OXFORD
INTERNATIONAL
AQA EXAMINATIONS

INTERNATIONAL A-LEVEL BIOLOGY

(BL03)

Unit 3: Populations and genes

Example responses with commentary

For teaching from September 2016 onwards
For A-level exams in May/June 2018 onwards

This guide includes some examples of student responses to a selection of questions from the summer 2018 BL03 unit.

The question parts are reproduced, along with the final mark scheme, student responses and a commentary from the Lead Examiner on each of the students' answers.

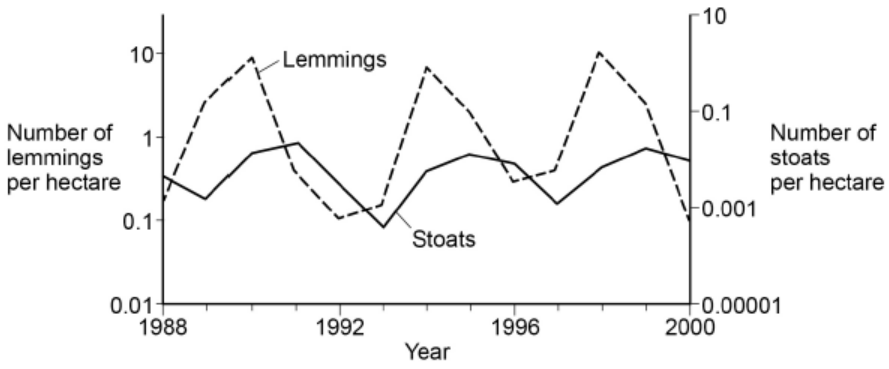
QUESTION

01.3

Stoats are carnivorous mammals that feed almost exclusively on lemmings.

Figure 1 shows the changes in the numbers of lemmings and stoats in one region from 1988 to 2000.

Figure 1



0 1 . 3 Describe the relationship between the number of lemmings and the number of stoats.

Use information from **Figure 1**.

[2 marks]

MARK SCHEME

Question	Marking guidance	Mark	Comments
01.3	1. Number of lemmings is (always) higher than the number of stoats;	1	1. Candidates need to show understanding of logarithmic scale. Do not accept 'number of lemmings is usually higher than the number of stoats' as it shows a lack of understanding.
	2. Number of lemmings increases (then) number of stoats increases / number of stoats increases (then) number of lemmings decreases;	1	2. The idea of link between lots of predators and decrease in prey or lots of prey and increase in predators.
	3. 4 year cycles / use of figures from graph;	1 2 max	

STUDENT A

0 1 . 3 Describe the relationship between the number of lemmings and the number of stoats.

Use information from **Figure 1**.

[2 marks]

~~stoats is the~~ They have a predator-prey relationship, where stoats are the predaters and lemmings are the prey.

EXAMINER COMMENTARY

No marks are awarded here. The answer does not refer to the numbers of organisms or the graph.

STUDENT B

0 1 . 3 Describe the relationship between the number of lemmings and the number of stoats.

Use information from **Figure 1**.

[2 marks]

- ~~the~~ when there is a high population of lemmings, the stoat population also increase because of high availability of food. when the lemming population decrease so does stoats. They are proportional -

EXAMINER COMMENTARY

One mark is awarded for stating the changes in size of the two populations but the higher number of lemmings was not commented on.

QUESTION

01.4

0 1 . 4 Lemmings feed on leaves, shoots, roots and bulbs. Predators of lemmings include stoats, owls and foxes.

A student suggests that an increase in the stoat population causes a decrease in the lemming population.

Evaluate this statement.

Use the information provided above and in **Figure 1**.

[4 marks]

MARK SCHEME

Question	Marking guidance	Mark	Comments
01.4	(Yes) 1. (Graph shows that) lemming population starts to decrease (one year) before stoat population peaks; (No) 2. Graph shows some years (89-90, 93-94, 97-98) when both populations are increasing; 3. There is a correlation, but does not mean cause; 4. (Lemming population could decrease due to) lack of food; 5. (lemming population could decrease due to) disease; 6. (Lemming population could decrease due to) (increase in) other predator;	1 1 1 1 1 1 4 max	Max 3 if only 'No'

STUDENT A

0 1 . 4 Lemmings feed on leaves, shoots, roots and bulbs. Predators of lemmings include stoats, owls and foxes.

A student suggests that an increase in the stoat population causes a decrease in the lemming population.

Evaluate this statement.

Use the information provided above and in **Figure 1**.

[4 marks]

As the lemming population increases, there is more prey for the stoats, the stoats increase in number by reproduction while the lemmings decrease. However there are other predators of the lemmings that could contribute to the decrease in population. A disease could'nt also decreased the number of lemmings.

EXAMINER COMMENTARY

This answer gives an argument for the statement by linking the changes in numbers of the two populations. There is also a reason against the statement referring to the effect of other predators. Therefore, two marks are scored.

STUDENT B

0 1 . 4 Lemmings feed on leaves, shoots, roots and bulbs. Predators of lemmings include stoats, owls and foxes.

A student suggests that an increase in the stoat population causes a decrease in the lemming population.

Evaluate this statement.

Use the information provided above and in **Figure 1**.

[4 marks]

- the statement is correct because as shown in figure 1, when the stoat population increases, the lemmings decreases because they are being preyed on. However, the figure doesn't take into account the owls and foxes that also have an affect on the lemming population.
- Foxes and owls contribute to the decrease in lemming population.
- the cyle repeats 3 times between 1988 and 2000.

EXAMINER COMMENTARY

Three marks are awarded here, one for the changes in the two populations, one for the possible effect of other predators and one for possible diseases.

QUESTION

02.2

0 2 . 2 **Figure 2** shows a regular fluctuation in the carbon dioxide concentration every year.

Suggest **one** reason for the fluctuation.

[2 marks]

MARK SCHEME

Question	Marking guidance	Mark	Comments
02.2	1. (Rises when) lower rate of photosynthesis; 2. less vegetation/lower temperature/shorter days/less light **OR** 3. Rises when weather is cold/rises in winter; 4. More fuel used (producing more CO_2);	1 1 1 1 2 max	1. Context of CO_2 levels rising or less CO_2 taken in. Mark as pairs Accept converse

STUDENT A

0 2 . 2 **Figure 2** shows a regular fluctuation in the carbon dioxide concentration every year.

