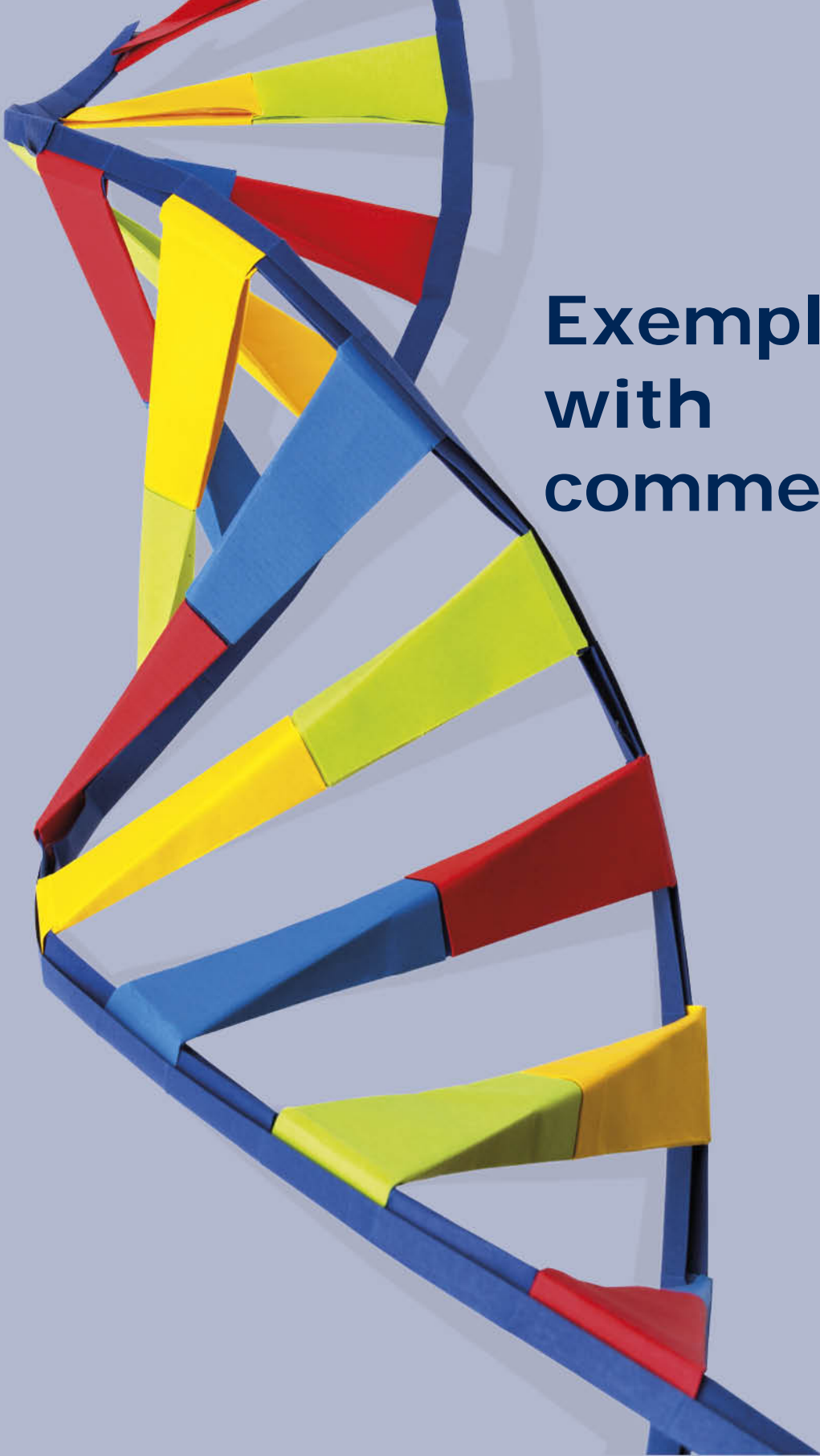


Exemplar work with commentary



GCSE (9-1) Biology

Pearson Edexcel Level 1/Level 2 GCSE (9-1) in Biology (1BI0)

GCSE (9–1) Biology Exemplars

Contents

Introduction	2
Practical skills	1
Combined Science (Foundation)	1
Combined Science (Higher)	8
Maths skills	16
Combined Science (Foundation)	16
Combined Science (Higher)	22
Separate Biology (Higher)	27
Extended open response	30
Combined Science (Foundation)	30
Combined Science (Higher)	33
Separate Biology (Higher)	35
Other examples	40
Combined Science (Foundation)	40
Combined Science (Higher)	41
Separate Biology (Higher)	43

Introduction

This guide has been put together using student responses to our sample assessment materials in GCSE (9-1) Biology. We have grouped the answers according to the overall themes that developed through the marking process, and hope that this will give you more information on key development areas for students studying for this qualification.

The assessment of practical skills covers both knowledge of core practicals, and candidates' ability to apply that knowledge to new contexts, or to apply investigative skills to scenarios presented in the examinations. These scientific enquiry skills are something candidates will need to practice, such as questions which focus on knowledge and understanding of specific methods in practicals and drawing conclusions based on practical work. It is important to note that questions set in a practical context but testing the theoretical knowledge and understanding will not count towards the 15% marks allocated to practical skills. Questions that are assigned to this percentage will be ones where candidates are at an advantage if they have carried out the core practical.

There is a set percentage of maths marks (10%) to be met in these papers. When looking at maths content to be assessed, there are two factors that need to be considered. Firstly, the breadth of maths to be covered (which can be found in Appendix 1 in the specification) and secondly the level of maths as specified by Ofqual. In general, candidates will need to practice answering maths questions in the same way as they do now. Practicing answering these types of questions will help to minimise the minor calculation errors or mistakes that are made. It is also important to highlight the importance of checking their answers, particularly when reading data from a graph or table, using an equation to substitute given numbers in a question, or giving answers to a set number of significant figures.

The extended open response questions (6 mark questions) test candidates' ability to construct a sustained line of reasoning. Questions assessing this are marked with an asterisk. As these items are more open ended, they are marked using a levels-based mark scheme. Our 2011 qualifications contained 6 mark questions, and candidates generally respond well to them. The general areas to develop and focus on when answering these questions are still focused on ensuring candidates answer the whole question and are able to make links both using information given in the question, and using their own knowledge. They should be able to draw conclusions, and make arguments or analyse information (backed up with their own knowledge) if the question requires it.

The question examples in this guide will give you a range of answers relating to the themes highlighted above to show you the varied answers candidates may give. There are also detailed examiner comments for each answer to explain how the marks have been allocated, and the merits or development points for each answer.

Practical skills

Combined Science (Foundation)

Example 1 - Question 1b

A scientist investigates the effect of light intensity on photosynthesis.

He sets up the equipment shown in Figure 1.

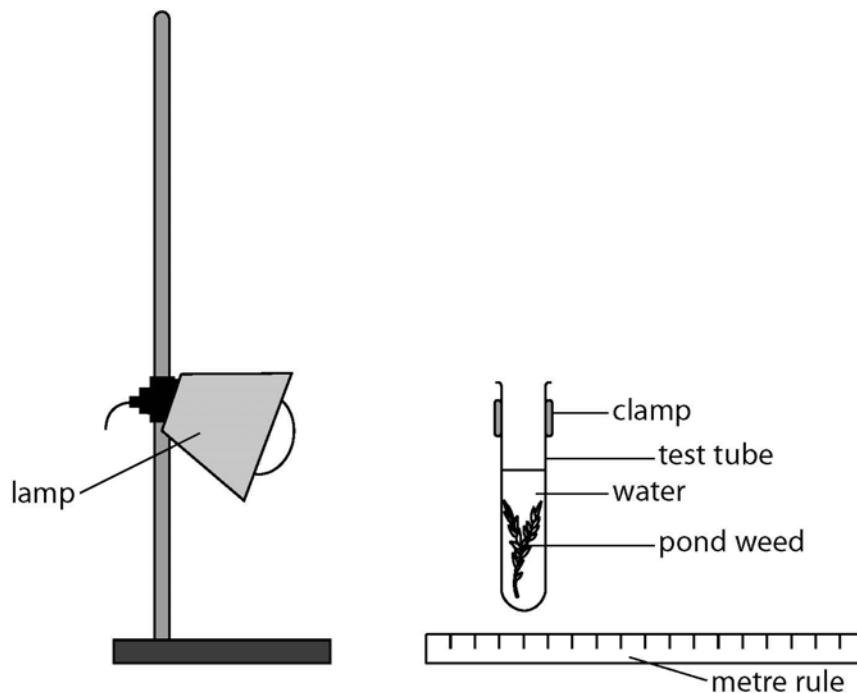


Figure 1

He places the lamp 10cm from the test tube and records the number of bubbles produced in five minutes.

