BIOLOGY

Paper 5090/11
Multiple Choice

Question Number	Key	Question Number	Key	Question Number	Key	Question Number	Key
1	C	11	C	21	C	31	D
2	C	12	B	22	C	32	C
3	D	13	C	23	D	33	D
4	A	14	B	24	A	34	D
5	D	15	B	25	B	35	B
6	B	16	B	26	A	36	A
7	D	17	D	27	A	37	D
8	A	18	D	28	D	38	C
9	D	19	C	29	C	39	C
10	A	20	B	30	B	40	D

General comments

255 candidates sat this paper. Marks were distributed between 9 and 39 out of 40.

Comments on specific questions

Question 3

B was the strongest distractor for more able candidates, who appreciated that CO_2 diffuses out of cells in which aerobic respiration is taking place but did not understand that diffusion takes place down a concentration gradient.

Question 4

This was a demanding question in which candidates were required to remember that absorption of nitrates takes place by active transport so that nitrate ions can continue to be absorbed even if the concentration in the soil is less than that in the cells. However, most candidates selected option **B** showing that they felt that the rate of absorption would reach a maximum when external and internal concentrations were the same.

Question 20

This was a demanding question and candidates were required to remember that the dialysis fluid provided contains glucose at the same concentration as the blood, to prevent glucose diffusing out of the blood.

Question 30

The nitrogen cycle can be confusing for candidates but the role of nitrogen-fixing bacteria is perhaps one of the more straightforward aspects to remember.

Question 34

The roles of hormones in the menstrual cycle is one of the more demanding parts of the syllabus, but again less able candidates preferred the other options to the correct response, **D**.

Questions 21 and 36

These questions did not differentiate well with most candidates at all ability levels selecting correct answers. However, both are legitimate questions for this syllabus and the high success rate reflects the fact that candidates were well-prepared for these aspects of the examination.

BIOLOGY

Paper 5090/12
Multiple Choice

Question Number	Key	Question Number	Key	Question Number	Key	Question Number	Key
1	C	11	C	21	B	31	D
2	B	12	A	22	C	32	C
3	B	13	C	23	C	33	D
4	A	14	C	24	A	34	D
5	C	15	B	25	D	35	D
6	D	16	B	26	B	36	A
7	D	17	A	27	C	37	A
8	D	18	D	28	B	38	C
9	B	19	B	29	C	39	C
10	C	20	C	30	A	40	D

General comments

Marks were distributed between 5 and 40 out of 40. The paper proved to be very accessible: candidates were clearly well-prepared and scored highly.

Comments on specific questions

Question 2

Option **D** proved popular, and it seems surprising that some candidates are apparently not aware of the continuous hollow tubes formed by xylem vessels.

Question 5

Many candidates selected options **A** and **B**, not appreciating that the rate of reaction was being measured by the disappearance of starch and therefore that the faster the reaction, the less would remain.

Question 9

This question differentiated well, with most able candidates choosing the correct option, **B**. This was a demanding question: candidates were required to firstly decide what would happen inside the membrane bag and then work out what would diffuse through the membrane, and then to identify the outcomes for the chemical tests.

Question 10

This question also differentiated well. The challenge here was to link the impact on lipid digestion of the removal of the gall bladder, the reduction in glycerol produced and the subsequent reduction in the amount absorbed.

Question 35

Less able candidates selected all four options, perhaps just guessing or omitting to identify the 'not' in the question. However, **C** proved surprisingly popular with many candidates, and it is difficult to see why, except perhaps that the passage of the virus across the placenta is not well known.

Question 38

This was a very demanding question, and it is encouraging to see that many more able candidates selected the correct response.

Questions 3 and 36

These questions did not differentiate well, with most candidates of all ability levels selecting correct answers. However, both are legitimate questions for this syllabus and the high success rate reflects the fact that candidates were well-prepared for these aspects of the examination.

BIOLOGY

Paper 5090/21
Theory

Key messages

In general, candidates scored best where they were being asked straightforward questions that required recall of knowledge. They found questions with an unfamiliar context more challenging suggesting that more practice at answering questions where they need to apply their knowledge and understanding, rather than simply recall, would be beneficial. It was encouraging to see that many candidates scored well on the data analysis question in **6bii** and that some analysed the data mathematically to score the maximum marks. Wherever possible it is advised that candidates be given opportunities to analyse data in different formats as this will help develop their problem solving skills.

General comments

The majority of candidates attempted all the compulsory questions and followed the rubric by answering only one of the optional questions in ***Section C***. Candidates' handwriting was legible and answers were, in general, concise so did not extend beyond the available answer lines. Candidates are recommended, however, to include as many relevant details as possible, particularly on the extended writing questions, to ensure that they do not miss out on marks.

Comments on specific questions

Section A

Question 1

Candidates were provided with a diagram of the skin to interpret. The linked questions assessed knowledge of skin structures and their functions.

(a) (i) This proved to be a straightforward question with the majority being able to identify B as a blood vessel and C as a sweat gland. A few lost marks by suggesting two names for a part. Sometimes B was identified as a nerve.

(ii) Many were able to achieve a mark for recognising that, as the external temperature dropped, blood vessels are involved in reducing heat loss from the body. Others understood that a process called vasoconstriction occurs. Unfortunately it was rare for candidates to achieve full marks on this question and many answers revealed that two misconceptions persist about this process. Firstly, some candidates suggested that it is the capillaries that constrict, forgetting that capillaries are only one cell thick and therefore do not have muscle tissue in their walls; without muscle to contract there can be no constriction of the blood vessel lumen. Secondly, other candidates suggested that blood vessels move away from the surface of the skin. A good answer would indicate an understanding that arterioles/blood vessels constrict which reduces the volume of warm blood flowing through the capillaries near the skin's surface thus reducing heat loss by radiation.

(b) Candidates were most likely to gain a mark for recognising that part A is a sensory receptor and they could then achieve a second mark for suggesting the stimulus for the receptor as pain, temperature or pressure. Some suggested a particularly sensitive part of the body such as hands, fingertips or lips which was credited with a mark. Suggestions for why a body part has a high or low concentration of receptors were not often provided.

(c) Although there was no requirement to name layer D a mark was available for giving a suitable name such as adipose tissue or fat cells. Fat, on its own, was not credited. Many understood that reducing food intake or an increase in exercise were ways of reducing stored fat. Only a few went on to explain that this was because fat was being respired to release energy.

