Introduction

This document provides guidance on how to construct and mark Advanced Higher Biology assessments and should be read in conjunction with the *Advanced Higher Biology: Guidance on gathering key evidence session 2020–21.*

Assessment structure

Approximately 30% of the available marks across the assessment should be targeted at grade A candidates and the remaining marks at grade C candidates. There is no intention of targeting grade B candidates. The probability is that grade B candidates would achieve most grade C marks and some of the grade A marks.

The Advanced Higher Biology question paper brief in Appendix 1 gives the structure of the SQA question paper, and the range of marks allocated to scientific problem-solving skills and knowledge and understanding. It gives the abbreviated codes for the knowledge and skills that are assessed. The question paper brief is a useful starting point to ensure that your questions have the correct balance and level of demand for constructing an assessment.

Grade C marks

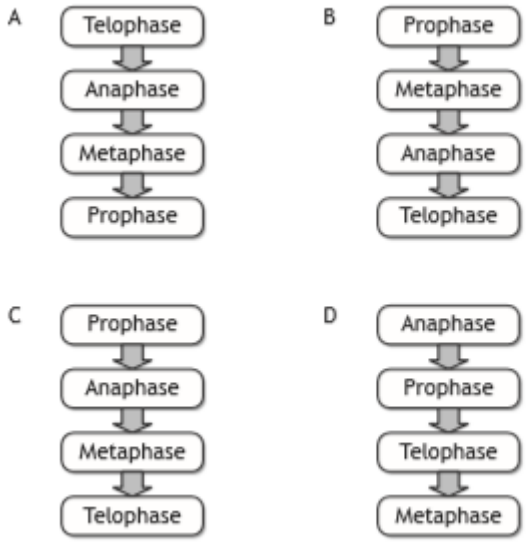
Questions with grade C marks require candidates to demonstrate successful performance in relation to the skills, knowledge and understanding for the course.

Examples of questions with grade C marks in Section 1 – Multiple-choice

Example 1 – 2017 Question 12

This question requires candidates to demonstrate their knowledge and understanding through straightforward recall of the order of the stages of mitosis. This is very accessible content, and a very high proportion of candidates would be expected to answer correctly.

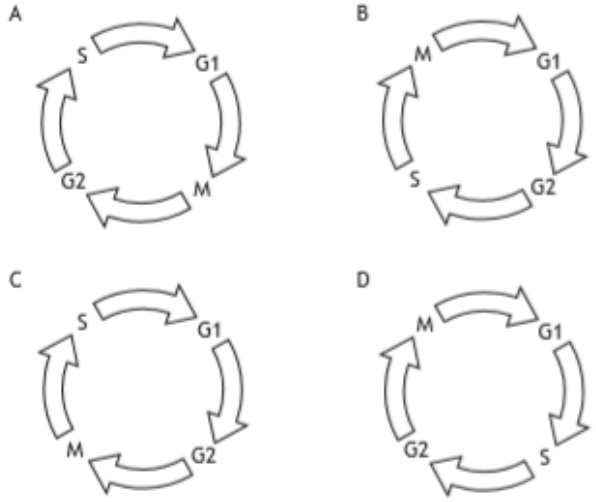
12. Which of the following diagrams represents the sequence of stages involved in mitosis?



Example 2 – 2017 Question 8

This question requires candidates to demonstrate their knowledge and understanding through straightforward recall of the order of the stages of the cell cycle. This is very accessible content presented in a form that should be familiar. Most candidates would be expected to answer correctly.

8. Which of the following diagrams represents the sequence of phases involved in the cell cycle?



Example 3 – 2017 Question 21

This question requires candidates to demonstrate their knowledge and understanding of the function of the enzyme reverse transcriptase. A very high proportion of candidates would be expected to answer correctly.

21. Which of the following conversions is catalysed by reverse transcriptase?

A RNA → DNA
B RNA → protein
C DNA → RNA
D DNA → protein

Example 4 – 2019 Question 7

This question is an example of a calculation that a very high proportion of Advanced Higher candidates would be expected to answer correctly. The equation to be used is given and processing the numbers is straightforward.

7. The surface area to volume ratio of a cell is an important factor affecting transport into cells.

$$\text{surface area to volume ratio} = \frac{\text{surface area}\,(\mu m^2)}{\text{volume}\,(\mu m^3)}$$

The surface area to volume ratio of an *E. coli* cell is 4·5. A eukaryotic cell has a surface area of 1809 μm^2 and a volume of 7235 μm^3.

Compared to *E. coli*, the surface area to volume ratio of the eukaryotic cell is approximately

A 1·1 times larger
B 1·1 times smaller
C 18 times larger
D 18 times smaller.

Example 5 – 2019 Question 8

This question requires candidates to demonstrate their knowledge and understanding. Although candidates find aspects of the content relating to protein structure demanding, this question only requires recall of the type of bond stabilising secondary structure. Most candidates would be expected to answer this question correctly.

8. Alpha helices in proteins are stabilised by

A hydrogen bonds
B ionic bonds
C disulphide bridges
D hydrophobic interactions.

Example 6 – 2019 Question 13

This question requires candidates to apply their knowledge and understanding, and would be accessible to a very high proportion of candidates. Evolution can be a challenging concept for candidates, but the information in the stem gives lots of support, which reduces the demand.

13. There are approximately 40 species of birds of paradise in New Guinea, on islands nearby, and in areas of mainland Australia. They are thought to have evolved from a crow-like common ancestor that lived 20 million years ago.

The list describes processes that are likely to have contributed to the evolution of the different species.

X The food availability on a certain part of one island favoured the survival of male and female individuals with slender curved bills.

Y On one island with abundant food choices, females choose mates whose head feathers have elongated plumes.

Z Some males and females of a species of crow-like mainland bird were blown by a freak storm to some of the islands.

Which row in the table matches processes of evolution with descriptions from the list?

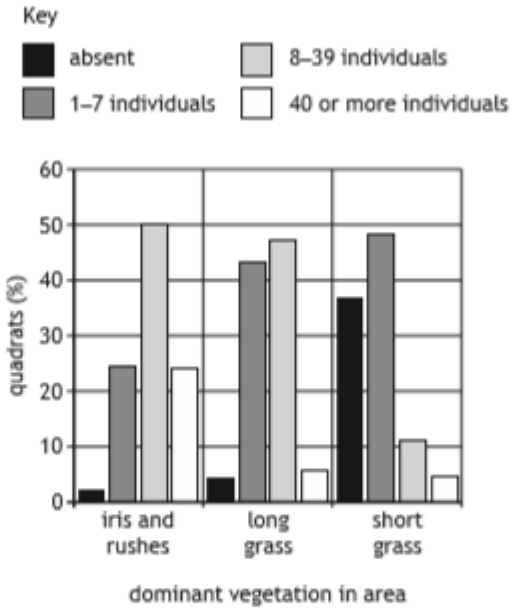
	Processes of evolution		
	Genetic drift	Selection	
		Natural	Sexual
A	X	Z	Y
B	Z	X	Y
C	Z	Y	X
D	Y	X	Z

Example 7 – 2019 Question 19

This question requires candidates to select information. It may initially appear complex, but its interpretation is straightforward, especially with the support of options. Most candidates would be expected to respond correctly.