Suggest **one** reason for the fluctuation.

[2 marks]

fluctuation can be due to photosynthesis and respiration ~~levels~~ levels. changes in those due to reasons, deforestation, growing of more plants etc.

EXAMINER COMMENTARY

There is reference to photosynthesis (and respiration) altering carbon dioxide levels but the answer is not specific enough to score any marks.

STUDENT B

0 2 . 2 **Figure 2** shows a regular fluctuation in the carbon dioxide concentration every year.

Suggest **one** reason for the fluctuation.

[2 marks]

Carbon dioxide ~~is~~ ~~low~~ concentration is lower in the summer as daytime is longer ~~and~~ ~~cools~~. While in the winter it is more as there is less sunlight, and plants photosynthesise less and respire more to release carbon dioxide.

EXAMINER COMMENTARY

Two marks are awarded here. They are for lower rates of photosynthesis in the winter linked to less sunlight.

QUESTION

02.3

0 2 . 3 Do the data in **Figure 2** support the idea that an increase in atmospheric carbon dioxide concentration has caused an increase in global temperature?

Explain your answer.

[3 marks]

MARK SCHEME

Question	Marking guidance	Mark	Comments
02.3	(Yes)		
	1. Both show an overall increase;	1	
	(No)		
	2. Considerable fluctuation in temperature;	1	2. Idea that temperature drops while CO_2 concentration continues to rise
	3. Temp increase could be due to chance/other named factor;	1	3. Methane/named greenhouse gas 3. Accept reference to correlation does not mean causation.
	4. CO_2 only recorded at one location;	1	
	5. Comment on quality of data – mean temperature increase is very small/no SD/no statistical test;	1 3 max	

STUDENT A

0 2 . 3 Do the data in **Figure 2** support the idea that an increase in atmospheric carbon dioxide concentration has caused an increase in global temperature?

Explain your answer.

[3 marks]

Carbon dioxide in the atmosphere has a clear upwards gradient from 300ppm → 400ppm over 50 years. Mean temp has increased but has heavy fluctuations. If a line of best fit was drawn there would be a positive increase. From this data we can see a correlation between the two however cannot conclude that it's a casual relationship as further information is needed as other factors can effect CO_2 and temperature.

EXAMINER COMMENTARY

A complete answer giving one reason supporting the idea and two casting doubt. A positive increase in temperature and carbon dioxide is stated. Against the idea, the fluctuations are highlighted and the possibility that there could be other factors involved.

STUDENT B

0 2 . 3 Do the data in **Figure 2** support the idea that an increase in atmospheric carbon dioxide concentration has caused an increase in global temperature?

Explain your answer.

[3 marks]

The data does show a correlation. As the carbon dioxide concentration has increased, so has the temperature. Although there are fluctuations

EXAMINER COMMENTARY

One mark is awarded for the overall increase in both variables. No mark is awarded for the fluctuations because they are not linked to temperature.

QUESTION

03.3

0 3 . 3 A plant breeder crossed a purple-flowered plant heterozygous for both genes with a white-flowered plant homozygous recessive for both genes.

The plant breeder expected pink, purple and white flowers in the ratio 1 : 1 : 2

Draw a genetic diagram to show how this ratio of phenotypes can be produced.

[3 marks]

Parent phenotypes Purple flowers White flowers

Parent genotypes

Gametes

Offspring genotypes

Offspring phenotypes

MARK SCHEME

Question	Marking guidance	Mark	Comments
03.3	(Parental genotypes AaBb aabb)		
	1. Gametes AB, Ab, aB, ab ab;	1	1. Allow ecf from dihybrid parental genotypes
	2. Offspring genotypes AaBb Aabb aaBb aabb;	1	2. Allow ecf from gametes with A/a and B/b
	3. Offspring phenotypes Purple Pink White White;	1	3. Phenotypes must be linked to correct genotype and must give expected phenotype purple:pink:white as 1:1:2

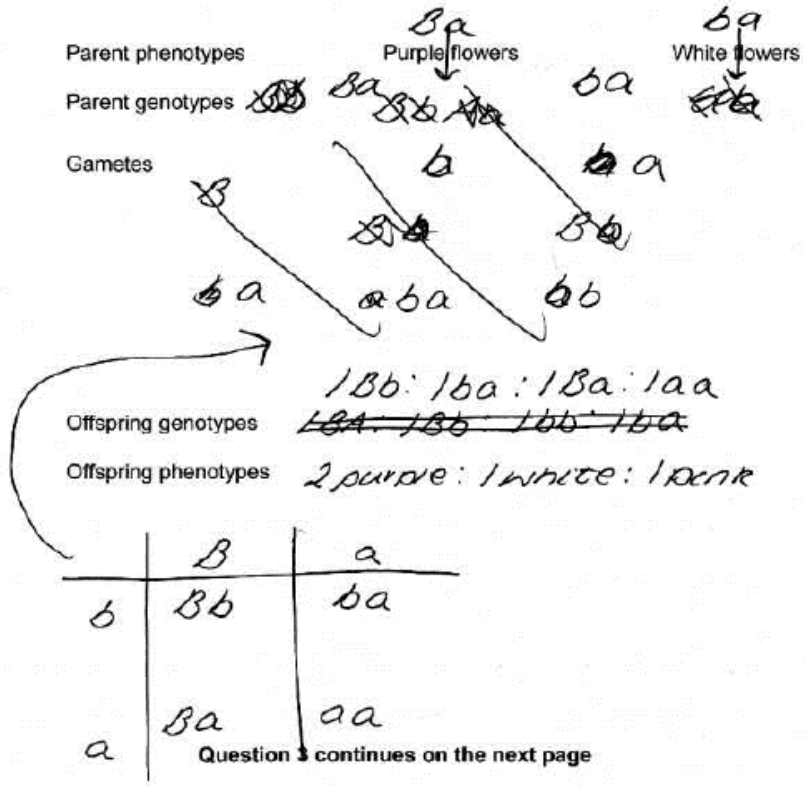
STUDENT A

0 3 . 3 A plant breeder crossed a purple-flowered plant heterozygous for both genes with a white-flowered plant homozygous recessive for both genes.

The plant breeder expected pink, purple and white flowers in the ratio 1 : 1 : 2

Draw a genetic diagram to show how this ratio of phenotypes can be produced.