He repeats the procedure with the lamp at a distance of 20cm and 30cm away from the test tube.

The scientist wants to repeat his investigation at each distance.

(b) (i) State **three** variables that should be kept constant to improve the results.

(3)

The scientist noticed that the temperature of water near the light increased.

(ii) Give **one** improvement the scientist could make to reduce the effect of this increase in temperature.

(1)

Mark scheme

Question number	Answer	Mark
1(b)(i)	<ul style="list-style-type: none"> temperature of water (1) start each experiment with the same amount of carbon dioxide (1) start each experiment with the same amount of water (1) 	(3)

Question number	Answer	Mark
1(b)(ii)	Any one improvement from: <ul style="list-style-type: none"> use a heat shield (1) use a water bath (1) 	(1)

Student answers to part (i)

(b) (i) State **three** variables that should be kept constant to improve the results.

(3)

- 1 Number of bubbles produced
- 2 Measurement
- 3 Timer-how long it will take to get a full set of data.

Examiner's comments

The candidate has confused variables with outcomes and given the number of bubbles produced as a variable to keep constant, which is incorrect. Measurement is too vague and time has already been stated in the question. Mark awarded = 0

(b) (i) State **three** variables that should be kept constant to improve the results.

(3)

- 1 Keep the time the same at 5 minutes
- 2 Keep the lamp at the same height.
- 3 Use the same test tube.

Examiner's comments

The mark scheme listed three variables for three marks; however, several other variables were also accepted and would gain marks. The variable accepted here

Practical skills

is keeping the lamp at the same height. The first one has been stated in the question. The third one is a weak answer.

Mark awarded = 1

(b) (i) State **three** variables that should be kept constant to improve the results.

(3)

1 The height of lamp

2 Volume of the water

3 amount of Pond weed

Examiner's comments

This candidate has scored all three marks as he has correctly stated three variables to be kept constant.

Mark awarded = 3

Student answers to part (ii)

The scientist noticed that the temperature of water near the light increased.

(ii) Give **one** improvement the scientist could make to reduce the effect of this increase in temperature.

(1)

put the test tube in a water bath
before using it so that there are all the same
temperature.

Examiner's comments

This is an example of a good response. The candidate has scored 1 mark.

Mark awarded = 1

The scientist noticed that the temperature of water near the light increased.

(ii) Give **one** improvement the scientist could make to reduce the effect of this increase in temperature.

(1)

Keep the lamp further away

Examiner's comments

The candidate stated 'keep the lamp further away', which would reduce the temperature; however, the experiment involves moving the lamp away so this would affect the outcome so no marks awarded.

Mark awarded = 0

Example 2 - Question 1c (ii)-(iii)

The number of bubbles counted for test 2 at 10 cm was anomalous.

(ii) State how the scientist could deal with this anomaly.

(1)

(iii) Give a conclusion about the effect of light intensity on photosynthesis.

(1)

Mark scheme

Question number	Answer	Mark
1(c)(ii)	repeat the reading to get concordant results/calculate the mean without the anomalous result	(1)

Question number	Answer	Mark
1(c)(iii)	{as light intensity decreases/distance from the lamp increases} the rate of photosynthesis decreases	(1)

Student answers to part (ii)

The number of bubbles counted for test 2 at 10 cm was anomalous.

(ii) State how the scientist could deal with this anomaly.

(1)

re-do the test.

Examiner's comments

The response is insufficient. The candidate needs to say that he will repeat the test until the readings are concordant or very similar in order to get the mark.

Mark awarded = 0

Practical skills

The number of bubbles counted for test 2 at 10cm was anomalous.

(ii) State how the scientist could deal with this anomaly.

(1)

Not include it in the mean

Examiner's comments

Not included in the mean, which is sufficient for calculating the mean without the anomalous result.

Mark awarded = 1

Student answers to part (iii)

(iii) Give a conclusion about the effect of light intensity on photosynthesis.

(1)

The further the light moves from the plant less oxygen produced.

Examiner's comments

Although the question asks about the rate of photosynthesis, this answer is still correct, although it refers to the amount of oxygen produced.

Mark awarded = 1

(iii) Give a conclusion about the effect of light intensity on photosynthesis.

(1)

The effect of light intensity on photosynthesis is very important because with no light that means no photosynthesis.

(Total for Question 1 = 8 marks)

Examiner's comments

This candidate has not answered the question as he is referring to a lack of light intensity, therefore he scores 0.

Mark awarded = 0

(iii) Give a conclusion about the effect of light intensity on photosynthesis.

(1)

As the distance increased
the number of bubbles decreased as
it took more time to carry out
photosynthesis.

(Total for Question 1 = 8 marks)

Examiner's comments

It is likely that candidates will be asked to make judgements and draw conclusions. This candidate has given a correct conclusion.

Mark awarded = 1

Example 3 - Question 9b

(b) Dieting can reduce the effects of cardiovascular disease.

A scientist is planning to test a new diet for weight loss.

She selects 40 obese people to take part in the test.

All the obese people are between 20 and 30 years of age.

(i) State **two** other factors the scientist should control when selecting the people.

(2)

(ii) Devise a plan the scientist could use to test the effectiveness of the new diet using the 40 obese people.

(3)

Mark scheme

Question number	Answer	Mark
9(b)(i)	Any two of the following points: <ul style="list-style-type: none"> • similar BMI (1) • same gender profile (1) • similar amount (and type) of exercise (1) 	(2)

Question number	Answer	Mark
9(b)(ii)	An answer that combines the following points to provide a plan: <ul style="list-style-type: none"> • weigh the 40 obese people (1) • half follow the new diet and half keep their normal diet (1) • after a fixed time period re-weigh the 40 people (1) 	(3)

Student answers to part (i)

(b) Dieting can reduce the effects of cardiovascular disease.

A scientist is planning to test a new diet for weight loss.

She selects 40 obese people to take part in the test.

All the obese people are between 20 and 30 years of age.

(i) State **two** other factors the scientist should control when selecting the people.

(2)

The ages should be close to one similar to each other. Also there should be a fair amount of people.

Examiner's comments

The candidate has missed the point that the age range was stated in the question and statements like 'a fair amount' are too vague. This answer scored 0.

Mark awarded = 0

Student answers to part (ii)

(ii) Devise a plan the scientist could use to test the effectiveness of the new diet using the 40 obese people.

(3)

weigh them at the start, give them the new diet for 1 month. Finally, weigh them at the end of the month and calculate the difference and see how many people were positively effected by the diet.

Examiner's comments

This candidate has correctly deduced that the people need to be weighed at the start and then again at the end; however, they did not distinguish between those on the new diet and those eating normally.

Mark awarded = 2

Combined Science (Higher)

Example 1 - Question 5a

This question illustrates the importance of completing core practicals, as candidates who have done this experiment will find the answering of the questions much more straightforward.

- 5 Diffusion, active transport and osmosis can be used to move substances into and out of cells.

(a) A student was investigating osmosis in potato cubes.

He used the following method:

cut a potato into equal-sized cubes

- record the mass of each potato cube
- place each potato cube into different concentrations of salt solution
- remove the potato cubes after 30 minutes
- dry the potato cubes and record the final mass of each cube.

He plots his results on a graph shown in Figure 6.