19. The population of the snail *Vertigo antivertigo* was investigated at a small site in Wales. Equal numbers of quadrat samples were taken in three areas with different dominant vegetation and the number of individual snails in each was recorded.

The results are shown in the chart.



The information in the chart indicates that this species of snail prefers

A short grass to long grass
B irises and rushes to long grass
C long grass to irises and rushes
D short grass to irises and rushes.

Example 8 – 2019 Question 21

This question requires candidates to apply their knowledge and understanding and would be accessible to a high proportion of candidates. The stem describes a context that may be unfamiliar to candidates, but the emphasis on ‘response’ in the stem reduces the demand.

21. In three-spined stickleback fish, males have a distinctive red underside in the breeding season, which is not present in females. Territorial males were presented with model fish, some of which had their undersides painted red and some of which were left unpainted. Males showed an automatic attack response to only the red-painted models.

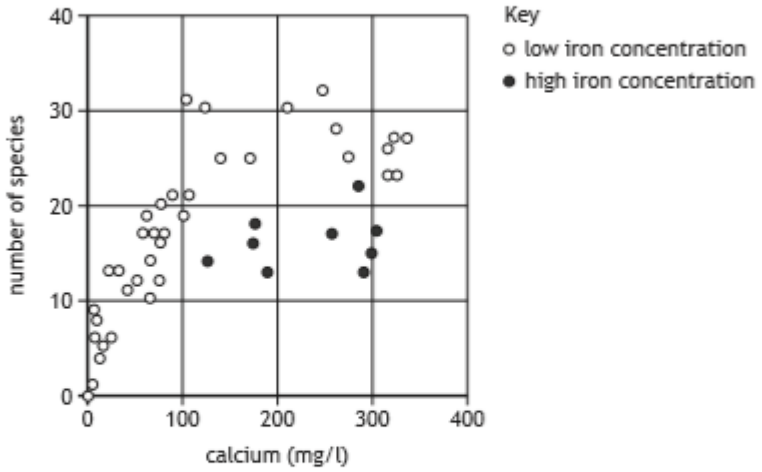
This attack response behaviour is triggered by

A sexual dimorphism
B sexual selection
C an honest signal
D a sign stimulus.

Example 9 – 2019 Question 23

This question requires candidates to make a generalisation. Two data sets increases the complexity, but the information is relatively straightforward to interpret, so a high proportion of candidates would be expected to respond correctly. If the question asked candidates to give a generalisation about this data without the support of the multiple-choice options, it would significantly increase the demand.

23. The graph shows species richness of mollusc populations in areas of fenland. The number of species of mollusc was recorded in several areas as well as the calcium concentration in the fenland water. At each site the concentration of iron was also measured.



Which of the following generalisations can be drawn from the graph?

A An increase in calcium from 100 to 400 mg/l increases the species richness

B High iron concentration leads to the highest species richness

C When both calcium and iron concentrations are high the species richness is highest

D An increase in calcium up to 150 mg/l increases species richness

Example 10 – 2016 Question 10

This question requires candidates to demonstrate their knowledge and understanding through straightforward recall of the cause of type 1 diabetes. This is very accessible content, and a very high proportion of candidates would be expected to answer correctly.

10. Type 1 diabetes is caused by

A excessive production of insulin

B loss of insulin receptor function

C failure of GLUT4 to respond to insulin binding

D insufficient production of insulin.

Example 11 – 2016 Question 12

This question requires candidates to demonstrate their knowledge and understanding through straightforward recall of the order of the stages of the cell cycle. Most candidates would be expected to answer correctly.

12. At which phase of the cell cycle is the retinoblastoma protein phosphorylated allowing progression to the next phase of the cycle?

A G1
B S
C G2
D M

Example 12 – 2016 Question 21

This question requires candidates to demonstrate their knowledge and understanding through straightforward recall of knowledge of the characteristics of r-selected species. A very high proportion of candidates would be expected to answer correctly.

21. Which row in the table best describes r-selected species?

	Number of offspring	*Offspring survival rate*	*Parental care*
A	many	low	little
B	few	high	extensive
C	many	high	extensive
D	few	low	little

Example 13 – 2018 Question 6

This question requires candidates to apply their knowledge and understanding. It presents accessible content of protein phosphorylation in an interesting format, while remaining relatively straightforward.

6. Transcription of gene Z only occurs when its transcription factor is dephosphorylated.

The distribution of the transcription factor together with the activities of a protein kinase and protein phosphatase specific to this transcription factor are shown in the table.

Tissue	*Transcription factor present*	*Protein kinase activity*	*Protein phosphatase activity*
Muscle	–	–	+
Heart	+	+	–
Brain	+	–	+

Gene Z is transcribed in the

A brain only
B heart only
C muscle and brain only
D heart and brain only.

Example 14 – 2018 Question 22

This question requires candidates to complete a definition for in vivo studies, which is straightforward for most candidates.

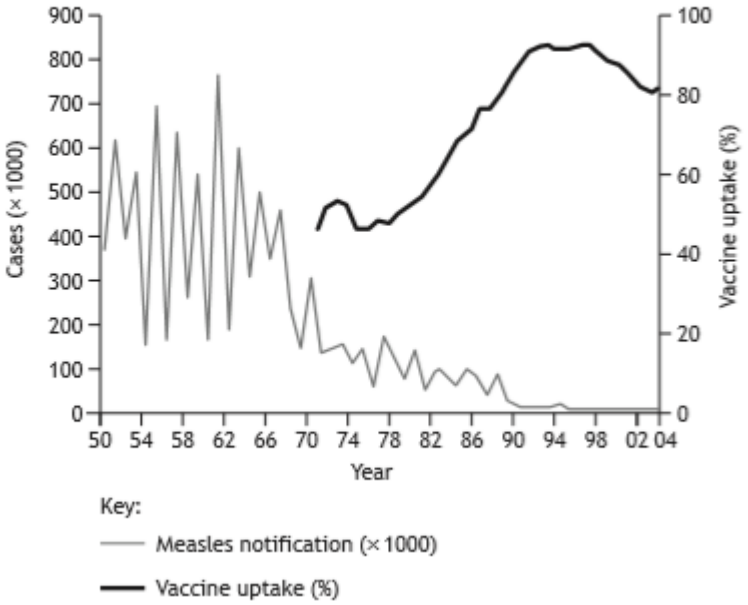
22. An *in vivo* study involves observations made in

A the natural habitat of an animal
B a living cell culture in the laboratory
C a living organism
D extracts prepared from living tissues.