Question 2

This question explored candidates' understanding of the role of the lungs and heart in providing muscles with the oxygen required for cellular aerobic respiration.

(a) (i) In this question, candidates could gain two marks for indicating the route taken by oxygen to reach the lung alveoli and two marks for explaining how the oxygen entered he blood and reached the muscles. There were plenty of marks available for candidates with knowledge of lung structure and the circulatory system and quite a few were able to gain four marks here. Those missing out on marks either did not provide sufficient biological facts or did not focus on the route that an oxygen molecule took, instead giving details about the breathing process or even cellular respiration.

(ii) This proved to be quite a challenging question for candidates. Relatively few were able to suggest both improving lung capacity and developing stronger heart muscles.

(b) (i) This question was well answered with the majority gaining the full two marks for 'aerobic respiration'.

(ii) Both the value of 3.4 and the unit dm^3 were required for the mark here. Most were able to read the correct value from the graph but some omitted the unit.

(iii) Many understood that once maximum oxygen consumption had been reached then cells would respire anaerobically, producing lactic acid. Some suggested that the man was running out of glucose or stored glycogen and did not gain marks.

(iv) Most attempted to sketch a graph but many of the graphs drawn suggested that the candidates had forgotten that the aim of the fitness training was to improve oxygen delivery to muscles and that successful training would mean that the maximum oxygen consumption would be greater than the original value of 3.4 cm^3. Quite a few appreciated that at low intensity exercise there would be no difference in oxygen consumption so the line should follow the same gradient. Fewer candidates then correctly extended the line so that it levelled off at a higher maximum value at a higher exercise intensity. It was pleasing to see that the majority used a ruler and pencil when constructing their graphs.

Question 3

This question covered the topics of transpiration, xylem, artificial selection and reproduction in plants.

(a) (i) Candidates were most likely to score a mark for recognising that the rate of transpiration would be reduced by removing leaves and covering with a plastic bag. Marks were harder to achieve for explaining why. It was rare for candidates to link leaf removal to reduction in surface area although some did link it to reduction in numbers of stomata and gained credit. The fact that the bag was described as transparent distracted many with their answers mentioning the bag either reduced light intensity or allowed sunlight to pass through. Very few realised that humidity would increase but some did realise that water vapour would condense on the bag and then drip back to the soil, preventing dehydration.

(ii) Many gave answers that focused on what asexual reproduction does <u>not</u> involve and were not credited. It is hoped that the definition of asexual reproduction provided to learners will include the facts that it involves a single parent, division is by mitosis and the offspring produced are <u>genetically</u> identical.

(b) Most knew that one of the functions of xylem is transport and could also state a relevant adaptation such as being long, thin, with no end walls or having no cell contents. It was less common for candidates to remember the important structural role that xylem vessels play and that cell walls thickened with lignin is a key adaptation.

(c) Not all candidates realised that sexual reproduction was necessary to produce a plant with disease resistance and red flowers. Despite being asked to refer to parts of flowers in their answers quite a few gave answers that suggested they thought grafting was appropriate. Those who understood that sexual reproduction was involved generally picked up marks for describing pollen being transferred from an anther of a dahlia with one desired characteristic to a stigma of a plant with the other characteristic. It was less common for candidates to mention selective breeding or artificial selection or to complete the story by explaining that fertilisation would happen, seeds would be grown and the plants with the correct combination of characteristics could be selected.

Question 4

This short question tested knowledge of absorption, the circulatory system and enzyme structure.

(a) Most knew that absorption happens in the small intestine but struggled to name the blood vessel involved in transporting amino acids to the liver. Hepatic artery, renal artery, capillaries, vein, pulmonary vein, aorta, hepatic portal artery, hepatic vein were all incorrect answers that were given.

(b) In this question candidates were given the terms 'active site' and 'specific' and tested on their understanding of enzyme specificity. Many could quote the lock and key hypothesis and could describe the enzyme and substrate fitting together to gain marks. Very few mentioned that it is the shape of the active site and the amino acid that are important and that they need to be complementary. Perhaps this is an area which would benefit from greater emphasis.

Question 5

This question explored candidates' knowledge and understanding of leaf structure and function.

(a) (i) Many candidates recognised that the leaf would gain access to sunlight by floating on the water's surface. Some missed out on a mark by not stating that the leaf would gain more sunlight or by not explaining that the sunlight was necessary for photosynthesis. Credit was given to candidates who suggested that more carbon dioxide would be available at the surface of the pond.

(ii) This question proved to be more accessible than **(a)(i)** with many able to identify A as a stoma and B as an air space. Common errors included naming A as a guard cell or B as an intracellular rather than an intercellular air space.

(iii) This part of the question was the most challenging for candidates. They needed to observe the leaf section carefully and think about ways in which it might differ from a 'typical' leaf section in order to explain adaptations to a pond environment. Too often, candidates simply stated what they knew about the functions of the stomata and air spaces without thinking about either the leaf section or the environment. Those gaining marks spotted that the stomata were on the upper surface, assisting gaseous exchange and that the air spaces were very large, aiding buoyancy.

(b) This was a straightforward end to the question with the majority of candidates recognising the plant as a producer.

Question 6

Candidates were asked to compare the structure of a typical virus with that of a typical animal cell and were then asked to describe the methods of Human Immunodeficiency Virus (HIV) transmission before analysing some data on HIV infection and treatment.

(a) In general, candidates did well on this question with most attempting to make four comparisons between a virus and animal cell for the four marks available. There was a good understanding that viruses lack organelles, cytoplasm and a cell membrane and that they have a protein coat. Many knew that both contained genetic material but were sometimes not clear that the genetic material of viruses is either DNA or RNA. Despite 'structure' being emboldened in the stem of the question some spent time comparing the physiology which was not relevant in this question.

(b) (i) Modes of transmission of HIV are very well known with the majority of candidates scoring at least two of the three marks available. It should be noted that stating that HIV is transmitted 'from mother

to child' is insufficient detail. The candidate needed to be more precise by describing that it happens during pregnancy or it passes across the placenta or during birth or when breastfeeding.

(ii) There were two straightforward marks available here. One for describing an increasing number of people infected with HIV and a second for identifying that the numbers being treated were also increasing. The third mark required deeper analysis and it was pleasing that a number of candidates did attempt to use the data from the table to illustrate their answers. Some gained credit for calculating that an extra 13 million were infected and that an extra 22.53 million were being treated between 2000 and 2018. A few carried out percentage change calculations to illustrate the points they were making. The more opportunities candidates get to analyse relevant data from different contexts and in different formats, the more confident and skilful they will become when answering data analysis questions.