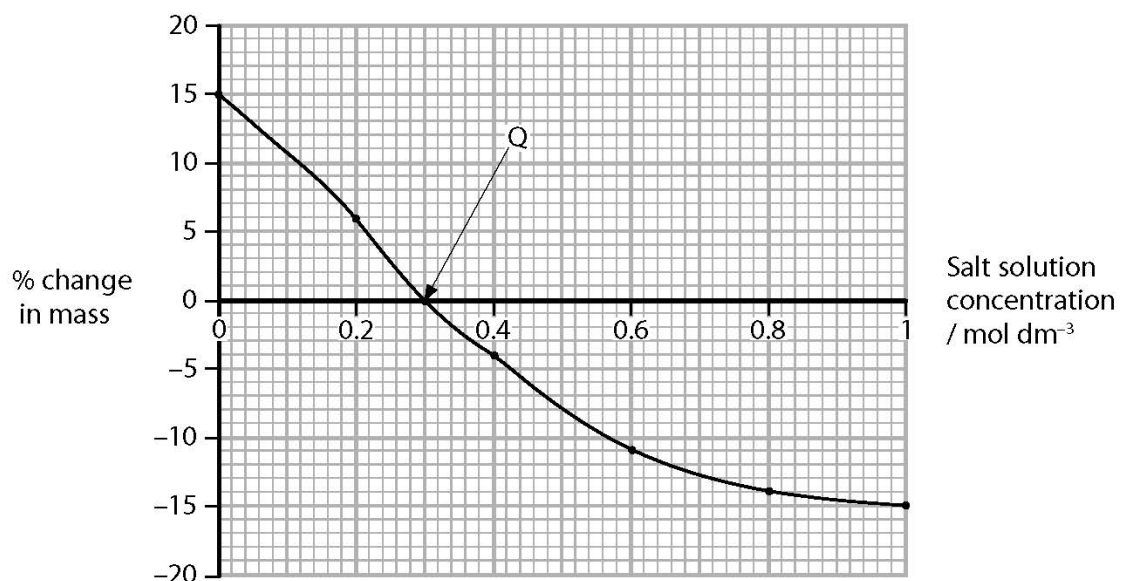


Figure 6

The method controls a number of variables.

- (i) Name **one** other variable that needs to be controlled during the student's investigation.

(1)

- (ii) Give a reason why the potato cube must be dried.

(1)

Practical skills

(iii) Explain the conclusion that can be made about point Q on Figure 6. (2)

(iv) Give one way that the student could obtain more data to increase the accuracy of point Q. (1)

Mark scheme

Question number	Answer	Mark
5(a)(i)	Any one variable from <ul style="list-style-type: none"> • temperature • amount of drying • type of potato • age of potato 	(1)

Question number	Answer	Mark
5(a)(ii)	To get an accurate reading of mass	(1)

Question number	Answer	Mark
5(a)(iii)	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (1 mark): any one identification point from: <ul style="list-style-type: none"> • there is no change in mass at 0.3 mol dm^{-3} (check once drawn) (1) • this is the isotonic salt concentration in the potato (1) Plus reasoning/justification <ul style="list-style-type: none"> • because there is no net movement of water/no salt concentration gradient (1) 	(2)

Question number	Answer	Mark
5(a)(iv)	<ul style="list-style-type: none"> • repeat the test using intermediate concentrations (between 0.2 and 0.4 mol dm^{-3}) 	(1)

Student answers to part (i)

(i) Name **one** other variable that needs to be controlled during the student's investigation.

(1)

Volume of salt solution

Examiner's comments

The volume of the salt solution was not stated in the method and was not in the mark scheme but is a valid variable to control.

Marks awarded = 1

Student answers to part (ii)

(ii) Give a reason why the potato cube must be dried.

(1)

Water that is still on the
cube may add to mass. So by
drying it the cube will have an
accurate mass.

Examiner's comments

A good answer which gives the reason why the potato cube is dried.

Marks awarded = 1

Student answers to part (iii)

(iii) Explain the conclusion that can be made about point Q on Figure 6.

(2)

It could be concluded that at a concentration
of 0.3 mol dm^{-3} , there is no change in the
mass of the potato cube.

Examiner's comments

This candidate gains 1 mark for identifying the point at which there is no change in the mass of the potato cube but they do not give justification of this conclusion so can only score 1 mark.

Marks awarded = 1

(iii) Explain the conclusion that can be made about point Q on Figure 6.

(2)

At point Q, the salt solution concentration
was at 0.3 mol dm^{-3} and at this concentration
there was 0% percentage change in the
mass of the potato, meaning no osmosis took
place at this concentration.

Examiner's comments

This candidate has given a clear answer, including both identification of Point Q and the reasoning behind this conclusion.

Marks awarded = 2

Student answers to part (iv)

(iv) Give one way that the student could obtain more data to increase the accuracy of point Q.

(1)

Include a larger range of salt ~~solution~~
solution.

Examiner's comments

This answer is too vague to score the mark.

Marks awarded = 0

(iv) Give one way that the student could obtain more data to increase the accuracy of point Q.

(1)

Test concentrations around 0.3 mol dm^{-3}
e.g. 0.29 mol dm^{-3} .

Examiner's comments

This scores 1 mark for extending the range around 0.3.

Marks awarded = 1

(iv) Give one way that the student could obtain more data to increase the accuracy of point Q.

(1)

repeat the experiment.
to get a reliable

Examiner's comments

Repeat the experiment is insufficient for the mark. They need to repeat in the specific region.

Mark awarded = 0

Example 2 - Question 5a (ii)-(iv)

- 5 A scientist investigated the effect of light intensity on the rate of photosynthesis of the aquatic *Cabomba* plant.

A lamp was used as a source of light. The lamp was placed at different distances (d) from the *Cabomba* plant, and the number of bubbles produced in 60 seconds was counted.

The number of bubbles produced in 60 seconds was used to calculate the rate of photosynthesis.

The light intensity was then calculated using the inverse square law $\left(\frac{1}{d^2}\right)$.

Figure 10 shows the scientist's results.

distance (d) of lamp from <i>Cabomba</i> (cm)	light intensity (arbitrary units)	bubbles produced in 60 seconds
5	0.0400	79
10	0.0100	21
15	0.0044	12
20	0.0025	7
25		5
30	0.0011	4

Figure 10

- (ii) Use information from Figure 10 to describe the effect of light intensity on the rate of photosynthesis.

(2)

- (iii) Give another method of measuring light intensity rather than calculating it.

(1)

- (iv) The scientist counted the number of bubbles produced by the *Cabomba* plant.

Another scientist stated that this was not the best method of measuring the volume of gas produced.

Explain how you could improve the method to measure the volume of gas released more accurately.

(2)

Mark scheme

Question number	Answer	Mark
5(a)(ii)	An answer that combines points of interpretation/evaluation to provide a logical description: <ul style="list-style-type: none"> as light intensity decreases the rate of photosynthesis also decreases (1) after 20 cm away when light intensity appears to have little effect on the rate of photosynthesis (1) 	(2)

Question number	Answer	Mark
5(a)(iii)	use a light meter/lux meter	(1)

Question number	Answer	Additional guidance	Mark
5(a)(iv)	An explanation that combines identification – improvement of the experimental procedure (1 mark) and justification/reasoning which must be linked to the improvement (1 mark): <ul style="list-style-type: none"> collect the gas/oxygen produced in a graduated gas syringe (1) to reduce the errors generated when counting bubbles which maybe of different sizes (1) 	accept alternative gas collection method with measuring cylinder and beehive shelf accept leave the apparatus for a longer amount of time	(2)

Student answers to part (ii)

(ii) Use information from Figure 10 to describe the effect of light intensity on the rate of photosynthesis.

(2)

The information suggests that the more intense the light, the more bubbles were produced, hereby increasing the rate of photosynthesis.

Examiner's comments

The candidate has correctly linked the light intensity to rate of photosynthesis and scored 1 mark but has not stated that the number of bubbles produced in 60 seconds does not decline at the same rate as distance increases.

Marks awarded = 1

Student answers to part (iii)

(iii) Give another method of measuring light intensity rather than calculating it.

(1)

Count the number of bubbles made every 60 seconds

Examiner's comments

This candidate has stated to count the number of bubbles. This would be a method of measuring photosynthesis rather than a method of measuring light intensity.

Marks awarded = 0

(iii) Give another method of measuring light intensity rather than calculating it.

(1)

Using a light meter.

Examiner's comments

This candidate correctly identified that light intensity could be measured using a light meter.

Marks awarded = 1

Student answers to part (iv)

(iv) The scientist counted the number of bubbles produced by the *Cabomba* plant.

Another scientist stated that this was not the best method of measuring the volume of gas produced.

Explain how you could improve the method to measure the volume of gas released more accurately.

You can attach a syringe. As the ^{gases} bubbles are produced, the syringe will be pushed out. The distance the syringe moves can show how much gas has been produced.

(2)

Examiner's comments

The candidate has correctly identified that a gas syringe could be used but has not gone on to explain how this would improve the accuracy.

