitochondrion.



With reference to the structures labelled on the diagram, describe the role of the mitochondrial membranes in the production of ATP.

There is a compartmentalisation of processes that take place in the mitochondria

Membranes of mitochondria keep enzymes involved in the Krebs cycle within the matrix

The inner mitochondrial has cristae to increase its surface area, this is where the ETC is located

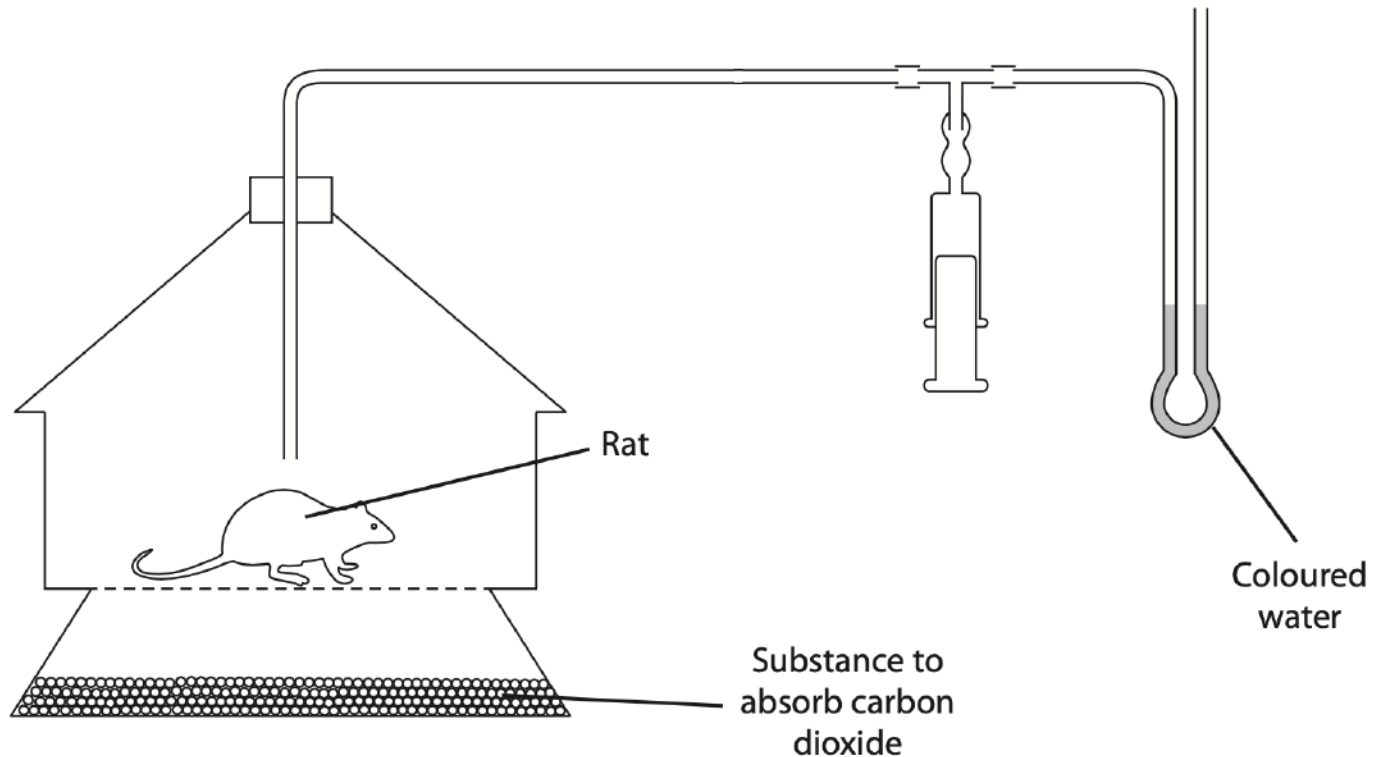
Both membranes are impermeable to hydrogen ions this helps to build an electrochemical gradient in the intermembrane space

The inner membrane contains ATP synthase

(Total 5 marks)

which provides a channel for the passage of hydrogen ions to the matrix, which helps to generate ATP by oxidative phosphorylation

- 1 The diagram below shows the apparatus that could be used to measure the respiration rate of a rat.