[3 marks]



Question 3 continues on the next page

EXAMINER COMMENTARY

No marks awarded. The candidate has tried to explain the results by completing a monohybrid cross.

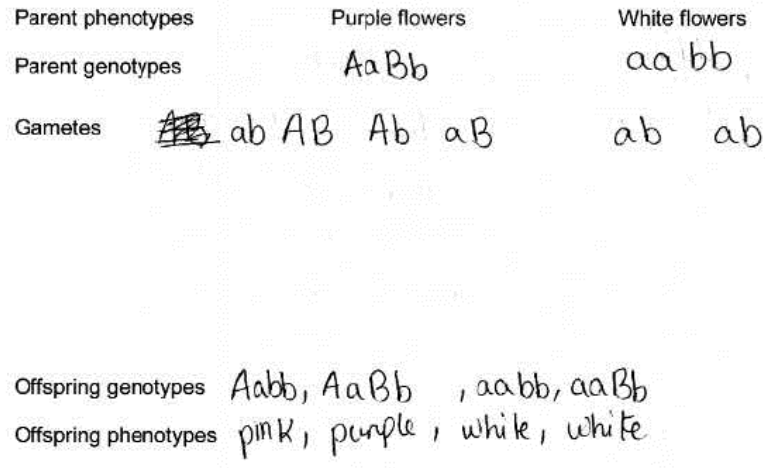
STUDENT B

0 3 . 3 A plant breeder crossed a purple-flowered plant heterozygous for both genes with a white-flowered plant homozygous recessive for both genes.

The plant breeder expected pink, purple and white flowers in the ratio 1 : 1 : 2

Draw a genetic diagram to show how this ratio of phenotypes can be produced.

[3 marks]



EXAMINER COMMENTARY

Three marks for the correct gametes, offspring genotypes and correct linking to phenotypes.

QUESTION

03.4

0 3 . 4 The plant breeder counted the number of plants with each flower colour and compared them with the expected ratio.

The plant breeder completed a statistical test to see if the difference in the observed and expected ratio was due to chance.

Table 1 shows values for χ^2 (chi squared) at different probability levels and for different degrees of freedom.

Table 1

Degrees of freedom	Probability, p				
	0.2	**0.1**	**0.05**	**0.02**	**0.01**
1	1.64	2.71	3.84	5.41	6.64
2	3.22	4.61	5.99	7.82	9.21
3	4.64	6.25	7.82	9.84	11.35
4	5.99	7.78	9.49	11.67	13.28
5	7.29	9.24	11.07	13.39	15.09

The value of χ^2 was calculated and found to be 4.73.

Explain what the results of the χ^2 test show about the difference between the observed and expected ratio.

Use **Table 1** and the calculated value of χ^2.

[2 marks]

MARK SCHEME

Question	Marking guidance	Mark	Comments
03.4	Critical value correctly identified; No significant difference (between observed and expected ratio) / difference due to chance **because** (calculated value of chi squared is) less than critical value; OR Nearest value (to calculated value of chi squared of 4.73) = 4.61; Difference due to chance **because** p = 0.1 / p > 0.05;	1 1	Either stated as 5.99 or identified as the value for 2 degrees of freedom for p = 0.05); Significance must be linked to critical value Allow mp2 if incorrect number of degrees of freedom (e.g. 3 from 4 genotypes and e.g. P≅0.2), but correct statement that no significant difference for this value.

STUDENT A

0 3 . 4 The plant breeder counted the number of plants with each flower colour and compared them with the expected ratio.

The plant breeder completed a statistical test to see if the difference in the observed and expected ratio was due to chance.

Table 1 shows values for χ^2 (chi squared) at different probability levels and for different degrees of freedom.

$\chi^2 = \Sigma \frac{(O-E)^2}{E}$

Table 1

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The value of χ^2 was calculated and found to be 4.73.

Explain what the results of the χ^2 test show about the difference between the observed and expected ratio.

Use **Table 1** and the calculated value of χ^2.

[2 marks]

4.73 is close to the degree of freedom of 5 showing the observed is close to the expected.

5 - 4.73 = 0.27

EXAMINER COMMENTARY

No critical value is selected from the table so no marks are scored.

STUDENT B

0 3 . 4 The plant breeder counted the number of plants with each flower colour and compared them with the expected ratio.

The plant breeder completed a statistical test to see if the difference in the observed and expected ratio was due to chance.

Table 1 shows values for χ^2 (chi squared) at different probability levels and for different degrees of freedom.

Table 1

Degrees of freedom	Probability, p				
	0.2	0.1	0.05	0.02	0.01
1	1.64	2.71	3.84	5.41	6.64
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The value of χ^2 was calculated and found to be 4.73.

Explain what the results of the χ^2 test show about the difference between the observed and expected ratio.

Use **Table 1** and the calculated value of χ^2.

[2 marks]

The χ^2 value of 4.73 is less than the critical value of 5.99. There is no significant difference.

EXAMINER COMMENTARY

The correct critical value is identified and the correct conclusion made. 2 marks.

QUESTION

03.5

0 3 . 5 A population of *Salvia* plants contains 49% white flowers.

Calculate the percentage of this population that you would expect to be heterozygous for the production of pigment gene.

Use the Hardy-Weinberg equation.

[2 marks]

Answer = _____

MARK SCHEME

Question	Marking guidance	Mark	Comments
03.5	42%;;	2	0.42 = 1 mark Award one mark for: $q^2 = 0.49$ / $q = 0.7$ / $p = 0.3$

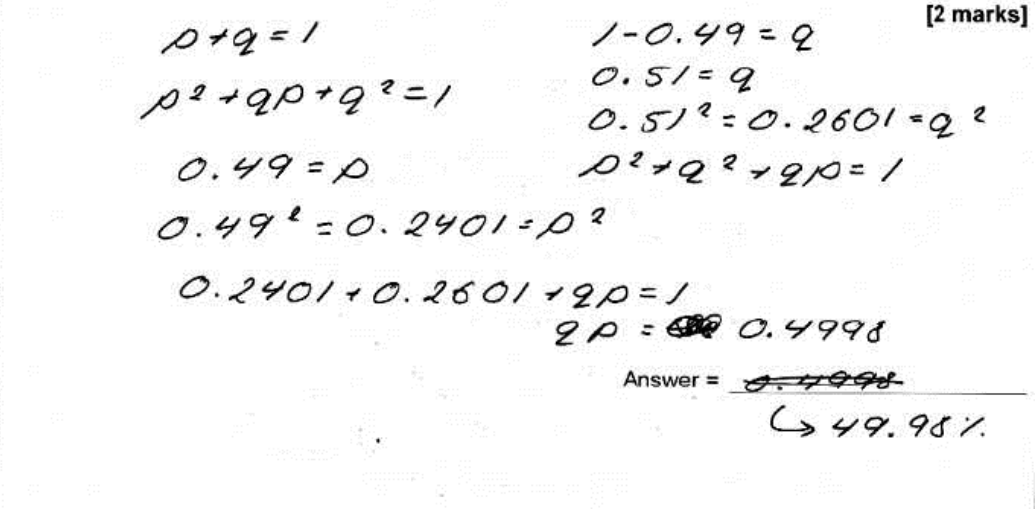
STUDENT A

0 3 . 5 A population of *Salvia* plants contains 49% white flowers.