Marks awarded = 1

Example 3 - Question 5b

distance (<i>d</i>) of lamp from <i>Cabomba</i> (cm)	light intensity (arbitrary units)	bubbles produced in 60 seconds
5	0.0400	79
10	0.0100	21
15	0.0044	12
20	0.0025	7
25		5
30	0.0011	4

Figure 10

(b) Explain what would happen to the levels of gas produced if the light intensity decreased to 0.0001 arbitrary units.

(2)

Mark scheme

Question number	Answer	Mark
5(b)	An explanation that combines identification via a judgment (1 mark) to reach a conclusion via justification/reasoning (1 mark): <ul style="list-style-type: none"> the volume of gas produced would decrease to below four bubbles (1) because light is needed for photosynthesis (1) 	(2)

Student answers

(b) Explain what would happen to the levels of gas produced if the light intensity decreased to 0.0001 arbitrary units.

(2)

Photosynthesis may not occur or if it does only 1 bubble would be produced, showing light intensity is a major part of photosynthesis.

Examiner's comments

This candidate has correctly identified that the volume of gas produced would be lower than 4 bubbles and has gone on to explain that light intensity is a major part of photosynthesis.

Marks awarded = 2

Maths skills

Combined Science (Foundation)

Example 1 - Question 1ci

(c) Figure 2 shows the results of the investigation.

distance (cm)	number of bubbles counted			
	test 1	test 2	test 3	mean
10	42	37	44	41
20	23	24	22	
30	10	11	12	11

Figure 2

(i) Calculate the mean result for a distance of 20 cm.

(1)

Mark scheme

Question number	Answer	Additional guidance	Mark
1(c)(i)	<ul style="list-style-type: none"> • $\frac{23 + 24 + 22}{3}$ (1) • $69 \div 3 = 23$ (1) 	award full marks for correct numerical answer without working	(1)

Student answers

Maths skills

(c) Figure 2 shows the results of the investigation.

distance (cm)	number of bubbles counted			
	test 1	test 2	test 3	mean
10	42	37	44	41
20	23	24	22	
30	10	11	12	11

Figure 2

(i) Calculate the mean result for a distance of 20cm.

~~23 + 24~~ $23 + 24 + 22 = 69$

$$69 \div 3 = 23$$

(1)

23

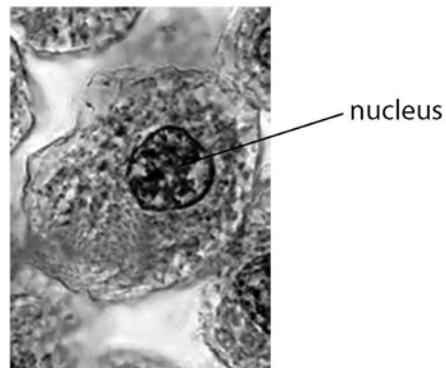
Examiner's comments

Students should be reminded whenever doing a calculation that it is important to show how they came to the answer. This is an example of a good answer.

Mark awarded = 1

Example 2 - Question 4b

Figure 7 shows an image of an animal cell taken using a microscope with a 10× eyepiece lens and a 40× objective lens.



(Source: © Ed Reschke/Getty Images)

Figure 7

(b) (i) The total magnification of the animal cell is (1)

- A** ×50
- B** ×140
- C** ×400
- D** ×4000

(ii) The diameter of the cell is 15 μm.

Use Figure 7 to estimate the diameter of the cell nucleus. (1)

diameter of nucleus = μm

(iii) Give the measurement of 15 μm in mm. (1)

..... mm

Mark scheme

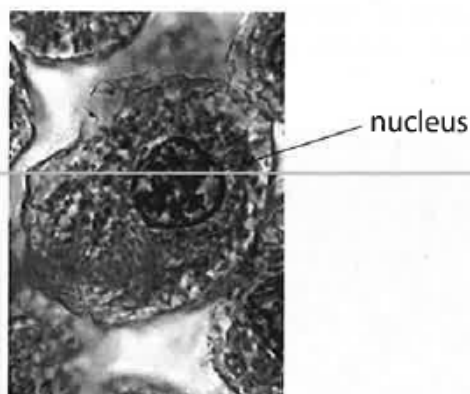
Question number	Answer	Mark
4(b)(i)	C	(1)

Question number	Answer	Additional guidance	Mark
4(b)(ii)	$5\ (\mu\text{m}) \pm 1.5$	approximately a third of the diameter of the cell	(1)

Question number	Answer	Mark
4(b)(iii)	0.015 (mm)	(1)

Student answers to part (i)

Figure 7 shows an image of an animal cell taken using a microscope with a 10× eyepiece lens and a 40× objective lens.



(Source: © Ed Reschke/Getty Images)

Figure 7

(b) (i) The total magnification of the animal cell is

(1)

- A ×50
- B ×140
- C ×400
- D ×4000

Examiner's comments

Magnification calculations are expected in this specification. Candidates would need to know that the right answer was eyepiece x objective lens, as all of the distractors could be calculated using the numbers given. This candidate has selected the correct answer.

Mark awarded = 1

Student answers to part (ii)

(ii) The diameter of the cell is $15\ \mu\text{m}$.

Use Figure 7 to estimate the diameter of the cell nucleus.

$15 \div 3 = 5$ (about a $\frac{1}{3}$ of the cell) (1)
 diameter of nucleus = 5 μm

Examiner's comments

This candidate has correctly estimated the diameter of the cell nucleus to be about a third of the cell so divided 15 by 3. The use of a photo micrograph or diagram which candidates use to estimate or measure is a required skill.

Mark awarded = 1

Student answers to part (iii)

(iii) Give the measurement of $15\ \mu\text{m}$ in mm.

(1)

0.015 mm

Examiner's comments

The ability to convert from one unit to another is a required skill.

Mark awarded = 1

Example 3 - Question 9a

9 The ratio of waist-to-hip measurements can be used to determine the risk of a person developing cardiovascular disease.

(a) Calculate the waist-to-hip ratio for a person with a waist measurement of 830 mm and a hip measurement of 0.99 m.

Give your answer to two decimal places.

(2)

Mark scheme

Question number	Answer	Additional guidance	Mark
9(a)	<ul style="list-style-type: none"> 830 mm = 0.83 m (1) $0.83/0.99 = 0.8383... = 0.84$ to two d.p. (1) <p>OR</p> <ul style="list-style-type: none"> 0.99 m = 990 mm (1) $830/990 = 0.8383... = 0.84$ to two d.p. (1) <p>Answer must be given to 2 decimal places</p>	award full marks for correct numerical answer without working	(2)

Student answers

9 The ratio of waist-to-hip measurements can be used to determine the risk of a person developing cardiovascular disease.

(a) Calculate the waist-to-hip ratio for a person with a waist measurement of 830 mm and a hip measurement of 0.99 m.

Give your answer to two decimal places.

(2)

$$830 \div 0.99 = 838.38384$$

Answer = 838.38384

Examiner's comments

This candidate has said he's dividing the 830 mm by 0.99. He should have calculated 830mm as 0.83m. His answer is also not to 2 decimal places, so he misses both marks. Candidates should be aware that they are expected to identify the units used and where necessary to convert them to the same unit before doing the calculation.

Marks awarded = 0

9 The ratio of waist-to-hip measurements can be used to determine the risk of a person developing cardiovascular disease.

(a) Calculate the waist-to-hip ratio for a person with a waist measurement of 830 mm and a hip measurement of 0.99 m.

Give your answer to two decimal places.

$$\frac{0.83\text{m}}{0.99\text{m}} = 0.8383838384 \quad (2)$$

Answer = 0.84

Examiner's comments

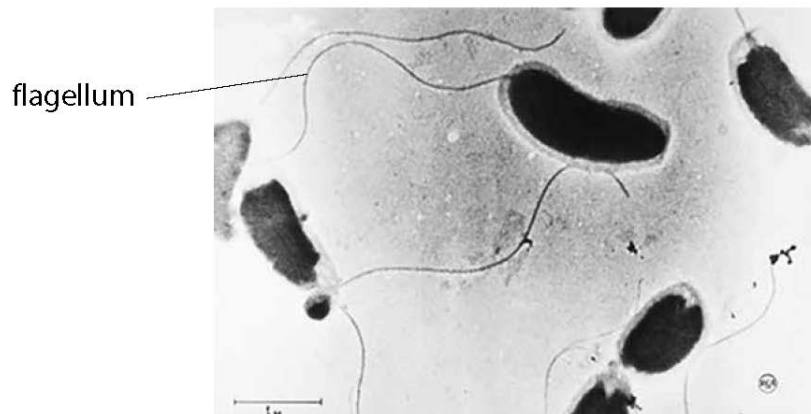
This candidate has correctly calculated the waist to hip ratio and to 2 decimal places, so scored 2 marks.