Question 7

A molar tooth was the context for this question and candidates were tested on their knowledge of its function, why it decays and how decay can be prevented. Additionally candidates were expected to apply their knowledge of blood and capillary function to describe the movement of materials between the capillaries and surrounding cells.

(a) (i) Almost all candidates gained a mark for this question by describing molar teeth grinding or crushing the food.

(ii) This proved to be the most difficult part to answer. Although there were plenty of marks available, many gave rather vague answers that lacked clarity and the necessary detail. Candidates were most likely to score marks for identifying named substances that moved between capillaries and the surrounding cells and for correctly stating the direction of travel e.g. glucose from a capillary to a surrounding cell. Many were also able to pick up a mark for mentioning diffusion as the means by which the molecules pass in and out of cells. It was rare, however, for candidates to mention that blood in capillaries is under pressure and that this forces liquid and dissolved nutrients out of the thin, one-cell-thick capillary walls.

(b) The majority of candidates obtained the two marks available for describing ways in which dental decay can be prevented. Scoring additional marks for describing what causes decay was trickier with many answers revealing that the links between food in the mouth, bacteria, acid production and subsequent enamel corrosion are not particularly well understood. Some simply stated that decay is caused by not brushing teeth regularly and then failed to explain the biological reason for this problem.

Question 8

Approximately 60 per cent of candidates opted to answer this optional question about coordination of the body.

(a) Candidates were asked to compare coordination by nerve impulses and by hormones. Generally at least two of the four marks were scored with candidates often opting to describe differences in the speed and mode of transmission. Candidates generally tended to focus on the differences between the two types of coordination and it is worth reminding them that the command word 'compare' should prompt them to think of both similarities and differences. Here they could have scored marks for mentioning that both trigger responses in cells and that both work on specific effectors.

(b) It was unusual for candidates to score the full six marks here indicating a lack of precise biological detail in answers. Marks were most readily obtained for correctly describing details of nerve cells responsible for bringing about a response when the girl spots the car. The purpose of releasing adrenaline was not as well known, although many were able to state that it was secreted by the adrenal glands.

Question 9

This question on the nitrogen cycle and the effects of fertilisers was tackled by approximately 40 per cent of candidates.

(a) Candidates found this part of the question more challenging than **(b)**. This was largely because they did not provide sufficient detail in their answers. They could gain a mark for mentioning a relevant nitrogen compound that is present in fertiliser and a further mark for mentioning that bacteria in the soil will carry out nitrification but these marking points were not often seen. Candidates tended to pick up marks for mentioning the uptake of nitrates by root hairs and their transport in the xylem. Few went on to describe the nitrogen being used to make amino acids and then protein.

(b) The disadvantages of artificial fertilisers are well known and many candidates could provide good answers which tended to focus on describing the process of eutrophication. Most also picked up a mark for stating that an advantage of fertilisers is that they improve crop yield. No candidates mentioned that the reason why artificial fertilisers are added to fields is because humans remove the crop and take away nitrogen (in the form of protein) so that the nitrogen cycle is interrupted.

BIOLOGY

Paper 5090/22
Theory

Key messages

Examiners noted that some candidates were able to respond well to information presented in unfamiliar contexts. The length of candidate responses was largely appropriate. The use of specific vocabulary by candidates is important when expressing scientific content clearly and correctly. The necessity to link concepts between different areas of the syllabus is important when answering some questions. In order to gain full credit for a question, candidates are expected to address all aspects of the question asked. Candidates are therefore advised to consider fully the scope of this requirement for each question before beginning to write a response. Centres are reminded that credit will **not** be awarded for information re-stated by the candidate that was made available in the wording of the question.

General comments

Some very competent work was seen from many candidates. Examiners were pleased to see full and accurate accounts from many candidates to those questions requiring a longer response such as in **Question 6** relating to peristalsis. Questions that require tailoring and application of knowledge, such as in **Question 2** relating to the breathing system, continued to provide more challenge for even some highly attaining candidates. A greater degree of specificity was required in some other responses as noted for individual questions below. Centres are advised to instruct candidates to answer **either Question 8 or Question 9** as stated in the rubric.

Comments on specific questions

Section A

Question 1

(a) There was a range of responses, with only a small number scoring all 4 marks. Most candidates who scored 3 marks did not correctly label **B** and a small number mis-labelled **D**. Those who scored 2 marks generally did so for correctly labelling both **A** and **C**, and the majority of candidates who scored one mark did so by labelling **A** correctly. Several candidates did not score the mark for **D** as they placed the label too far down, and only a few did not gain credit due to label lines that did not touch the diagram.

(b) (i) This question had a mixed response. A significant number of candidates did not correctly identify a correct component. The most common correct response was ‘sweat gland’, followed by ‘blood vessel’ and ‘hair erector muscle’. Only a very small number of candidates identified ‘smooth muscle’. A small but significant number of candidates offered two answers, with one of them being incorrect and therefore no credit was awarded. A significant number of candidates misread the question and offered responses that were not related to structures in the skin, such as the ‘hypothalamus’.

(ii) A small number of candidates did not answer this question despite having attempted the previous linked question. \those who answered ‘sweat gland’ in **(b)(i)** mainly went on to gain full credit in **(b)(ii)**.

Question 2

(a) (i) The majority of candidates scored the mark for some description of 'decreasing', however a small proportion answered that it would 'rise' so did not gain credit.

(ii) This question had a range of responses; most candidates were awarded 2 marks, for the correct concentration and the idea that the oxygen concentration in the air would decrease. The majority of candidates correctly identified the correct percentage. Many candidates went on to correctly identify that this would decrease, however some did not gain credit as they indicated a 'decrease' followed by a later 'increase'. Very few candidates linked the uptake of oxygen to either it entering the blood or being used for aerobic respiration. A significant proportion of candidates made reference to 'respiration' but did not specify 'aerobic respiration'.

(iii) The majority of candidates scored this mark. Those who did not generally made incorrect reference to 'urine' or 'urea' instead of correct reference to 'carbon dioxide'.

(b) (i) This question was not answered well by many candidates. Only a small number of the more able candidates recognised that **N** was inhalation only. A significant number of candidates did not make reference to either the 'diaphragm' or to the 'intercostal muscles', instead writing about the heart or arm muscles and therefore did not gain credit. A significant number of candidates first described inhalation, then described exhalation which did not score credit.