Examples of Questions with grade C marks in Section 2

Example 1 – 2017 Question 10(c)

10. The graph shows the number of measles notifications (reported cases) since 1950 and vaccination rates since 1970.



(c) Describe the correlation suggested by the graph. 1

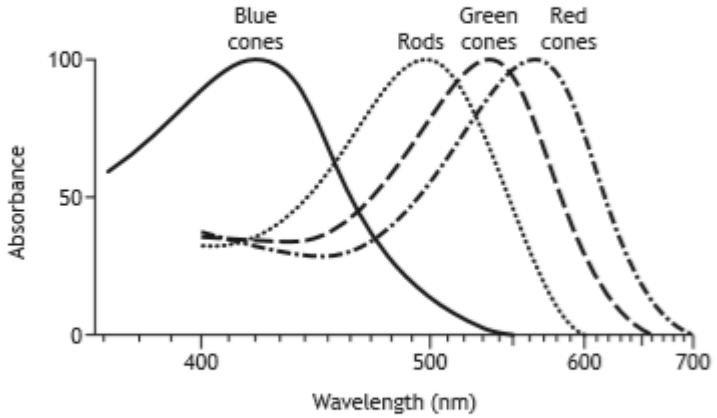
This question requires candidates to select information from a graph.

The data shows a straightforward correlation, which a very high proportion of Advanced Higher candidates would be expected to be able to describe correctly.

Example 2 – 2017 Question 2(a)(i)

2. The light sensitive layer at the back of the human eye is called the retina. It is able to detect light due to the presence of photoreceptor cells called cones and rods. There are three types of cone cells (blue, green and red) which are sensitive to different wavelengths of light as shown in Figure 1. Different wavelengths of light are perceived as different colours.

Figure 1



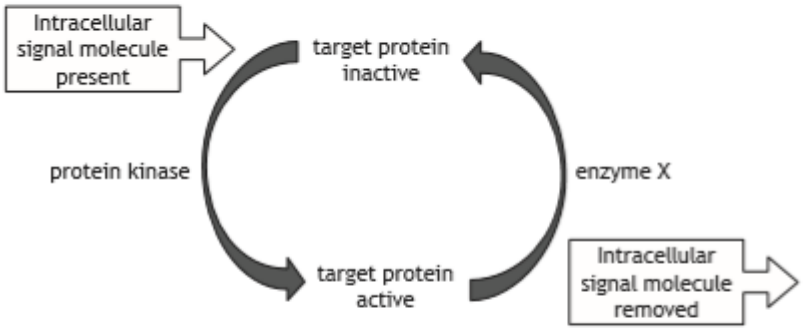
(a) (i) In cone cells, the light sensitive molecule retinal combines with a membrane protein to form photoreceptor proteins.

Name this membrane protein. 1

This question allows candidates to demonstrate their knowledge and understanding.
A very high proportion of Advanced Higher candidates would be expected to be able to recall names and terms.

Example 3 – 2017 Question 4(a)(i)

4. The diagram shows how two types of enzyme can be involved in controlling the activity of a protein in response to the presence of a signalling molecule within the cell (intracellular signal molecule). Intracellular signalling molecules are often produced as a result of extracellular signals received by cell-surface receptors.



(a) (i) Explain how the action of protein kinase can switch a target protein from inactive to active. 1

This is an example of a question which requires factual recall of an area of the course that candidates find accessible. A very high proportion of Advanced Higher candidates would be expected to answer correctly.

Example 4 – 2017 Question 7(d)

7. Students observed a group of California sea lions (*Zalophus californianus*) that were situated on a rocky outcrop off the coast of California. During each observation period, ten sea lions were observed for six minutes each. The sea lions were watched from a distance using binoculars. The checklist was used as a reference when recording the behaviours observed.

California sea lion

Behaviour	*Description of behaviour*
grooming	Licking, smoothing self with tongue, scratching
observing	Sitting up on flippers looking around
resting	Lying down with some head raising, barking or yawning
movement, aggressive	Barking, aggressive charging or chasing
movement, non-aggressive	Moving for better position on rock
other	Behaviours not specified above

(d) Observing the sea lions from a distance made distinguishing some details of behaviour difficult.

Suggest an improvement to the method, other than direct observation, that would reduce this source of error. 1

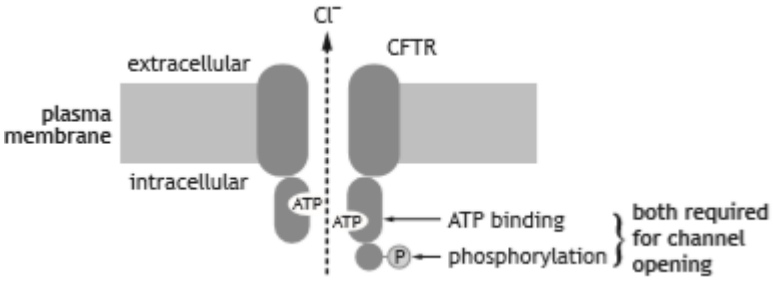
The level of challenge posed when suggesting improvements to experimental procedures is affected by the complexity and the familiarity of the experimental context. In this example, the context is relatively accessible, so a high proportion of candidates would be expected to achieve this mark.

Example 5 – 2019 Question 4(b)(ii)

4. The *CFTR* gene encodes a large transmembrane protein (CFTR) with a symmetrical structure. This is composed of two transmembrane regions and two ATP-binding regions.

(b) The protein CFTR is involved in the regulation of water content of extracellular mucus in the lungs and digestive system.

The figure represents the action of CFTR. It regulates the passage of chloride ions (Cl^-) across membranes of epithelial (lining) cells. In order for this ion channel to open, the protein must bind two ATP molecules, as well as a phosphate group. The increased concentration of Cl^- outside the cell draws water out of the epithelial cells into the mucus, maintaining its fluidity.



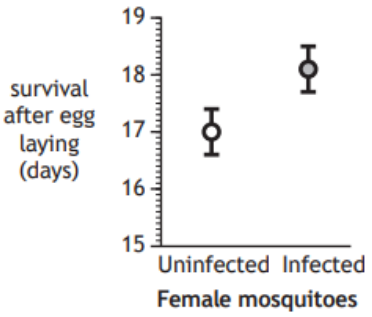
(ii) Suggest how the binding of ATP results in the opening of the chloride ion channel. 1

This question requires candidates to apply their knowledge and understanding. It is relatively straightforward because the area of the course being assessed is very accessible.

Example 6 – 2016 Question 1(b)(i)

Figure 3 shows mean survival times after egg laying for uninfected and infected female mosquitoes.

Figure 3



(b) **Refer to Figure 3 in the Supplementary Sheet for Question 1.**

(i) The data shows that infection by *Plasmodium* appears to increase the longevity of female mosquitoes.

Explain why the difference between the two groups can be regarded as significant. 1

This question allows candidates to explain the difference between two similar data sets, showing understanding of the term *significant differences*.

