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BIOLOGY

Paper 0610/11
Multiple Choice (Core)

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

General comments

The paper provided a good balance of questions and challenge at this level. Some misconceptions exist about the roles of photosynthesis and respiration, the meaning of genus and species, the position of the cell membrane and the cell wall in a plant cell, and the difference between an organ system and an organ. Few were familiar with the role of pectinase and that it is tar in cigarette smoke that causes cancer. It is important that candidates study graphs and the information given carefully. The use of dichotomous keys and the role of the xylem were well understood.

Comments on specific questions

Question 1

While most candidates gave the correct response, a significant number indicated that chlorophyll is used for respiration, suggesting some misconceptions exist.

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Question 2

The majority of candidates showed a good understanding of the binomial system, only a few were unable to distinguish between a genus and a species.

Question 3

The majority of candidates showed a sound understanding of how to use a dichotomous key.

Question 4

Although some candidates were able to work out the correct labelling of a plant cell, the question, on the whole, proved challenging. Some were unsure of the positions of the cell membrane and the cell wall.

Question 5

Most candidates correctly identified the different levels of organisation. Some appeared to be unfamiliar with the term *organ system*.

Question 6

Many found the calculation challenging.

Question 7

Many candidates correctly identified the direction of diffusion of oxygen.

Question 8

The type of pressure required in cells to support a plant was correctly identified by many candidates. A common error was to select 'pressure inwards on the cell vacuoles' helps to support plants.

Question 9

Many candidates appreciated that a protease acts on a protein (the chain of amino acids), the commonest incorrect response was the protease acting on an amino acid.

Question 10

Many candidates did not appear to know the role of pectinase and most commonly option chosen was 'amylase.'

Question 11

Many candidates correctly identified the optimum pH for stomach enzymes as pH2, although a slightly smaller number of candidates opted for pH7.

Questions 12, 14, 16, 17, 20, 22, 24, 26 and 28

Candidates showed a good understanding the topics in these questions.

Question 13

Similar numbers of candidates were choosing each option, indicating that the fact that chlorophyll contains magnesium ions was not well known.

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Question 15

While many candidates appreciated that starch is broken into simpler sugars in the mouth, some believed that it was fats that were broken down into fatty acids and glycerol.

Question 18

The role of the xylem was very well understood by most candidates.

Question 19

Although some candidates correctly identified that an ECG is performed on the heart, many opted for the brain, colon or ear, suggesting that this was not well understood.

Question 21

Similar numbers of candidates identified 'mucus and stomach acid' (the correct answer) and 'mucus and white blood cells' as chemical barriers to the transmission of disease.

Question 23

While many candidates opted for the correct answer, some did not appreciate in which bottle anaerobic respiration occurred, with enough carbon dioxide accumulating inside it to inflate the balloon.

Question 25

Some candidates were able to answer this question correctly but a similar number thought that the kidney makes urea and that urea is excreted from the bladder.

Question 27

This question was well-answered by many candidates who understood the order of the structures involved in the reflex pathway.

Question 29

Most commonly, candidates opted for 'nicotine' as the cancer causing substance in cigarette smoke which was incorrect.

Question 30

While most candidates correctly identified the 'contraceptive pill' as a means of preventing ovulation, some chose 'vasectomy.'

Question 31

It was not widely known that light is not always required for germination.

Question 32

Many candidates were familiar with the sequence of processes involved in labour and birth.

Question 33

Many candidates were able to derive the correct answer from a heterozygous cross.

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Question 34

Many candidates were aware that a gene codes for a protein, although some believed it to be the chromosomes or an amino acid that does this.

Questions 35, 36 and 37

These questions were well understood by most candidates.

Question 38

Although some candidates opted for the correct answer, others did not realise that fertiliser would have the same effect on crop plants and plants in the lake.

Question 39

While many candidates were able to interpret the graphs on the depth and rate of breathing correctly, a similar number interpreted the depth of breathing as decreasing instead of increasing.

Question 40

Many candidates correctly identified the cause of increasing atmospheric carbon dioxide levels. The commonest incorrect response was pollution of air by sulfur dioxide.

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BIOLOGY

Paper 0610/12
Multiple Choice (Core)

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

General comments

The exam paper provided a good balance of questions and challenge at this level. The meanings of terms 'species' and 'assimilation' were not widely understood. The presence of magnesium in chlorophyll was also not well known. Some candidates were also unclear about the definitions of diffusion and osmosis. Identifying an artery from a diagram proved to be challenging for some candidates. The use of dichotomous keys and how to calculate a magnification were well understood, and the definition of transpiration was known by most candidates.

Comments on specific questions

Question 1

Whilst some candidates answered correctly, the majority opted for respiration, suggesting there is some misunderstanding about the roles of respiration and excretion.

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Question 2

Many candidates appreciated that organisms only belong to the same species if they can breed and produce fertile young. Some were not aware that the offspring must be fertile.

Question 3

This question was well-answered.

Question 4

Most candidates were not aware that chlorophyll contains magnesium.

Question 6

Many candidates were aware that the experiment demonstrated diffusion, some believed this to be absorption or osmosis.

Question 7

Candidates showed a good understanding of how to calculate a magnification.

Question 8

While many candidates had a good understanding of what is involved in osmosis, some did not appreciate that this process also involves diffusion.

Question 9

Many candidates appreciated that a protease acts on a protein (the chain of amino acids), the commonest incorrect response was the protease acting on an amino acid.

Question 10

Many candidates were aware that biuret solution is used to test for the presence of protein. Some candidates wrongly identified Benedict's solution being used to test for protein.

Question 11

The majority of candidates chose the correct option, some believed that boiling amylase makes it work faster.

Question 12

Many candidates were aware that root hair cells did not possess chloroplasts.

Question 13

This question was well-answered, showing a good understanding of the role of fibre in the body.

Question 14

Most candidates were able to work out which length was represented by the small intestine.

Question 15

Whilst many candidates correctly recognised the cause of obesity, some believed that obesity is caused by an increase consumption of dietary fibre.

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Question 16

There appeared to be some uncertainty about the meaning of the terms used in human nutrition, in particular, the terms 'absorption' and 'assimilation.'

Question 17

While many candidates correctly recognised the structure as representing the phloem, there was some uncertainty as to whether the organ was a root or a stem.

Question 18

The definition of transpiration was known by most candidates.

Question 19

Most candidates correctly identified the blood vessel as an artery, some opted for a capillary or a vein.

Question 20

There was some uncertainty about which blood vessel carries blood directly from the lungs.

Question 21

There appeared to be some uncertainty as to what a mechanical barrier to pathogens is.

Question 22

Many candidates were uncertain about the composition of oxygen in exhaled air.

Question 23

While many candidates chose the correct option, some did not appreciate in which bottle anaerobic respiration occurred, with enough carbon dioxide accumulating inside it to inflate the balloon.

Question 24

This question was well-answered.

Question 25

Although many candidates chose the correct option, some believed that the function of sweating was to remove excess salts from the body.

Question 26

This question was generally well-answered by many candidates who understood the order of the structures involved in the reflex pathway.

Questions 27 and 29

These questions were well-answered.

Question 28

This question was well-answered by some candidates. Some thought that the sweat glands acted as receptors, sense organs or stimuli.

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Question 30

Most candidates were aware that fertilisation in a flowering plant occurs in the ovary. The commonest incorrect answer was that it occurred on the stigma.

Question 31

Whilst most candidates correctly identified the 'contraceptive pill' as a means of preventing ovulation, some opted for 'vasectomy.'

Question 32

It was not widely known that light is not always required for germination.

Question 33

Many candidates were able to derive the correct answer from a genetic cross.

Question 34

Many candidates found the interpretation of information from a family tree challenging.

Question 35

Many candidates correctly identified 'height' as an example of continuous variation, the commonest incorrect response was 'blood group'.

Question 36

This question was well understood by most candidates.

Question 37

Some candidates did not appreciate that more growth in the rabbit means there is more energy for the fox.

Question 38

Although some candidates selected the correct answer, many were unsure of which arrows represented respiration.

Question 39

Some candidates were unfamiliar with what was required in the juice extracting process.

Question 40

Many candidates correctly identified the cause of increasing atmospheric carbon dioxide levels. The commonest incorrect response was pollution of air by sulfur dioxide.

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BIOLOGY

Paper 0610/13
Multiple Choice (Core)

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

General comments

The exam paper provided both balance and challenge. Only a minority of candidates knew the function of the duodenum. Some candidates also found it challenging to relate the blood cell in the photomicrograph to its function. The details of how genetic engineering is carried also proved very difficult. Methodical working is essential when working through questions on involving genetic crosses. The definition of mutation was very well known, as was the structure of a white blood cell, the role of adrenaline, and the effects of rainforest destruction.

Comments on specific questions

Question 1

Many candidates selected the correct option. Some believed that it is osmosis that releases water and energy.

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Question 2

Although some candidates selected the correct option, others were less familiar with the binomial system.

Questions 3, 5, 6, 12, 13, 16, 21, 22, 24, 26, 27 and 29

These questions were well answered.

Question 4

Many candidates correctly identified the palisade mesophyll cell although some thought it was a spongy mesophyll cell.

Question 7

While many candidates opted for the correct response, some believed active transport to be the net movement from a high concentration to a low concentration.

Question 8

In interpreting the effect of placing a plant cell in pure water, many candidates incorrectly thought the cell would burst or be plasmolysed.

Question 9

Many candidates knew the correct colour change the reducing sugars test and only a few selected the incorrect option of 'blue to purple.'

Question 10

Many candidates were aware that amylase is secreted into the small intestine, although some believed that it was secreted into the oesophagus.

Question 11

While many candidates appreciated that protease acts on a protein (the chain of amino acids), some opted for the protease acting on an amino acid.

Question 15

Most candidates opted for an incorrect distractor, although some candidates knew that the function of the duodenum is digestion.

Question 17

Many candidates were able to identify the correct description of transpiration. However, a similar number opted for one of the incorrect distractors.

Question 18

The definition of transpiration was known by most candidates.

Question 19

Most candidates were able to identify an artery from the diagram.

Question 20

While some candidates were able to correctly connect the cell in the diagram with antibody production most candidates thought that the cell helped to clot blood or that it carried oxygen.

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Question 25

Although many candidates identified the correct option, many were less secure in their understanding of the function of sweating. Selection from the three distractors was fairly equal.

Question 28

Similar numbers of candidates opted for **A**, **C** and **D**. Only some candidates appreciated that the sweat glands were acting as effectors.

Question 30

Whilst most candidates correctly identified the 'contraceptive pill' as a means of preventing ovulation, some wrongly chose 'vasectomy.'

Question 31

It was not widely known that light is not always required for germination.

Question 32

There was some uncertainty about where pollen grains are found inside the flower after pollination.

Questions 33 and 34

Many candidates were able to select the correct option for the genetic cross and clearly understood the terms commonly used in genetics.

Questions 35, 37, 38 and 40

These questions were well understood by the majority of candidates.

Question 39

This proved to be a challenging question. Only a few candidates showed a secure understanding of genetic engineering.

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BIOLOGY

Paper 0610/21
Multiple Choice (Extended)

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

General comments

The exam paper provided a balance of questions and challenge at this level. The meaning of the term 'metabolism' was unfamiliar to some candidates. The use of ligase enzymes in genetic engineering was not widely known. The effect of placing cells in a solution which has a higher water potential was well understood, as was enzyme action and enzyme specificity. Most candidates had a clear understanding of discontinuous variation. Candidates must study graphs and information given carefully.