- *(a) Describe how this apparatus could be used to make a valid comparison of the respiration rates of male and female rats.

(6)

Obtain 10 male and 10 female rats

of the same age and same body mass

use a water-bath to control temperature

Measure the distance moved by the coloured water

Coloured water moves left because CO₂ is absorbed by NaOH

Over five minutes

Calculate the rate of respiration by dividing the distance over time

Reset the position of the coloured liquid by using the syringe

Repeat for the other rats and calculate the average for males and for females

✓ D · phosphodiester (1)

Do not accept: A, B or C · hydrogen bonds join the two strands, and ionic/peptide bonds are not in DNA; nucleotides in a strand are joined by phosphodiester bonds.

● 1 (b)

Describe · [3 marks]

Describe how genes can be switched off by transcription factors.

Model answer

✓ Transcription factors are proteins that bind to sections of DNA (the promoter region of the gene), ✓ catalysing methylation / deacetylation of the histone proteins (so the DNA is wrapped more tightly, as heterochromatin), ✓ which prevents RNA polymerase binding to the DNA, so transcription is stopped.

Mark scheme any three · 3 marks

✓ transcription factors are proteins (1)

✓ (TF/proteins) bind to sections of DNA / genes / the promoter region (1)

✓ catalysing methylation / deacetylation of histone proteins (1)

✓ preventing the binding of RNA polymerase (to the DNA) (1)

Accept: causing the DNA to be wrapped more tightly / heterochromatin; stop/decrease transcription; makes the DNA inaccessible to RNA polymerase.

Ignore: 'bases' / 'enhancer sequence'; histone modification unqualified.

Examiner's insight

Keep transcription factors central · describing how genes switch on and off in general, without the TF, limited the marks.

Jan 2024 · Question 5 · Microarrays & gene identification

● 5 (a)

Describe · [2 marks]

Describe how active genes could be identified.

Model answer

✓ Use a microarray to detect the mRNA present (which shows which genes are being transcribed), ✓ making cDNA from the mRNA and using fluorescent tags/labels/probes to reveal it.

Mark scheme any two · 2 marks

✓ use a microarray (1)

✓ to detect mRNA (1)

✓ reference to the use of cDNA / fluorescent labels / probes / tags (1)

Examiner's insight

Be specific about 'fluorescent' · say fluorescent TAGS / LABELS / PROBES; 'fluorescence' on its own did not earn the mark.

● 5 (b)(i)

Multiple choice · [1 mark]

Which is the role of histones in the cell?

Model answer

✓ The answer is C – give structural support for DNA molecules. ✓ Histones are the proteins around which DNA is wound, supporting and packaging it.

Mark scheme 1 mark

✓ C · give structural support for DNA molecules (1)

Do not accept: A, B or D · histones are not transcription factors, do not form nuclear pores, and do not make RNA polymerase.

● 5 (b)(ii)

Multiple choice · [1 mark]

Which is the process that regulates gene expression?

Model answer

✓ The answer is B – epigenetic changes. ✓ Epigenetic changes (e.g. methylation, histone modification) switch genes on or off without altering the base sequence.

Mark scheme 1 mark

✓ B · epigenetic changes (1)

Do not accept: A, C or D · crossing over, post-transcriptional and post-translational changes do not regulate gene expression in this way.

● 5 (c)(i)

Explain · [3 marks]

In Prader·Willi syndrome the paternal chromosome 15 has genetic deletions and the maternal chromosome has DNA methylation. Explain why these changes would cause Prader·Willi syndrome.