Example 7 – 2016 Question 4(c)

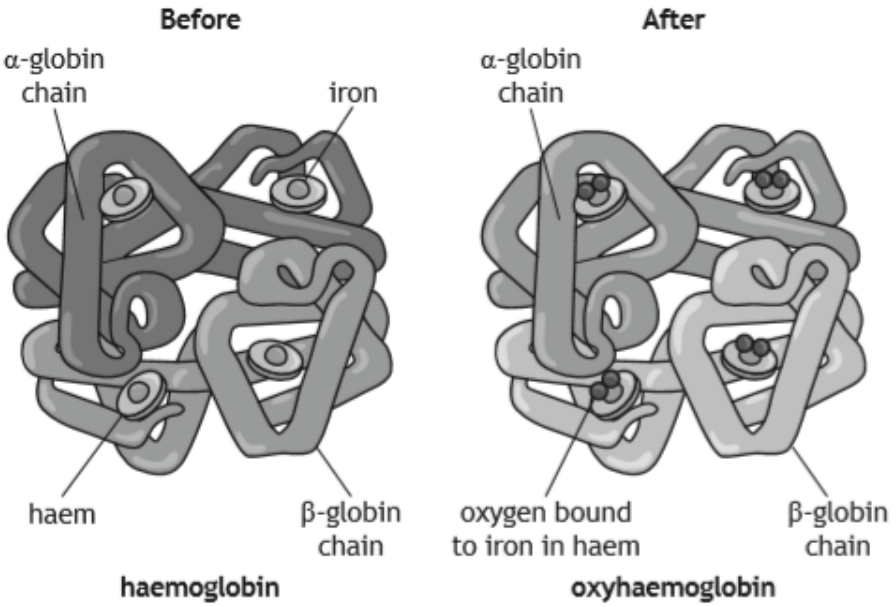
4. (continued)

(c) Explain the term cooperativity in relation to oxygen binding to haemoglobin. **1**

A very accessible question allowing candidates to demonstrate their knowledge of cooperativity. The specific context in the wording of the question increases the challenge slightly beyond just giving a description of cooperativity.

Example 8 – 2018 Question 2(a)(i)

2. (a) The figure represents the four subunits (two α, two β) of a haemoglobin molecule before and after binding with oxygen molecules.

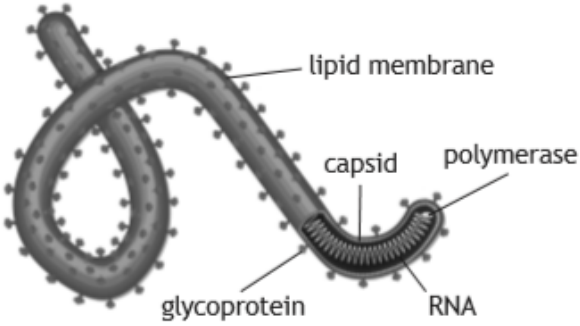


(i) Name the process whereby binding of oxygen to one subunit of haemoglobin alters the affinity of the remaining subunits. **1**

This question requires candidates to demonstrate their knowledge and understanding through straightforward recall of a process based on its description.

Example 9 – 2018 Question 10(a)

10. The figure shows an Ebola virus, cause of Ebola virus disease (EVD), prevalent in a number of West and Central African countries. The virus is transmitted to people from wild animals and outbreaks may then occur through human to human transmission.



(a) Ebola viruses have a diameter of 8×10^{-2} µm.

Give this measurement in nanometres (nm). (1 nm = 10^{-3} µm) **1**

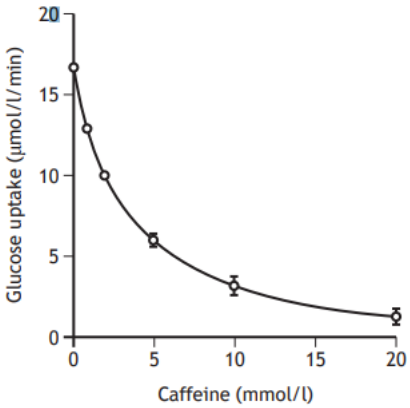
Space for calculation

This question requires candidates to perform a straightforward unit conversion calculation. Most candidates should be able to process this correctly.

Example 10 – 2018 Question 1(e)

Figure 3 shows data obtained from a recent study of the effect of increasing caffeine concentration on the uptake of glucose by GLUT1. The uptake of glucose in these experiments was measured per litre of intracellular fluid.

Figure 3



(e) **Refer to Figure 3 in the supplementary sheet for question 1.**

Describe the trend shown in Figure 3. **1**

This question requires candidates to select information and describe a straightforward trend in data, relating the two variables shown.

Example 11 – 2018 Question 6(c)(ii)

6. The following customer comment was used to promote a product intended to treat cats that suffered from cancer.

> 'My cat was diagnosed with bone cancer three years ago. Her leg was amputated, and I was told that she would only live for another six months. I saw advertising for *Vivafel* and immediately started her on this product. She has been in remission and healthy ever since. I thoroughly recommend this product and the effect it has on cancer in cats.'

6. (continued)

(c) Trials to test the effectiveness of the drug Vivafel were set up using living cats.

(ii) State an appropriate null hypothesis for these trials. **1**

_____

_____

This is a novel context, which is slightly more challenging, but most candidates would be expected to apply their knowledge of null hypothesis to an example.

Grade A marks

Approximately 30% of total available marks should be targeted at grade A candidates.

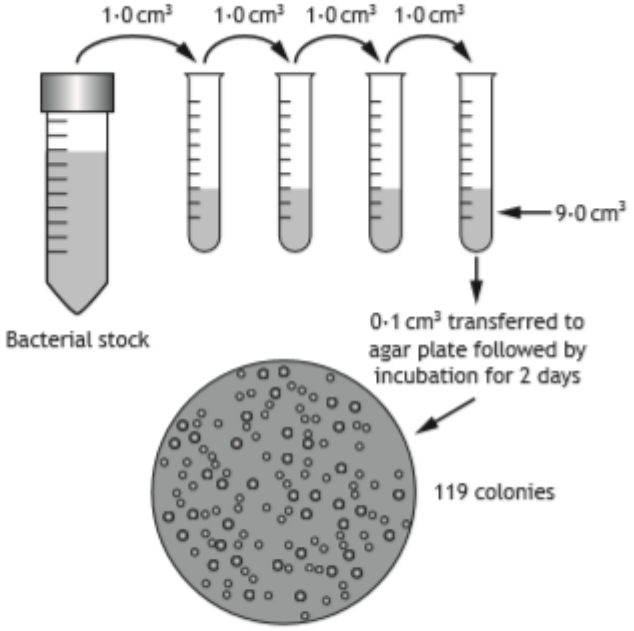
Questions with grade A marks are more demanding and test more complex skills.

Examples of questions with grade A marks in Section 1 – Multiple-choice

Example 1 – 2017 Question 3

In this skills-based question, calculating dilution factors for serial dilutions are challenging as candidates have to follow multiple dilutions and avoid errors with the powers of ten.

3. The figure shows how a scientist used serial dilution followed by plating to check the number of bacteria in a stock culture.



How many bacteria were there in 1 cm³ of the original bacterial stock?

A $1{\cdot}19 \times 10^5$

B $1{\cdot}19 \times 10^6$

C $1{\cdot}19 \times 10^7$

D $1{\cdot}19 \times 10^8$

Example 2 – 2017 Question 7

This question requires candidates to apply their knowledge and understanding. Although many candidates can state the purposes of positive and negative controls, identifying them in the context of an experimental situation is challenging.

7. In an immunoassay used to detect the presence of an antigen for a disease-causing organism (pathogen), the following samples were tested.

1 A sample from an individual thought to be infected with the pathogen.

2 A sample from an organism known to cause similar symptoms, but unrelated to the pathogen.

3 A sample from the pathogen.

4 A sample of purified water.

Which row in the table identifies the purpose of each sample?

