

INTERNATIONAL ADVANCED LEVEL

BIOLOGY

**Exemplars with examiner
commentaries –
Unit 3 - WBI13**



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Introduction

1.1 About this booklet

This booklet has been produced to support teachers delivering the Pearson Edexcel International Advanced Level in Biology specification. The Unit 3 exemplar materials will enable teachers to guide their students in the application of knowledge and skills required to successfully complete this course. The booklet looks at questions 1(1a)(iii), (1(c)(ii), 2(a)(iii), 2(c)(ii) 3(a)(i) and 3(b)(iii) from the June 2019 examination series, showing real candidate responses to questions and how examiners have applied the mark schemes to demonstrate how student responses should be marked.

1.2 How to use this booklet

Each example covered in this booklet contains:

- Question
- Mark scheme
- Exemplar responses for the selected question
- Example of the marker grading decision based on the mark scheme, accompanied by examiner commentary including the rationale for the decision and where relevant, guidance on how the answer can be improved to earn more marks.

The examples highlight the achievement of the assessment objectives at lower to higher levels of candidate responses.

Centres should use this content to support their internal assessment of students and incorporate examination skills into the delivery of the specification.

1.3 Further support

A range of materials are available from the Pearson qualifications website to support you in planning and delivering this specification.

Centres may find it beneficial to review this document in conjunction with the [Examiner's Report](#) and other assessment and support materials available on the [Pearson Qualifications website](#).

Question 1(a)(iii)

- 1 The stigma of a flower secretes a solution of sucrose. Pollen grains germinate in this solution to produce pollen tubes.

The effect of sucrose concentration on the germination of pollen grains was investigated.

Pollen grains from a single flower were scraped into the cavity of a slide containing sucrose solution.

After one hour, the slide was viewed through the high power of a microscope.

The number of germinating pollen grains was counted together with the total number of grains in the field of view.

This procedure was repeated for each sucrose solution, using pollen grains from the same flower.

The percentage germination of pollen grains was calculated.

- (iii) Explain why the results might have been affected if the variable you named in (a)(ii) had not been controlled.

Mark scheme

Question number	Answer	Additional guidance	Mark
1(a)(iii)	<p>An explanation that includes the following points:</p> <ul style="list-style-type: none">• an effect of the factor on the germination (1)• because enzymes are involved in (pollen germination/metabolism) (1)• description of {metabolism/enzymes} being affected by the factor (1)	<p>Accept growth Do not accept reference to seeds</p>	<p>(3)</p>

Exemplar response A

because temperature increases the rate of the reaction the pollen grains in a optimum temperature'll germinate quickly. and if the temperature is too high it'll cause denaturation of enzymes. If the enzymes are denatured the pollen grains can't germinate. So the changing temperature causes change in germination rate.

Examiner's comments:

This response was given 3 marks.

The answer starts off gaining the third marking point as it is a description of an effect on metabolism ('...temperature increase rate of reaction...'). On its own, this would be borderline for the mark as it is not clear whether the candidate understands that this would happen with a *higher* temperature. However, this could be pieced together with the statement later about the temperature being 'too high' and awarded the mark. In fact, the statement '....if the temperature is too high it will cause denaturation of enzymes...' would be awarded marking points 3 and 2, as it is an effect of (high) temperature (3) on enzymes (2).

The first marking point is gained at the end where it is noted that if enzymes are denatured, germination would not occur.

Exemplar response B

- The percentage germination of pollen grains might change if the temperature ~~was~~ is not controlled
- There would be unreliable results as ~~the temperature can increase~~ the higher temperature could increase the rate of reaction which will lead to a larger percentage germination of pollen grain.
- The samples need to be ~~to~~ investigated under the same conditions ~~to be~~ to prevent errors or bias and to have a valid investigation.

Examiner's comments:

This response was given 2 marks.