Model answer

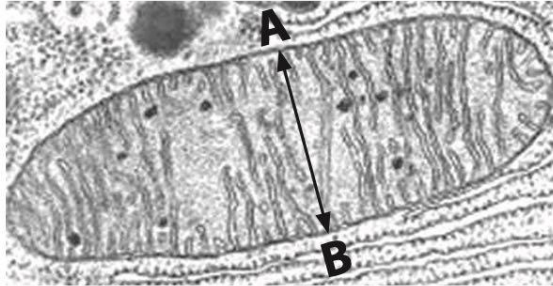
✓ On the maternal chromosome, methyl groups are added to the cytosine bases (at CpG sites), and on the paternal chromosome the gene/base sequence is deleted, ✓ so on both chromosomes the binding/action of RNA polymerase is inhibited, ✓ meaning there is less/no transcription (mRNA), so less/no protein is synthesised – the affected genes are not expressed from either chromosome.

Mark scheme any three · 3 marks

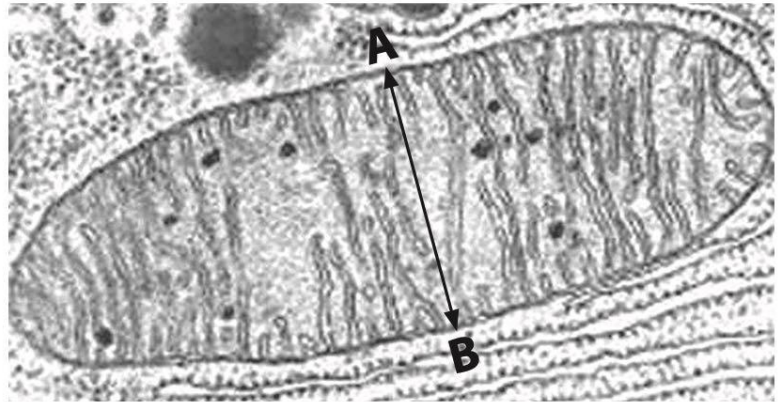
✓ methyl groups added to the cytosine bases / CpG sites (maternal chromosome) (1)

- (b) The electron micrographs below show a typical mitochondrion in muscle before and after training.

Before training



After training



Magnification $\times 10\,000$

- (i) The width of each mitochondrion is shown by the line A to B.

Calculate the percentage change in the width of the mitochondrion after training. Show your working.

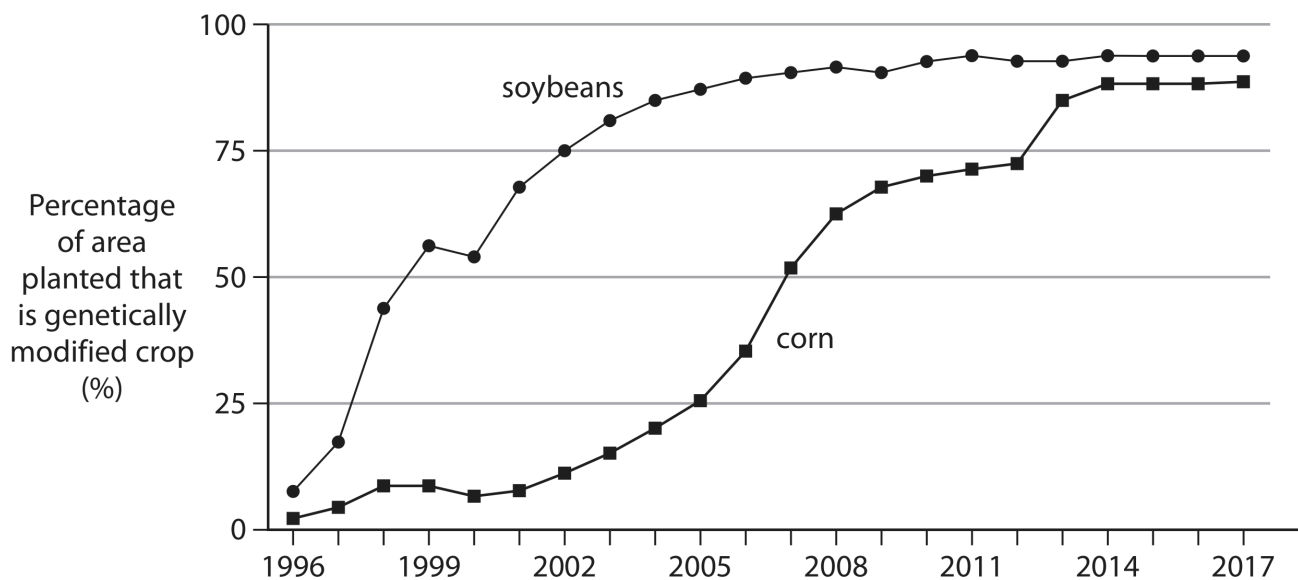
(2)