	Positive control	*Negative control*	*Test assay*
A	3	4	2
B	3	2	1
C	2	4	3
D	2	3	1

Example 3 – 2019 Question 5

Candidates perform well when asked to describe the action of the sodium-potassium pump. This question is more challenging as candidates have to apply their knowledge to work out the effects of inhibiting the pump.

5. Which row in the table describes the expected effects of inhibition of the Na/KATPase?

	Intracellular Na ion concentration	**Intracellular K ion concentration**	**Membrane polarity**
A	increase	decrease	increase
B	decrease	increase	increase
C	increase	decrease	decrease
D	decrease	increase	decrease

Example 4 – 2019 Question 24

This question requires candidates to apply their knowledge and understanding. The challenge of a question is increased if candidates have to consider a negative statement – in this example the least effective method of control. Candidates are also required to integrate knowledge about transmission of the Plasmodium parasite to identify the usefulness of the control mechanisms.

24. New patterns of resistance in *Plasmodium* have increased the challenge experienced in the treatment of malaria.

Which of the following strategies is **least** likely to reduce the challenges in the treatment and control of malaria?

A Improved sanitation

B Development of new culture methods for *Plasmodium*

C Coordinated vector control

D Building of new low-density housing in malarial areas

Example 5 – 2016 Question 17

This question requires candidates to apply their knowledge and understanding. The challenge of this question is increased by asking candidates to not only recall the equation, but to consider the implications of changing the values within the equation, as well as the possible causes of these value changes.

17. A population of chafer beetles were damaging the tees and greens of a golf course. Results from a mark and recapture study suggested a population size that was too small to account for the extent of the damage caused.

One possible reason for this is that the

A white paint used to mark the beetles washed off some of them before the recapture

B white paint used to mark the beetles made them more visible to predators than unmarked beetles

C total number of beetles in the recaptured sample was less than the number first captured and marked

D marked beetles did not have enough time, after release, to spread out and mix with the rest of the population.

Example 6 – 2018 Question 5

In this skills-based question, candidates need to appreciate the initial stock solution was 80%, and to allow for the other components in the calculation. This is a calculation that many candidates would find challenging.

5. A student is preparing media for an experiment to investigate the effect of an inhibitor on cell growth. Flask 1 contains a control medium with no inhibitor.

The concentration of the stock inhibitor solution used to prepare the final solution is **80%**.

Flask	*Inhibitor volume* (cm^3)	*Glucose volume* (cm^3)	*FBS volume* (cm^3)	*Buffer volume* (cm^3)	*Final inhibitor concentration* (%)
1	0·00	1·00	5·00	19·00	0
2		1·00	5·00		20

What volumes of inhibitor and buffer should be added to flask 2 to give 25 cm^3 of medium with an inhibitor concentration of 20%?

A 4·75 cm^3 inhibitor + 20·25 cm^3 buffer

B 4·75 cm^3 inhibitor + 14·25 cm^3 buffer

C 6·25 cm^3 inhibitor + 18·75 cm^3 buffer

D 6·25 cm^3 inhibitor + 12·75 cm^3 buffer

Examples of Questions with grade A marks in Section 2

Example 1 – 2017 Question 8

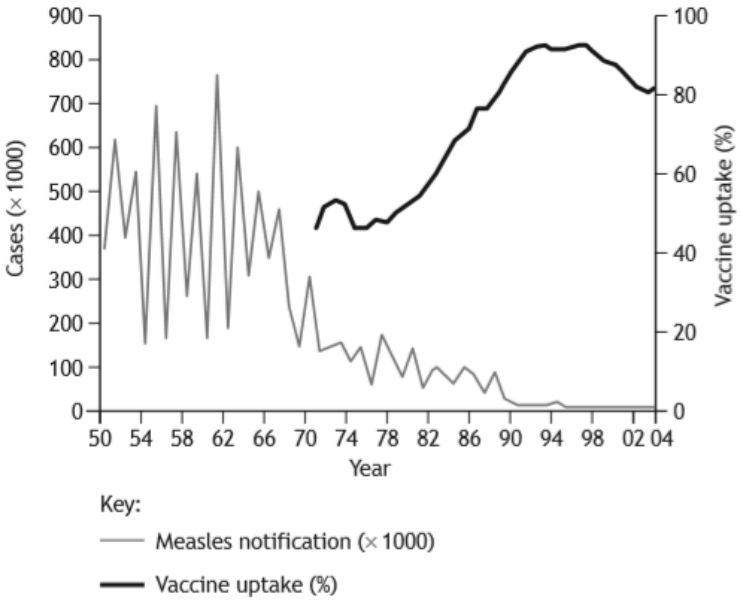
8. "So sex exists to keep parasites at bay." (Lane, 2009)

With reference to the Red Queen hypothesis, discuss the importance of sexual reproduction in defence against parasites. **5**

This type of question requires an extended response. It does not have an optional alternative, which increases the demand as candidates must be able to demonstrate accurate and detailed knowledge of the topic to score highly. These questions usually contain one or two grade A marks depending on the maximum number of marks available and the difficulty of the topic. This example contains two grade A marks as candidates find it challenging to express ideas relating to evolution, including the Red queen hypothesis, clearly and accurately. This compares with question 5 from the 2016 question paper (structure of microtubules and their role in chromosome movement during cell division). That question has one grade A mark because the maximum mark is four, and the content is more accessible.

Example 2 – 2017 Question 10(b)

10. The graph shows the number of measles notifications (reported cases) since 1950 and vaccination rates since 1970.

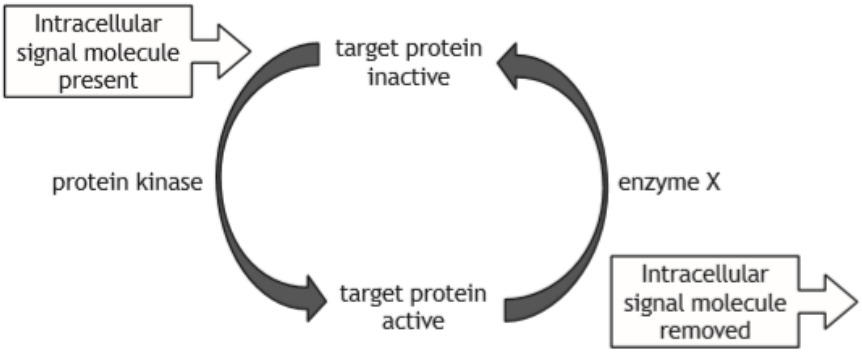


(b) Describe the pattern of measles notifications prior to the introduction of vaccination. **1**

This skills-based question is challenging because candidates need to study the data carefully and show good understanding to observe and describe the pattern. Many candidates noted that the numbers 'went up and down' but did not make any comment about the timing.

Example 3 – 2017 Question 4(b)(ii)

4. The diagram shows how two types of enzyme can be involved in controlling the activity of a protein in response to the presence of a signalling molecule within the cell (intracellular signal molecule). Intracellular signalling molecules are often produced as a result of extracellular signals received by cell-surface receptors.



(b) Protein kinase A (PKA) is an enzyme that is involved in this type of signalling. To test the hypothesis that PKA is found in a variety of cell types, cell extracts were prepared from different cell types and the proteins in the extracts separated by electrophoresis in a gel. The proteins were blotted onto a solid support and an antibody recognising PKA (anti-PKA antibody) was used to detect the presence of PKA.