(ii) A small number of candidates did not attempt this question. The majority of the candidates scored the mark. Some candidates incorrectly wrote about changes in breathing rate rather than about how these changes would be represented on the chart. Irrelevant reference was sometimes made to changes in the amplitude of the waves.

Question 3

(a) (i) Most candidates gained full credit. Those who did not, generally used an incorrect figure from the graph or just wrote down 4.5.

(ii) Many candidates scored two marks by writing about both respiration and carbon dioxide. The third mark was not scored very often, as many had the correct idea, but did not specify where the carbon dioxide was lost from/to, or they focused on ethanol produced by fermentation.

(iii) Many candidates correctly began the line at the origin and continued this to the left of that provided. A smaller number of candidates correctly identified that the line should level off at the same end value as that provided.

(b) (i) Candidates that correctly identified the chemical to be 'amylase' did not always go on to correctly describe in some way the reaction as one involving the breakdown of starch.

(ii) The first mark was scored by all but a small number of candidates. Only a small number scored the second mark, with many selecting a value that was much higher than the required range.

(iii) There was a mixed response for this question; the vast majority of candidates attempted it, but some only discussed the results in general terms so did not score any marks. Many scored only one point for reference to one of 'carbon dioxide' being produced, 'enzyme', '40 °C and optimum' or '80 °C and yeast killed'. Some candidates found a pattern in the figures and assumed that doubling the temperature would double the volume of dough produced, hence incorrectly expecting a very large volume of dough at 80 °C. There were very few references to 'kinetic energy' or to 'collisions'.

Question 4

(a) (i) This question was often answered correctly. The most common incorrect responses were 'stomach' and 'small intestine'.

(ii) The majority of candidates scored only one or two marks for this question, with only a small number scoring all three marks. The most common mark was for reference to the concept of the shape of the substrate and that of the enzyme being complementary. Credit was often awarded for correct reference to the term 'active site'. Only a small number of candidates made reference to either 'binding' or to 'enzyme-substrate complex'.

(b) (i) This question was often not answered well. A significant number of candidates made irrelevant reference to genetic abnormalities or diseases. Often candidates did not make accurate reference to the structure of a gene. Many made incorrect reference to a change in chromosome number. Centres are reminded that the syllabus provides definitions where they are required.

(ii) Many candidates scored two marks for reference to 'reducing protein' in the diet. A significant number of candidates wrote in general terms about consuming a healthy diet and having a healthy lifestyle and therefore did not gain credit.

(iii) A range of responses was seen here and whilst there were many correct answers, there was evidence that some candidates found completing the simple genetic diagram and determining the outcome challenging.

Question 5

(a) This question challenged a high proportion of candidates and drew together concepts from different areas of the syllabus.

(b) Many candidates gained full credit for reference to water vapour evaporating through the stomata, or for correct reference to 'diffusion' and 'air spaces'. There was an encouraging number of responses that correctly included all six marking points.

Section B

Question 6

(a) Many candidates failed to gain credit by providing a general account of digestion without addressing the question at all. The most commonly scored marks were for 'muscles', 'push', 'wave-like' and 'from T to U'. Only a small number of candidates scored the point for a correct explanation of the role provided by mucus. Many candidates made correct reference to both 'circular' and 'longitudinal' muscles and to the terms 'peristalsis' and 'antagonistic'. Incorrect reference to 'radial' muscles was occasionally seen.

(b) This question was often answered correctly, with incorrect reference to vitamin C and scurvy the most common error. Some candidates did not refer sufficiently accurately to 'brown' rice for example.

Question 7

(a) In the first part, only the most able candidates related their general knowledge of enzymes to the situation asked in the question. Many candidates gave only a general account of enzyme action rather than a specific account of how enzyme action is involved in the process of germination. In the second part, many candidates made reference only to 'identical' rather than to 'genetically identical' cells as the outcome of mitosis. Some candidates made incorrect reference to both 'mitosis' and 'meiosis'.

(b) This question was generally well answered with the majority of candidates scoring one or more marks. Most candidates made correct reference to 'light' and to 'photosynthesis'. References to the process of transpiration were quite common and did not gain credit.

Section C

Question 8

(a) An encouraging number of candidates answered this question very well with many gaining full credit. There was confusion in some responses about the structure of the blood vessels, the oxygenation of blood that the vessels contain and the direction of blood flow in the vessels.

(b) Some candidates did not gain credit as they confused platelets with white blood cells. The majority of the remainder of the candidates scored at least one mark for describing the prevention of blood loss. Many went on to gain full credit for correctly describing blood clotting and the prevention of

pathogen entry. A proportion of candidates included reference to stages in the clotting mechanism beyond those required by the syllabus.

Question 9

(a) A relatively small proportion of the candidates gained full credit. Many candidates made correct reference to the urethra carrying sperm but did not link this to a function in males only. There was a significant number of candidates who were unable to correctly identify the origin and destination of the ureter and urethra. The location and role of each structure involved in the male and female excretory, digestive and reproductive systems was sometimes confused by candidates.

(b) There were some very good responses to this question. Most commonly, correct reference was made to ‘dialysis fluid’ and the presence of a ‘semi-permeable membrane’. Many candidates made reference to a point, for example the presence of urea in blood, but did not go on to link that point to molecular movement to gain credit. Some candidates made correct reference to a concentration gradient being formed but did not go on to specify the direction of molecular movement down that gradient.

BIOLOGY

Paper 5090/31
Practical Test

Key messages

It is expected that candidates will have had hands-on experience of using basic laboratory equipment and reagents.

Candidates should read the questions very carefully so that they answer the questions as set.

Candidates need to carry out all instructions given in questions fully if they are to receive full credit for their answers.

Technique in constructing graphs and making biological drawings is important. Candidates should plot the independent variable values on the x-axis of a graph and ensure that the plotted points are clearly visible. Sharp pencils should be used when drawing to make smooth, clear continuous lines.

General comments

Candidates appeared to have adequate time to complete the paper.

Comments on specific questions

Question 1

(a) (i) The majority of the candidates correctly inserted *minutes* and cm^3 in the table headings although *seconds* were seen instead of *minutes* despite minutes being clearly stated in the information given.

(ii) Results were fully recorded for both **A** and **B** with the greater volume of juice being produced in **A** after 10 minutes. As the two volumes at 0 minutes were recorded to one decimal place, the majority of candidates also recorded their results to one decimal place.