low value range of 2.1 to 2.2

high range value of 3.0 to 3.1

Answer between 36.36 and 47.61

Answer %



Model answer

✓ From the data: crops have been engineered for herbicide tolerance (soybean, not killed by glyphosate) and pest resistance (corn, resistant to the corn borer). ✓ The graph shows GM planting rose steeply – herbicide-tolerant soybean from 7% (1996) to 95% (2017) and insect-resistant corn from 6% to 88% – with more GM soybean than corn planted. ✓ Benefits: higher yields / less pest damage, longer shelf life and improved nutritional content, reduced use of herbicides and pesticides, and more predictable food supplies for a growing **population**. ✓ Risks: increasing monoculture and declining **biodiversity**, more land taken for agriculture, ✓ and unknown long-term consequences of foreign gene expression, including horizontal gene transfer (e.g. herbicide resistance passing to weeds).

Mark scheme levels • 6 marks

- ✓ data: crops engineered for herbicide/pest resistance (soybean glyphosate-tolerant; corn borer-resistant)
- ✓ data from the graph: soybean 7%· 95%, corn 6%· 88% (1996· 2017); more GM soybean than corn
- ✓ benefits: higher yields, longer shelf life, better nutrition, reduced herbicide/pesticide use, reliable food supply
- ✓ risks: monoculture, declining biodiversity, more land needed
- ✓ risks: unknown long-term effects; horizontal gene transfer (e.g. herbicide-resistant weeds)

How to reach full marks

Level 3 (5· 6) = comment on BOTH the table AND the graph, PLUS a DETAILED discussion of BOTH benefits AND risks, selective and logical. You MUST refer to the data (the question says 'use all the data') · good benefit/risk knowledge without any data reference was capped lower. Level 2 = both data sources with a basic both-sides discussion, or detailed on one side only.

- (ii) The energy required for contraction of muscle fibres is provided by ATP. Describe how enough ATP is made available for contraction of this muscle fibre, despite there being only a few mitochondria.

(5)

ATP is made from the phosphorylation of ADP

The energy required for phosphorylation

comes from glycolysis in cytoplasm where glucose is split to pyruvate

Pyruvate is then converted to lactate during anaerobic respiration

NADH from glycolysis is oxidised by reducing pyruvate

ADP can also be phosphorylated by phosphocreatine

Some oxidative phosphorylation can take place in mitochondria

- (iii) Explain why you would expect this type of muscle fibre to fatigue quickly.

(2)

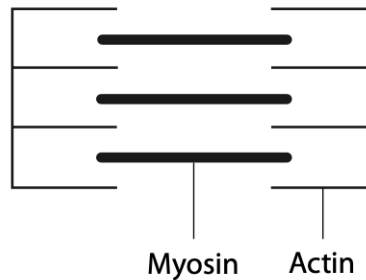
ATP supply is limited from anaerobic respiration

Lactate also lowers the pH

and affects enzyme activity preventing muscle contraction

(Total for Question 2 = 10 marks)

- (d) The diagram below shows the arrangement of actin and myosin myofilaments in part of an extended muscle.



Complete the diagram below to show accurately the arrangement of actin and myosin when the muscle is contracted.

(3)



- *(e) Describe and explain the role of calcium ions and ATP in muscle contraction.