(ii) Explain how the anti-PKA antibody would be used to detect the presence of PKA. **2**

This question requires candidates to apply their knowledge and understanding.

Using antibodies to detect specific proteins is quite a demanding concept for candidates to explain. The challenge is greater when, as in this question, this has to be done in the context of an unfamiliar example.

Example 4 – 2017 Question 9(a)

9. *Acraea encedon* is a butterfly found in tropical Africa.

Females of this species can be one of two types: either producing broods that are entirely female or producing broods that have males and females in an approximate 1:1 sex ratio. One hypothesis proposed to explain the all-female broods was that bacteria inherited from the mother kill male embryos only.

(a) Explain how antibiotics that kill bacteria could be used in a controlled trial to test this hypothesis. **2**

This question requires candidates to apply knowledge and skills. Many candidates would be expected to recognise that the trait should disappear following administration of antibiotic. The second mark is much more challenging as it requires integration and application of knowledge from a different curricular area - the importance of a control group.

Example 5 – 2019 Question 2(d)

(d) Infection with *F. hepatica* in cattle results in weight loss and a reduction in milk yield.

Suggest a reason for the reduced milk yield in infected cattle. **1**

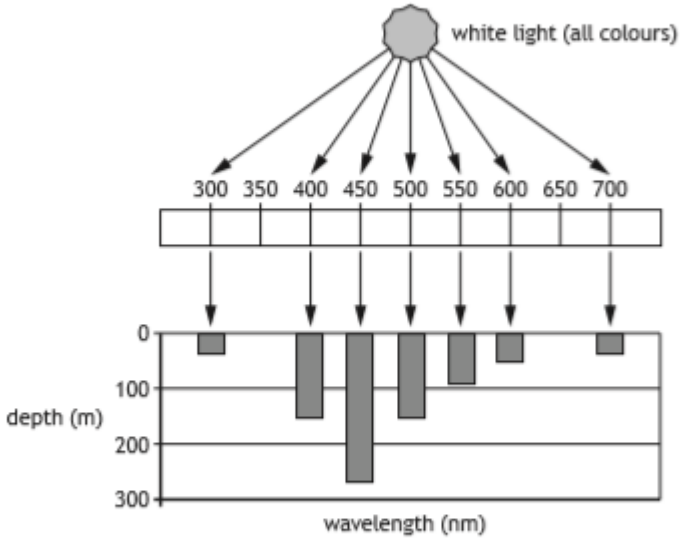
This question requires candidates to demonstrate their knowledge and understanding. It is challenging because candidates cannot simply make a generalised statement about the effects of parasites on their hosts; they must make the link between infection and milk production.

Example 6 – 2019 Question 3(c)

3. (continued)

Figure 2 shows the depth of penetration in water of the wavelengths in daylight.

Figure 2



(c) Crab species tend to live in shallower coastal waters, whereas octopus species can live in open seas.

Explain how the data from Figures 1 and 2 support this statement. 2

In this skills-based question candidates have to select from and make links between two sources of information, which is a complex skill. In addition, Figure 2 is presented in a way that is likely unfamiliar, so more interpretation is required. Presenting information in an unfamiliar, or less familiar, format is more challenging for candidates to interpret than presenting information in a format that they are more familiar with, for example, line graphs, and bar charts.

Example 7 – 2019 Question 5(c)(ii)

5. It is thought that the level of fruit and vegetable consumption could influence the risk of some diseases in humans. One large study has examined the relationship between the level of fruit and vegetable consumption and the risk of mortality. This was a *meta-analysis*, which is a type of observational study that combines and summarises data from several previous similar studies.

(c) One possible criticism of meta-analyses is that the people carrying them out select the previous studies to include, which could result in selection bias.

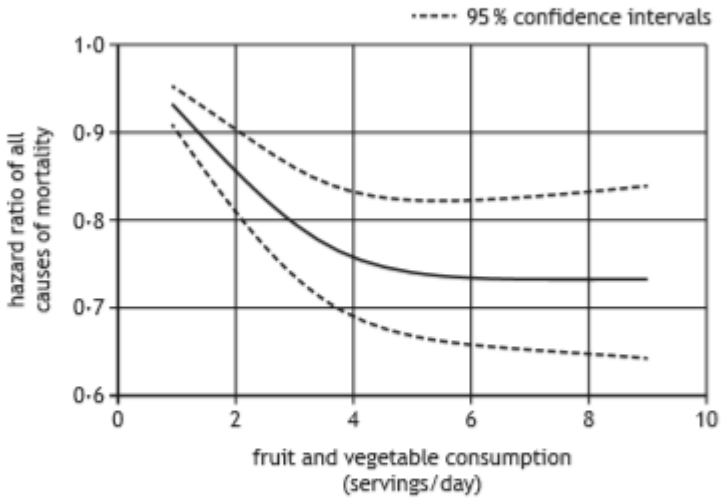
(ii) State the effect that selection bias would have on the sample obtained. 1

This question requires candidates to demonstrate their knowledge and understanding. It assesses an area of the course that candidates find challenging, which increases the demand.

Example 8 – 2019 Question 5(d)

5. (continued)

The results from this meta-analysis are shown in the graph. The risk of mortality was expressed as a hazard ratio, with a hazard ratio of 1·0 indicating no effect on the risk of mortality.



(d) The graph shows the 95 % confidence intervals for the data.

The confidence interval for six servings per day is wider than that for two servings.

What does this indicate about these two sets of data? 1

This question requires candidates to apply their knowledge and understanding. It has a high level of demand because it addresses a challenging concept in the context of a particular set of data.

Example 9 – 2016 Question 3(f)

MARK

3. Multiple sclerosis (MS) is a neurological condition in which the body's immune system destroys the myelin sheath that surrounds and insulates nerve axons.

A clinical study was carried out into the effects of a new drug *interferon beta-1b* for this condition. A randomised trial, with a negative control group (placebo), was carried out across four different health centres. During the study patients were given one of three treatments: 0·00 mg (placebo), 0·05 mg or 0·25 mg interferon. The patients administered the drug themselves at home.

The study measured how effective the drug was by asking patients to record any worsening of symptoms after 2 years of treatment. The study involved 372 patients aged 18-50 years. Fourteen patients dropped out before completing the trial.

Patients' results are shown in Table 1.

Table 1

Level of interferon beta-1b in treatment (mg)	*Proportion of patients reporting no worsening of symptoms after 2 years of treatment* (%)
0·00	16
0·05	18
0·25	25

At one health centre 52 patients were MRI scanned every 6 weeks to monitor any new damage to nerve tissue. The results are shown in Table 2.

Table 2

Level of interferon beta-1b in treatment (mg)	*Proportion of patients showing new nerve damage* (%)
0·00	29
0·05	no data recorded
0·25	6

(f) Suggest **two** conclusions that can be drawn from the results of this trial. 2

Conclusion 1 _____

_____

Conclusion 2 _____

_____

In this skills-based question data is presented in a number of ways for a complex trial. Candidates need to draw two overall conclusions and avoid just stating trends in the data.