The answer starts with a statement which is correct but too vague on its own for any marks. Again, a vague statement such as '... there would be unreliable results...' is correct but not markworthy. However, when the candidate states that '... the higher temperature could increase rate of reaction...', they gain the third marking point. The sentence goes on to suggest that the effect of this increase of the rate of reaction would lead to a '...larger percentage germination...', gaining the first marking point. The final paragraph is not relevant.

A mention of enzymes would have given this answer 3 out of 3.

Question 1(c)(ii)

(c) The table shows the results of an investigation into the effect of boric acid concentration, in a sucrose solution, on the growth of pollen tubes.

(ii) You are provided with a solution containing 500 g dm^{-3} of sucrose.

Devise a procedure to investigate the effect of different concentrations of sucrose on the rate of growth of pollen tubes, using this sucrose solution.

Mark scheme

Question number	Answer	Additional guidance	Mark
1(c)(ii)	<p>An answer that includes five of the following points:</p> <ul style="list-style-type: none"> • use a range of at least 5 concentrations of (sucrose) solutions (1) • detail of dilution method using the sucrose solution (of 500 g dm^{-3}) (1) • at least one control variable named (1) • use 100 ppm boric acid solution (1) • use a microscope and graticule to measure pollen tube length (1) • stated times (for measurements of pollen tube) (1) 	<p>Accept stock and distilled water as one of the concentrations.</p>	(5)

Exemplar response A

Plan a dilution table to dilute 500 g dm^{-3} to a range of concentrations including 250 g dm^{-3} , 100 g dm^{-3} , 50 g dm^{-3} , 25 g dm^{-3} , 10 g dm^{-3} . Take pollen grains from the same plant and put it in 5 different petri dishes. Label each of the 5 petri dishes according to the corresponding concentration of sucrose. Using 5 beakers, labelled to each concentration, ^{with} a clean syringe and distilled water make 10 dm^3 of each solution. Add ~~the~~ ^{the same} amount of each concentration solution into each petri dish with the same number of pollen grains each. Keep them in an incubator with 25°C to maintain temperature and prevent difference in humidity. Leave them for 48 hours. After which take 1 pollen tube from each petri dish and place on a microscope slide with clean forceps. Using a graticule aligned to correct size for pollen grains record the length of each pollen tube. ^{measure} ~~Record multiple~~ ^{mean} lengths from each petri dish and find ^{mean} length. Compare ^{mean lengths} ~~the~~ ^{the} ~~table~~ ^{table}. Ensure no one is allergic to pollen or gets cut by glass.

(Total for Question 1 - 10 marks)

Examiner's comments:

This response was given 5 marks.

The response gains the first marking point by the end of the first sentence, although it is not clear how the dilutions are being made at this point for the second marking point. On line 6 it is clear that this is being done with distilled water - this gives the second marking point. The pollen grains in the solutions are placed in an incubator at 25° C, gaining the third marking point. They are then left in there for 48 hours, gaining the final marking point. The response gains the fifth marking point where a microscope and graticule are combined for the measurement.

Exemplar response B

Take 5 different ^{concentrations} sucrose solutions (1 cm^3 , 3 cm^3 , 5 cm^3 , 7 cm^3 , 9 cm^3). Keep temperature, humidity and time same for each tube. Use same type of flower (6). For each flower give different concentrations of sucrose and wait for ~~one month~~ ^{two weeks} for each, then look at how fast the pollen tube grows ~~with~~ ⁱⁿ different concentration of sucrose. ^{Don't put any sucrose to one of flowers to make comparison} Draw a calibration curve after repeating 5 times and taking mean. Draw SD diagram. Wear gloves during holding sucrose as a safety precaution.

Examiner's comments:

This response was given 3 marks.

The first marking point is gained in the first line. Control variables are mentioned in lines 2 and 3. Humidity is not relevant but it can be ignored; time is correct but must be a stated one for the last marking point (see below). However, temperature is correct for the third marking point. The last marking point is gained at the mention of leaving the grains for 2 weeks.