(5)

The sarcoplasmic reticulum contains calcium ions
These ions bind to troponin which changes its shape
Causing tropomyosin to move exposing binding sites for myosin
ATP is required to remove calcium ions
And to change the shape of myosin
Which helps to break the cross bridges
ATP is also required for the synthesis of the neurotransmitter

(Total for Question 4 = 13 marks)

to PR. PFR is the active form that stimulates germination – germination needs more PFR than PR. ✓ Group 1 (red light): red light converts PR into PFR, and the PFR causes germination – so the seeds germinate. ✓ Group 2 (darkness only): no red light, so no PR is converted to PFR; with no PFR there is no germination (PR inhibits germination). ✓ Group 3 (red then dark): red light raises PFR; the dark period is not long enough to convert the PFR back to PR, so enough PFR remains and germination occurs. ✓ Group 4 (red, far-red, dark): the final far-red flash converts the PFR back into PR, and the darkness converts any remaining PFR to PR, leaving more PR than PFR – not enough PFR, so no germination. ✓ Group 5 (far-red, red, dark): the far-red is reversed by the following red flash (PR → PFR again), and the short dark period leaves enough PFR, so the seeds germinate. ✓ It is the LAST light flash that matters, because each treatment reverses the previous one; PFR then initiates the transcription of the germination genes (activating the amylase gene, so starch is hydrolysed to maltose/glucose for respiration and growth).

Mark scheme levels • 6 marks

- ✓ basic (B): PR → PFR by red/far-red light; PFR slowly → PR in the dark; PFR is the active form that stimulates germination (PR inhibits)
- ✓ group 1: red light converts PR → PFR, PFR causes germination
- ✓ group 2: PFR slowly reverts to PR in darkness; no PFR so no germination
- ✓ group 3: red light raises PFR; darkness too short to revert it, so germination occurs
- ✓ group 4: far-red (and darkness) converts PFR back to PR; less PFR than PR, so no germination
- ✓ group 5: far-red reversed by the later red flash → PFR; short darkness leaves PFR, so germination occurs
- ✓ additional (A): PFR initiates transcription of germination genes / activates the amylase gene → starch hydrolysed to maltose/glucose for respiration / growth

How to reach full marks

Level 3 (5–6): explain the phytochrome mechanism for at least two groups (E), PLUS additional explanation of why germination occurs. 6 marks = two group explanations + two additional points (e.g. amylase / transcription of germination genes); 5 marks = two group explanations + one additional. Level 2 (3–4) = one or two group explanations only. Level 1 (1–2) describes the outcomes without linking to the phytochrome form. DO NOT ACCEPT 'PFR acts as a transcription factor'.

Examiner's insight

This was the strongest discriminator → EXPLAIN each group by the phytochrome form (PR/PFR), not just whether germination happened; watch the DIRECTION of conversion (red: PR → PFR; far-red: PFR → PR) and consider the cumulative sequence, not only the final flash in isolation.

- (ii) The cellular levels of messenger RNA involved in the synthesis of actin change after landing on Earth.

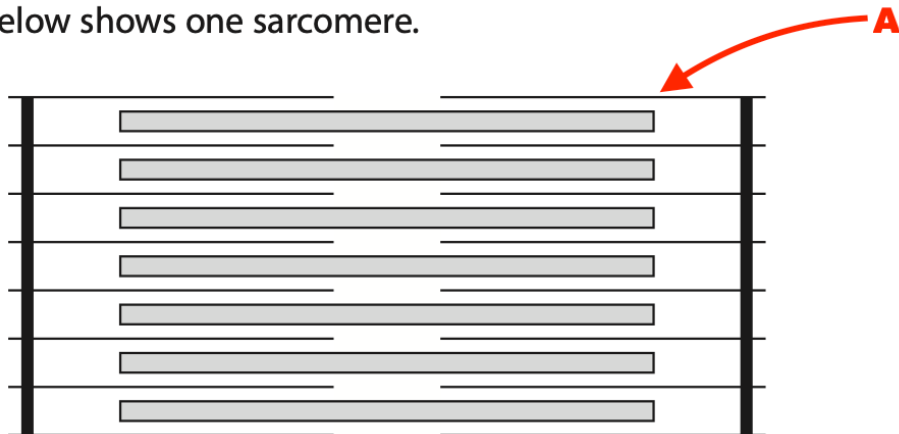
Suggest how this might explain the change in muscle volume between 4 days and 19 days after landing on Earth.