Calculate the percentage of this population that you would expect to be heterozygous for the production of pigment gene.

Use the Hardy-Weinberg equation.

[2 marks]



EXAMINER COMMENTARY

The Hardy-Weinberg formula is recalled but the candidate links 0.49 to p rather than to q^2. Therefore, no marks are scored.

STUDENT B

0 3 . 5 A population of *Salvia* plants contains 49% white flowers.

Calculate the percentage of this population that you would expect to be heterozygous for the production of pigment gene.

Use the Hardy-Weinberg equation.

[2 marks]

aa = 0.49
a = 0.7
b = 0.3
bb = 0.09
1 − 0.49 − 0.09 = 0.42 x100

Answer = 42 %

EXAMINER COMMENTARY

This answer uses a and b correctly to represent the frequencies of the two alleles. The correct percentage is calculated for 2 marks.

QUESTION

04.3

0 4 . 3 The student adds a reagent to the suspension of photosynthesising algal cells.

The reagent is blue when oxidised and is colourless when reduced.

The blue colour disappears when the suspension of algal cells is exposed to light.

Explain why.

Use your knowledge of the light-dependent reaction of photosynthesis.

[2 marks]

MARK SCHEME

Question	Marking guidance	Mark	Comments
04.3	Electrons/e^- (from chlorophyll) excited / reduced NADP formed; hydrogen/electrons (from water/chlorophyll) change dye colour;	1 1	Reject NAD

STUDENT A

0 4 . 3 The student adds a reagent to the suspension of photosynthesising algal cells.

The reagent is blue when oxidised and is colourless when reduced.

The blue colour disappears when the suspension of algal cells is exposed to light.

Explain why.

Use your knowledge of the light-dependent reaction of photosynthesis.

[2 marks]

- In the light-dependant reaction, electrons are gained by NADP to make NADPH and so are reduced. NADPH is a product of the light-dependant reaction.

EXAMINER COMMENTARY

As was the case with many answers, a mark is scored for appreciating that NADP is usually formed in the light dependent reactions. However, the second mark was not awarded as the answer does not state that the dye accepts the electrons in the place of NADP and so changes colour.

STUDENT B

0 4 . 3 The student adds a reagent to the suspension of photosynthesising algal cells.

The reagent is blue when oxidised and is colourless when reduced.

The blue colour disappears when the suspension of algal cells is exposed to light.

Explain why.

Use your knowledge of the light-dependent reaction of photosynthesis.

[2 marks]

when light is absorbed by the ~~the~~ chlorophyll, electrons are lost from the chlorophyll molecule, these electrons are ~~are~~ gained by the reagent, reducing it and becoming colourless.

EXAMINER COMMENTARY

Both marks are awarded here for linking the loss of electrons from chlorophyll to the change in colour.

QUESTION

04.4

0 4 . 4 Some purple bacteria can photosynthesise, but use hydrogen sulfide instead of water. The hydrogen sulfide has a similar role to water in photosynthesis.

Suggest how the bacteria use hydrogen sulfide.

[3 marks]

MARK SCHEME

Question	Marking guidance	Mark	Comments
04.4	Any **three** from four		
	1. (hydrogen sulfide is) source of hydrogen/protons/H^+ and electrons/e^-;	1	
	2. (hydrogen/protons/H^+ used for) reduction of NADP/electron carrier;	1	2 Reject NAD 2. Accept production of NADPH/$NADPH_2$/reduced NADP
	3. (electrons) replace electrons lost from chlorophyll/pigment;	1	
	4. (protons) generate ATP;	1	
		3 max	

STUDENT A

0 4 . 4 Some purple bacteria can photosynthesise, but use hydrogen sulfide instead of water. The hydrogen sulfide has a similar role to water in photosynthesis.

Suggest how the bacteria use hydrogen sulfide.

[3 marks]

- the hydrogen sulfide is broken down by photolysis to make electrons
- these electrons are for the chlorophyll molecule which had lost electrons during the light dependent reaction
- replenishment of electrons for chlorophyll molecule

EXAMINER COMMENTARY

Two marks are awarded for the loss of electrons from the hydrogen sulfide and their use in replacing those lost from chlorophyll.

STUDENT B

0 4 . 4 Some purple bacteria can photosynthesise, but use hydrogen sulfide instead of water. The hydrogen sulfide has a similar role to water in photosynthesis.

Suggest how the bacteria use hydrogen sulfide.

[3 marks]

Splits the hydrogen sulfide molecule into electrons, protons using energy from light. (Photolysis). The electrons are used to replace the ones lost from the chlorophyll and the protons are used to reduce the NADP.

EXAMINER COMMENTARY

As well as describing the loss of electrons from the hydrogen sulfide and their use in replacing those lost from chlorophyll, this answer also links the loss of protons to the reduction of NADP. Therefore, three marks are scored.

QUESTION

05.2

0 5 . 2 A student interprets the results in **Table 2** and concludes that 20 °C is the optimum temperature for chicken growth.

Evaluate this conclusion.

[2 marks]

MARK SCHEME

Question	Marking guidance	Mark	Comments
05.2	(Yes) Highest mean growth rate and highest efficiency of conversion (to biomass);	1	Accept converse
	(No) No intermediate temperature (between 10 and 20, or between 20 and 30);	1	Do not accept temperatures below 10 or above 30

STUDENT A

0 5 . 2 A student interprets the results in **Table 2** and concludes that 20 °C is the optimum temperature for chicken growth.

Evaluate this conclusion.