Marks awarded = 2

Combined Science (Higher)

Example 1 - Question 5c

(c) Figure 7 shows some *Vibrio cholerae*, the bacteria that cause cholera.



Magnification $\times 8000$

(Source: Corbis)

Figure 7

The length of one flagellum on Figure 7 is 68mm.

Calculate the length of the flagellum in μm .

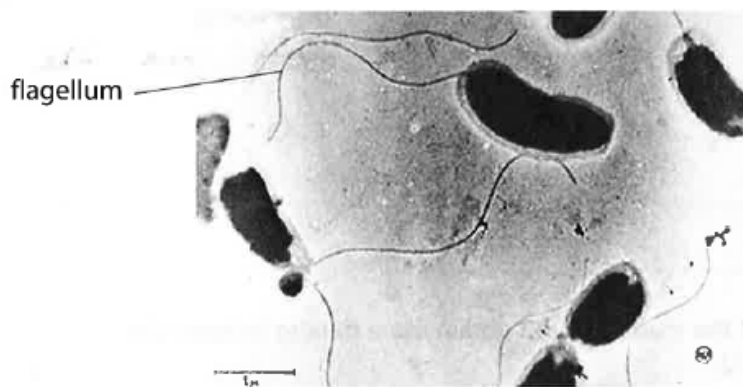
(3)

Mark scheme

Question number	Answer	Additional guidance	Mark
5(c)	<ul style="list-style-type: none"> • $68 \div 8000$ (1) • 0.0085 (1) • $8.5 (\mu\text{m})$ (1) 	award full marks for correct numerical answer without working	(3)

Student answers

(c) Figure 7 shows some *Vibrio cholerae*, the bacteria that cause cholera.



Magnification $\times 8000$

(Source: Corbis)

Figure 7

The length of one flagellum on Figure 7 is 68 mm.

Calculate the length of the flagellum in μm .

(3)

$$\frac{68}{8000} =$$

$$8.5 \times 10^{-3} \mu\text{m}$$

Examiner's comments

This candidate has correctly calculated the length and has put the answer in standard form, which is acceptable for 2 marks. However, they did not convert their answer into micrometres for the final mark.

Marks awarded = 2

Example 2 - Question 5ai

- 5 A scientist investigated the effect of light intensity on the rate of photosynthesis of the aquatic *Cabomba* plant.

A lamp was used as a source of light. The lamp was placed at different distances (d) from the *Cabomba* plant, and the number of bubbles produced in 60 seconds was counted.

The number of bubbles produced in 60 seconds was used to calculate the rate of photosynthesis.

The light intensity was then calculated using the inverse square law $\left(\frac{1}{d^2}\right)$.

Figure 10 shows the scientist's results.

distance (d) of lamp from <i>Cabomba</i> (cm)	light intensity (arbitrary units)	bubbles produced in 60 seconds
5	0.0400	79
10	0.0100	21
15	0.0044	12
20	0.0025	7
25		5
30	0.0011	4

Figure 10

- (a) (i) Calculate the light intensity when the lamp is 25 cm from the *Cabomba* plant. (2)

Mark scheme

Question number	Answer	Additional guidance	Mark
5(a)(i)	$25 \times 25 = 625$ (1) $1 \div 625 = 0.0016$ (1)	award full marks for correct numerical answer without working	(2)

Student answers

- (a) (i) Calculate the light intensity when the lamp is 25 cm from the *Cabomba* plant.

$$\frac{1}{25^2} = 1.6 \times 10^{-3} = 0.0016 = 0.0016 \quad (2)$$

light intensity = 0.0016 arbitrary units

Examiner's comments

This candidate has correctly used the inverse square law to calculate the light intensity for 2 marks. They also showed their working, which is good practice.
Marks awarded = 2

Example 3 - Question 7ai

7 A diabetic athlete is advised to estimate the number of grams of carbohydrate in his meals in order to calculate the number of units of insulin he will need to inject to lower his blood glucose concentration.

Each unit of insulin he injects reduces his blood glucose concentration by 1.5 mmol dm^{-3} .

He needs to inject 1 unit for every 10 grams of carbohydrate he consumes.

Figure 12 shows the estimated carbohydrates in the breakfast eaten by the athlete.

food consumed	estimated carbohydrate /grams
orange juice	25
2 slices brown toast	68
350 grams baked beans	38
tea with sugar	25

Figure 12

(a) (i) Calculate how many units of insulin the athlete would need to inject to control the rise in blood glucose levels.

Give your answer to two significant figures.

(2)

Mark scheme

Question number	Answer	Additional guidance	Mark
7(a)(i)	<ul style="list-style-type: none"> • $156 \div 10$ (1) • 16 units (1) Answer to two significant figures	award full marks for correct numerical answer without working	(2)

Student answers

- (a) (i) Calculate how many units of insulin the athlete would need to inject to control the rise in blood glucose levels.

Give your answer to two significant figures.

$$25 + 68 + 38 + 25 = 156g$$

(2)

$$\frac{156}{10} = 15.6$$

..... 15.6 units of insulin

Examiner's comments

The candidate has done the correct calculation for 1 mark but has not converted his answer to 2 significant figures.

Marks awarded = 1

- (a) (i) Calculate how many units of insulin the athlete would need to inject to control the rise in blood glucose levels.

Give your answer to two significant figures.

Per unit of insulin = reduces blood glucose concentration = 1.5 mmol dm^{-3} (2)

1 unit for every 10g of carbohydrates.

$$25 \div 10 = 2.5$$

$$68 \div 10 = 6.8$$

$$38 \div 10 = 3.8$$

$$25 \div 10 = 2.5$$

$$\underline{15.6}$$

..... 15 units of insulin

Examiner's comments

This candidate has correctly calculated the levels of insulin. However, he has incorrectly rounded 15.6 down to 15 rather than up to 16, so only scores 1 mark.

Marks awarded = 1

Maths skills

- (a) (i) Calculate how many units of insulin the athlete would need to inject to control the rise in blood glucose levels.

Give your answer to two significant figures.

$$25 + 68 + 38 + 25 = 156 \text{ g} \quad (2)$$

$$156 \div 10 = 15.6 \text{ units}$$

$$\text{rounded} = 16 \text{ units}$$

16 units of insulin

Examiner's comments

This candidate has clearly set out the calculation in a series of steps

Marks awarded = 2

Separate Biology (Higher)

Example 1 - Question 8ai

- 8 (a) Figure 13 shows a food chain for organisms in a stream.

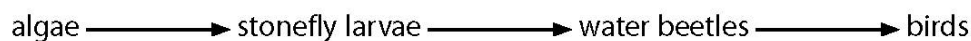


Figure 13

- (i) In the food chain there is $2.1 \times 10^4 \text{ J}$ of energy in the biomass of stonefly larvae. 90% of the energy is lost between each trophic level of the food chain.

Calculate the energy value that enters the birds.

(2)

Mark scheme

Question number	Answer	Additional guidance	Mark
8(a)(i)	<ul style="list-style-type: none"> $2.1 \times 10^4 = 21\,000 \times 0.1 = 2\,100$ in the water beetle (1) 210 J in the bird (1) 	award full marks for correct numerical answer without working	(2)

Student answers

8 (a) Figure 13 shows a food chain for organisms in a stream.



Figure 13

(i) In the food chain there is $2.1 \times 10^4 \text{ J}$ of energy in the biomass of stonefly larvae. 90% of the energy is lost between each trophic level of the food chain.

Calculate the energy value that enters the birds.

$$(2.1 \times 10^4) \times 0.1 = 2100.$$

(2)

2100 J

Examiner's comments

This candidate has calculated the energy lost from the stonefly larvae to the water beetles but has not gone on to calculate the energy lost from the water beetles to the birds.

Marks awarded = 1

8 (a) Figure 13 shows a food chain for organisms in a stream.



Figure 13

(i) In the food chain there is $2.1 \times 10^4 \text{ J}$ of energy in the biomass of stonefly larvae. 90% of the energy is lost between each trophic level of the food chain.

Calculate the energy value that enters the birds.

$$2.1 \times 10^4 \times 0.1 = 2100 \text{ J} \times 0.1 = 210$$

(2)

210 J

Examiner's comments

This is a good example where the candidate has shown both stages of the working for 2 marks.