Comments on specific questions

Question 1

While most candidates selected the correct option, some believed that the term for all the chemical reactions that occur in cells is 'respiration.'

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Question 2

The majority of candidates selected the correct option.

Question 3

Although this question was well-answered, some candidates appeared not to convert the length of the image to the same units as the actual length of the mitochondrion.

Question 4

This question was well answered, although some were unable to differentiate between the terms organ and organ system.

Question 5

While many candidates selected the correct option, some did not appreciate that increasing the concentration gradient across a membrane will increase the rate of diffusion.

Question 6

The effect of placing cells in a solution which has a higher water potential than the cells was well understood.

Question 7

The action of enzymes was very well understood by most candidates.

Question 8

While most candidates were able to identify the base in the diagram of the DNA molecule correctly, some identified it as an amino acid or a protein.

Question 9

The relationship between enzyme specificity and the shape of an enzyme's active site was well understood by most candidates.

Question 10

While many candidates selected the correct option, a minority were not aware of the role of pectinase in the production of fruit juice.

Questions 11, 12, 13, 14, 16, 18, 21, 24, 25 and 30

These questions were correctly answered by a large number of candidates.

Question 15

While many candidates were able to deduce the correct answer, a similar number of candidates did not realise that carbon dioxide is being produced because the rate of reaction is greater than the rate of photosynthesis.

Question 17

Most candidates selected the correct option; some identified the capillary as a lymph vessel.

Question 19

Many candidates selected the correct option.

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Question 20

While many candidates identified the correct muscle actions required for inspiration.

Question 22

This proved to be quite a challenging question with only some candidates being able to use the information to draw the correct conclusion.

Question 26

This question required both an understanding of the structures found in a reflex arc and an appreciation of the direction of the impulse and hence the neurotransmitter. Some candidates were able to relate the two sets of information and selected the correct option.

Question 27

While many candidates responded correctly, some believed that it was antibodies or memory cells that trigger an immune response.

Question 28

Many candidates responded correctly, although some candidates believed that oxygen or a suitable temperature were not necessary for germination.

Question 29

While many candidates selected the correct option, some believed that an adaptive feature of sperm cells is the presence of a jelly coat.

Question 31

Many candidates were aware that a length of DNA that codes for a protein is a gene but some students opted for amino acid or chromosome.

Question 32

Most candidates were able to work out the sequence of events that leads to protein synthesis.

Question 33

Discontinuous variation was well understood by the majority of candidates.

Question 34

While many candidates appreciated the fact that people that are heterozygous for sickle-cell anaemia have a resistance to malaria, some believed that heterozygous individuals are more likely to suffer from malaria.

Question 35

Some candidates did not appreciate that in the nitrogen cycle, nitrogen fixation occurs by the action of bacteria and lightning.

Question 36

This question was answered correctly by the majority of candidates.

Question 37

While many candidates were able to interpret the graphs on the depth and rate of breathing correctly, some interpreted the depth of breathing as decreasing instead of increasing.

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Question 38

Few candidates knew how ligase enzymes are used in genetic engineering.

Questions 39

Most candidates were able to answer this question correctly.

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BIOLOGY

Paper 0610/22
Multiple Choice (Extended)

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

General comments

The exam paper provided both a balance of questions and challenge at this level. Calculating the actual size of a mitochondrion proved to be challenging for many candidates. Not converting measurements to the same units appears to be part of the problem. The use of ligase enzymes in genetic engineering was not widely known. Most candidates were not aware at which stage chromosomes are copied during cell division. Also, the function of the rod cells in the eye was not well understood. When working through a genetic cross, methodical working and care are needed. The effect of high temperatures on the activity of enzymes was well understood, as were the role of fibre in the body and the structure of an artery. A good understanding of pyramids of numbers was also shown.

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Comments on specific questions

Question 1

While many candidates correctly identified the group as 'ferns,' some opted for 'dicotyledons' and 'monocotyledons.'

Questions 2, 9, 11, 12, 14, 16 17 and 18

These questions were well understood with the vast majority of candidates selecting the correct option.

Question 3

This question was well-answered, although the difference between the terms organ and organ system were less well known by some.

Question 4

This question proved to be challenging for many candidates.

Question 5

While many candidates selected the correct option, some did not appreciate that decreasing the concentration gradient between the inside of the cell and the outside would decrease the rate of diffusion of oxygen into an animal cell.

Question 6

This question was well-answered by most candidates.

Question 7

Many candidates selected the correct option.

Question 8

This proved to be a challenging question for most candidates.

Question 10

While many candidates selected the correct option, a small number thought that boiling amylase makes it work faster.

Question 13

While most candidates selected the correct option, some were uncertain about the difference between the terms 'absorption' and 'assimilation.'

Question 15

Although many candidates correctly identified the function of translocation, some thought that it involved the transport of starch.

Question 19

Many candidates responded correctly to this question, although some thought that 'phagocytosis in the blood' was an example of mechanical barriers to pathogens.

Question 20

While many candidates correctly identified the muscle actions required for inspiration, some did not.

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Questions 21, 22, 23, 25, 27, 28, 33, 34, 35, 36, 37, 39 and 40

On the whole, these questions were well-answered.

Question 24

Although some candidates responded correctly, many were uncertain about the functions of the rod cells in the eye.

Question 26

This question required both an understanding of the structures found in a reflex arc and an appreciation of the direction of the impulse and hence the neurotransmitter. Only some candidates were able to relate the two sets of information in order to select the correct option.

Question 29

Many candidates responded correctly, although some candidates believed that oxygen or a suitable temperature were not necessary for germination.

Question 30

Many candidates were able to derive the correct answer for a genetic cross.

Question 31

Similar numbers of candidates opted for the correct and the incorrect options. Only some candidates understood that two double recessive parents could not produce offspring with a dominant allele.

Question 32

While many candidates correctly identified the diploid number for this organism, some did not appreciate that to derive the diploid number, the number of chromosomes which were in the cell that was produced by meiosis needed to be doubled.

Question 38

Few candidates knew how ligase enzymes are used in genetic engineering.

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BIOLOGY

Paper 0610/23
Multiple Choice (Extended)

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

General comments

Many candidates were not aware that heroin binds with receptors. Also, there was uncertainty about where pollen grains are found inside the flower after pollination. There was also uncertainty about the inheritance of colour blindness. Many candidates were not familiar with the uses of ligase enzymes in genetic engineering. Many candidates demonstrated a very good understanding of what constitutes a diploid cell. Also, the definition of mutation was well known. Care needs to be taken by some candidates when working through a genetic cross or interpreting a table of data.

Comments on specific questions

Questions 1 and 2

These questions were answered correctly by the vast majority of candidates.

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Question 3

While many candidates correctly identified the level of organisation as 'tissue,' some opted for 'cell.'

Question 4

Most candidates were able to select the correct option.

Question 5

Many candidates correctly worked out that the potato piece that gained most mass must have been put into the distilled water. Some thought there would be no change in mass.

Question 6, 7, 8, 10, 11, 12, 13, 14, 17, 18 and 19

These questions were correctly answered by most candidates.

Question 9

Many candidates selected the correct option.

Question 15

While many candidates correctly identified the uses of water by plants, some candidates did not appreciate that evaporating water from the surface of the plant would cool the plant.

Question 16

Many candidates selected the correct option.

Question 20

Many candidates correctly identified the muscle actions required for inspiration.

Question 21

While many candidates selected the correct option, some believed that both balloons would fully inflate. Not enough carbon dioxide would be produced to fully inflate the balloon on the bottle which did not contain sugar, since this is needed for anaerobic respiration to occur.

Question 22

Many candidates opted for the correct colour but some got the colour changes the wrong way round.

Question 23

Generally, this was well-answered although some were not aware of the most important function of sweating.

Questions 24, 25, 29, 33, 34 and 36

These questions were well-answered.

Question 26

Many candidates responded well to this question. The question required both an understanding of the structures involved in a reflex arc and an appreciation of the direction of the impulse and hence the neurotransmitter.

Question 27

Some candidates selected the correct option, but many with thought that heroin prevents the diffusion of a neurotransmitter across the synaptic gap.

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Question 28

There was some uncertainty about where pollen grains are found inside the flower after pollination.

Question 30

Many candidates were able to derive the correct answer from the genetic cross.

Question 31

Most candidates selected the correct option.

Question 32

This question was challenging for many candidates.

Question 35

While many candidates selected the correct option, some did not realise that that the trophic level representing herbivores is the one with the second largest mass. The producers have the largest mass.

Question 37

Similar numbers of candidates opted for the correct and incorrect options, suggesting that many were unsure of the role of ligase in genetic engineering.

Question 38

Only some candidates were aware that bacteria share the same genetic code as the other four kingdoms.

Question 39

Many candidates were aware that increased soil loss is a direct result of deforestation. Some candidates, however, thought that deforestation would result in 'decreased leaching of minerals' or an 'increased production of methane.'

Question 40

While many candidates arrived at the correct answer, not all interpreted the data correctly.

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BIOLOGY

Paper 0610/31
Theory (Core)

Key messages

Read all questions carefully and answer the question asked. See **Questions 4(b)** and **7(a)(iii)**.

Command words such as 'describe', 'explain', 'suggest' and 'compare' require different responses. Candidates should be encouraged to identify the differences in requirement for command words and in particular the difference between 'explain' and 'describe' questions.

Where a description of a graph or table of data is required, it is expected that data will be quoted (with units where appropriate) in the description given. Many candidates are able to do this effectively.

Where numbered answer lines are given there should be only one response on each numbered line.

General comments

Many excellent scripts were seen and a good understanding of many areas of the syllabus was shown.

Comments on specific questions

Question 1

The majority of candidates gave the correct response.

Question 2

(a) The best responses were able to provide an accurate definition.

(b) (i), (ii) and (iii) These questions were answered well by the majority of candidates.

(iv) Most candidates answered this question well, and many gave a complete explanation and made reference to the correct feeding relationships. A common error was to describe the effect on organisms other than the starfish and the limpets

(v) Some candidates were able to provide the correct responses but some found this a challenging question.

(c) Many were able to correctly identify the principal source of energy. Common errors were producers, algae, phytoplankton, and water.

(d) Many candidates showed a good understanding of the water cycle. Most correctly identified B and D, fewer could identify process C. A common misconception was to identify A as evaporation.

Question 3

(a) The majority of candidates showed a good understanding of this topic. Less confident responses were unsure of how to classify female sterilisation, vasectomy and IUD.

(b) Many candidates provided good responses to this question. A common error was to substitute 'enzymes' for 'hormones'.

(c) (i) This proved challenging for many with only a few able to correctly state the full name.

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(ii) A good understanding was shown by the majority of candidates. Common correct responses were sharing needles and sexual intercourse.

(iii) A good understanding was shown by the majority of candidates. Common correct responses were not sharing needles, the use of condoms and avoiding blood to blood contact.

Question 4

(a) The petal was correctly labelled by most candidates. Identification of the stigma was challenging for some.

(b) This proved to be challenging form some candidates. A common error was to provide features of the flowers rather than the pollen.

(c) A few candidates were able to correctly identify the process involved.

(d) This was well answered. Functions of the ovary and petal were common correct responses.

Question 5

(a) (i) Some were able to correctly identify the structure. Common errors were to identify tissue A as epidermis or cuticle and cell B as a stoma(ta).

(ii) This was well answered by the majority of candidates.

(b) Most candidates answered this question well. Cell wall and permanent vacuole were the most frequent incorrect responses.