(b) Credit was given for explaining that more apple juice was produced with enzyme than without enzyme. Those candidates who recognised that the enzyme speeded up the process also received credit. Fewer candidates applied these facts, as asked in the question, to state why the use of the enzyme benefitted the fruit juice industry, in terms of e.g. increased productivity, efficiency or profits.

(c) (i) Most answers correctly stated that the stirring was done to mix or evenly distribute the various contents of the beakers. There were a few erroneous references to stirring making dissolving easier.

(ii) Some candidates did not give sufficient thought to answering this question. They should have appreciated that beaker **B** needed to remain free of enzyme to be the control for this investigation. The stirring rod was cleaned after being used in beaker **A** to remove any possible traces of enzyme before being put into beaker **B**. Answers referring to the prevention of contamination with dust, dirt, impurities, germs etc. received no credit.

(d) Candidates were familiar with the word ‘control’ but many were unable to explain why the contents of beaker **B** acted as a control in this investigation. The most frequently scored mark was for knowing that the results from **B** could be compared to the results from **A** to see if there was any

difference. In order to be a valid comparison the contents of the two beakers had to be identical except for the factor under investigation – the enzyme. So the volume of apple was the same and the volume of water in **B** was equal to the volume of enzyme in **A.** The results from **B** provided information about the effect of water on the apple. These results could then be compared to the results from **A** to discover whether the enzyme caused any different effect.

(e) (i) Some excellent graphs were constructed with the independent variable, time, plotted on the x-axis and the dependent variable, total volume of juice collected from **A**, on the y-axis. Both axes should have been fully labelled. It was important to include 'total' in the volume of juice collected label as a graph of the volume of juice collected every two minutes would have looked very different. Creditworthy scales were linear and made good use of the grid provided. If no values were recorded at the origin then credit could not be given for the scale. It was expected that points would be accurately plotted and clearly visible. It should be noted that crosses or ringed dots should be becoming the norm for plotted points. The question clearly stated that plotted points should be joined with ruled straight lines. Some candidates drew curves and others ruled just one line, presumably thought to be the line of best fit, so these received no credit. A minority of candidates failed to join the plot at the origin to the one at 2,12 or extrapolated the line beyond 10,22 although data beyond that point had not been provided.

(ii) The most common reason for not scoring full marks was the omission of the required working on the graph – at least a line drawn from the time axis at 5 minutes to meet the drawn graph line or a line from that point to the axis for the total volume of juice reading. When units are not given on the answer line provided, it is expected that candidates will include them in their answer.

(g) Designing an investigation based on a method already described requires candidates to have carefully read through that method and visualised themselves carrying it out. Then the reasons why certain procedures are described become clear and can be carried over into the new investigation. A few candidates did just that and gave full descriptions of how the method could be applied to investigate the effect of the enzyme on the production of juice from different varieties of apple. Valid extra details were also included by some e.g. reference to keeping the temperature constant showing that they had really understood experimental procedures.

Common errors were either mixing the apple samples and enzyme while in the filter paper having given the enzyme no time to work, or forgetting to actually mix the apple and enzyme. A few described carrying out the investigation on samples of juice already extracted from different types of apple.

Some candidates simply repeated the given investigation or described how enzymes work. It cannot be expected that such investigations or descriptions will score many marks as they do not answer the question as set.

(h) Most candidates knew that the solution used for testing for reducing sugar is Benedict's. Most knew that heating was required for this test and quoted acceptable temperatures complete with ºC.

For the conclusion too many candidates described the colour change that would be seen if sugar was present. The colour change had already been described in the question and was a result of the test, not the conclusion to be drawn from that result – that reducing sugar was present in the apple.

Question 2

(a) Making biological drawings requires very different skills from making artistic impressions of a specimen or a diagram and there was evidence that some candidates appreciated this. Some of the lines drawn were clear and clean rather than sketchy or with overhangs. The different regions in the cell should have been identified by complete delimiting lines, making the use of shading, stippling or cross-hatching unnecessary.

A large drawing was required, so good use should have been made of the space provided on the question paper.

The cell may have appeared to be quite simple but nevertheless the overall shape of the cell and the shape of the nucleus as it appeared should have been carefully depicted to show e.g. that the

outline of nucleus meets the outline of the cell membrane at one point and that the lobes of the nucleus, occupying most of the cell, are not symmetrical.

(b) Three visible differences between the two labelled cells were asked for. Answers in terms of size, shape, nature of the cytoplasm or presence/absence of a nucleus received credit.

Candidates knew that red blood cells such as cell **C** are biconcave, but that feature was not visible in the photomicrograph and therefore could not be credited.

In the whole photomicrograph there were many more of cell **C** than cell **D**, but, as only differences between the two cells **C** and **D** were asked for, the difference in numbers could not be credited.

(c) (i) Most candidates measured the line accurately.

The answer line indicated that the measurement should be recorded in mm. Some recorded measurements showing that there are those who do not understand the metric system. Instead of recording the (correct) measurement as e.g. 16 (mm) 160,10.6, 1.6 or 0.16 were seen.

(ii) Most candidates drew a line in the appropriate place on their drawing as asked.

Most candidates measured their line accurately and recorded it correctly but some made the same errors as in **(c)(i).**

(iii) Most candidates were aware that to calculate the magnification the measurement of their drawing should be divided by the measurement of the cell in the photomicrograph but there were candidates who divided the cell measurement by their drawing measurement. It should be pointed out to them that, if their drawing is larger than the cell in the photomicrograph, then its magnification must be more than x1 so if an answer of e.g. x 0.2 is obtained (instead of x4.4) they must have miscalculated.

As magnifications expressed to 1 decimal place were required, excess decimal places could not be credited neither could answers incorrectly rounded to 1 decimal place.

It should be noted that when a magnification is recorded there should be no units.

BIOLOGY

Paper 5090/32
Practical Test

Key messages

It is expected that candidates will have had hands-on experience of using basic laboratory equipment and reagents.

Candidates should read the questions very carefully so that they answer the questions as set.

Candidates need to carry out all instructions given in questions fully if they are to receive full credit for their answers.

Technique in constructing graphs and making biological drawings is important. Candidates should plot the independent variable values on the x-axis of a graph and ensure that the plotted points are clearly visible. Sharp pencils should be used when drawing to make smooth, clear continuous lines.