[2 marks]

I agree ~~the~~ with this conclusion as the mean growth rate is at its highest and the efficiency of conversion of food to biomass is at its highest as well. begins to decrease higher than 20°C and is less under 20°C

EXAMINER COMMENTARY

Most candidates only scored one mark for this question, failing to give an argument against the conclusion. One mark is scored here for stating that the growth rate and efficiency are highest at this temperature.

STUDENT B

0 5 . 2 A student interprets the results in **Table 2** and concludes that 20 °C is the optimum temperature for chicken growth.

Evaluate this conclusion.

[2 marks]

at 20°C, the mean growth is at its highest and the conversion to biomass is also the highest.

EXAMINER COMMENTARY

Again, only one mark is awarded here.

QUESTION

05.5

0 5 . 5 Evaluate the use of cages for intensive chicken farming.

Use information from **Figure 4**.

[3 marks]

MARK SCHEME

Question	Marking guidance	Mark	Comments
05.5	1. Temperature kept at optimum for maximum efficiency of conversion of food to biomass;	1	1. Accept 'warm environment so less heat loss/so less energy needed to keep body warm.'
	2. Reduced movement/less muscle use so more energy available for production of biomass;	1	
	3. Use of data to show that 750cm^2 is insufficient space (e.g. Minimum length 30 cm and minimum wingspan 45 cm so need at least 1350cm^2);	1	
	4. Animal welfare – prevents natural behaviour / causes stress / debeaking to prevent pecking and cannibalism / lack of movement cause joint pain/problems;	1	4. Do not accept unqualified reference to cruelty / ethics 4. Accept psychological effect on chickens described e.g. having adverse effect on growth rate 4. Accept cages protect against predators
	5. Disease – (chickens are) close together so disease can spread easily/so have to add antibiotics to food;	1 3 max	

STUDENT A

0 5 . 5 Evaluate the use of cages for intensive chicken farming.

Use information from **Figure 4**.

[3 marks]

Unable to move as much therefore less energy is used for movement. Environments controlled, temperature is controlled, small confined spaces increase heat therefore less energy is converted to heat. Saves money as less food is converted to more biomass for food for humans. amounts of food given is controlled therefore less food waste occurs. cost effective

EXAMINER COMMENTARY

This answer concentrates only on the advantages and scores two marks for correct references to the control of temperature and restriction of movement.

STUDENT B

0 5 . 5 Evaluate the use of cages for intensive chicken farming.

Use information from **Figure 4**.

[3 marks]

The chickens are kept in cages to restrict their movement, so all the energy is converted into biomass and is not lost by respiration and muscle contraction. They are also kept close together to maintain their body temperature to prevent energy being used for it. However with such close proximity the chickens are more likely to pass on disease which reduces productivity.

EXAMINER COMMENTARY

As well as two advantages of using the cages, this candidate gives a disadvantage referring to the spread of disease. Therefore, all three marks are awarded.

QUESTION

06.1

0 6 Glucose is the main respiratory substrate used by cells.
The overall equation for the aerobic respiration of glucose is:

$$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$$

Oleic acid is a fatty acid. Fatty acids can be used as respiratory substrates.
The overall equation for the aerobic respiration of oleic acid is:

$$2C_{18}H_{34}O_2 + 51O_2 \rightarrow 36CO_2 + 34H_2O$$

0 6 . 1 Calculate the ratio of the respiratory quotient (RQ) for the aerobic respiration of oleic acid to the RQ for the aerobic respiration of glucose.

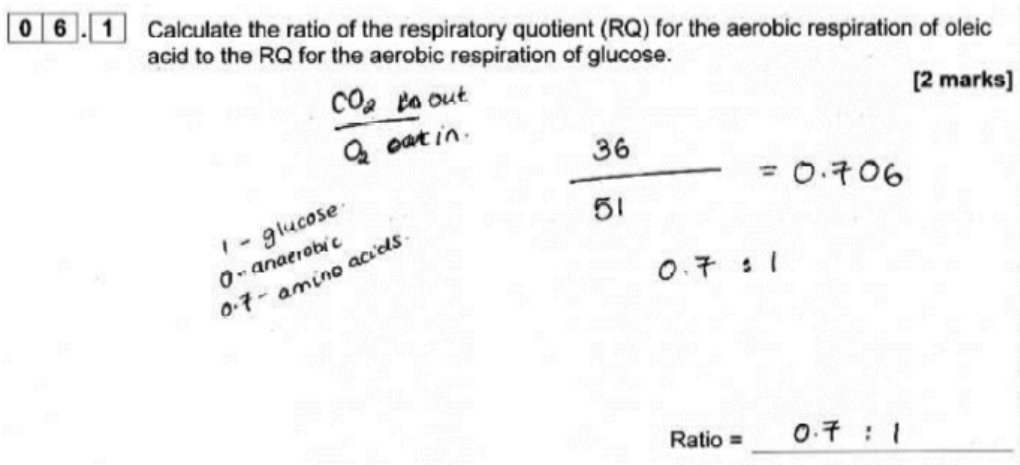
[2 marks]

Ratio = _____

MARK SCHEME

Question	Marking guidance	Mark	Comments
06.1	(36/51 =) 0.7/0.71; 0.7 : 1;	1 1	Calculation mark $\frac{36}{51}$ 1 mark for: 0.72 : 1 / 1 : 0.7 / 12 : 17

STUDENT A



0 6 . 1 Calculate the ratio of the respiratory quotient (RQ) for the aerobic respiration of oleic acid to the RQ for the aerobic respiration of glucose.

[2 marks]

$\frac{CO_2 \text{ given out}}{O_2 \text{ taken in}}$

1 - glucose
0 - anaerobic
0.7 - amino acids

$\frac{36}{51} = 0.706$

0.7 : 1

Ratio = 0.7 : 1

EXAMINER COMMENTARY

Two marks are awarded for the correct ratio in its simplest form.

STUDENT B

0 6 . 1 Calculate the ratio of the respiratory quotient (RQ) for the aerobic respiration of oleic acid to the RQ for the aerobic respiration of glucose. **[2 marks]**

oleic
RQ = $\frac{36}{51}$ = 0.7

glucose
RQ = $\frac{6}{6}$ = 1

Ratio = 0.7 : 1

EXAMINER COMMENTARY

Again, two marks are awarded.

QUESTION

06.3

Table 3 shows the relative energy values of carbohydrate and lipid.