(c) Many were able to recall the reactants for photosynthesis. Some responses provided only one reactant or gave the products of the reaction.

(d) Some were able to describe good explanations for their choice of leaf and made reference to the diagram provided.

Question 6

(a) This was well answered by most candidates. In general candidates were familiar with alcohol and tobacco, less so with the effects of heroin.

(b) (i) and (ii) The majority of candidates were able to give good responses to these questions.

(iii) This question asked for a description not an explanation. Many were able to provide a good description and included a data quotation in their response.

(c) This proved to be a challenging question with some giving specific examples of infections rather than the type of microorganism that is affected by antibiotics.

Question 7

(a) (i) Well answered by most candidates.

(ii) A challenging question for some. A common error was to give the value per ten minutes rather than per minute.

(iii) Some candidates provided good responses. A common error was to describe transpiration rather than the movement of the air bubble.

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(b) Most responses identified where water enters a plant, fewer could recall the process involved.

(c) This proved challenging for many. Better responses showed a good understanding of what processes were involved and where in the plant they occurred.

(d) Many correct responses were seen.

Question 8

(a) Well answered. A common error was to name specific foods rather than the component groups to which they belonged. For example a named meat was given rather than protein.

(b) Some candidates were able to recall the specific part of the alimentary canal.

(c) Some candidates were able to correctly identify the structures labelled on the excretory system diagram. The spelling of words like ureter and urethra must be accurate.

(d) The majority of candidates answered this question well.

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BIOLOGY

Paper 0610/32
Theory (Core)

Key messages

It is essential that candidates read instructions and follow them precisely. There was evidence in this paper that some candidates were writing answers without giving sufficient thought to precisely what the question asked. Similarly, where a question requires a specific number of responses, it is important that candidates give only the number required. Finally, the process of photosynthesis needs to be understood with greater clarity by almost all candidates.

General comments

There were many excellent scripts showing that candidates had been both well taught and well prepared for the examination. It would be helpful to all candidates if those definitions that are stated in the syllabus are learnt.

Comments on specific questions

Question 1

In this question, candidates were asked to draw five lines to link named drugs with their effects on the body. Many candidates drew three lines only and so limited the number of marks that could be awarded. In general, those candidates who indicated that alcohol, nicotine and heroin could all result in addiction gained full marks. A common misconception was that nicotine causes liver damage.

Question 2

(a) Candidates were asked to name the four flower parts indicated. Some weaker candidates knew names of flower parts, but could not identify them correctly. Most candidates could not name the ovule which was commonly identified as a pollen grain or as an ovum.

(b) To answer this question, candidates had to complete a table comparing structural differences between insect-pollinated and wind-pollinated flowers, and to give a brief reason for each difference. Candidates of all abilities performed poorly, indicating that this area of the syllabus needs reinforcing. Weaker candidates tended to copy or modify what had been given in the example for the anther. More able candidates were able to identify the structural differences but were unable to give precise reasons for them.

Question 3

This question about methods of birth control was answered accurately by candidates of all abilities. The most common errors were to state that an IUD was a barrier method, and that a vasectomy was a mechanical method, of birth control.

Question 4

(a) (i) Here candidates had to extract one piece of information from a graph. Most candidates performed this accurately, but some misinterpreted the scale or gave the figure for the wrong bar.

(ii) Candidates then had to give a simple conclusion from the results shown in the graph. On the whole, this was carried out satisfactorily. Some candidates failed to gain marks as they referred to

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aspects of the plant's life other than the information given (which was the length of time taken for one petal to fall off). Other more able candidates attempted to explain the theory behind the results and, in so doing, failed to actually state a conclusion from the results.

(b) (i) Most candidates were able to specify the xylem as the tissue responsible for water transport. A few candidates were unsure and named phloem, the vascular bundle, or root hair cells. The latter response indicates that the question had not been read with sufficient care.

(ii) Here candidates had to explain how the glucose (in the flower food) was used by the flower. This was answered inadequately by candidates of all abilities. Many appeared to think that the glucose was used as a reactant in photosynthesis. Responses were muddled and very few candidates were awarded two marks.

(iii) The majority of candidates had not learnt the definition of a decomposer (as given in the syllabus). Many thought that decomposers were dead, or that they attacked and killed other organisms. Other candidates knew that decomposers fed off dead or waste material, but only a few candidates referred to energy.

Question 5

(a) The leaf diagram was labelled quite well. The epidermis and palisade mesophyll were better known than the guard cell and the stoma.

(b) Candidates were required to give an account of how plants produce carbohydrates. Most candidates identified the process as photosynthesis, but that was often the only relevant fact stated. The most frequently omitted information was that light is the energy source for the process and that chlorophyll absorbs the light and converts it into chemical energy. Some able candidates gave succinct and accurate accounts, but in general there was much confusion about the photosynthetic process.

Question 6

(a) The majority of candidates could use the key and identified most, if not all, of the insects correctly. A few candidates appeared to be unfamiliar with how to use a key.

(b) (i) Arthropod features were not well known. Most candidates stated the distinguishing features of insects.

(ii) The classes of arthropods were better known. Most candidates could name one class and many could name two. A considerable number of candidates named insects, indicating that they had not read the instructions carefully.

Question 7

(a) (i) **Question 7** was based on a food web. Naming the organisms with specific roles in the food web was well answered by candidates of all abilities.

(ii) Most candidates stated that there were six types of carnivore present in the food web. Weaker candidates thought that there were two types only.

(iii) The majority of candidates thought that the algae were the energy source for the food web. It is important that they realise that plants obtain their energy from sunlight via the process of photosynthesis.

(b) Candidates had to predict and explain what would happen in the food web shown if all the trout died. Nearly all candidates stated that the kingfishers would also die, or that they would migrate, as they would have no food. Weaker candidates thought that the kingfishers would start to eat other organisms in the food web, indicating that they did not understand the information contained in the diagram. The majority of candidates also concluded correctly that the shrimp population would decrease, but many gave an incomplete explanation for this referring to trout and leeches and not to the relationship between leeches and shrimps.

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(c) Finally, candidates were asked to add some more information to the food web. Most performed this correctly. Some candidates placed arrows in the wrong direction.

Question 8

(a) (i) Many candidates do not know that the liver produces urea, the most common misconception being that kidneys produce it.

(ii) Few candidates could state that excess proteins or amino acids resulted in urea formation.

(b) This question required candidates to identify some structures from a diagram of the urinary system and complete a table naming the structures and giving a brief function for each one. Most could identify and state a function for the ureter and the bladder, although there was some confusion between the urinary bladder and the gall bladder. The identification of the vena cava proved much more difficult and the final two marks were awarded very rarely.

(c) The other main components of urine (water and salts) were quite well known. Some candidates appeared to have read the question with insufficient care and gave urea as a component.

(d) (i) Most candidates stated that the lungs excrete carbon dioxide. A few mistakenly named the nose. Some weaker candidates thought that carbon dioxide was excreted by the skin.

(ii) Most candidates knew that carbon dioxide is transported in the blood and some were more specific and named the plasma or the red blood cells. A significant number of candidates named blood vessels or named a type of blood vessel. This was not creditworthy as it is the blood within these vessels that is responsible for the transportation.

Question 9

(a) Candidates were asked to state two effects of alcohol on the body that would contribute to the risk of having an accident. Most candidates could describe at least one such effect and many could state two effects. Some candidates cited effects such as liver damage, which was not awarded a mark as this would not contribute to the risk of having an accident. This indicates that some candidates did not pay sufficient attention to the wording of questions.

(b) For this question candidates had to state three trends shown by a graph. The graph represented the number of alcohol-related deaths for men and women over an eighteen year period. Candidates worked hard on the answer, but many were awarded one mark only as they were not describing trends, but instead giving individual facts drawn from the graph. Some candidates went beyond the information supplied and made statements such as ‘men drink more alcohol than women’.

(c) (i) In general, this was well answered.

(ii) Most candidates could carry out the required calculation accurately.

(iii) The majority of candidates gave a convincing reason for their answer. However, they were required to give two reasons, and a significant number gave one reason only.

Question 10

(a) (i) Candidates of all abilities knew that the hormone was adrenaline.

(ii) The specific effects of adrenaline on the body were less well known, especially by weaker candidates. The latter tended to give vague answers referring to, for example, flight and fight or to eyes becoming wider. A significant number of candidates of all abilities thought that adrenaline reduced reaction times, which is not the case.

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BIOLOGY

Paper 0610/33
Theory (Core)

Key messages

Candidates need to read each question carefully, particularly any information given at the beginning of the question. They should make sure they follow the instructions, using the given data or information in their answers.

General comments

There was a good understanding of the terms used in questions, e.g. suggest, describe, state. Some candidates still have difficulty with the wording of definitions.

Comments on specific questions

Question 1

(a) Most candidates were able to give the characteristics of all birds. A few gave features specific to the water birds shown in the pictures, however the question asks for features of **all** birds.

(b) An excellent understanding of the use of keys was shown, with most candidates correctly identifying all five birds.

(c) (i) An excellent understanding of the features needed for bird **A** to survive was shown, with candidates giving a number of different correct answers.

(ii) This question was about features needed for survival. Some candidates gave *reproduction* as an answer for the process, whereas the correct answer was *natural selection* or *evolution*. A few candidates gave *adaptive features* as an answer, but this is not a process. The question clearly asked for a process to be named.

Question 2

(a) (i) Most candidates correctly identified the bladder (label **H**) as the organ where urine is stored.

(ii) Most candidates were able to correctly name the bladder.

(b) This question was asking for the functions of the ureter and the urethra. An answer referring to the transport of urine was not sufficient to distinguish the two structures and many candidates confused the urethra with the ureter, and vice versa.

(c) (i) Many candidates correctly identified amino acids as being broken down to produce urea.

(ii) Lower scoring candidates confused the role of the kidney and liver, but in general many candidates correctly identified the organ.

(d) Nearly all candidates were able to correctly calculate water and urine volumes.

(e) While many candidates understood that a greater water intake would result in a greater volume of urine, few understood the effect on concentration. There may be a misconception that if *concentrated* means *more of* then more urine will be more concentrated.

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Question 3

(a) Candidates showed a good understanding of the risks associated with alcohol and heroin. While nearly all candidates were aware of lung cancer as a consequence of smoking, they did not give COPD or heart disease as a risk.

(b) An excellent understanding of addiction and smoking was shown, with many candidates giving detailed answers.

(c) (i) Candidates were able to give descriptions of the results shown in the graph, but often did not give enough detail. For example, data quotes could have been used to say how high the blood alcohol gets.

(ii) and (iii) Most candidates completed these calculations accurately.

(iv) Several answers given were about hormones rather than the relative size or mass of the man and the woman.

Question 4

A very good knowledge and understanding was shown in this set of questions.

(a) Most candidates understood the beginning and end of development of the baby, but some were unclear whether zygote or embryo comes first.

(b) Most candidates provided excellent answers here.

(c) (i) Many candidates failed to expand their answer to include the mode of transmission as body fluids, although generally this was well answered.

(ii) Most candidates correctly identified the disease as AIDS.

(iii) Excellent understanding of the transmission of HIV was shown by most candidates.

Question 5

(a) (i) to (iv) A very good understanding of the male parts of the flower was shown, but few candidates knew both female parts.

(b) Candidates often did not read the whole question together with the introductory information about the corpse flower. Hence many answers referred to seeds rather than pollination, or to smell. Other answers showed a good understanding of adaptations.

(c) Candidates did not always understand the difference between growth and germination, so frequently gave *light* as a condition needed for germination.