(2)

**The gene for actin switched on
causing an increased levels of transcription
and increased translation of the actin protein**

- (iii) Actin is a structural protein found in the sarcomeres of a muscle fibre.

The diagram below shows one sarcomere.



Draw a line, labelled A, to show the location of actin in this sarcomere.

(1)

- (iv) Actin has a role in muscle contraction.

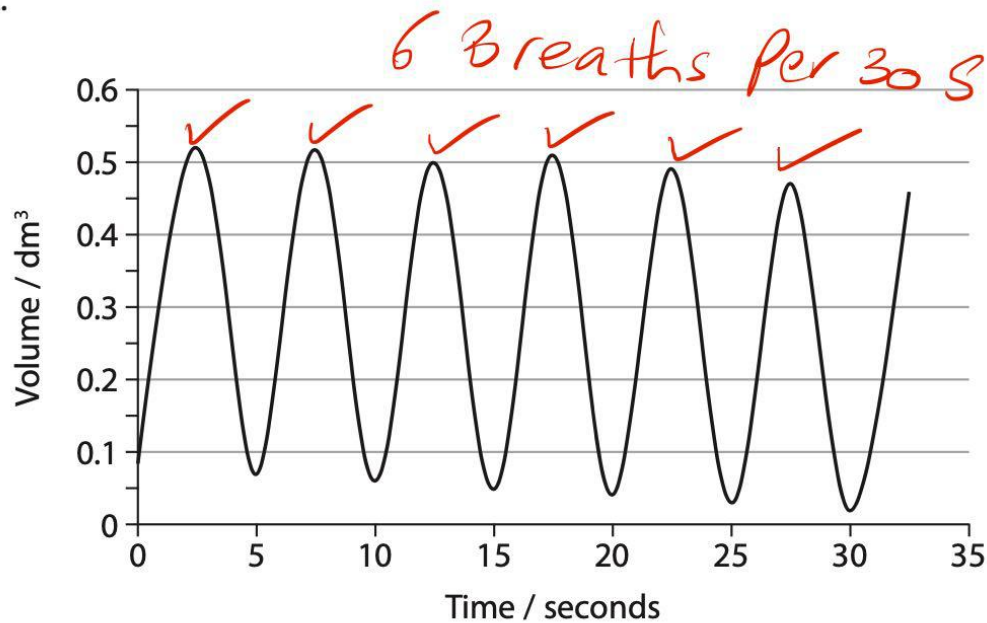
Name **two** structural proteins present in a sarcomere, other than actin, that have a role in muscle contraction.

(1)

myosin and troponin / tropomyosin

- (b) The respiratory system will also undergo physiological changes during a period of exercise.

The spirometer trace shown below was recorded when an adult was at rest. This trace can be used to calculate the resting breathing rate and tidal volume of the adult.



- (i) Place a cross in the box (☒) that correctly identifies the **approximate** value for resting breathing rate and tidal volume for this adult.

(2)

Approximate value for	0.1 dm ³	0.5 dm ³	6 dm ³ min ⁻¹	6 breaths min ⁻¹	12 breaths min ⁻¹
Resting breathing rate	☐	☐	☐	☐	☒
Resting tidal volume	☐	☒	☐	☐	☐

● 2 (b)(ii)

Describe • [3 marks]

Describe how steroid hormones regulate gene transcription.

Model answer

✓ The steroid hormone is lipid-soluble, so it diffuses across the cell membrane into the cell/nucleus, ✓ and binds to a receptor (protein) inside the cell, forming a hormone-receptor complex that acts as (interacts with) a transcription factor, ✓ which causes the activation or repression of the gene – switching transcription (mRNA formation) on or off.