General comments

Candidates appeared to have adequate time to complete the paper.

Comments on specific questions

Question 1

(a) (i) The majority of the candidates correctly inserted *minutes* and cm^3 in the table headings although *seconds* were seen instead of *minutes* despite minutes being clearly stated in the information given.

(ii) Results were fully recorded for both **A** and **B** with the greater volume of juice being produced in **A** after 10 minutes. As the two volumes at 0 minutes were recorded to one decimal place, the majority of candidates also recorded their results to one decimal place.

(b) Credit was given for explaining that more apple juice was produced with enzyme than without enzyme. Those candidates who recognised that the enzyme speeded up the process also received credit. Fewer candidates applied these facts, as asked in the question, to state why the use of the enzyme benefitted the fruit juice industry, in terms of e.g. increased productivity, efficiency or profits.

(c) (i) Most answers correctly stated that the stirring was done to mix or evenly distribute the various contents of the beakers. There were a few erroneous references to stirring making dissolving easier.

(ii) Some candidates did not give sufficient thought to answering this question. They should have appreciated that beaker **B** needed to remain free of enzyme to be the control for this investigation. The stirring rod was cleaned after being used in beaker **A** to remove any possible traces of enzyme before being put into beaker **B**. Answers referring to the prevention of contamination with dust, dirt, impurities, germs etc. received no credit.

(d) Candidates were familiar with the word ‘control’ but many were unable to explain why the contents of beaker **B** acted as a control in this investigation. The most frequently scored mark was for knowing that the results from **B** could be compared to the results from **A** to see if there was any

difference. In order to be a valid comparison the contents of the two beakers had to be identical except for the factor under investigation – the enzyme. So the volume of apple was the same and the volume of water in **B** was equal to the volume of enzyme in **A.** The results from **B** provided information about the effect of water on the apple. These results could then be compared to the results from **A** to discover whether the enzyme caused any different effect.

(e) (i) Some excellent graphs were constructed with the independent variable, time, plotted on the x-axis and the dependent variable, total volume of juice collected from **A**, on the y-axis. Both axes should have been fully labelled. It was important to include 'total' in the volume of juice collected label as a graph of the volume of juice collected every two minutes would have looked very different. Creditworthy scales were linear and made good use of the grid provided. If no values were recorded at the origin then credit could not be given for the scale. It was expected that points would be accurately plotted and clearly visible. It should be noted that crosses or ringed dots should be becoming the norm for plotted points. The question clearly stated that plotted points should be joined with ruled straight lines. Some candidates drew curves and others ruled just one line, presumably thought to be the line of best fit, so these received no credit. A minority of candidates failed to join the plot at the origin to the one at 2,12 or extrapolated the line beyond 10,22 although data beyond that point had not been provided.

(ii) The most common reason for not scoring full marks was the omission of the required working on the graph – at least a line drawn from the time axis at 5 minutes to meet the drawn graph line or a line from that point to the axis for the total volume of juice reading. When units are not given on the answer line provided, it is expected that candidates will include them in their answer.

(g) Designing an investigation based on a method already described requires candidates to have carefully read through that method and visualised themselves carrying it out. Then the reasons why certain procedures are described become clear and can be carried over into the new investigation. A few candidates did just that and gave full descriptions of how the method could be applied to investigate the effect of the enzyme on the production of juice from different varieties of apple. Valid extra details were also included by some e.g. reference to keeping the temperature constant showing that they had really understood experimental procedures.

Common errors were either mixing the apple samples and enzyme while in the filter paper having given the enzyme no time to work, or forgetting to actually mix the apple and enzyme. A few described carrying out the investigation on samples of juice already extracted from different types of apple.

Some candidates simply repeated the given investigation or described how enzymes work. It cannot be expected that such investigations or descriptions will score many marks as they do not answer the question as set.

(h) Most candidates knew that the solution used for testing for reducing sugar is Benedict's. Most knew that heating was required for this test and quoted acceptable temperatures complete with ºC.

For the conclusion too many candidates described the colour change that would be seen if sugar was present. The colour change had already been described in the question and was a result of the test, not the conclusion to be drawn from that result – that reducing sugar was present in the apple.

Question 2

(a) Making biological drawings requires very different skills from making artistic impressions of a specimen or a diagram and there was evidence that some candidates appreciated this. Some of the lines drawn were clear and clean rather than sketchy or with overhangs. The different regions in the cell should have been identified by complete delimiting lines, making the use of shading, stippling or cross-hatching unnecessary.

A large drawing was required, so good use should have been made of the space provided on the question paper.

The cell may have appeared to be quite simple but nevertheless the overall shape of the cell and the shape of the nucleus as it appeared should have been carefully depicted to show e.g. that the

outline of nucleus meets the outline of the cell membrane at one point and that the lobes of the nucleus, occupying most of the cell, are not symmetrical.

(b) Three visible differences between the two labelled cells were asked for. Answers in terms of size, shape, nature of the cytoplasm or presence/absence of a nucleus received credit.

Candidates knew that red blood cells such as cell **C** are biconcave, but that feature was not visible in the photomicrograph and therefore could not be credited.

In the whole photomicrograph there were many more of cell **C** than cell **D**, but, as only differences between the two cells **C** and **D** were asked for, the difference in numbers could not be credited.

(c) (i) Most candidates measured the line accurately.

The answer line indicated that the measurement should be recorded in mm. Some recorded measurements showing that there are those who do not understand the metric system. Instead of recording the (correct) measurement as e.g. 16 (mm) 160,10.6, 1.6 or 0.16 were seen.

(ii) Most candidates drew a line in the appropriate place on their drawing as asked.

Most candidates measured their line accurately and recorded it correctly but some made the same errors as in **(c)(i).**

(iii) Most candidates were aware that to calculate the magnification the measurement of their drawing should be divided by the measurement of the cell in the photomicrograph but there were candidates who divided the cell measurement by their drawing measurement. It should be pointed out to them that, if their drawing is larger than the cell in the photomicrograph, then its magnification must be more than x1 so if an answer of e.g. x 0.2 is obtained (instead of x4.4) they must have miscalculated.

As magnifications expressed to 1 decimal place were required, excess decimal places could not be credited neither could answers incorrectly rounded to 1 decimal place.

It should be noted that when a magnification is recorded there should be no units.

BIOLOGY

Paper 5090/61
Alternative to Practical

Key messages

This paper tests the ability to use a range of practical skills. Candidates should have experience of practical work, including biological tests and experimental design. Candidates should be able to draw, describe and interpret graphs.