Question 6

A very good understanding of food webs and feeding relationships was shown.

(a) Correct points were given, but often were not expanded as required by the term ‘explain’.

(b) (i) Well answered by most candidates.

(ii) Again, well answered by most candidates.

(c) Generally this question was very well answered, but not all candidates indicated clearly that locusts are the food for scorpions and that, as well as locusts, lizards and kangaroo rats eat desert plants.

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Question 7

There was a good understanding of photosynthesis and parts of the leaf, but candidates did not always study the diagram carefully enough.

(a) (i) Most candidates correctly identified chlorophyll.

(ii) Although candidates understood the role of chloroplasts, often they did not know the name of the cells containing them.

(b) (i) Not all candidates knew cuticle as the name for the waxy covering.

(ii) The number of candidates giving mesophyll as their answer, rather than epidermis, suggests that more careful examination of the diagram was needed.

(c) Most candidates showed a good understanding of plant transport.

(d) There was generally a good understanding of gases used for, and produced by, photosynthesis.

Question 8

(a) (i) Many candidates confused the groups of chemicals, often giving enzymes as the group that insulin belongs to.

(ii) Many candidates correctly identified the pancreas as the organ which produces insulin.

(iii) Although most candidates had some idea of the role of insulin, often they did not explain their answer. They needed to be clear about the location of glucose or glycogen molecules, in the blood or in the cell. Simply stating *control* does not explain whether glucose is being reduced or increased.

(b) Most candidates understood how insulin is transported.

(c) (i) This question required a definition, but some candidates gave details of the uses of genetic engineering instead.

(ii) Most candidates were aware of the uses of genetic engineering, but often did not state how the crop was modified. It was not sufficient to simply name an example of a plant or fruit.

Question 9

Some candidates confused the meaning of the words phenotype and genotype, which led to mistakes throughout this set of questions.

(a) (i) This question was answered well by those candidates who understood the term *phenotype*.

(ii) This was answered well by those who understood the term *genotype*.

(iii) Many candidates understood the meaning of *heterozygous*.

(b) (i) While many candidates answered this correctly, some did not read the question carefully so gave the genotype for **D** as well.

(ii) Most candidates gave the correct phenotypic ratio as 3:1.

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BIOLOGY

Paper 0610/41
Theory (Extended)

Key messages

Some candidates continued their responses in the blank spaces on the question paper or in extra booklets. In some cases, these candidates did not indicate which question they were continuing. Candidates should always state where they have continued an answer and also write the question number (e.g. **1(d)(ii)**) at the beginning of their continuation answer.
Data quotes should be given as a value with a unit, e.g. 110–122 GJ per ha rather than 110–122 energy yield / GJ per ha.
Key terms are defined in the syllabus. It is expected that candidates will know these definitions. This paper asked for two definitions: allele (question **3(c)(i)**) and sustainable development (question **5(c)**). Very few candidates knew the second of these.
Candidates are advised to read questions carefully and answer without repeating information already given as marking points are not available for the information given in the question stem.

General comments

Many candidates should be congratulated for their clear and precise responses to extended questions, particularly those involving data analysis and interpretation (questions **5(b)** and **2(c)**). However, some responses did not include units when quoting data in answer to question **2(c)**.

Some responses used the term 'affect' instead of 'increase' or 'decrease'. 'Affect' on its own does not imply a directional change.

The calculation in question **5(b)(iii)** proved challenging for many. Candidates should be encouraged to check their answers to ensure that they are realistic, given the context.

Very few candidates identified the genetic cross in question **3** as a test cross, although many completed the steps of the genetic diagram in **3(c)(iii)** correctly.

Comments on specific questions

Question 1

(a) Many candidates knew that villi are responsible for absorption. Some gave further detail by stating that they provide an increased surface area for absorption.

(b) Interpretation of the images of villi, specially the section in Fig. 1.2 proved challenging for some candidates. Candidates were asked to identify and describe two of the labelled components of a villus. Fig. 1.2 was often identified as a cell and hence labels **P**, **R**, and **S** were incorrectly identified. **S** was most commonly identified as a membrane and **R** as the nucleus. These responses indicate the importance of candidates reading the question carefully. Where answers did relate to the villus section the most common responses included the lacteal (**Q**) and the blood vessel (**R**). Identifications of **P** as a goblet cell and **S** as the epithelium of the villus were seen more rarely. Candidates often knew the function of particular parts of the villus even though they were unsure of their names.

(c) (i) This question was answered well. Most responses included reference to dehydration and watery faeces, with candidates generally using the correct terms. Only a few noted that minerals would also be lost in cases of severe diarrhoea.

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(ii) Descriptions of this treatment were accepted providing that it was clear that both water and minerals would be required.

(d) (i) A common error was 'red blood cells'.

(ii) Some candidates were able to name the process.

(iii) Many candidates gave correct examples. A common error was to state the name of an organelle rather than a molecule.

Question 2

(a) Many candidates gave the correct response. Some responses were overly complicated and tried to devise complex apparatus that would measure 'breathing output'. Some confused pulse rate or heart rate with breathing rate.

(b) Many responses referred to high breathing rates *after* exercise in their hypothesis, rather than stating that physical activity causes the rate to rise. The most straightforward answers stated that 'physical activity would cause an increase in breathing rate and that when exercise stops the rate decreases'.

(c) The question asked for both a description *and* an explanation of the data. Many good responses were seen which gave an excellent interpretation of the decrease in carbon dioxide concentration after exercise. The best responses referred to oxygen debt and the breakdown of lactic acid. A very small number of responses did not provide units when comparing the data.

(d) (i) The risk factors for coronary heart disease (CHD) are listed in Section 9.2 of the syllabus. These could have been used as the basis for responses to this question. People with CHD are at increased risk of having a medical emergency should they undertake vigorous exercise especially if they do not normally undertake much exercise at all. The researchers could ask a health professional to assess her state of health by investigating the various risk factors, such as high blood pressure and high concentration of cholesterol in the blood.

(ii) Most candidates were aware of exercise lowering cholesterol and fats in the blood. Also that exercise is likely to reduce the problems of obesity, and reduce the risk of atheroma. Few mentioned lowering stress or lowering blood pressure.

Question 3

(a) Almost all candidates provided three features of flowers that would attract insects.

(b) The best responses described events following the dispersal of pollen grains from the anthers until fertilisation occurs. They described a pollen grain landing on the stigma, the growth of the pollen tube through the style towards the ovary and ovule and the fusion of the male and female nuclei. Some responses did not refer to fertilisation. Some appeared not to appreciate that the pollen tube delivers the male nucleus to the ovule and that fusion occurs when this nucleus leaves the pollen tube and enters the ovule.

(c) (i) The term allele was well known by most candidates.

(ii) This question proved challenging as few were able to identify this type of cross as a test cross.

(iii) The genetic diagram was completed correctly and in full in most cases. Candidates should take particular care to make upper case letters clearly distinguishable from lower case letters.

(iv) In contrast to **(c)(iv)**, many candidates gave confident responses to this question about the use of homozygous recessive plants (**tt**) in order to produce pure-breeding dwarf pea plants. They often stated that this is to ensure that a dominant allele (**T**) is not available to give rise to tall pea plants.

Question 4

(a) (i) Few candidates identified stem cells as the unspecialised cells that give rise to neurones.

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(ii) Most candidates gave good responses to this question.

(iii) Many candidates gave a correct explanation.

(b) (i) The term motor neurone was known by many candidates.

(ii) An effector organ would generally be a muscle or a gland. Suitable examples of muscles or glands were accepted. The eye was sometimes given, but this was not accepted without some further qualification e.g. the muscles in the iris, as it is generally considered to be a sensory organ rather than an effector.

(c) (i) The mitochondrion (**E**) and the nucleus (**M**) were well known, the rest less so.

(ii) The majority of candidates correctly identified the brain or spinal cord.

(d) Neurotransmitters move across the synaptic gap by diffusion due to a concentration gradient from the side where the vesicles release neurotransmitters to the receptors on the post synaptic neurone. Many candidates mentioned the direction of the flow of neurotransmitters, but did not relate the movement to diffusion.

(e) Correct responses had to be comparative and include a reference to the speed of transmission and duration of effects. 'Nerves are faster and their effects do not last as long' was a typical correct response.

Question 5

(a) Most candidates gave a correctly balanced equation. A minority wrote a word equation.

(b) (i) Almost all candidates chose sugar beet and used the information provided to support their answer. Many excellent responses were seen.

(ii) Few candidates gave an example of a named molecule containing nitrogen. Suitable examples are DNA, RNA, enzymes and chlorophyll.

(iii) The calculation proved challenging for many with few correct responses. A common error was to give 0.002 GJ per ha.

(iv) Candidates could approach their answers to this question from the perspective of using algae for biofuel or using land crops for biofuel. Weaker responses discussed the role of fertilisers and eutrophication, which did not answer the question. Better response included references to crops as food and the amount of land required to grow them; deforestation to release land for growing biofuel crops and the disruption to food chains that this would cause.

(c) Few candidates knew the definition of sustainable development.

Question 6

(a) (i) In answering this question candidates were not restricted to structural features as they were in **Question 4(a)(ii)**. Protein coat and genetic material are listed as features of viruses in the syllabus and these were seen quite often. Candidates gave other features such as small size.

(ii) Many candidates gave excellent responses to this question. The best responses referred to antigens, antibodies produced by lymphocytes, memory cells and long-term immunity. Some also referred to programmes of mass vaccination.

(b) The drawings in Fig. 6.1 should have been helpful to candidates. Responses did not have to be restricted to features visible in the drawings of the viruses, so features other than shape and size were accepted. Examples included the type of genetic material (DNA or RNA), the type of organism that the virus infects and the types of disease that the viruses cause.

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BIOLOGY

Paper 0610/42
Theory (Extended)

Key messages

Some candidates continued their responses in the blank spaces on the question paper or in extra booklets. In some cases, these candidates did not indicate which question they were continuing. Candidates should always state where they have continued an answer and also write the question number (e.g. **1(d)(ii)**) at the beginning of their continuation answer.

Data quotes should be given as a value with a unit, e.g. 13.2 mmol dm^{-3} rather than 13.2 blood lactic acid / mmol dm^{-3}.

Key terms are defined in the syllabus. It is expected that candidates will know these definitions. This paper asked for two definitions: sustainable development (question **3(d)**) and hormone (question **6(b)(i)**). Very few candidates knew the first of these.

Candidates are advised to read questions carefully and answer without repeating information already given as marking points are not available for the information given in the question stem.

Responses to question **6(c)** on thermoregulation revealed that most candidates were unclear about the role of shunt vessels.

General comments

A common error to omit the units when data was quoted in a response.

Candidates should be encouraged to read the stimulus material and each question carefully and complete all the instructions contained within the question to ensure that they are answering the question that has been asked.

Many answers to the long response question (**2(b)**) were very good as they included both appropriate descriptive comments with data quotes as well as good explanations. The use of correct scientific terminology, as stated in the syllabus, is to be encouraged.

Comments on specific questions

Question 1

(a) (i) Most candidates gave carbon dioxide as the excretory substance and many indicated that it is produced in cells. Some candidates qualified their answer by stating that this happens in respiring cells; some also stated that carbon dioxide is made by mitochondria. A common error was to give the lungs as the site of production.

(ii) Fewer candidates identified a nitrogenous waste substance correctly. Urea was the most common correct response. Many stated that the substance is removed because it is toxic or a waste.