The next part of the answer fails to consider how what is suggested could be achieved. The candidate does suggest that the speed of growth of the grains should be 'looked at' but fails to say how this can be done. It was quite common for candidates to say that pollen grains should be measured but not say how this could be done. One point to make here is that candidates should be prepared to draw on any and all of their experience in these questions. Core practical 5 requires candidates to '...use a graticule with a microscope to make measurements...'. Therefore, it is not unreasonable to expect them to know how to make measurements of microscopic objects such as pollen tubes.

Question 2(a)(iii)

- 2 An investigation was carried out to determine the relative concentration of reducing sugars in a range of foods.

In each case, some food was ground up with distilled water. The resulting liquid was filtered to give an extract.

This extract was then tested for the presence of reducing sugars using a reagent.

- (iii) It was assumed that the extract contained all the reducing sugars from the food sample.

Suggest how this assumption could be tested.

Mark scheme

Question number	Answer	Additional guidance	Mark
2(a)(iii)	An answer that includes the following points: <ul style="list-style-type: none">• take the food residue (from the filter paper) (1)• and test it (for reducing sugars) with Benedict's (1)	Accept Fehling's or other suitable test	(2)

Exemplar response A

(2)

add some water on the residue that was left on the filter paper, put it in a beaker, add the Benedict's reagent if there is a change in color then the sample still has a reducing sugar.

Examiner's comments:

This response was given 2 marks.

This question was not always well answered. Some candidates, however, were able to gain full marks. All that was needed was a suggestion that residue (or a similar word or phrase, e.g. as some said: 'the remainings') was tested with Benedict's.

This kind of question, which is likely to be common on this paper, requires candidates to plan to do something outside of the things they have learned, although within the context of learned material.

Exemplar response B

~~the extract~~ Make another solution from the food ^{sample} that remained on the filter ^{paper} when it was filtered and ~~test~~ ~~make~~ ~~also~~ test it.

Examiner's comments:

This response was given 1 mark.

Here the candidate has the right idea as to what to test: '...the food sample that remained on the filter paper...'. However, the suggestion to '...test it...' is too vague to gain the second marking point.

Question 2(c)(ii)

- (c) The reagent used to test for reducing sugars is a blue solution containing soluble copper ions. Reducing sugars react with the copper to form an insoluble precipitate.

After testing, the precipitate formed can be removed. This leaves a solution that is less blue.

- (ii) Devise a procedure to determine the concentration of reducing sugars in a sweet potato.

Mark scheme

Question number	Answer	Additional guidance	Mark
2(c)(ii)	<p>An answer that includes four of the following points:</p> <ul style="list-style-type: none"> • use {standard / known} {mass/volume} of sweet potato / use a standard volume of sweet potato extract / volume of extraction liquid (1) • carry out reducing sugar test (1) • {filter the solution / remove precipitate} (after the test is carried out) (1) • {weigh the precipitate remaining in the filter paper / measure intensity of blue color in filtrate} (1) • convert this {mass / intensity} to a concentration of reducing sugar / compare colour of tube contents precipitate with a colour chart qualified (1) 	<p>Accept size</p> <p>e.g. that has been devised using a range of concentrations of reducing sugars / in which the colours correspond to a range of concentrations of reducing sugars</p>	(4)

Exemplar response A

Get the same sweet potato and crush it then dry it. Measure the mass of the sweet potato and split it into 5 equal portions. Dissolve each portion in the same volume of water (100cm^3). Add 5 drops of Benedict's Solution to each test tube. Place them in a water bath at 40°C for 15 minutes. Be careful when taking out test tubes so use tongs & wear gloves. By using an online table for color chart, take an average for all test tubes. Repeat and take average, draw a graph and calculate standard deviation.

(Total for Question 2 = 16 marks)

Repeat the same procedure by using a range of concentrations of reducing sugars and by using a color chart colorimeter. Plot a graph of the color light intensity against the concentration of reducing sugars. Find the light intensity for the solution of sweet potato after filtering the precipitate.

Using the graph, extrapolate to find the concentration of reducing sugars which ^{had} produced same light intensity as the sweet potato. Repeat under same conditions and take an average.

Examiner's comments:

This response was given 4 marks.