Marks awarded = 2

Example 2 - Question 8bi

(b) A group of students investigated the level of pollution in two different streams, A and B.

Figure 14 shows the student's results.

indicator species	total number in	
	stream A	stream B
Mayfly nymph	4	0
Caddis fly larva	29	0
Stonefly larvae	74	1
Water louse	34	4
Bloodworm	10	45
Sludge worm	2	100

Figure 14

Mayfly nymphs, caddis fly larvae and stonefly larvae are indicators of clean water.

(i) Calculate the percentage of organisms in stream A that are clean water indicators.

Give your answer to two significant figures.

(2)

Mark scheme

Question number	Answer	Additional guidance	Mark
8(b)(i)	<ul style="list-style-type: none"> $107 \div 153$ (1) $0.699\ 3464 \times 100 = 70\%$ (1) Answer to 2 significant figures	award full marks for correct numerical answer without working	(2)

Student answers

(i) Calculate the percentage of organisms in stream A that are clean water indicators.

Give your answer to two significant figures.

(2)

$$\frac{107}{153}$$

$$69.936642$$

$$69.93\%$$

Examiner's comments

The candidate has done the correct calculation but not converted their answer to two significant figures, or perhaps thought that two decimal places was the same as two significant figures.

Marks awarded = 1

Extended open response

Combined Science (Foundation)

Example 1 - Question 9c

Smoking is a lifestyle factor that can cause many diseases.

Figure 15 shows the trends in smoking between 1960 and 2010 for men and women.

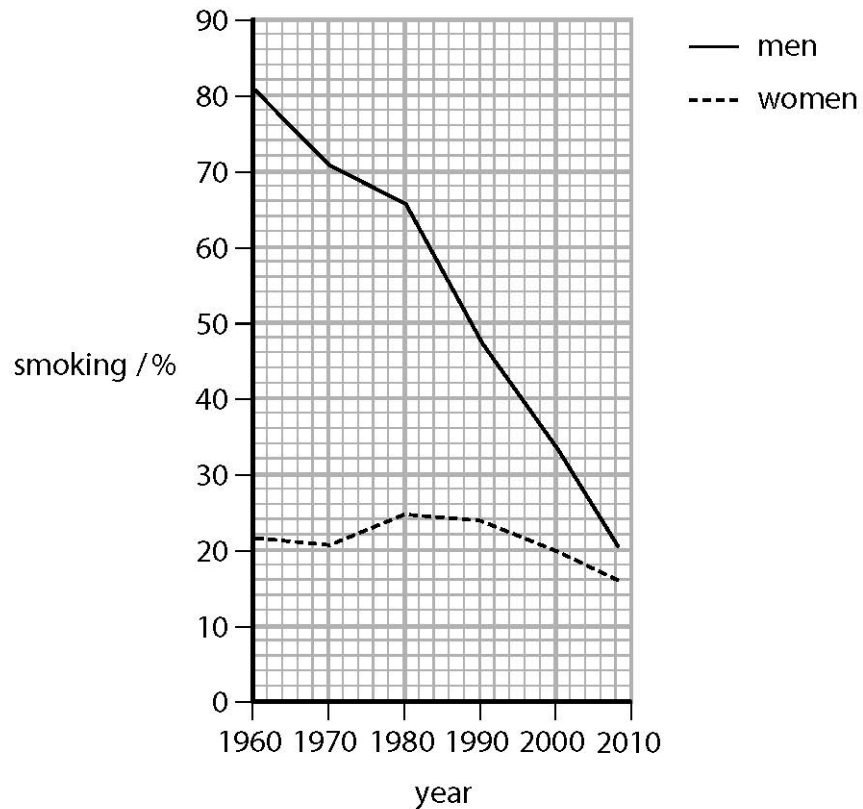


Figure 15

*(c) Explain how the changes in the trends for smoking may affect the occurrence of cardiovascular disease.

(6)

Mark scheme

There are two strands to this question. The candidates have to interpret the graph and relate the information in the graph to the occurrence of cardiovascular disease. They need to show both of these skills in order to progress through the levels.

Extended open response

Question number	Indicative content	Mark
*9(c)	<p>Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme.</p> <p>The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant.</p> <p style="text-align: center;">A02 (3 marks) and A03 (3 marks)</p> <p>A03: Interpretation and evaluation from the graph</p> <ul style="list-style-type: none"> • the trend is downwards • women are less likely to smoke than men • the trend for men is decreasing more steeply than for women • the decreasing trend in smoking should lead to a decrease in the occurrence of cardiovascular disease • the decrease of cardiovascular disease in men would be greater than in women <p>A02: Link between reducing smoking and cardiovascular disease:</p> <ul style="list-style-type: none"> • less damage to alveoli so reduced effect on surface area of lungs • less fatty deposits build up in arteries so less chance of a heart attack or stroke • effect of nicotine raising heart rate and blood pressure is reduced • the risk of blood clotting is reduced so lower chance of heart attack or stroke 	(6)

Level	Mark	Descriptor
	0	No awardable content
Level 1	1–2	<ul style="list-style-type: none"> • Interpretation and evaluation of the information attempted but will be limited with a focus on mainly just one variable. Demonstrates limited synthesis of understanding. (A03) • The explanation attempts to link and apply knowledge and understanding of scientific ideas, flawed or simplistic connections made between elements in the context of the question. (A02)
Level 2	3–4	<ul style="list-style-type: none"> • Interpretation and evaluation of the information on both variables, synthesising mostly relevant understanding. (A03) • The explanation is mostly supported through linkage and application of knowledge and understanding of scientific ideas, some logical connections made between elements in the context of the question. (A02)
Level 3	5–6	<ul style="list-style-type: none"> • Interpretation and evaluation of the information, demonstrating throughout the skills of synthesising relevant understanding. (A03) • The explanation is supported throughout by linkage and application of knowledge and understanding of scientific ideas, logical connections made between elements in the context of the question. (A02)

Student answers

*c) Explain how the changes in the trends for smoking may affect the occurrence of cardiovascular disease.

(6)

Due to the fact that the percentage of smoking males in 1960 was just over 80% it shows that rates of cardiovascular disease was probably quite high as smoking increases the chances of occurrence of the disease. This has changed over time as trends of smoking has decreased from 80% down to 20% for males in 2010, from this it affected the occurrence of cardiovascular disease by decreasing it. Also, the percentages of women smoking was always considerably lower than males; just over 20% in 1960, down to 16% in 2010, this ~~she~~ could show that cardiovascular disease was less occurred for women in comparison to males as their % was lower than males for smoking.

(Total for Question 9 = 13 marks)

Examiner's comments

The candidate was able to analyse the data and state it accurately, and link it to cardiovascular disease correctly, but did not explain how smoking results in cardiovascular disease.

Marks awarded = 3

Extended open response

* (c) Explain how the changes in the trends for smoking may affect the occurrence of cardiovascular disease.

(6)

The more cigarettes you smoke results in more damage to your lungs resulting in difficulty to breath meaning that you will be able to do less and less exercise each day and eventually it will result in cardiovascular disease

Examiner's comments

This candidate has not interpreted the graph at all but has given a limited explanation of how cigarettes affect cardiovascular disease, so is awarded 1 mark in level 1.

Marks awarded = 1

Combined Science (Higher)

Example 1 - Question 7bii

- 7 A diabetic athlete is advised to estimate the number of grams of carbohydrate in his meals in order to calculate the number of units of insulin he will need to inject to lower his blood glucose concentration.

Each unit of insulin he injects reduces his blood glucose concentration by 1.5 mmol dm^{-3} .

He needs to inject 1 unit for every 10 grams of carbohydrate he consumes.

Figure 12 shows the estimated carbohydrates in the breakfast eaten by the athlete.

food consumed	estimated carbohydrate /grams
orange juice	25
2 slices brown toast	68
350 grams baked beans	38
tea with sugar	25

Figure 12

The doctor diagnosed this person with an underactive thyroid gland.

- *(ii) Explain why an underactive thyroid could cause this patient to have an increased body mass.