(b) (i) Some candidates identified the glomerulus as the site of filtration in the kidney. The Bowman's capsule was also accepted, although the spelling of these two terms was quite variable. There were many different incorrect responses including other structures in the kidney, such as renal artery, nephron, cortex, medulla and ureter. The term renal capsule was also seen quite frequently. The renal capsule is the thin layer of connective tissue around each kidney; it is not an alternative term for the Bowman's capsule.

(ii) This question attracted a wide range of responses. Many candidates gave red and white blood cells. Another common correct response was 'blood cells and blood proteins'. Often these proteins were described as plasma proteins and occasionally examples, such as fibrinogen and albumen, were given. Some candidates gave substances in the plasma that are filtered.

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(c) (i) Many candidates identified correctly all three structures visible in the electron micrograph of cells from the nephron. Identifying the nucleus as A was the most common incorrect response.

(ii) Almost all candidates gave an appropriate function of the nucleus. Incorrect responses included 'control what enters and leaves the cell' which is a function of the cell membrane.

(iii) Candidates listed a variety of places in the body where microvilli are found. Most gave the small intestine or the ileum.

(iv) The most commonly cited features were the microvilli and the mitochondria. Some responses gave a description of the role of these cells or described the processes of filtration and reabsorption without referring to any details of the cells. The enhanced rate of diffusion was seen on several occasions, but was only accepted if it was clearly linked to the high surface area of these cells.

Question 2

(a) Many candidates gave a valid explanation. Many mentioned sexually transmitted infections in their responses, especially HIV.

(b) There were many excellent responses to this question. These were nearly always illustrated by appropriate data quotes. Weaker responses tended to describe the changes but lacked explanations. Better responses qualified words such as 'increase' and 'decrease' by using words such as steep or gradual.

(c) (i) Many candidates identified the threshold concentrations correctly. Common errors were to give them the wrong way round and quote figures such as 19 and 17 km h^{-1}.

(ii) Most candidates explained that athlete **P** has a higher threshold because more time had been spent training so **P** was 'fitter' than **Q**. A few candidates mentioned reasons for the greater level of fitness, such as a larger lung capacity or greater stamina. Many simply stated that athlete **Q** had been training for longer, but this could suggest that he or she had started that particular exercise session earlier and so was ambiguous.

(iii) The link between physical activity and breathing was often explained in terms of increasing the depth and rate of breathing to provide more oxygen for respiration. Few candidates considered the removal of the extra carbon dioxide that is produced during exercise and the detection of the increase in carbon dioxide concentration in the blood by receptors. Weaker responses lacked detail and often omitted words such as 'more' or 'increase', for example, 'physical activity requires energy' was not sufficient. A number of candidates wrote about the effect of anaerobic respiration on breathing rate and the subsequent repayment of the oxygen debt, while others referred in depth to the increase in heart rate that would occur.

Question 3

(a) Most candidates followed the instructions to describe the trend line shown in Fig. 3.1 and gave good responses to the question. Some candidates wrote about the changes in the actual population of sheep in Tasmania, which did not answer the question. Some responses gave explanations rather than the required description.

(b) Some candidates repeated their descriptions instead of explaining the change in the population of sheep. Good responses explained the exponential and stationary phases of the population growth. Some candidates realised that the factors affecting the population of livestock, such as sheep, will be different to the factors affecting wild populations and mentioned the import of sheep in the early years (equivalent to immigration) and the culling of sheep for meat during the stationary phase. A few candidates referred to the carrying capacity of the island. Some candidates simply referred to changes in reproduction rate without any reference to death rates. A common error was to say that the sheep were becoming more adapted to the environment and so their numbers increased.

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(c) This was a challenging question and few candidates identified all the steps involved in carrying out selective breeding:

choice of feature or features to improve by breeding
choice of individuals that show these features
breeding these individuals together
selecting the offspring that show improvement in the chosen features (and culling those that do not)
breeding these offspring together
continuing to select and breed for many generations

Most candidates referred only to the second and third points from this list. Some candidates stated that artificial insemination (AI) could be used, but far more described the process of genetic engineering. Some did not answer the question, but instead wrote about improving the environment, for example by providing better food. Some even referred to natural selection and survival of the fittest. Given the context of the question, surprisingly few cited a trait that would be selected, while those who did often described characteristics that are selected in domesticated animals for increased meat or milk productivity which did not answer the question.

(d) Very few candidates defined the term *sustainable development* successfully, although quite a few recognised that it involves minimising harm to the environment. Many appeared not to recognise the term and attempted to define it in terms of sustainable resources for farm animals. The definition is given in Section 21.4 of the syllabus. Some wrote that development is needed for increasing populations, but omitted to state that the aim of sustainable development is to meet the needs of the *human* population.

Question 4

(a) Many of the responses to this question referred to features of asexual reproduction in plants. For example, candidates often suggested that plants produced by self-pollination cannot spread far from parent plants. Often this followed the statement that self-pollination only requires one parent and is fast. While it is true that self-pollination requires a single individual, the process still involves all the stages of sexual reproduction, such as flower development, meiosis, seed set and seed dispersal, so is no faster than cross-pollination. It was very common for candidates to refer to increased competition between parent and offspring plants as a disadvantage of self-pollination. Inexplicit references to the idea of a disease 'wiping out' all members of a species could be improved by explaining how plants produced by self-pollination are less likely to be able to adapt to a change in their environment. Overall the disadvantages were more widely known that the advantages.

(b) (i) Many candidates completed Table 4.1 correctly, although some gave the recessive allele as 'white flower' rather than using the symbol **b**. Weaker responses gave phenotypes for all four rows in the table.

(ii) Many of the genetic diagrams were completed correctly. Common errors included; writing two alleles in each of the circles provided for the gametes, mismatching alleles to form the genotypes of the offspring and using the terms *genotype* and *phenotype* interchangeably. Generally, candidates who used a Punnett square were more successful in identifying the offspring of the test crosses than those who used 'criss-cross' lines. Some made errors in transcribing the genotypes from the 'space for working' to the answer lines. A small number of candidates also seemed to think that in this case, flower colour was a result of co-dominant alleles and so gave incorrect phenotypes.

(c) (i) In these crosses many candidates incorrectly used two letters, i.e. GW and gw. Some also thought that the alleles were co-dominant and used the notation for blood group alleles, e.g. I^G and I^g.

(ii) This was a challenging question and few candidates identified the fact that white pickerel plants are homozygous recessive or have no dominant alleles. Some explained that these albino plants do not make chlorophyll and therefore cannot carry out photosynthesis. Some candidates stated that the plants cannot live long, but did not say that they would die before flowering and so would not be suitable for test crosses. A number of candidates thought that the plant would be underwater and that this would affect pollination.

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Question 5

(a) Most candidates gave *Helicobacter* as the generic name. Some wrote out the binomial name in full and others gave *pylori*, prokaryote or bacteria.

(b) Many responses did not answer the question as they gave structures that are present in animal or plant cells that are not present in bacteria. Many identified the flagellum visible in Fig. 5.1, although some did not know what it is called.

(c) (i) Most candidates stated that an infection of *H. pylori* could be treated with antibiotics. Some wrote 'antibodies' or 'white blood cells'.

(ii) Again, almost all candidates gave a correct response referring to the acid in the stomach. Fewer identified mucus. White blood cells, or named examples, were a relatively common incorrect response.

(d) There were many good comparisons of active and passive immunity. Almost all the points on the mark scheme were seen, although only a few pointed out that the response of active immunity to first exposure to an antigen is slow. Some responses confused the two forms of immunity. Weaker responses were limited by a lack of use of the correct terminology. Some confused active and passive with natural and artificial immunity and some used the term antibiotics for antibodies. Some also thought that vaccines contained antibodies.

Question 6

(a) Many candidates gave correct responses in all parts of Table 6.1. Some identified the blood vessels transporting oxygenated blood (**C** and **D**) rather than those transporting deoxygenated blood. The hepatic portal vein was often misidentified. The pulmonary vein was often incorrectly identified as the pulmonary artery.

(b) (i) Some responses incorrectly stated that all hormones are proteins. Some referred to hormones affecting the body in general rather than target organs specifically. Some only discussed secretion but not transport or target. Many gave examples, with effects but this did not answer the question. A common error was to identify the role of hormones as affecting growth, puberty or fertility which again did not answer the question.

(ii) Some candidates wrote very succinct descriptions of the role of insulin usually stating that it decreases the blood glucose concentration by stimulating the liver to convert glucose to glycogen. Candidates often stated that insulin 'converts glucose to glycogen' as if it were an enzyme. Some wrote glucagon instead of glycogen and others stated that insulin has the effect of increasing the glucose concentration. Some wrote that insulin controls 'glucose levels in the body' rather than in the blood.

(c) This was a challenging question for some candidates. Some response discussed the sweat glands and hairs which did not answer the question. Candidates should have concentrated on the dilation of arterioles supplying the capillaries in the skin and the constriction of the shunt vessels that take blood direct from arteries to veins by-passing these capillaries. Very few responses referred to shunt vessels, and many who did were confused as to whether they are open or closed when heat is lost. It was often not made clear that when this happens there is an increase in blood flow near to the *surface* of the skin so that heat is lost to the environment. Many were unable to give a clear description of vasodilation and many suggested that vasodilation involved blood vessels moving closer to the skin or that the capillaries dilated.

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BIOLOGY

Paper 0610/43
Theory (Extended)

Key messages

Some candidates continued their responses in the blank spaces on the question paper or in extra booklets. In some cases, these candidates did not indicate which question they were continuing. Candidates should always state where they have continued an answer and also write the question number (e.g. **1(d)(ii)**) at the beginning of their continuation answer.
Data quotes should be given as a value with a unit, e.g. 24 beats per minute rather than 24 average heart rate recovery / beats per minute.
Key terms are defined in the syllabus. It is expected that candidates will know these definitions. In this paper very few candidates knew the definition of sustainable development (**4(e)**).
Candidates are advised to read questions carefully and answer without repeating information already given as marking points are not available for the information given in the question stem.
Answers to **6(b)(i)** on thermoregulation revealed that many were unclear about the role of shunt vessels.

General comments

The majority of candidates were well-prepared and showed a good knowledge and understanding of the syllabus points tested.

Careful reading of questions is essential as it was evident that some responses did not answer the question asked.

Many of the answers to the long response question (**2(c)**) were very good as they included both appropriate descriptive comments, illustrated with data quotes and provided thoughtful explanations.

Comments on specific questions

Question 1

(a) Almost all candidates knew that carbon dioxide is at a higher concentration in expired air. Only a few candidates incorrectly stated oxygen.

(b) Most candidates recognised and described the functions of some of the structures in the photomicrograph. The most common structures correctly identified were the cilia (**B**). Most candidates also stated the correct function of cilia as moving mucus out of the trachea. Common errors were to identify **B** as villi and to suggest that they were responsible for trapping dust, dirt, pathogens or bacteria rather than attributing this function to mucus. Weaker responses stated that cilia moved mucus 'down towards the stomach'.

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(c) (i) Some sequenced the events that occur during inspiration correctly. Others found this more challenging.

(ii) Most candidates knew that gas exchange by diffusion occurs across the thin walls of the alveoli, but slightly fewer stated that this allows for a short distance for the gases to travel or that rapid diffusion can occur. A number of responses referred to diffusion, but then described the movement of something other than gases, such as blood. Some also suggested incorrectly that the thin walls increase the surface area of the alveoli.