This question proved difficult for most candidates. It requires to go beyond what the candidates may have learned or experienced. Four-mark answers were rarely seen and only achieved by the most able candidates. First, candidates had to take on board the requirement for an actual concentration to be determined, not just an indication of it. This means that they need to measure something and get numbers as an answer. In other words, candidates need to take the semi-quantitative idea from the core practical (CP1) and expand it to give a quantitative result. Only those candidates who were able to see that the final colour of the clear solution over the precipitate or the mass of the precipitate could allow such a quantitative measurement could progress to full marks.

In this response, the first marking point was gained with the idea that the sweet potato should be weighed and then divided into equal portions. Crushing and drying it is not needed but would work so it is not an issue. In addition, the volume of extraction liquid (water) is stated.

A Benedict's test is then suggested for the second marking point.

The next section of the response addresses the fifth marking point by explaining how a calibration curve would be prepared using a range of known reducing sugar solutions at different concentrations and measuring the '...light intensity...' using a colorimeter. It would have been better to say 'absorbance' or 'transmission', but 'light intensity' was accepted. Finding the light intensity of the sweet potato was acceptable for marking point four and doing this after filtration was also given for marking point three. Therefore, this answer, although not perfect in every detail, gains all 5 possible marking points for a total of 4/4.

Exemplar response B

Same ~~Different~~ sized (surface area) sweet potato ^{measured by digital balance (4)} cubes are cut from same sweet potato. Each cube ^(both control and original) should be added to test tubes and heated in waterbath for 5 minutes which contain same volume and concentration of Benedict's solution. The test tubes are removed and colour change is observed for ^{control group without potato and potato} ~~different masses of cubes~~ cubes. Absorbance can be calculated by colorimeter or calibration curve can be used from dates obtained before from range of different reducing sugar concentrations. Repeat at each concentration to calculate the mean for reliability.

Examiner's comments:

This response was given 2 marks.

Same size sweet potato is acceptable for the first marking point and then another marking point for doing the right test.

Although a colourimeter (sic) is mentioned as is a calibration curve, there is not a clear idea of what it is being used to measure or how any measurement would be converted into what is wanted; a concentration of reducing sugars. So, this is a potentially full mark answer if these details had been given. The candidate had an idea of what to do but does not express it clearly enough.

Question 3(a)(i)

3 The enzyme urease catalyses the following reaction:



The effect of pH on this reaction was investigated using the following method.

- One test tube containing 5 cm³ of urease solution was placed in a water bath at 40 °C and left for 10 minutes.
- Another test tube containing 5 cm³ of urea solution in a buffer at pH 3.0 was placed in the same water bath and left for 10 minutes.
- After 10 minutes, the contents of both tubes were mixed together in one test tube.
- This test tube was replaced in the water bath.
- The concentration of ammonia was measured after 15 minutes and again after 60 minutes.
- The procedure was repeated for pH values of 4.0, 6.5, 6.8, 7.3, 8.0 and 9.0.

(a) (i) Explain why the urease solution and the urea solution were kept in the water bath at 40 °C before and after being mixed.

Mark scheme

Question number	Answer	Additional guidance	Mark
3(a)(i)	<p>An explanation that includes four of the following points:</p> <ul style="list-style-type: none"> • for equilibration (1) • because mixing the solutions at different temperatures would make the temperature $\neq$ 40 °C (1) • (40 °C could be) optimum for urease (1) • (so if the mixture) {cooled down / warmed up} rate would change during experiment (1) • ensures only pH is varied (1) 	<p>Accept when mixing the temperature stays at 40°C / constant</p>	(4)

Exemplar response A

To equilibrate the solutions so the difference in ammonia concentration is only due to the pH.
40°C is the optimum temperature of the enzyme urease and the greatest number of enzyme-substrate complexes form in one second due to high kinetic energy.
At optimum temperature the rate of catalysis is the greatest. They were kept separately at first to ensure the reaction started when both solutions had the same temperature.
After being mixed ~~they~~^{the tube} was placed back in the water bath to ensure the reaction took place at a constant temperature as the reaction may be endothermic/exothermic.