Table 3

Respiratory substrate	Mean energy value / kJ g^{-1}
Carbohydrate	15.8
Lipid	39.4

0 6 . 3 Glucose is a carbohydrate with the chemical formula $C_6H_{12}O_6$

Oleic acid is a breakdown product of lipids. The chemical formula for oleic acid is $C_{18}H_{34}O_2$

Explain why cells gain more energy from lipid than from carbohydrate.

Use your knowledge of aerobic respiration.

[3 marks]

MARK SCHEME

Question	Marking guidance	Mark	Comments
06.3	1 More H in lipid/12H (in glucose) **and** 34H (in oleic acid); And any **two** from: 2 (More protons so) more reduced NAD/FAD / (more protons) move across inner mitochondrial membrane; 3 More ATP produced; 4 More electrons moving down the ETC;	1 1 1 1 3 max	Idea of 'more' needed once in whole answer 3. Must be in context of more reduced FAD/NAD or more protons moving

STUDENT A

0 6 . 3 Glucose is a carbohydrate with the chemical formula $C_6H_{12}O_6$

Oleic acid is a breakdown product of lipids. The chemical formula for oleic acid is $C_{18}H_{34}O_2$

Explain why cells gain more energy from lipid than from carbohydrate.

Use your knowledge of aerobic respiration.

[3 marks]

- lipids have a more larger molecule and more carbons which can under more oxidation and reduction mechanisms and substrate-level decarboxylation during the krebs cycle to provide energy for the addition of Pi to ADP (ADP + Pi ⟶ ATP).

EXAMINER COMMENTARY

No marks are awarded here. The production of ATP is referred to but not in the context of more reduced NAD or more proton movement.

STUDENT B

0 6 . 3 Glucose is a carbohydrate with the chemical formula $C_6H_{12}O_6$

Oleic acid is a breakdown product of lipids. The chemical formula for oleic acid is $C_{18}H_{34}O_2$

Explain why cells gain more energy from lipid than from carbohydrate.

Use your knowledge of aerobic respiration.

[3 marks]

As lipids are longer molecules they can store more energy. When the lipid splits it is a larger molecule than triose phosphates. There are more hydrogens that be used to reduce NAD and FAD to release energy.

EXAMINER COMMENTARY

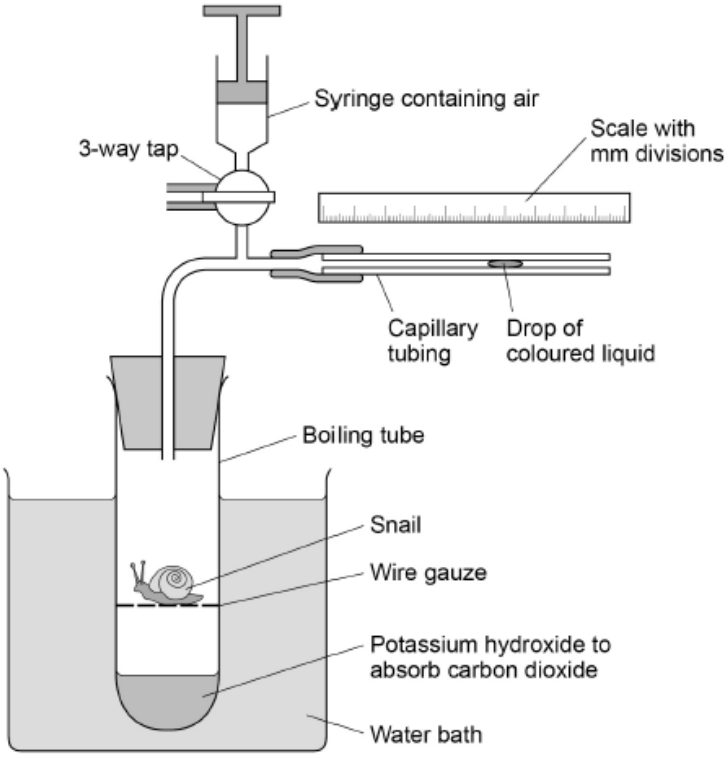
Two marks are awarded. One for realising that there are more hydrogen atoms in lipids and the second for linking that to NADH production.

QUESTION

07.1

0 7 A student investigates the effect of temperature on the rate of respiration of a snail. The student uses the apparatus shown in **Figure 6**.

Figure 6



0 7 . 1 Explain what would happen if the student replaced the potassium hydroxide with water.

[2 marks]

MARK SCHEME

Question	Marking guidance	Mark	Comments
07.1	drop of coloured liquid would not move;	1	
	(because) pressure/volume inside the boiling tube would not decrease;	1	Accept idea that oxygen = carbon dioxide Ignore effect of CO_2 on snail

STUDENT A

0 7 . 1 Explain what would happen if the student replaced the potassium hydroxide with water.

[2 marks]

carbon dioxide would not be absorbed and therefore water would ~~but~~ become full of CO_2 and bubble. Damage snail as it would breach CO_2

EXAMINER COMMENTARY

No marks awarded as the answer concentrates on the effect on the snail.

STUDENT B

0 7 . 1 Explain what would happen if the student replaced the potassium hydroxide with water.

[2 marks]

carbon dioxide will not be absorbed and the coloured liquid will not move as ~~oxygen is taken~~ the lost tube pressure doesn't decrease.

EXAMINER COMMENTARY

Both marks awarded here for the lack of movement linked to a correct reason.

QUESTION

07.2

0 7 . 2 The internal diameter of the capillary tubing is 1 mm
The drop of coloured liquid moves 30 mm in 10 minutes
The snail has a mass of 7 g

Calculate the rate of oxygen uptake in $mm^3\ g^{-1}\ hour^{-1}$

Volume of a cylinder = $\pi r^2 h$

Use $\pi = 3.14$. Give your answer to 3 significant figures.