(d) This question required candidates to explain why sickle-cell anaemia reduces delivery of oxygen to tissues. This was not widely understood with very few being able to explain why the delivery of oxygen to tissues is reduced in people with sickle-cell anaemia. Most stated that red blood cells are sickle-shaped, but few described the effect on haemoglobin or its consequences. A common error was to state that the haemoglobin, rather than the red blood cells, was sickle-shaped. Very few stated that the sickle-shaped cells could cause a blockage in blood vessels. A few candidates stated that the red blood cell count is reduced.

Question 2

(a) (i) A considerable number gave the aims of the investigation rather than a hypothesis. Many also gave a hypothesis for an experiment with exercise intensity as the independent variable rather than referring to the information provided in the bullet points.

(ii) Most candidates described one of the methods that they could use to determine their pulse rate. However, many omitted a time interval over which the number of heart beats should be counted.

(b) Many responses did not focus on the effects on the heart and instead described the effects on the whole body. Additionally, some described the effects of atherosclerosis, which is beyond the scope of the syllabus, and blocking of arteries in general rather than specifically writing about the coronary artery. Most wrote about blood supply 'to the heart' rather than describing the blood supply to the muscles, tissues or wall of the heart. Many correctly stated that a blockage increases the risk of a heart attack.

(c) This was generally quite well answered with good use of data quotes. However, some responses only gave a description of the data and did not consider an explanation for the observed patterns. It was generally well recognised by candidates that an exercise plan produced by the patient was less likely to be strictly followed and that a plan designed by a doctor would be more effective. Weaker responses simply quoted data from the bar chart without making any comparative comments. Candidates did not always refer to the 'heart rate recovery' but instead wrote 'heart rate', which is not what is plotted on the bar chart.

(d) The most common correct responses were to lower the fat content in the diet or to stop smoking. A significant number of referred simply to 'healthy diets' or 'balanced diets' which lacked sufficient detail.

Question 3

(a) (i) Many candidates knew that genes and alleles were made of DNA. However, a considerable number stated that they were made of proteins or amino acids or chromosomes.

(ii) Many candidates found the completion of this genetic cross challenging. The most common error was to state incorrect parental genotypes or to use two alleles in each gamete as opposed to one.

(b) (i) Many candidates realised that using a heterozygous parent plant could result in disease-sensitive offspring and would therefore not be the best choice for breeding programmes. Many candidates referred to the 'recessive gene' instead of to the recessive allele.

(ii) A wide range of suitable suggestions were given. Many candidates stated artificial selection instead of artificial pollination. Although artificial selection is not wrong, it is a term that encompasses the whole procedure and not just the step that was the focus of this question.

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(iii) Many candidates knew that artificial and natural selection differed with respect to the driving force (humans or the environment respectively). However, many did not extend their answers to include additional points. It was common to find responses where the same point was made from the perspective of both artificial and natural selection. A considerable number of responses confused artificial selection with genetic engineering.

Question 4

(a) (i) Almost all candidates identified the correct species. The most common incorrect response, species **K**, suggested that some candidates did not realise that the *y*-axes on the two bar charts had different scales.

(ii) Fewer candidates identified species **L**. The most common incorrect response was species **K**, as it rose significantly in the later years.

(iii) Many candidates calculated the correct percentage increase. One of the more common errors was to use the wrong denominator.

(b) The majority of candidates gave suitable suggestions. The most common responses were eutrophication and pollution.

(c) (i) Almost all candidates gave the correct response.

(ii) Many candidates gave good accounts of the methods that could be used to prevent overfishing. However, many only described these methods and did not explain how they were effective.

(d) Many candidates used the food web to suggest how the extinction of cod might affect the other organisms. Some were confused by the direction of the arrows and referred to the predators in the food web as 'prey' and vice versa. Some referred to the consequences on the food web in general terms without referring to the species named in Fig. 4.3.

(e) The definition of sustainable development was not well known.

Question 5

(a) (i) The function of mitochondria was well known, but many candidates went on to describe what the energy was used for, rather than how it is released. It was common for candidates to use colloquial analogies such as 'power house', rather than the appropriate scientific terminology. A common error was to suggest that energy is produced, made or generated rather than released or provided. Interestingly, many candidates stated that mitochondria 'release energy *for* respiration', and although this is technically correct as ATP is required in glycolysis (a concept beyond this syllabus), it does not suggest that the role of mitochondria involves releasing energy *by* respiration.

(ii) Many candidates gave two distinguishing features between fungi and plants, but many incorrect answers were also seen. Many referred to a lack of cell walls in fungi or a lack of a nucleus, both of which are incorrect.

(b) Candidates gave some excellent, well considered suggestions as to why yeast is useful in bread-making. The most common response stated that yeast respires and releases carbon dioxide which causes the dough to rise. Other valid suggestions were also seen on many scripts.

(c) (i) Fewer candidates were able to describe how the mould fungus, *Penicillium*, is used to make penicillin. Those candidates who were familiar with the commercial fermentation process wrote detailed responses, often giving more points than were necessary. The most common incorrect idea was to suggest that genetic engineering was required. Some described the use of penicillin to treat bacterial infections which did not answer the question.

(ii) Some candidates wrote very detailed responses that explained how antibiotics act on bacterial cell walls. Many candidates also seemed to know that antibiotics are not used to treat viral infections, but did not explain why. Some misconceptions included; viruses are too small, do not contain antigens, do not have a cell membrane and that viral invasion of host cells provides protection from antibiotics.

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(d) Candidates familiar with the mechanical and chemical barriers that prevent pathogens from entering the human body gave very detailed responses. However, many either described the process of vaccination or the role of the white blood cells in the immune process; both of which are only relevant once a pathogen has breached the mechanical and chemical barriers.

Question 6

(a) (i) Most candidates identified the sensory and motor neurones in the flow diagram. Relay neurone was a common incorrect response for either **X** or **Y** on the flow diagram.

(ii) The sweat glands and the hair erector muscles were the most common effectors identified from the flow diagram. Many candidates seemed familiar with the term *effector*, but did not use the flow chart to identify an example.

(iii) Some candidates knew that negative feedback is the mechanism that controls homeostasis. Many of the incorrect suggestions, such as central nervous system and skin, suggested that candidates were thinking of an organ rather than a mechanism.

(b) (i) The role of shunt vessels in regulating body temperature when the body is too hot was not well understood. Many candidates suggested that shunt vessels had a role in increasing the secretion of sweat. There was much confusion about shunt vessels dilating and blood vessels moving towards the skin. Candidates also needed to refer to 'heat loss from the blood' which was not always clear in the responses seen.

(ii) Most candidates described how sweat glands and hair erector muscles are involved in cooling the body when the external environment is hot.

(c) (i) The most common suggestion as to why nerves, rather than hormones are involved in thermoregulation was that they provide a faster response. Weaker responses referred to 'neurones travelling faster'.

(ii) Many hormones were suggested as being involved in homoeostasis. Many candidates suggested insulin and glucagon. The spelling of glucagon was not always accurate. The most common incorrect suggestions were oestrogen and testosterone.

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BIOLOGY

Paper 0610/51
Practical Test

Key messages

The practical test requires candidates to have good experience of using a wide range of practical equipment to gather data, or to design an experiment that produces suitable data. This data should be presented in a table using the appropriate SI units. Candidates are required to present data in a suitable graphical form including a suitable line to represent the trend. The practical test requires candidates to be able to draw an accurate representation of a biological specimen using appropriate conventions.

General comments

In order to be successful on the practical test, candidates should be able to do the following:

Use a wide range of practical equipment to gather data that is valid and reliable, or to design an experiment that produces suitable data. Candidates should be able to justify their choice of equipment and evaluate its accuracy.

Design an experiment that takes into consideration the control variables, how the data is going to be collected and how the data will be analysed.

Present data in a table using the appropriate SI units. Tables must include appropriate headings. Appropriate SI units or suitable abbreviations should be used. Units should not be used in the body of the table.

Present data in a suitable graphical form including a suitable line to represent the trend. Axes must be labelled and have units.

Draw an accurate representation of a biological specimen using appropriate conventions. Lines must be clear and continuous, using a sharp pencil. Candidates should note the appropriate detail of the specimen, including the shape and proportion of the structures.

Comments on specific questions

Question 1

(a) (i) It was pleasing to see that most candidates were able to access full marks for drawing a table. In some cases, candidates failed to provide suitable heading titles or units for the data collected. It is important that candidates do not include units in the body of the table. The most common error was not including data for the two measurements at ten and twenty minutes.

(ii) Candidates were expected to state a suitable trend for the most effective to least effective pH values, which were linked to the results they obtained. Many candidates were able to draw a suitable conclusion.

(iii) Most candidates made reference to the idea of a control being used as a comparison.

(iv) This question was well answered. Almost all candidates were able to correctly identify lemon juice with a suitable explanation. The most common error was simply stating that the lemon juice had a pH value of two, without *explaining* how this made it a suitable choice.

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(b) (i) Again, this question was answered well by most candidates and they were able to suitably identify an appropriate control variable. Many candidates correctly identified time as a suitable variable. The most common error was not qualifying these variables. For example, simply stating 'solution' without qualifying this by stating the volume of solution was not accepted. It was essential that candidates qualified time by discussing either the observation time or the time left in solution.

(ii) Most candidates were able to identify that oxygen was needed for the reaction. 'Air' was not accepted as it was too vague an answer.

(c) Many candidates could correctly convey the idea that using colour intensity as a measurement was subjective. Candidates did this in a variety of acceptable ways; including the idea that it was measured by eye or that there were several tones of the same colour.

(d) The most common error identified was that the size or amount of apple was not the same. Candidates needed to give an explanation as to how this could be improved, such as weighing the mass of each piece of apple or using a ruler to cut the same sized slice. Some candidates were able to correctly identify that some apple slices had more time in the solution than other apple slices, however they rarely went on to state that to avoid this, they should be tested separately.

(e) For this experimental design question, candidates were asked to describe a method that students could use to find the optimum temperature of the enzyme. Many candidates found this question particularly challenging and failed to interpret what was being asked of them. Rather than discussing extract of polyphenol, they planned an experiment to do with apple pieces. Some candidates correctly identified control variables, including the same volume of substrate and enzyme. Some candidates were able to correctly identify a suitable temperature range in which to complete their investigation. Unfortunately, many failed to identify how to measure the success of the enzyme reaction or the need to time the reaction to an end point. Candidates should be familiar with investigations to determine the optimum temperature or pH for an enzyme to function.

(f) (i) Most candidates were able to draw a very suitable graph. The most common error was failing to plot data for both the apricot and the avocado. Some candidates did not provide suitable units for the axes. It is important to note that plots should be clear and lines should follow any suitable trend.

(ii) Most candidates were able to draw a suitable conclusion. Many stated that the enzyme activity for both fruits decreased with time. Some candidates identified that the apricot enzyme was denatured earlier, or activity decreased faster, than for the avocado.

Question 2

(a) (i) Candidates were asked to state two visible differences between the red blood cells and the white blood cells shown in the picture. Most candidates were able to access full marking points for this question; however a small number lost a marking point for lack of clarity in their response. The most common error was the idea that white blood cells are bigger than red blood cells - whilst this was true for the phagocytes, it was not for the lymphocytes.

(ii) This question assessed candidates' ability to produce a standard biological drawing, following all necessary conventions. Candidates must be able to draw using a sharp pencil to produce clear and continuous lines. It is important that candidates do not use shading or jagged lines. Candidates were required to draw the phagocytes. Some drew only one cell or also drew other blood cells. Many candidates were unable to access full marks as the lines drawn were not continuous and/or shading of the nuclei was common.