(6)

Mark scheme

Question Number	Indicative content	Mark
*7(b)(ii)	<p>Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme.</p> <p>The indicative content below is not prescriptive and candidates are not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant.</p> <p style="text-align: center;">AO1 (6 marks)</p> <ul style="list-style-type: none"> • the thyroid gland produces thyroxine • thyroxine helps to regulate metabolic rate • low levels of thyroxine should stimulate the production of TRH • TSH being produced and more thyroxine being released • an underactive thyroid would cause less thyroxine to be produced • metabolic rate to drop • less energy (calories) are available for tasks • more fat storage so the person gains body mass 	(6)

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1-2	<ul style="list-style-type: none"> • Demonstrates elements of biological understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • Presents an explanation with some structure and coherence. (AO1)
Level 2	3-4	<ul style="list-style-type: none"> • Demonstrates biological understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5-6	<ul style="list-style-type: none"> • Demonstrates accurate and relevant biological understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)

Student answers

The doctor diagnosed this person with an underactive thyroid gland.

*(ii) Explain why an underactive thyroid could cause this patient to have an increased body mass.

(6)

The thyroid gland produces hormones which control all metabolic processes, if there is an underactive thyroid gland, this hormone would be ~~produced~~^{released} in lesser quantities therefore causing the rate of metabolism to slow down. As a result less food is broken down. This may cause larger molecules of food may lead to an increase in body mass.

Examiner's comments

This candidate has correctly linked the thyroid gland to metabolism and has explained that low levels of thyroid hormones cause the metabolism to slow down, so demonstrates elements of biological understanding and is awarded level 1 for 2 marks. In order to gain level 2 or 3, the candidate should show knowledge of the hormone thyroxine and its effect on the production of TRH.

Marks awarded = 2

Separate Biology (Higher)

Example 1 - Question 10b

*(b) Some sexually transmitted infections (STIs) can be diagnosed by testing urine samples.

These tests use monoclonal antibodies that bind to an antigen on the pathogen.

Describe how a monoclonal antibody can be developed and used to detect an STI using a urine sample.

(6)

Mark scheme

Question number	Indicative content	Mark
*10(b)	<p>Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme.</p> <p>The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant.</p> <p style="text-align: center;">A02 (6 marks)</p> <ul style="list-style-type: none"> • isolate an antigen from the pathogen which causes the STI • inject the antigen into a mouse/rodent • collect lymphocytes producing an antibody to the STI antigen • fuse the B-lymphocyte with a myeloma cell • production of a hybridoma • hybridoma produces a monoclonal antibody against the antigen of the STI • attach the monoclonal antibody to coloured bead/indicator • incorporate into a test strip. 	(6)

Level	Mark	Descriptor
	0	No awardable content
Level 1	1-2	<ul style="list-style-type: none"> • The explanation attempts to link and apply knowledge and understanding of scientific enquiry, techniques and procedures, flawed or simplistic connections made between elements in the context of the question. (A02) • Lines of reasoning are unsupported or unclear. (A02)
Level 2	3-4	<ul style="list-style-type: none"> • The explanation is mostly supported through linkage and application of knowledge and understanding of scientific enquiry, techniques and procedures, some logical connections made between elements in the context of the question. (A02) • Lines of reasoning mostly supported through the application of relevant evidence. (A02)
Level 3	5-6	<ul style="list-style-type: none"> • The explanation is supported throughout by linkage and application of knowledge and understanding of scientific enquiry, techniques and procedures, logical connections made between elements in the context of the question. (A02) • Lines of reasoning are supported by sustained application of relevant evidence. (A02)

Student answers

*(b) Some sexually transmitted infections (STIs) can be diagnosed by testing urine samples.

These tests use monoclonal antibodies that bind to an antigen on the pathogen.

Describe how a monoclonal antibody can be developed and used to detect an STI using a urine sample.

(6)

Monoclonal antibodies can be made by using B-lymphocytes. These cannot divide so they're fused with tumour cells which divide rapidly to produce Hybridomas. They can be made with the complementary antigens so when in contact with the target molecule it will bind to it. They can be used to detect STIs in urine similarly to pregnancy tests. Antibodies can be put on a testing strip & when it comes in contact with the infection will bind to its antigens. The antibodies are usually attached to beads of dye so that a colour change can occur when they bind to the infection pathogens.

Examiner's comments

This candidate has correctly linked their knowledge of monoclonal antibodies in a logical fashion and applied their use in pregnancy testing to develop a test to detect STIs. They have sustained lines of reasoning throughout the response.

Marks awarded = 6

*(b) Some sexually transmitted infections (STIs) can be diagnosed by testing urine samples.

- These tests use monoclonal antibodies that bind to an antigen on the pathogen.

Describe how a monoclonal antibody can be developed and used to detect an STI using a urine sample.

(6)

Monoclonal antibodies are many antibodies of the same type. They are made by giving a mouse ~~the~~ the certain antigen lymphocytes will need to fight against and the mouse produces B lymphocytes which are extracted and combined with a tumour cell as this will allow it to divide. This is a hybridoma cell. It can now produce the antibodies.

If ~~the~~ the antigen for the STI is given to the mouse then we can use monoclonal antibodies to detect it as it will bind to the antigen ~~is~~ in the urine sample.

Examiner's comments

The answer the candidate has given shows the procedure for making monoclonal antibodies but does not apply it correctly to detecting STIs. Level 2.

Marks awarded = 4

*(b) Some sexually transmitted infections (STIs) can be diagnosed by testing urine samples.

These tests use monoclonal antibodies that bind to an antigen on the pathogen.

Describe how a monoclonal antibody can be developed and used to detect an STI using a urine sample.

(6)

The lymphocyte that may fight off the infections in an STI is fused with a cancer cell to form a hybridoma cell which can divide hundreds of times. The urine sample is added to some of the hybridoma cells. As a result the hybridoma cells will be attracted to the pathogen in the urine and bind to it forming bundles of lymphocytes around the pathogen if an STI is present.

Examiner's comments

This candidate has started to explain how monoclonal antibodies are formed but then incorporates some incorrect science and the lines of reasoning are unclear. Level 1.

Marks awarded = 2

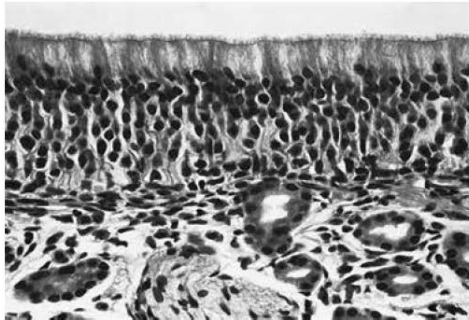
Other examples

Combined Science (Foundation)

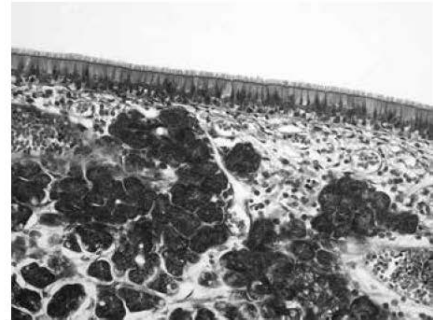
Example 1 - Question 4c: Application of knowledge and understanding

The development of electron microscopes has increased our understanding of cells and their features.

Figure 8 shows two images of ciliated epithelium, one taken using a light microscope and one using an electron microscope.



Light microscope



Electron microscope

(Science photolibrary Epithelium C022/2228 ©Steve Gschmeissner/Science Photolibrary)

Figure 8

(c) Explain how the electron microscope image helps us to understand more about ciliated epithelium.

(3)

Mark scheme

Question number	Answer	Mark
4(c)	<p>An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (2 marks):</p> <ul style="list-style-type: none"> • higher magnification can be used (1) • so the cilia are more visible (1) • and the sub-cellular structures are visible (1) 	(3)

Other examples

Student answers

- (c) Explain how the electron microscope image helps us to understand more about ciliated epithelium.

(3)

The electron microscope allows us to see a more clear and detailed image. This means that we can see ~~how~~ the cell structure and the functions it has more clearly.

Examiner's comments

This scores 1 mark for it being a clearer and detailed image. A second mark can be given for seeing the cell structures but no mark for being able to observe the functions.

Mark awarded = 1

Combined Science (Higher)

Example 1 - Question 7a(ii): Application of knowledge and understanding

- 7 A diabetic athlete is advised to estimate the number of grams of carbohydrate in his meals in order to calculate the number of units of insulin he will need to inject to lower his blood glucose concentration.

Each unit of insulin he injects reduces his blood glucose concentration by 1.5 mmol dm^{-3} .