Examiner's comments:

This response was given 4 marks.

The response gains 2 marks in the first sentence with a mention of '...equilibration (sic)...' and the idea the pH needs to be the only independent variable. It then goes on to get a third mark for the suggestion that the 40° C is the optimum for urease. From here, there is just further elaboration of what optimum means and a restatement of the idea embodied in the word equilibration, none of which is incorrect but gains no further marks.

Then, in the last sentence the examiner has pieced together what the candidate has said to award the fourth marking point. Award of full marks was rarely seen for this question.

Exemplar response B

To check if the enzymes are functioning properly. 40°C is the optimum temperature for enzymes. If the enzymes are denatured they won't work properly and would not catalyse the urea. After mixing, they were placed in a water bath in order to keep the temperature constant (at 40°C) so enzymes won't denature if the temperature is lower or higher. In this way we will get the maximum amount of ~~ammonia~~ ammonia and CO₂.

Examiner's comments:

This response was given 2 marks.

This type of answer was much more common. Many candidates gained the first marking point by suggesting that 40° C may be the optimum. The suggestion that the temperature might not be kept at 40° C after mixing, which could lead to denaturation, is taken as an implication of a rate change due to temperature and gains the fourth marking point.

Question 3(b)(iii)

(b) The graph shows the results of this investigation.

(iii) Compare and contrast the results shown in the graph at 60 minutes with those at 15 minutes.

Mark scheme

Question number	Answer	Additional guidance	Mark
3(b)(iii)	<p>An answer that includes the following points:</p> <p>Similarities</p> <ul style="list-style-type: none"> both sets of results have a similar pattern (1) both peak at same pH (1) <p>Differences</p> <ul style="list-style-type: none"> no ammonia produced at pH 4 after 15 minutes but {some / 10 a.u.} produced at 60 minutes (1) more ammonia produced at every pH after 60 minutes than after 15 minutes (1) 	<p>Accept 60 min graph starts at pH 3 and 15 at pH 4</p>	(3)

Exemplar response A

Both For both, increasing pH increases concentration of ammonia until 7.3. After pH 7.3, both concentrations decrease as pH increase. Overall, rate of reaction at 60 minutes is higher than at 15 minutes. The difference at pH of 7.3 is 40 a.u. For 15 minutes there is no change in concentration from pH of 3 to 4 but there is 10 a.u increase at 60 minutes.

Examiner's comments:

This response was given 3 marks.

The key in this question is to make sure that there is at least one difference and one similarity.

Full marks cannot be gained in a *compare and contrast* question if this is not the case.

In this answer, the second marking point is gained for the observation in the first 4 lines with its description of the rise to 7.3 and the subsequent fall. Marking point 4 is obtained with the description of the higher rate of reaction after 60 minutes compared with after 15 minutes. It is of course, not strictly speaking, the rate of reaction that candidates are told about but the production of ammonia. However, this is due to a higher rate of reaction, so the mark was given. Finally, marking point 3 is gained at the end.

Exemplar response B

(3)

For 60 minutes, the pH is 3 and the 15 minutes, the pH is 4 at the start of the experiment. The graph for 60 minutes is gradually increasing and meeting its optimum at 7.3 the pH and the concentration is 100. The graph for 15 minutes is gradually constant at first and meets its optimum at 7.3 the pH and the concentration is 60. The most effective graph is with 60 minutes and the least effective one is the 15 minutes.

Examiner's comments:

This response was given 1 mark.

The first sentence is too unclear to gain any marks. Although not all well expressed, the second marking point was given for the lines from 2 to 5. The candidate did not take the thoughts expressed in the last sentence to a more precise statement for marking point 4.

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PEARSON EDUCATION LIMITED. REGISTERED IN ENGLAND AND WALES NO. 872828
REGISTERED OFFICE: 80 STRAND, LONDON WC2R 0RL
VAT REG NO GB 278 537121

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