(b) (i) Most candidates were able to correctly measure the blood cells in either cm or mm. The most common error was in calculating the mean value.

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(ii) The question proved challenging for many candidates. Some correctly used their answer and the given formula to calculate the average. A common error was not correctly converting this to micrometres or giving the response as a whole number. Candidates should ensure they read the question carefully to determine what is being asked of them and express their calculated value appropriately.

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BIOLOGY

Paper 0610/52
Practical Test

Key messages

The criteria for this paper are skills based, so it is essential that candidates gain experience of carrying out practical activities. Many candidates were able to identify variables, recognise errors and plan experiments. They also showed that they were familiar with laboratory equipment and understood which apparatus was appropriate to use in each circumstance.

General comments

Many candidates gave well-presented concise responses. Many good of examples of table construction were seen. Weaker responses often omitted units from headings or included units in the body of the table, another error was to record observations instead of time.

There were some good examples of drawings, made with a sharp pencil which occupied more than half of the space provided. Good drawings also showed the correct proportions and good observation of the shape of the cells.

The calculations of magnification were often correct, with only a few omitting the line on their drawing as instructed or drawing it in a different place. Candidates should be aware that one of the skills tested is that of 'following instructions'.

Some candidates found it challenging to plan an experiment that use a potometer. This highlights the need to practise planning style questions. Good responses gave at least three values for the independent (changed) variable, knew how to change the independent variable, knew how to measure the effect of the independent variable and knew which variables should be kept constant. The ability to describe a control experiment if it is relevant is also a useful skill.

The Supervisor's report is very important in ensuring that candidates are credited appropriately when materials have to be substituted for those specified in the Confidential Instructions. Supervisors should trial practical materials, as stated in the confidential instructions, as far in advance of the actual examination as possible. This gives time, if any difficulties arise, to seek advice about alternative materials from Cambridge International, using the contact information on the Confidential Instructions. In cases, where a substitution is made the Supervisor's report should include as much detail as possible to allow examiners to assess the candidates responses appropriately.

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Comments on specific questions

Question 1

(a) (i) Some candidates were able to correctly complete a suitable table. The many created a table with two columns, one of which was headed time, but the other was more commonly headed 'tube' with A, B and C listed, instead of the concentration of amylase. Units were often omitted from the headers. It is usual to make the first column of a table the independent (changed) variable and the second column the dependent (measured) variable. In this experiment there were two sets of results per concentration of amylase, which should have been recorded separately. Candidates were asked to record the time at which the starch had been digested. The majority recorded colours of the iodine at different times. It was evident that some had not realised that the first two rows of the tile were preliminary tests that were not part of the timed sequence and that row three was the start time from which the minutes should be counted. Error carried forward was allowed for times that extended to eight minutes, which was assumed to be row eight on the tile. Times in whole minutes or seconds that corresponded to whole minutes were accepted. One error was to record time as <5minutes as the candidates should have been able to state the time at which the iodine remained brown from the row on the tile.

(ii) Most candidates gave a correct answer. Weaker responses stated that iodine became colourless or that the end point was when iodine became blue-black.

(iii) Most candidates knew that Benedict's solution should be added, but many did not then go on to heat the mixture. The most common error was to use biuret solution instead of Benedict's solution. A less frequent error was to the starch test for starch.

(b) (i) Most candidates were able to choose a correct variable. The commonest correct response was temperature with a description of how it would be maintained. re and able to describe how it was kept constant. Weaker responses lacked detail, for example 'use a water-bath' but with no indication of the temperature at which it should be kept.

(ii) Many were able to give a correct reason. The most common incorrect response was to provide the optimum temperature for the enzyme.

(iii) Some candidates gave a precise response which showed that they understood that the amylase was being tested for the presence of starch before it was used to digest starch.

(c)(i) and (ii) Many candidates found it challenging to identify a source of error and suggest an improvement. Many gave human errors, such as not following the instructions properly or not washing the glass rod. Better responses showed that using the glass rod to add drops was a source of error as the volume of the drop would vary each time, or the volume added to each drop of iodine on a row would be different. These candidates gave acceptable improvements, such as using a different glass rod for each test-tube or a graduated pipette to measure the volume added. Weaker responses did not identify the error in sufficient detail e.g. 'using a glass rod' unqualified, but some did then go on to suggest a valid improvement. Some candidates realised that it was not possible to time the removal of the first drop accurately, but did not suggest a suitable improvement.

(d) (i) Most candidates were able to calculate the volume of the starch agar block, but fewer realised that this had to be multiplied by 100 to find the mass of starch. The majority divided 100 by the volume of the starch agar block. Weaker responses omitted the units from their calculations.

(ii) Many found this question challenging. Many tried to calculate a value by calculating the difference between the rates of reaction at different temperatures.

(iii) The majority of candidates answered this question well. Weaker responses either missed out the units from the axes labels or used an uneven scale for the rate of reaction. One error was extrapolation of the line beyond the plotted points. Candidates should be aware that only the plotted points should be joined together unless a line of best fit is specified.

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Question 2

(a) (i) The majority identified chloroplasts and described the difference correctly. Many also identified cell wall as a feature, but stated that epidermal cells do not have a cell wall, even though one is labelled on Fig.2.1. Some identified the shape of the cells, but found describing the shape challenging. The quality of drawings varied considerably.

(ii) There were many well drawn responses that showed good observation with attention to proportion of the size of the stoma in relation to the guard cells. Some did not follow the instruction to draw only the part within the enclosed section of Fig.2.1 and drew both stomata. The better responses had clear, continuous, lines drawn with a sharp pencil, without any shading and occupied at least half of the space available. Good drawings also showed a distinct cell wall that was thicker next to the stoma. Weaker responses were too small or were drawn with a blunt pencil that gave a thick indistinct line or were drawn without any clear separation between the two guard cells.

(b) Most candidates gave a correct measurement in mm. Similarly, most candidates drew a line on their diagram and measured accurately. Some responses were given in centimetres and others with inaccurate measurements. Candidates should know how to measure in mm and to be aware that with a standard ruler, it is not possible to measure more accurately than 0.5 mm. A minority of responses did not have a line drawn on their diagram, which was a marking point. The majority of candidates were able to use their measurement to give an acceptable magnification. Error carried forward was allowed for incorrect measurements of Fig. 2.1 or their diagram. Some candidates followed the instructions and remembered to round to the nearest whole number. Some also recalled that magnifications do not have units.

(c) There were some good responses to this question. Weaker responses did not quote the correct times from the graph or only looked at specific times instead of describing the overall pattern. One error was to confuse the lines for absorption and transpiration.

(d) Responses to this question varied greatly. Candidates who had experience of this or similar apparatus were able to give good descriptions of how to use a potometer to find the effect of varying environmental conditions on transpiration. Temperature was the most commonly chosen factor. The best responses referred to three of more different temperatures or humidities, stated appropriate values for temperature, described a suitable way of maintaining these temperature or humidity for a fixed period of time before measuring the distance moved by the air along the scale of the capillary tube. Candidates were not expected to know a specific time for which the potometer would be left, so credit was given for knowing that a potometer is left set period of time, whatever the actual times given in the response. Better responses also showed an understanding that other external factors such as light and wind speed needed to be standardised. Weaker responses only referred to two different conditions, commonly hot and cold, without stating any specific temperatures. These responses also tended to describe measuring 'the amount or volume of water lost', rather than the distance moved by the water or air, even though this information was given in the question. There were many candidates who did not appear to be familiar with using a potometer and gave descriptions of the results that might be expected from varying temperature or humidity.

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BIOLOGY

Paper 0610/53
Practical Test

Key messages

- Candidates should ensure that they read the questions carefully before starting to answer. This is particularly important for any planning exercise that is required. Identification of the dependent (measured) and independent (changed) variables is vital before a plan is completed. Controlled variables must also be considered and included in a plan.
- Candidates should also try to match the answers they give with the number of marks available for each part of a question.
- Candidates should be familiar with the practical procedures indicated in the syllabus. This means that candidates are expected to be able to carry out these procedures safely, but also that they should be able to work safely and with competence on practical procedures that derive from learned methods.
- When asked about safety considerations, candidates should be able to identify a risk and also a method of reducing that risk.
- Mathematical calculations form an important part of the practical assessment. It is essential that candidates check all of their working carefully and take time to consider whether the resulting answer is realistic.

General comments

Generally candidates performed well throughout the paper, but certain areas proved more challenging than others. The identification of the controlled variables and possible sources of error was reasonably well done but constructing a table of results proved challenging for some candidates. The planning exercise was also well executed by the majority of candidates as was the drawing task. Plotting a line graph proved to be challenging for some candidates.

Comments on specific questions

Question 1

(a) (i) Almost all candidates correctly recorded the name of the fruit and the volume of juice collected.

(ii) Many candidates correctly followed the instructions in step 7 and recorded the colour of the solution before it was heated. Some did not which made any analysis of the results more difficult and also made **1(a)(v)** more challenging. It is important that candidates read each step carefully and follow all of the instructions given.

An infrequent error was to give a list of results instead of a table of results.

(iii) Almost all candidates gave the correct response. A few stated biuret.

(iv) Most candidates gave suitable answers based on their results for a colour change. Some responses did not take into account the effect of the colour of the fruit juice when deciding the final colour of the solution and recorded the colour observed before heating.

(v) This was a challenging question. However, many candidates did correctly identify that they had to look for a change in colour in the solution from before heating, not a change in colour from before adding juice. The most observant pointed out that the colour changed from blue to yellow-orange even before heating.

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(b) Most candidates correctly identified a suitable controlled variable, usually the volume of juice or the volume of the Benedict's solution.

(c) Some candidates gave suitable errors, but many quoted human errors, which were not accepted, such as parallax errors, inaccurate measurement of the volumes of the solutions or timing errors. As in previous series, candidates need to find a suitable improvement that will overcome the error.

(d) Almost all candidates were able to identify the biuret test as a method for testing for proteins.

(e) The planning exercise was well done by the majority of candidates, comparing favourably with previous series of the examination. Most identified two or more temperatures at which to test the juice (although the use of 'room temperature' should be discouraged), and many described how these temperatures would be maintained. The majority of candidates also described controlled variables such as the volume of juice or the time heated. Some chose to investigate vitamin C content in different fruits and simply repeated the previous practical activity rather than relating it to heating, this did not answer the question.

(f) The drawing of an orange section proved relatively straight-forward, but a significant number of candidates found drawing sharp clear lines with no shading challenging. A common error was the use of a compass to draw the outline which was not accepted.

Question 2

(a) (i) Almost all candidates correctly calculated the average root length from the data supplied in the table.

(ii) A large number of candidates were unable to identify the anomalous result from the table. A common error was to compare the data vertically in each column rather than in the horizontal rows for each concentration. Another error was to identify the mean values as anomalous rather than individual data points.

It is also important that the correct number of decimal places is given in the response. In this question values should have been given to one decimal place.

(iii) The plotting of the line graph proved challenging for a large number of candidates

Most were able to select a suitable scale for the two axes, although it should be noted that the plotting area should cover at least half of the grid area.

A common error when labelling the axes was the omission of 'percentage' from the auxin axis or 'average' from the root length axis.

The plotting of the points themselves was generally well executed, but the choice of scale sometimes made it difficult for candidates to plot accurately.

In this graph, the line could have been a line of best fit, or a ruled line joining each plotted point to the next plotted point. In either case the line should not have been extrapolated beyond the plotted points, and should have been smooth and unbroken.