Mark scheme any three • 3 marks

- ✓ steroid hormone diffuses across the cell membrane / into the cell / nucleus (1)
- ✓ binds to a receptor / protein (inside the cell / nucleus) (1)
- ✓ which acts as / interacts with a transcription factor (1)
- ✓ causing activation / repression of gene transcription (1)

Accept: steroids are lipid-soluble; forms a hormone-receptor complex; binds to the promoter region / RNA polymerase; switching genes on/off; allowing/preventing transcription.

Do not accept: binding to cell-membrane receptors; steroid making mRNA / activating neurones.

Examiner's insight

For the last mark, say what the transcription factor DOES • activates or switches OFF the gene; repeating 'regulates transcription' from the stem earned nothing.

June 2025 • Question 6 • Phytochromes & germination

● 6 (a)

Multiple choice • [1 mark]

Which molecule detects light during germination of seeds?

Model answer

✓ The answer is B – phytochrome. ✓ Phytochrome is the plant photoreceptor that detects red/far-red light and controls germination.

Mark scheme 1 mark

- ✓ B • phytochrome (1)

Do not accept: A, C or D • chlorophyll absorbs light for photosynthesis, and retinal/rhodopsin are pigments in the eye.

● 6 (b)

Determine • [4 marks]

The graphs show the height of peanut seedlings in red, blue and white light at low and high light intensity. Determine the effect of light on the growth of the seedlings.

*(b) The treadmill test can be used to diagnose heart problems.

This test requires a person to walk on a treadmill whilst an electrocardiogram (ECG) is recorded.

The angle of the treadmill is raised to increase the level of exercise. The photograph below shows a person carrying out the treadmill test.



Explain how the heart rate of this person is controlled as the level of exercise increases during this test.

(6)

The increase in respiration rate in muscle cells

increase the levels of CO₂ and lactic acid in the blood

Chemoreceptors in medulla get stimulated

which causes the cardiovascular control centre in medulla to send impulses

through sympathetic nerves releasing noradrenaline onto the SAN

This causes the SAN excitation rate to be increased

resulting in an increased heart rate

proteins) on the cancer cell, ✓ which results in enhanced phagocytosis – the cancer cells are engulfed and destroyed by phagocytes (opsonisation).

Mark scheme any two · 2 marks

✓ (BVZ antibodies are) complementary to antigens / receptors / membrane proteins on the cancer cell (1)

✓ (antibody) binds to the antigens / receptors on the cancer cells (1)

✓ resulting in (enhanced) phagocytosis / destruction by phagocytes (1)

Accept: opsonisation; agglutination / causing cancer cells to clump; macrophages for phagocytes; a marker for T killer cells.

Ignore: 'the antibody binds to the cancer cells' unqualified (say antigens).

Examiner's insight

Say the antibody binds to ANTIGENS (not just 'the cancer cells'); 'opsonisation' followed by enhanced phagocytosis was pleasingly common.

● 7 (c)

Assess · [6 marks]

*The tables show growth/toxin data for maize infected with normal vs GM fungus (with SDs), and a model of maize infection at higher temperatures. Assess the risks and benefits of genetically modifying the fungus for future food production in a warming world. Use the tables and your own knowledge.

Model answer

✓ From the data: with the GM fungus the maize is taller (320 vs 285 cm) and has more grains per cob (117 vs 113), and the toxin concentration is much lower (270 vs 530); the toxin difference is significant (SDs don't overlap) but the height/grain differences are not (SDs overlap). ✓ The model shows infection increases with temperature – a positive correlation – so global warming will make fungal infection (and toxin) more of a problem, since fungi make more toxin under stress like heat/drought. ✓ Benefits: the GM fungus outcompetes the normal fungus, giving taller plants, more cobs and higher yield – more food/food security, more efficient land use – and the lower toxin makes the food safer, so fewer humans/animals are poisoned. ✓ Risks: reduced **biodiversity** (monoculture); the modified gene/toxin could enter food chains or transfer to other **fungi/species** (superpests), with unknown long-term effects, ✓ and there are ethical/financial concerns (GM seen as unnatural, cost to farmers/consumers) and unknown health effects of eating GM-fungus-grown crops.