He needs to inject 1 unit for every 10 grams of carbohydrate he consumes.

Figure 12 shows the estimated carbohydrates in the breakfast eaten by the athlete.

food consumed	estimated carbohydrate /grams
orange juice	25
2 slices brown toast	68
350 grams baked beans	38
tea with sugar	25

Figure 12

- (ii) The athlete miscalculated his carbohydrate intake to be greater than his actual intake.

Explain how the increase in the number of units injected would affect his blood glucose concentrations.

(2)

Mark scheme

Question number	Answer	Mark
7(a)(ii)	<p>An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark):</p> <ul style="list-style-type: none"> • an increase in the units of insulin injected would cause more blood glucose to be converted to glycogen and stored in the liver/muscles (1) • leading to blood glucose levels becoming critically low/person would become hypoglycemic (1) 	(2)

Student answers

- (ii) The athlete miscalculated his carbohydrate intake to be greater than his actual intake.

Explain how the increase in the number of units injected would affect his blood glucose concentrations.

(2)

The increase in insulin levels controls the glucose levels by decreasing the concentration in the blood. This is an example of negative feedback. Insulin converts more glucose into glycogen to be stored in muscle and liver cells.

Examiner's comments

This candidate has explained that glucose is converted to glycogen and stored, which leads to a decrease in the concentration of glucose in the blood.

Marks awarded = 2

Separate Biology (Higher)

Example 1 - Question 8bii: Application of knowledge and understanding

(b) A group of students investigated the level of pollution in two different streams, A and B.

Figure 14 shows the student's results.

indicator species	total number in	
	stream A	stream B
Mayfly nymph	4	0
Caddis fly larva	29	0
Stonefly larvae	74	1
Water louse	34	4
Bloodworm	10	45
Sludge worm	2	100

Figure 14

(ii) Use the results to explain which stream is more polluted.

(2)

Mark scheme

Question number	Answer	Additional guidance	Mark
8(b)(ii)	<p>An explanation that combines identification via a judgment (1 mark) to reach a conclusion via justification/reasoning (1 mark):</p> <ul style="list-style-type: none"> stream B is more polluted than stream A (1) <p>Plus one from:</p> <ul style="list-style-type: none"> (because) stream A contains stonefly larvae/mayfly larvae/caddis fly larvae (which are indicators of clean water) (1) (because) stream B contains larger numbers of blood worm and sludge worm (which are indicators of polluted water) (1) 	<p>accept other correct indicators from the table.</p> <p>accept higher oxygen levels in place of clean water</p> <p>accept lower oxygen levels in place of polluted water</p>	(2)

Student answers

(ii) Use the results to explain which stream is more polluted.

(2)

Stream B is more polluted as there are very few clean water indicators such as mayfly nymph, and many Sludge worms, which indicate polluted water.

Examiner's comments

Candidates could state that stream B is more polluted due to the absence of clean water indicators, which are given in the question or by making it clear which species are indicators of polluted water. In this case the student did both.

Marks awarded = 2

Example 2 - Question 8c: Application of knowledge and understanding

The student investigated a third stream, which is very slow flowing and runs through an area where intensive farming methods are used.

Figure 15 shows the thick layer of algae formed on top of this stream.



Figure 15

(c) Explain the effect of this algal growth on the organisms in the stream.

(4)

Other examples

Mark scheme

Question number	Answer	Mark
8(c)	<p>An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (3 marks):</p> <ul style="list-style-type: none"> • plants growing on the bottom of the stream will be unable to receive sunlight due to the thick layer of algae (1) • these plants will not be able to photosynthesise and will die and start to decompose (1) • the microorganisms decomposing the plants will respire, removing oxygen from the water (1) • the stream will become anoxic/oxygen depleted and other respiring organisms (plants and animals) will not be able to survive so biodiversity will be reduced (1) 	(4)

Student answers

(c) Explain the effect of this algal growth on the organisms in the stream.

(4)

Eutrophication has occurred where the fertilizers used in farms have washed into the river promoting the growth of algae. This layer of algae blocks light that would be used for photosynthesis for the plants below, when these plants die and decompose the plants and uses the oxygen in the river for respiration. As oxygen levels decrease fish die because of oxygen and the process continues.

Examiner's comments

Eutrophication in this question illustrates the need to understand the process and the need to explain it in a logical order.

This candidate has explained and sequenced his answer using all relevant steps for 4 marks.

Marks awarded = 4

Example 3 - Question 10a: Application of knowledge and understanding

10 There are different types of white blood cell in the body. One type is called CD4+ T-Helper cells.

The normal range of these cells in the blood is between 5×10^8 and 1.2×10^9 cells/dm³

An AIDS patient has a CD4+ T-Helper cell count of 1.5×10^8 cells/dm³

(a) Explain why the CD4+ count of 1.5×10^8 cells/dm³ has led to the diagnosis of AIDS.

(2)

Mark scheme

Question number	Answer	Mark
10(a)	<p>An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark):</p> <ul style="list-style-type: none"> the CD4+ count is significantly below the normal range because the HIV has destroyed the {white blood cells/CD4+ cells} (1) so the person is more susceptible to opportunistic infections and classified as having AIDS (1) 	(2)

Student answers

10 There are different types of white blood cell in the body. One type is called CD4+ T-Helper cells.

The normal range of these cells in the blood is between 5×10^8 and 1.2×10^9 cells/dm³

An AIDS patient has a CD4+ T-Helper cell count of 1.5×10^8 cells/dm³

(a) Explain why the CD4+ count of 1.5×10^8 cells/dm³ has led to the diagnosis of AIDS.

(2)

CD4+ are helper cells that recognize foreign pathogens and are needed for an immune response. HIV cells attack and kill these cells resulting in a lower amount of them meaning from this AIDS can be diagnosed.

Examiner's comments

This candidate has recognised that HIV destroys CD4+ cells, which then leads to a diagnosis of AIDS, for 2 marks.

Marks awarded = 2

Example 4 - Question 10c: Application of knowledge and understanding

A single marking point may contain more than one piece of information linked together, so it is important that the understanding of a topic is given and not merely a list of recall points.

(c) The antigens on pathogens can be proteins with a specific amino acid sequence.

Explain how the order of amino acids in a protein is determined by the sequence of the gene.

(4)

Mark scheme

Question number	Answer	Additional guidance	Mark
10(c)	<p>An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (3 marks):</p> <ul style="list-style-type: none"> • a single strand of messenger RNA is transcribed from the gene in the nucleus (1) • messenger RNA molecule binds to the ribosome (1) • the triplet code from the mRNA is matched by a complementary tRNA anticodon at the ribosome (1) • tRNA transfers amino acids to the polypeptide chain in a specific order (1) 	to gain maximum marks the process must be in a logical sequence	(4)

Student answers

(c) The antigens on pathogens can be proteins with a specific amino acid sequence.

Explain how the order of amino acids in a protein is determined by the sequence of the gene.

(4)

Transcription: takes place inside the nucleus

DNA unzips by breaking weak hydrogen bonds between bases

A strand is used + bases complementary to this strand

link to it forming mRNA

Translation: mRNA attaches to ribosome

decodes 3 base triplets

acid attaches to tRNA

Each tRNA carries which amino acid it carries

tRNA releases amino acid which joins to amino acid chain

chain = polypeptide

(Total for Question 10 = 12 marks)

Examiner's comments

This candidate has scored all 4 marks. the process is a logical sequence and both mRNA and tRNA are explained effectively. Although set out as series of bullet points, this answer shows understanding of the whole process.

Marks awarded = 4

(c) The antigens on pathogens can be proteins with a specific amino acid sequence.

Explain how the order of amino acids in a protein is determined by the sequence of the gene.

(4)

The sequence of the gene determines the protein as when transcribed by ~~the~~ unzipping of the DNA and genes, an ~~the~~ mRNA strand ~~is~~ decodes the coding of base pairs and escapes through the nucleus membrane and connects to a ribosome that decodes the codons in the strand bringing along a specific amino acid and joining them to a chain. After complete decoding the ^{long} chain ~~is~~ of amino acids folds to create a polypeptide that joins with others to create a protein with a specific 3D shape which determines what protein it is.

(Total for Question 10 = 12 marks)

Examiner's comments

This candidate has correctly described transcription including the role of mRNA and the binding of mRNA to the ribosome. Although the remainder of the response is good science, it does not contain the level of detail required and does not refer to the role of tRNA.

Mark awarded = 2