General comments

The number of marks awarded overall covered the whole range of those available and it appeared that the candidates had sufficient time to complete the paper. There were few instances of questions that were not attempted.

There continues to be improvement in the drawing of graphs with more candidates following instructions and drawing the type of graph indicated as well as using linear scales with values at the origin. To improve further, candidates should be careful to plot all the required data.

There is also some improvement in experimental design particularly with regard to the use of more precise terminology such as *mass* or *volume* rather than *amount*. To improve further, candidates should consider which variables should be controlled and what should be measured, including an appropriate time frame over which measurements should be taken.

Comments on specific questions

Question 1

(a) (i) The majority of candidates were able to enter the units and the temperature in the table. A few incorrectly included the units with the data and thus did not score the second mark.

(ii) Most candidates were able to read the tally chart and correctly transfer the totals to the table.

(b) (i) Many good graphs were seen with the independent variable (temperature) plotted on the x-axis, fully labelled axes, good linear scales and with points plotted correctly and joined with ruled lines as instructed. A few candidates did not gain full credit as the point at (0,0) was sometimes omitted. On some occasions, despite being plotted, this point was not included when the plots were joined.

(ii) Most candidates were able to correctly estimate the number of bubbles produced in five minutes at 25 °C by using their graph. A few did not give their answer to the nearest whole number and some did not follow instructions and show their working, so not gaining full credit.

(c) Candidates were asked to use the data and their graph to describe the effect of temperature on the rate of photosynthesis. The best answers noted that the rate initially increased with temperature with the rate of increase slowing between 30 – 50 °C, after which the rate decreased. Weaker responses did not note the change in rate of increase.

(d) (i) Many candidates gained marks for noting that some of the bubbles could be missed with reasons being given (although not required) such as ‘they were produced too quickly’ or ‘they were too small to be seen’, and therefore the answers obtained would be less precise than measuring the volume. Fewer candidates noted that the size of the bubbles would vary.

(ii) Most candidates were correctly able to suggest that a measuring cylinder or gas syringe would be a suitable piece of apparatus in which to collect and measure the volume of gas released.

(e) (i) Candidates were asked to design an investigation to find the effect of using different masses of pondweed on the rate of photosynthesis. There were many good responses indicating using a range of masses of pondweed and listing a number of factors that should be controlled as well as stating what should be measured and for how long. Weaker responses were limited in the number of control variables identified and vague about how the results would be obtained and compared, with some giving more theoretical answers that lacked experimental detail.

(ii) Most candidates correctly predicted that increasing the mass of pondweed would cause the rate of photosynthesis to increase.

(f) The majority of responses stated that iodine solution should be used to test for starch and that a blue-black colour would be seen if starch was present. Some candidates realised that the leaf should be decolourised and described the method but did not state why this was done, whilst others missed the point of the question and wrote about de-starching the leaf before carrying out the test – not appreciating that the exercise was to discover whether starch was present, not to remove it; neither of these responses could receive full credit.

Question 2

(a) Most drawings were of a good size, roughly circular and clearly showed two outer layers with the cell wall labelled **W** as instructed. The contents of the cell were less well drawn with the structures not always shown in the correct position and the contents of these structures often roughly shaded. In the best drawings a sharp pencil was used, there were continuous outer lines and there was no shading anywhere.

(b) There were some good responses indicating the clear visible differences between the two cells, however many responses referred to structures that could not be seen such as vacuoles, chloroplasts and nuclei. Other non-creditworthy answers referred to the position of the cells within the root or their function.

(c) (i) Most measurements of **C** – **D** on cell **B** were within the acceptable range of 14 – 16 mm. Since units were given, it was expected that the line be measured and the answer expressed in millimetres; a few answers were recorded in centimetres although in some cases the measurement in centimetres was erroneously divided by 10 in an attempt to express the answer in millimetres. Numerous incorrect examples of converting units were seen, involving multiplying or dividing by various factors of 10. A number of candidates did not draw the line as instructed and therefore did not receive full credit.

(ii) The majority of candidates correctly divided their measurement of cell **B** by the magnification of the photomicrograph (×150) although a few inverted the expression. Some did not follow the instruction to give the answer to two decimal places whilst others did not give units.

BIOLOGY

Paper 5090/62
Alternative to Practical

Key messages

It is expected that candidates will have had hands-on experience of using basic laboratory equipment and reagents.

Candidates should read the questions very carefully so that they answer the questions as set.

Candidates need to carry out all instructions given in questions fully if they are to receive full credit for their answers.

Technique in constructing graphs and making biological drawings is important. Candidates should plot the independent variable values on the x-axis of a graph and ensure that the plotted points are clearly visible. Sharp pencils should be used when drawing to make smooth, clear continuous lines.

General comments

Candidates appeared to have adequate time to complete the paper.

If the space provided is insufficient for a candidate's answer, they should make use of blank spaces on the question paper, clearly indicating where their answer continues.

Comments on specific questions

Question 1

(a) Many of the candidates were able to identify pieces of apparatus which can be used for measuring small volumes accurately. Syringe, graduated pipette and burette were frequent correct answers, although it should be noted that spellings of burette that confuse it with biuret, e.g. biurette, cannot be credited. Beakers, test-tubes, droppers and pipettes cannot be used to measure accurately unless they are graduated.

(b) The majority of candidates entered units correctly in the table but a few omitted to enter any, presumably because they had not read the question or looked at the table sufficiently carefully. Occasionally *seconds* were seen instead of *minutes* although minutes was clearly stated in the information given. A few gave *m* as the abbreviation for minutes which was unacceptable as *m* indicates metres. The volumes were usually correctly read and entered but a very small minority incorrectly took readings from the top of the meniscus instead of the bottom.

(c) Credit was given for explaining that more apple juice was produced with enzyme than without enzyme. Those candidates who recognised that the enzyme speeded up the process also received credit. Fewer candidates applied these facts, as asked in the question, to state why the use of the enzyme benefitted the fruit juice industry, in terms of e.g. increased productivity, efficiency or profits.

Comments about the quality of the juice in terms of e.g. its flavour or concentration were irrelevant as no data was given regarding them.

(d) (i) The vast majority of answers correctly stated that the stirring was done to mix or evenly distribute the various contents of the beakers. There were a few erroneous references to stirring making dissolving easier.