[3 marks]

Rate of oxygen uptake = _____ $mm^3\ g^{-1}\ hour^{-1}$

MARK SCHEME

Question	Marking guidance	Mark	Comments
07.2	20.2;;;	3	Accept 20 / 20.1 / $\frac{\pi \times 3 \times 6}{4 \times 7}$ for 2 marks If incorrect answer, max 2 marks for: 1. Volume of oxygen calculated ($3.14 \times 0.5^2 \times 30$) = 23.55/23.56; 2. Volume per gram calculated (answer 1 ÷ 7) = 3.36/3.37 3. Volume per gram per hour calculated (answer 2 × 6) = 20.186/20.196; Volume calculated using $3.14 \times 0.5^2 \times 30$ or $3.14 \times 1^2 \times 30$ **and** divided by 7 = 1 mark

STUDENT A

0 7 . 2 The internal diameter of the capillary tubing is 1 mm
The drop of coloured liquid moves 30 mm in 10 minutes
The snail has a mass of 7 g

Calculate the rate of oxygen uptake in $mm^3\ g^{-1}\ hour^{-1}$

Volume of a cylinder = $\pi r^2 h$

Use π = 3.14. Give your answer to 3 significant figures.

[3 marks]

d ½ = 0.5
0 1mm
180

mm³ → 30 → x 6 = 180
g⁻¹ → 7g → 7g
hour⁻¹ → 10m → x 6 = 60

(π(0.5)²)180 = 141.3

141.3 / 7 = 20.186

Rate of oxygen uptake = 20.186 $mm^3\ g^{-1}\ hour^{-1}$

EXAMINER COMMENTARY

This answer calculates the rate correctly but finally fails to give the answer to the correct number of significant figures. Therefore, two marks are scored.

STUDENT B

0 7 . 2 The internal diameter of the capillary tubing is 1 mm
The drop of coloured liquid moves 30 mm in 10 minutes
The snail has a mass of 7 g

Calculate the rate of oxygen uptake in $mm^3\ g^{-1}\ hour^{-1}$

Volume of a cylinder = $\pi r^2 h$

Use $\pi = 3.14$. Give your answer to 3 significant figures.

$\pi \times 0.5^2 \times 180 = \frac{141.3}{7} = 20.18$ **[3 marks]**

Rate of oxygen uptake = 20.2 $mm^3\ g^{-1}\ hour^{-1}$

EXAMINER COMMENTARY

Here the rate is calculated correctly and is rounded to 3 sig figs so full marks are awarded.

QUESTION

07.3

A student investigates the effect of temperature on the rate of oxygen uptake in seashore snails. Seashore snails are covered with sea water at high tide and exposed to the air at low tide.

The student:

- measures the oxygen uptake of snails kept at different temperatures in moist air
- repeats the experiment using the same snails in different temperatures of sea water
- calculates the means and standard deviations for each temperature.

The student's results are shown in **Table 4**

Table 4

	Mean oxygen uptake of snails / $mm^3\ g^{-1}\ h^{-1}$ (± standard deviation)	
Temperature / °C	**In moist air**	**In seawater**
5	35 ± 2	28 ± 8
10	34 ± 6	32 ± 3
15	36 ± 3	35 ± 3
20	86 ± 8	52 ± 10
25	141 ± 13	96 ± 15
30	132 ± 14	108 ± 9
35	120 ± 16	79 ± 21

0 7 . 3 The student concludes that 25 °C is the optimum temperature for the rate of oxygen uptake.

Evaluate this conclusion.

[3 marks]

MARK SCHEME

Question	Marking guidance	Mark	Comments
07.3	(Yes) Oxygen uptake (significantly) higher in moist air at 25 °C than at 20°C;	1	Accept that temperatures between 20 and 25 / 25 and 30 not tested
	(No) oxygen uptake is not highest at 25 °C in seawater	1	Accept converse e.g. oxygen uptake is highest at 30°C in sea water Accept comparative use of figures from table
	No significant difference between 25, 30 and 35 °C in either experiment;	1	Must give all three temperatures Ignore 'standard deviations overlap' if no temperatures given

STUDENT A

0 7 . 3 The student concludes that 25 °C is the optimum temperature for the rate of oxygen uptake.

Evaluate this conclusion.

[3 marks]

the most acc
for ~~been~~ environment 25 °C is where the mean is at it's highest. After this temp the mean begins to decrease from 1.41 at 25 °C to 1.32 at 30 °C. In the seawater environment the mean is at it's highest at 30 °C then decreases when temp increases more and the standard deviation is less as the values that ~~th~~ at 25 °C and 35 °C therefore optimum for in seawater seems to be 30 °C whereas optimum in most acc is more 25 °C

EXAMINER COMMENTARY

A mark is awarded for realising that in seawater the mean is at its highest at 30°C rather than at 25. However, there are no references to the overlap in the standard deviations at 25, 30 and 35°C.

STUDENT B

0 7 . 3 The student concludes that 25 °C is the optimum temperature for the rate of oxygen uptake.

Evaluate this conclusion.

[3 marks]

At 25 °C the mean rate is at its highest ~~for~~ in moist air but the mean rate in seawater at 25°C is not the highest. The standard deviations overlap, ~~a~~ which means there is no ~~ot~~ significant difference.

EXAMINER COMMENTARY

Again, a mark is scored for realising that in seawater the mean is not at its highest at 25°C. There are references to overlap of standard deviations but the answer does not give the temperatures at which this occurs.

QUESTION

0 8 Open pit mining is a technique used to extract copper ore near the surface of the earth.

After mining finishes, the pit is filled in and the soil is replaced.

0 8 . 1 Over time, succession occurs and the ecosystem around an old copper mine changes.

Describe and explain these changes.

[6 marks]

MARK SCHEME

Question	Marking guidance	Mark	Comments
08.1	1. (Colonisation by) pioneer (species);	1	1. accept reference to correct example of pioneer species e.g. moss, lichen
	2. (Pioneer species cause) change in environment/(cause) change in abiotic conditions;	1	2. Accept an example of change caused by pioneer species eg produce soil
	3. Environment becomes less hostile / abiotic conditions become more favourable;	1	
	4. (Change to environment/abiotic conditions allow) new species colonise / pioneer species outcompeted;	1	
	5. Change in biodiversity (during succession);	1	5. Accept increase in biodiversity (early to mid succession) and decrease in biodiversity (mid succession to climax community) as long as correct context
	6. (Final stage of succession is) climax community;	1	

STUDENT A

0 8 . 1 Over time, succession occurs and the ecosystem around an old copper mine changes.

Describe and explain these changes.