Mark scheme levels · 6 marks

✓ data: GM fungus gives taller plants, more grains and less toxin; toxin SDs don't overlap (significant), height/grain SDs overlap (not significant)

- ✓ model: infection increases with temperature (positive correlation); fungi produce more toxin under stress (heat/drought)
- ✓ benefits: GM fungus outcompetes normal fungus • higher yield / food security / efficient land use
- ✓ benefits: lower toxin makes food safer • fewer humans/animals poisoned; reduced health risk
- ✓ risks: reduced biodiversity / monoculture; gene or toxin entering food chains; gene transfer / superpests
- ✓ risks: ethical (unnatural) / financial cost / unknown health effects of eating GM-grown crops

How to reach full marks

Level 3 (5–6) = comprehensive: select and apply relevant biology, use BOTH tables (growth/toxin AND the temperature model), and discuss BOTH benefits and risks with sustained scientific reasoning. Level 2 (3–4) = some relevant facts with occasional linkage. Level 1 (1–2) = isolated, vague statements.

Examiner's insight

Assess means weigh BOTH sides using the data • link the GM fungus's lower toxin and higher yield (benefits) against biodiversity/gene-transfer risks, and bring in the warming-world model showing infection rising with temperature.

June 2025 • Question 7 • Parts of the brain

● 7 (a)(i)

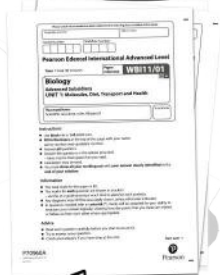
Multiple choice • [1 mark]

The diagram shows a cross-section through the brain. Which label identifies the pituitary gland?

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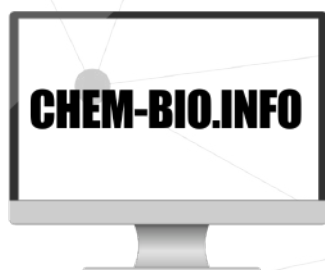
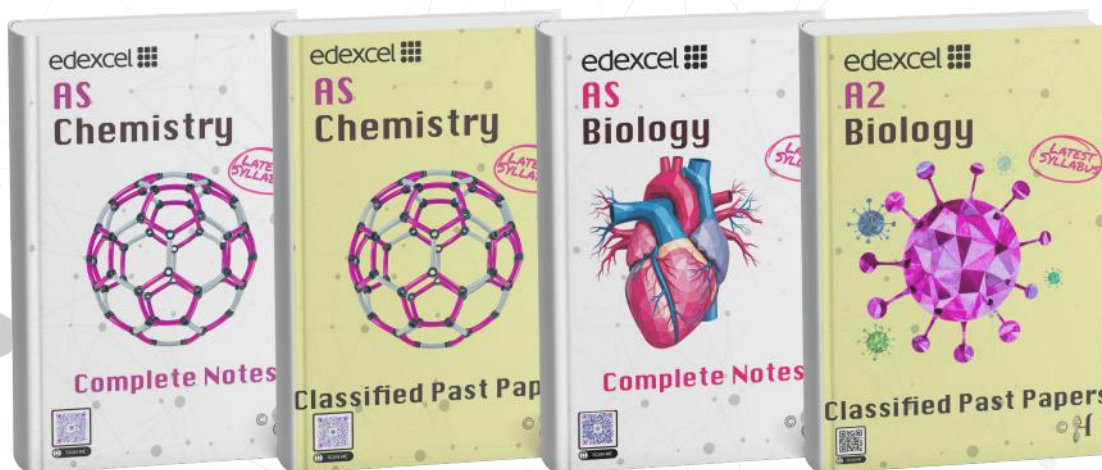


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