Example 10 – 2016 Question 4(e)

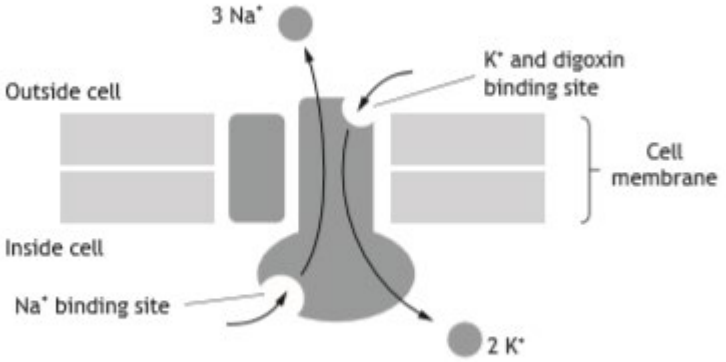
(e) Molecules of sickle cell haemoglobin clump together preventing access to oxygen binding sites.

Suggest why this is a result of the substitution of glutamic acid by valine. 1

This question requires candidates to apply their knowledge and understanding. It is challenging because candidates need to understand the classification groups of the two swapped amino acids, and the impact this would have on the 3D structure of the protein.

Example 11 – 2016 Question 6(c)

(c) Digoxin is a chemical that inhibits the sodium potassium pump by binding to the potassium ion (K^+) binding site as shown in the diagram below.



Explain why binding by digoxin prevents further binding of sodium (Na^+) ions by the pump. 2

This question requires candidates to apply their knowledge and understanding.

Applying the sodium-potassium pump knowledge to unfamiliar contexts challenges candidates' understanding of the way in which the pump works.

Example 12 – 2016 Question 10(b)(iii)

10. The Figures below show male and female capercaillies (*Tetrao urogallus*) which are found in some Scottish pine forests. Males are much larger and darker than females and the breast feathers of the male have a metallic green sheen.

male capercaillie

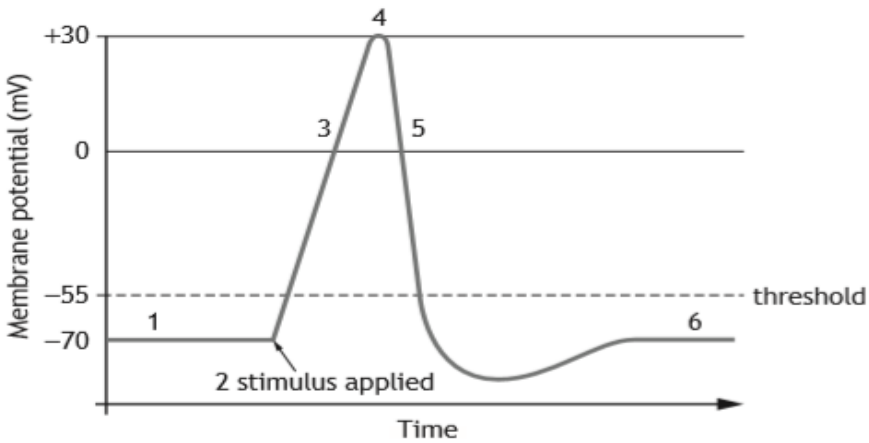
female capercaillie

(iii) If the display provides honest signals, state the benefit that may be obtained by females receiving these signals. **1**

This question requires candidates to demonstrate their knowledge and understanding. The concept of fitness is challenging for some candidates, and they need to connect the honest signal as a measure of increased fitness survival chances.

Example 13 – 2018 Question 3(a)(iii)

3. The diagram shows stages in the transmission of a nerve impulse.



1 Membrane potential before nerve impulse initiated
2 Binding of a neurotransmitter to a ligand-gated sodium ion (Na^+) channel
3 Voltage gated Na^+ channels open
4 Voltage gated Na^+ channels become inactivated
5 Voltage gated potassium ion (K^+) channels open
6 Membrane potential after nerve impulse has passed

(iii) Use the information in the diagram to explain the importance of K^+ channels in nerve transmission. **2**

This question requires candidates to apply their knowledge and understanding. Candidates need to remember the direction of K^+ ion movement and then apply this to nerve impulses to explain their role in nerve transmission.

Example 14 – 2018 Question 8(a)

8. Giraffes are the tallest terrestrial animals, growing up to 5 m tall. Approximately half of a giraffe's height is due to its long neck. Modern giraffes have evolved from ancestors with much shorter necks.

The figures represent two different hypotheses regarding the evolution of the giraffe's long neck.

Competing browsers hypothesis Necks for sex hypothesis

Charles Darwin suggested that the long necks evolved by natural selection: longer necks allowed animals to feed higher up trees with less competition — the 'competing browsers' hypothesis.

This hypothesis was not thought to be consistent with all the evidence available and a rival hypothesis, 'necks for sex', has been put forward. This suggests long necks have evolved as a result of sexual selection through male–male rivalry, where male giraffes fight for access to females by standing side by side and hitting each other with their heads.

(a) Use the competing browsers hypothesis to explain how long necks evolved by natural selection. **2**

This question requires candidates to demonstrate and apply their knowledge and understanding, and use the theory described to explain natural selection. Candidates find difficulty in expressing their ideas on natural selection clearly, and with references to the context.

Example 15 – 2018 Question 9(b)

(b) New Zealand mud snails are commonly infected with parasitic worms of the genus *Microphallus*. Sexual reproduction is more common in the snails when the prevalence of parasites is high.

Explain how this observation supports the Red Queen hypothesis. **2**

Candidates are required to apply knowledge of the advantages of sexual reproduction to the concept of the Red Queen hypothesis. Candidates who were able to make connections across topic areas performed well in this question.

Example 16 – 2018 Question 10(e)

(e) EVD has a very high mortality rate. Some researchers have suggested that new treatments should not be assessed by clinical trials that use negative control groups.

State whether you agree or disagree with this suggestion.

Justify your answer. 1

This is a challenging question because it requires candidates to justify conclusions. This question drew on unit 3 knowledge of ethics and validity, applied to a novel context.

Additional information

Extended-response questions

Each assessment should contain a maximum of two extended-response questions of 12–15 marks in total. One of these questions should include a choice of topic: 8-10 marks and have at least three grade A marks. The other should not include options: 4-5 marks and have at least one grade A mark. The subject matter can also determine the level of demand, increasing the number of grade A marks.

Extensive data-handling question

Each assessment should contain one extensive data-handling question of 7-10 marks in total. This style of question has at least 2 grade A marks.

Large experimental design question

Each assessment should contain one large experimental design question of 5-9 marks in total. This style of question has at least 1 grade A mark.

The following table shows the extended-response, extensive data-handing, and large experimental design questions from SQA past papers and the topics covered.