(ii) Many candidates did not give sufficient thought to answering this question. They should have appreciated that beaker **B** needed to remain free of enzyme to be the control for this investigation. The stirring rod was cleaned after being used in beaker **A** to remove any possible traces of enzyme before being put into beaker **B**. Answers referring to the prevention of contamination with dust, dirt, impurities, germs etc. received no credit.

(e) Candidates were familiar with the word 'control' but many were unable to explain why the contents of beaker **B** acted as a control in this investigation. The most frequently scored mark was for knowing that the results from **B** could be compared to the results from **A** to see if there was any difference. In order to be a valid comparison the contents of the two beakers had to be identical except for the factor under investigation – the enzyme. So the volume of apple was the same; the volume of water in **B** was equal to the volume of enzyme in **A.** The results from **B** provided information about the effect of water on the apple. These results could then be compared to the results from **A** to discover whether the enzyme caused any different effect.

(f) (i) There were many excellent graphs constructed with the independent variable, time, plotted on the x-axis and the dependent variable, total volume of juice collected from **A**, on the y-axis. Both axes should have been fully labelled. It was important to include 'total' in the volume of juice collected label as a graph of the volume of juice collected every two minutes would have looked very different. Creditworthy scales were linear and made good use of the grid provided. If no values were recorded at the origin then credit could not be given for the scale. It was expected that points would be accurately plotted and clearly visible. It should be noted that crosses or ringed dots should be becoming the norm for plotted points. The question clearly stated that plotted points should be joined with ruled, straight lines. Some candidates drew curves and others ruled just one line, presumably thought to be the line of best fit so these received no credit. A minority of candidates failed to join the plot at the origin to the one at 2,12 or extrapolated the line beyond 10,22 although data beyond that point had not been provided.

Although the question asked for a graph, bar charts were seen and although the instruction about plotting the data for **A** was emphasised, data for **B** was also plotted in few cases. Credit cannot be given when candidates do not follow the instructions given.

(ii) This question was generally answered well. The most common reason for not scoring full marks was the omission of the required working on the graph – at least a line drawn from the time axis at 5 minutes to meet the drawn graph line or a line from that point to the axis for the total volume of juice reading. When units are not given on the provided answer line, it is expected that candidates will include them in their answer.

(g) Designing an investigation based on a method already described requires candidates to have carefully read through that method and visualised themselves carrying it out. Then the reasons why certain procedures are described become clear and can be carried over into the new investigation. A good number of candidates did just that and gave full descriptions of how the method could be applied to investigate the effect of the enzyme on the production of juice from different varieties of apple. Valid extra details were also included by some e.g. reference to keeping the temperature constant showing that they had really understood experimental procedures.

Common errors were either mixing the apple samples and enzyme while in the filter paper having given the enzyme no time to work or forgetting to actually mix the apple and enzyme. A few described carrying out the investigation on samples of juice already extracted from different types of apple.

A small minority of candidates simply repeated the given investigation, described how enzymes work, designed an investigation into the effect of temperature on the rate of juice extraction or described an investigation using mangoes or oranges and not apples. It cannot be expected that such investigations or descriptions will score many marks as they do not answer the question as set.

There were a few candidates who considered 'concentration' and 'volume' to be interchangeable words, so concentrations were measured rather than volumes. Candidates need to appreciate that there is a major difference.

The responses of some candidates needed more lines than were available on the question paper.

In many such cases, blank spaces on the paper were utilised and some indication of this was given. A few candidates filled the lines provided and then stopped, even though they had not finished describing what should be done. They should be advised to make use of any blank spaces in future to continue their answer.

(h) This was generally well-answered with most candidates knowing that the solution used for testing for reducing sugar is Benedict's, although the occasional incorrect biuret and iodine were seen. Many candidates knew that heating was required for this test and quoted acceptable temperatures complete with ºC.

For the conclusion too many candidates described the colour change that would be seen if sugar was present. The colour change had already been described in the question and was a result of the test, not the conclusion to be drawn from that result – that reducing sugar was present in the apple.

Question 2

(a) Making biological drawings requires very different skills from making artistic impressions of a specimen or a diagram and there was evidence that most candidates appreciated this.

The majority of candidates drew cell C as asked, but a few drew only the nucleus within cell C and therefore could not receive full credit.

Most of the lines drawn were clear and clean rather than sketchy or with overhangs. The different regions in the cell should have been identified by complete delimiting lines, making the use of shading, stippling or cross-hatching unnecessary.

A large drawing was required, so good use should have been made of the space provided on the question paper. Some very small drawings were seen.

The cell may have appeared to be quite simple but nevertheless the overall shape of the cell and the shape of the nucleus as it appeared should have been carefully depicted to show e.g. that the outline of nucleus meets the outline of the cell membrane at one point and that the lobes of the nucleus, occupying most of the cell, are not symmetrical.

(b) Most candidates were able to identify the two cells correctly. A few erroneously identified platelets while a small number answered wbc and rbc which could not be credited.

(c) Three visible differences between the two labelled cells were asked for. Answers in terms of size, shape, nature of the cytoplasm or presence/absence of a nucleus received credit.

Candidates knew from theory that red blood cells such as cell C are biconcave but that feature was not visible in the photomicrograph and therefore could not be credited.

In the whole photomicrograph there were many more of cell C than cell D, but, as only differences between the two cells C and D were asked for, the difference in numbers could not be credited.

A few candidates entered their answers in the wrong columns of the table.

(d) (i) Many candidates measured the line accurately.

The answer line indicated that the measurement should be recorded in mm. Some recorded measurements showed that there are those who do not understand the metric system. Instead of recording the (correct) measurement as e.g. 16 (mm) 160,10.6, 1.6 or 0.16 were seen.

(ii) Most candidates drew a line in the appropriate place on their drawing as asked.

Most candidates measured their line accurately and recorded it correctly but some made the same errors as in **(d)(i).**

(iii) Most candidates were aware that to calculate the magnification the measurement of their drawing should be divided by the measurement of the cell in the photomicrograph but there were candidates who divided the cell measurement by their drawing measurement. It should be pointed out to them that, if their drawing is larger than the cell in the photomicrograph, then its magnification must be more than x1 so if an answer of e.g. x 0.2 is obtained (instead of x4.4) they must have miscalculated.

As magnifications expressed to 1 decimal place were required, excess decimal places could not be credited neither could answers incorrectly rounded to 1 decimal place.

It should be noted that when a magnification is recorded there should be no units.