[6 marks]

Succession is a change in a species ~~and habitat~~ over a long period of time due to a ~~natural~~ change in there habitat. The change in this habitat is the ~~deer~~ removal of copper from the surface of the earth and replacing with soil. Succession to species living amongst this change will occur. Copper can be harmful to species therefore species which lived there may have been unable to flourish due to copper being present however since replaced with soil, a more favourable environment species may be able to flourish and ~~repo~~ population size may increase and new/different traits will be favoured because of the environmental change therefore overtime these traits will become more popular/survive and the population ~~of~~ of the species will change.

EXAMINER COMMENTARY

This answer discusses changes in general terms but there are no references to specific stages of succession or the organisms involved. One mark is awarded for the reference to a more favourable environment being created which is marking point 3.

STUDENT B

0 8 . 1 Over time, succession occurs and the ecosystem around an old copper mine changes.

Describe and explain these changes.

[6 marks]

- after mining, the soil is deprived of mineral ions and so is difficult for the plants to survive.
- colonisation of a pioneer species. The pioneer species is able to fix nitrogen in the air to make ammonium ions for the soil and replenish its nutrients. The pioneer species rapidly germinate and grow, whilst making the soil fertile again
- the ecosystem becomes less hostile as the soil is more suitable for other species to live.
- the new species outcompete the pioneer species.
- the biodiversity of the ecosystem increases and food chains become more complex.
- climax community is established

EXAMINER COMMENTARY

Each of the marking points are given in this answer in a clear and sequenced way. Full marks were awarded.

QUESTION

08.2

0 8 . 2 Soil around old copper mines has a high concentration of copper ions.
Copper ions are toxic to many plant species.
Some species of grass have developed a high tolerance to copper ions and grow readily in the soil around copper mines.

Explain how natural selection could produce a population of copper-tolerant grass.
[4 marks]

MARK SCHEME

Question	Marking guidance	Mark	Comments
08.2	1. genetic variation present (in original population) OR (Random) mutation	1	
	2. (copper) tolerant individuals more likely to survive/to reproduce;	1	2. Answer must refer to tolerance, not just a generic answer
	3. (these reproduce and) pass on (tolerance) allele(s)/gene(s) (to next generation/to offspring);	1	3. Do not accept 'pass on traits', must be in context of genes/alleles
	4. more/increase (in frequency) of copper tolerance allele(s)/gene(s);	1	4. Must be linked to allele(s)/gene(s) for copper tolerance, not a generic response

STUDENT A

0 8 . 2 Soil around old copper mines has a high concentration of copper ions.
Copper ions are toxic to many plant species.
Some species of grass have developed a high tolerance to copper ions and grow readily in the soil around copper mines.

Explain how natural selection could produce a population of copper-tolerant grass.
[4 marks]

Do not write outside the box

Environments such as high concentration of copper can be toxic, However gene mutations and adaptations of species may give them traits, such as high copper ion tolerance to survive, these traits will enable them to survive be referred as unfavourable conditions and those with those mutations and adaptations to survive and reproduce and those without to not survive of reproduce. Those with favourable traits may be able to pass on the favourable traits to offspring. so then the population overtime will have a higher tolerance to copper. as those surviving and reproducing are those with a copper tolerence. & gene pool decrease. directional change favouring one trait.

EXAMINER COMMENTARY

A mark is awarded for reference to mutations and another for stating that this allows the organisms to survive. However, no other marks are scored as there are no references to alleles or genes being passed on.

STUDENT B

0 8 . 2 Soil around old copper mines has a high concentration of copper ions.
Copper ions are toxic to many plant species.
Some species of grass have developed a high tolerance to copper ions and grow readily in the soil around copper mines.

Explain how natural selection could produce a population of copper-tolerant grass.
[4 marks]

- grass species start developing resistant genes to the copper ions.
- individuals with this gene survive and reproduce more whilst other grass die
- the adaptive gene is passed on to the offspring and the following generation increasing the frequency of the gene

EXAMINER COMMENTARY

Although there is no reference to mutation this candidate scores three marks as there is reference to the genes being passed on and a change in frequency in the population.

QUESTION

08.3

0 8 . 3 Copper-tolerant grass produces its flowers earlier in the year than non-tolerant grass of the same species.

Explain how this might produce two different species of grass.

[5 marks]

MARK SCHEME

Question	Marking guidance	Mark	Comments
08.3	1. (populations are) reproductively isolated/no interbreeding (due to different flowering times);	1	1. Accept description of reproductive isolation
	2. (so) no flow of alleles/genes between the populations / separate gene pools / different (random) mutations in each group;	1	
	3. different selection pressures;	1	
	4. type/frequency of alleles will change/gene pools will change;	1	
	5. (genetic differences lead to) members of populations become unable to (interbreed and) produce fertile offspring;	1	5. Accept converse e.g. interbreeding produces infertile offspring

STUDENT A

0 8 . 3 Copper-tolerant grass produces its flowers earlier in the year than non-tolerant grass of the same species.

Explain how this might produce two different species of grass.

[5 marks]

geographical changes such as copper on ground may cause changes to species overtime. Copper-tolerant grass produce flowers earlier on the year, there genes show different traits to those which aren't copper tolerant and produce later. A species must be able to reproduce to get fertile offspring, and must have similar genes. If overtime the genes become so different the species may seperate to become 2 due to the difference in genes. Allele frequency of non copper tolerence may decrease.

EXAMINER COMMENTARY

Only one mark is awarded here for the change in the genes in the population over time.

STUDENT B

0 8 . 3 Copper-tolerant grass produces its flowers earlier in the year than non-tolerant grass of the same species.

Explain how this might produce two different species of grass.

[5 marks]

- Sympatric Speciation.
- differences in the genes and alleles become so significant that the grass species become two different species and are unable to produce fertile offspring
- the grass species and flowers become exposed to different abiotic factors and thus have different adaptations which causes certain mutations in the alleles. Grass with this allele survive and reproduce.

EXAMINER COMMENTARY

Exposure to different abiotic factors was awarded a mark for the implication of different selection pressures. A second mark is awarded for interbreeding being unable to produce fertile offspring.

FURTHER GUIDANCE AND CONTACTS

You can contact the subject team directly at science@oxfordaqaexams.org.uk

Please note: We aim to respond to all email enquiries within two working days.

Our UK office hours are Monday to Friday, 8am – 5pm local time.

OXFORD INTERNATIONAL AQA EXAMINATIONS
GREAT CLARENDON STREET, OXFORD, OX2 6DP
UNITED KINGDOM

enquiries@oxfordaqaexams.org.uk
oxfordaqaexams.org.uk