Key

ER Extended-response

DH Data-handling

ED Experimental Design

Year	Question	Type	Topic	Marks
2016	5; 11A/B	ER	Cytoskeleton and cell division A – Reproduction B – Treatment and control of parasites	4; 9
	1	DH	Parasitism	9
	3	ED	Investigative biology	7
2017	8; 11A/B	ER	Red queen hypothesis A – Protein structure B – Transport proteins	5; 9
	1	DH	Apoptosis	9
	5	ED	Investigative biology	6
2018	7; 11A/B	ER	Sampling strategies A – Concept of niche B – Meiosis and variation	4; 9
	1	DH	Glucose transport	9
	6	ED	Investigative biology	5
2019	6; 10A/B	ER	Animal behaviour A – hydrophilic signalling B – Control of the cell cycle	4; 10
	1	DH	Reproduction	9
	5	ED	Investigative biology	6

The data analysis grids, published separately, provide the structure of the questions in the SQA Advanced Higher Biology past papers (2016-2019) by knowledge/skill; key area; maximum mark, and tags questions that performed as grade A marks. It also indicates where content is no longer part of the Advanced Higher Biology course as a result of revised national qualification (RNQ). The annual course report gives further detail on how specific questions performed.

Marking reliably

Teachers and lecturers should be familiar with the general marking principles for Advanced Higher Biology (see Appendix 2) and the published marking instructions that accompany SQA past papers, as these demonstrate the required marking standard.

It is recommended that centre-devised marking instructions follow the same format and standard as those published by SQA. It is good practice to prepare the marking instructions at the same time as the assessment is constructed. Marking instructions can then be refined in light of candidate responses.

Some common marking issues include:

- Inconsistent application of the marking instructions.
- Arithmetical errors when totalling marks.
- Extended response questions: a tick can help to identify where the mark is allocated; it is important to be consistent in the approach to marking these, and that the marks are totalled correctly.

Marks should only be allocated based on the written response and not what the response infers.

Marking instructions should be agreed between all markers and applied consistently. Cross-marking of a sample of each markers work should occur to ensure the marking instructions have been applied accurately and consistently.

Using cut-off scores

The notional cut-off scores for course assessment are:

70% A grade
60% B grade
50% C grade
40% D grade

Cut-off scores should be appropriate to the instrument of assessment. They should be amended to reflect any differences between centre assessments and SQA question papers.

Such differences could include:

- an assessment being split over a number of sessions rather than a single sitting
- assessments with an insufficient number of grade A marks
- assessments that do not adequately sample the skills, knowledge and understanding of the course
- assessments that do not adequately integrate the skills, knowledge and understanding of the course

You should raise the cut-off scores above notional difficulty to reflect such differences.

It is important to note that sometimes intended grade A marks perform as relatively straightforward marks. The overall performance of the cohort should therefore be reviewed after all candidates' assessments have been marked. If the grade A marks did not perform as intended, you should consider why this might be and whether the grade cut-off score should be adjusted to reflect candidate performance.

A question that is considered as relatively straightforward may yield responses that are significantly different to the marking instructions, suggesting that the wording of the question caused confusion, or that the question was too challenging. Grade cut-off scores may need to be adjusted to reflect this.

Appendix 1 – Advanced Higher Biology question paper brief

	Marks		
Component	**Knowledge and understanding**	**Skills**	**Total**
Question paper	70+/-5	30+/-5	100

Knowledge and understanding/skills	**Range of marks**
♦ demonstrating knowledge and understanding of biology by making statements, describing information, providing explanations, and integrating knowledge	min 25
♦ applying knowledge and understanding of biology to new situations, interpreting information and solving problems	min 25
♦ planning or designing experiments/investigations, including safety measures, to test given hypothesis or to illustrate particular effects	25–35
♦ selecting information from a variety of sources	
♦ presenting information appropriately in a variety of forms	
♦ processing information/data (using calculations and units, where appropriate)	
♦ making predictions and generalisations based on evidence/information	
♦ drawing valid conclusions and giving explanations supported by evidence/justification	
♦ identifying sources of error and suggesting improvements to experiments	

A maximum of two extended-response questions: 12–15 marks in total: ♦ one of the extended-response questions will include a choice of topic: 8-10 marks ♦ one of the extended-response questions will not include options: 4-5 marks
One extensive data handling question: 7–10 marks.
One large experimental design question: 5–9 marks.
Grade A marks: approximately 30%.

Appendix 2 – General marking principles for Advanced Higher Biology

This information is provided to help you understand the general principles you must apply when marking candidate responses to questions in this paper. These principles must be read in conjunction with the detailed marking instructions, which identify the key features required in candidate responses.

(a) Marks for each candidate response must always be assigned in line with these general marking principles and the detailed marking instructions for this assessment.

(b) Marking should always be positive. Marks should be awarded for what is correct and not deducted for errors or omissions.

(c) If a specific candidate response does not seem to be covered by either the principles or detailed marking instructions, and you are uncertain how to assess it, you should seek guidance from your Team Leader.

(d) There are no half marks awarded.

(e) Where a candidate makes an error in the first part of a question, credit should normally be given for subsequent answers that are correct with regard to this original error. Candidates should not be penalised more than once for the same error.

(f) Unless a numerical question specifically requires evidence of working to be shown, full marks should be awarded for a correct final answer (including units) on its own.

(g) Larger mark allocations may be fully accessed whether responses are provided in continuous prose, linked statements or a series of discrete developed points.

(h) In the detailed marking instructions, if a word is **underlined** then it is essential; if a word is **(bracketed)** then it is not essential.

(i) In the detailed marking instructions, words separated by / are alternatives.

(j) A correct answer can be negated if:

- an extra, incorrect, response is given;
- additional information that contradicts the correct response is included.

(k) Where the candidate is instructed to choose one question to answer but instead answers both questions, both responses should be marked, and the better mark awarded.

(l) The assessment is of skills, knowledge and understanding in Biology, so marks should be awarded for a valid response, even if the response is not presented in the format expected. For example, if the response is correct but is not presented in the table as requested, or if it is circled rather than underlined as requested, give the mark.

(m) Unless otherwise required by the question, use of abbreviations (eg DNA, ATP) or chemical formulae (eg CO2, H20) are acceptable alternatives to naming.

(n) If a numerical answer is required and units are not given in the stem of the question or in the answer space, candidates must supply the units to gain the mark. If units are required on more than one occasion, candidates should not be penalised repeatedly.

(o) Incorrect spelling is given. Sound out the word(s),

- if the correct word is recognisable then give the mark
- if the word can easily be confused with another biological term then do not give the mark, eg ureter and urethra
- if the word is a mixture of other biological terms then do not give the mark, eg mellum, melebrum, amniosynthesis.

(p) Marks are awarded only for a valid response to the question asked. For example, in response to questions that ask candidates to:

- **identify**, **name**, **give**, or **state**, they need only name or present in brief form;
- **describe**, they must provide a statement or structure of characteristics and/or features;
- **explain**, they must relate cause and effect and/or make relationships between things clear;
- **compare**, they must demonstrate knowledge and understanding of the similarities and/or differences between things;
- **calculate**, they must determine a number from given facts, figures or information;
- **predict**, they must suggest what may happen based on available information;
- **evaluate**, they must make a judgement based on criteria;
- suggest, they must apply their knowledge and understanding of Biology to a new situation. A number of responses are acceptable: marks will be awarded for any suggestions that are supported by knowledge and understanding of Biology;
- **account for**, they must give a reason or reasons for a particular action, event, observation, change, or state.