(iv) Most candidates performed well, describing the shape of the line and identifying the point of highest root growth. The best responses made full reference to the data and quoted values with units.

(b) This question was well answered by the majority of candidates. A few found manipulation of the equation challenging. Rearranging formulae is an important skill as is the correct use of units and conversion from one unit of measurement to another. However, in this case most candidates chose suitable units or were able to convert from cm to mm correctly.

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BIOLOGY

Paper 0610/61
Alternative to Practical

Key messages

Candidates should be familiar with experimental methodology, such as enzyme investigations, and should have plenty of experience of the practical procedures outlined in the syllabus. This includes planning investigations and drawing conclusions from practical work.

The investigation in question one included a lot of steps in the methodology. It is important that candidates spend enough time reading through the methodology and data collected and use the information given to answer the questions.

Candidates should use a sharp pencil for drawings and graphs. Any incorrect lines must be erased completely to avoid any confusion.

General comments

Most candidates could confidently draw tables and graphs and most completed good drawings of the two phagocytes in **Question 2**. Planning the investigation to find the optimum temperature of the enzyme polyphenol oxidase proved difficult for many.

Comments on specific questions

Question 1

This question involved an investigation into the effect of pH on the activity of the enzyme polyphenol oxidase which causes polyphenols (in fruit) to turn brown when exposed to oxygen. Candidates should be familiar with a range of different enzyme investigations such as this. The candidates had to read through a lot of information at the beginning of the paper which outlined the methodology, before answering the questions.

(a) (i) Candidates were shown a diagram of the student's results and had to draw a table in which to record the results. Many different arrangements of tables were drawn, but most were appropriate. Tables should be drawn using a sharp pencil and ruler with the data clearly in boxes and the headings within the table outline. Most candidates gave the correct column and row headings and included the units in the headings rather than in the body of the table. The most common mistake was to just give the results for the colour intensity at 20 minutes, rather than the colour intensity at 0, 10 and 20 minutes.

(a) (ii) Using the results, candidates had to list the pH values from most effective to least effective in preventing the browning of the apple. The vast majority of candidates answered this correctly.

(a) (iii) Stating the purpose of the control proved difficult for a lot of candidates. Many thought that the control could be used as a comparison, but did not go on to further explain that it is to compare what happens to the apple with the solutions and without the solution.

(a) (iv) Good answers were seen for this question. Most candidates used their understanding of the results and identified that lemon juice should be used to prevent cut apples from going brown, because the investigation had shown that a low pH stops the enzymes from working.

(b) (i) Candidates had to state a variable that was kept constant and describe how it was kept constant. The most commonly credited answer was the volume of solution as an example of a controlled

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variable. To achieve the second mark, candidates were expected to give detail from the methodology as to how the variable was kept constant, e.g. 20 cm^3 of solution was used in each Petri dish. In this case it was not enough to say the same volume was used in each Petri dish. The variable of time should have been qualified as either the observation time or the time to soak in the solution. Temperature was ignored as this was not mentioned as being controlled in the methodology.

(b) (ii) A lot of candidates realised that the lid was not put back onto the Petri dish so that the apple could be exposed to oxygen for the polyphenol to react. Candidates must remember to use the information given to them in the exam paper to answer this type of question.

(b) (iii) Many candidates did not understand the meaning of the term *hazard*. They thought that they were being asked to identify a source of error in steps 6 and 7 and many gave an answer relating to the inaccurate volume of apple used. Many candidates that did say that cutting was a hazard, found it hard to describe how to reduce the risk of cutting.

(c) Candidates had to explain why the method to find the colour intensity value was a source of error. Many gave their explanation in terms of there being more than three shades of brown or that judging the colour by eye could be a problem. This idea of subjectivity is something candidates should be familiar with.

(d) The most common error identified was that the amount of apple in each Petri dish may not have been the same. Candidates were expected to give some detail in their explanation as to how this error could have been avoided, e.g. by weighing the mass of each piece of apple to ensure they were the same. Stating that the apple was measured to ensure all the pieces were the same size was not sufficient to get the second mark. Some candidates also realised that the crushing may have been uneven and suggested using a mortar and pestle to crush the apple.

(e) The planning question asked candidates to describe a method that students could use to find the optimum temperature for the enzyme to function. Many candidates struggled to gain high marks for this question. Firstly, the candidates were told that the students were provided with extracts of the enzyme and substrate. However, many described using slices of apple rather than the extract of polyphenol. Few talked about controlling variables, such as pH and the volume of enzyme and substrate. Many understood that samples of the enzyme and substrate should be put at different temperatures and left for a set time or timed until the substrate turned brown. However, a number of candidates described a method where the enzyme and substrate were mixed, and then put at a low temperature with the temperature increased until the substrate turned brown. This is not a valid method for this experiment. Candidates should be familiar with investigations to determine the optimum temperature, or pH, for an enzyme.

(f) (i) Candidates had to plot the data for the apricot and avocado enzyme activity against time. The majority of candidates drew a line graph with an even scale and appropriate labels for the axes. Candidates must ensure that their plots are easily visible. For this graph three of the apricot plots were at 0% and therefore along the x-axis. Candidates should try to make their plots and line visible when the plots are against one of the axes. Most candidates remembered to label the two lines; however, a few did not do this and so failed to gain the last marking point.

(f) (ii) With reference to the table of results or the graph, candidates had to draw a conclusion. The most common mistake was to refer to enzyme activity at more than one temperature. This investigation was only done at 65 °C. Most candidates realised that the enzyme activity for both fruits decreased as time went on and that the apricot enzyme activity decreased faster than the avocado enzyme activity.

Question 2

For **Question 2** candidates were shown photomicrographs of some blood cells.

(a) (i) Candidates had to state two visible differences between the red blood cells and the white blood cells shown in Fig. 2.1. A large number of responses were creditworthy and most were able to score at least one mark. The most common response was to note that the red blood cells lack a nucleus whereas the white blood cells have a nucleus. Many candidates also stated that there are more red blood cells than white blood cells. A common mistake was to say that the white blood

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cells are bigger than the red blood cells. Although this is the case for the phagocytes, this is not true for the lymphocyte which is an equivalent size to the red blood cells.

(a) (ii) Many candidates achieved at least three marks for the drawing question. The question asked the candidates to draw both phagocytes. The most common mistake was to shade in the nuclei. Drawings should have clear, continuous lines and no shading. It is important that candidates use a sharp pencil and eraser for drawings. The drawing should also be freehand and rulers or a compass should not be used. Most candidates drew the monocyte larger than the neutrophil, but it some cases it was hard to tell the difference in size. Most drew the nucleus of the neutrophil with appropriate proportions. It is important that candidates practise their drawing skills before the exam.

(b) (i) This question asked candidates to measure the three marked blood cells and to put their results into a given table. The preferred unit for measurement was millimetres, but measuring in centimetres was also accepted. Most candidates were able to measure the cells correctly. The most common mistake was in calculating the average diameter.

(b) (ii) The final question asked candidates to use their answer from **2(b)(i)**, and the formula given, to calculate the average diameter of a red blood cell. Many candidates found this question difficult. Candidates were expected to rearrange the formula so that they were dividing their answer from **2(b)(i)** by 1500 and to also convert their answer into micrometres.

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BIOLOGY

Paper 0610/62
Alternative to Practical

Key messages

The standard of drawing graphs showed an improvement over that of previous years. However, candidates still need more practice in drawing a table of results for more complex sets of data, identification of errors in methodology and in following instructions. In particular, candidates need to realise that instructions to round an answer, or to give an answer to a particular number of decimal places, must be followed.

General comments

This was a challenging paper which provided a wide spread of final marks. To answer **Question 1** adequately, candidates needed to understand the description of the investigation given. Many candidates had drawn sketches in the margins of test-tubes and other apparatus to help them to understand the described procedures. This is acceptable practice and it appeared that those candidates who did this had a clearer understanding of the investigation.

Comments on specific questions

Question 1

(a) (i) Candidates were asked to construct a table to record the results of the investigation that had been described. They were instructed to show the amylase concentration and the time taken for starch to be digested. The majority of candidates gained marks for drawing a table and for showing the three amylase concentrations. The mark for the headings was frequently not awarded because either the units were incomplete or units were repeated in the body of the table.

(ii) Here, candidates were asked to give a reason why the results shown were unreliable. Able candidates performed well, the most common answers being the lack of repetition, or the fact that some drops on the tile had coalesced. Less able candidates focused on errors in the method rather than on the results.

(iii) In this section, candidates had to describe how they would test for the presence of reducing sugar. Many gained full marks for using Benedict's solution and heating. It should be noted that use of a water bath unqualified is insufficient – candidates must state that the water bath provides heat. It was fairly common for heating to be omitted from the description completely. A few candidates mistakenly used biuret reagent or iodine solution to test for reducing sugars.

(b) (i) Candidates had to name one variable and then state how their chosen variable was kept constant. Most gained the first mark for choice of variable. The second mark proved more difficult, mainly because too little detail was provided. For example, where temperature was the chosen variable, candidates often said that it was kept constant by use of a water bath, neglecting to state that the water bath was at 60°C. Another common error was to mention the use of some other apparatus, e.g. use of a burette to measure volume (instead of stating the volume used) or use of a Bunsen burner to keep the water bath hot.

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(ii) Here, candidates had to explain the reason for keeping all the test-tubes in the water bath for three minutes before the reactants were combined. Over half the candidates answered correctly, stating the need for all the reactants to be at the same temperature. Many candidates were side-tracked by ideas of providing the optimum temperature for enzyme activity, or by the idea that reactions occur faster at higher temperatures.

(iii) This question asked candidates to explain why the amylase solution was tested with iodine solution prior to the mixing of starch and amylase. Candidates of all abilities found this question difficult to answer, most probably because they had not understood the experimental method fully.

(c) (i) and (ii) The question centred on possible errors in the method for the investigation. Candidates were asked to identify two such errors and then, in **(c)(ii)**, suggest how the method could have been improved to redress one of these errors.

The most common errors selected were the use of a glass rod leading to variation in drop size or leading to contamination. Candidates of all abilities struggled to complete **Questions (c)(i)** and **(c)(ii)** satisfactorily. Many stated one error only, or gave an improvement which was unconnected to their errors.

(d) (i) In this section, candidates were asked to complete a calculation using information they were given. This was performed accurately by most candidates. The most common mistake was to divide by three instead of multiplying by three. However, candidates who divided by three could still gain two marks if their workings were shown. Unfortunately, many candidates did not show their working.

(ii) The calculation of the missing rate of reaction was not answered as accurately as the previous calculation. Less able candidates found it very difficult and many of them did not offer an answer.

(iii) On the whole, the graph was well drawn, indicating that candidates had been well instructed in this skill. The axes were usually labelled with units, plots were accurate and the lines carefully drawn with a ruler or drawn smoothly by hand. A few scales were uneven. The most frequent errors were to draw a line of best fit or to extrapolate the line to zero.

Question 2

(a) (i) Here, candidates were shown a photomicrograph of guard cells and some surrounding epidermal cells (with accompanying explanatory details). They then had to complete a table giving two differences in the features of these cell types. Many candidates gained both marks. Those candidates who selected cell shape had difficulties describing the shape of epidermal cells.

(ii) The drawing of the two guard cells proved difficult for many candidates and few gained full marks. The great majority of drawings were sufficiently large, and shading was rare. Many candidates represented the relative sizes of the cells and the stoma inaccurately, or did not draw the cell walls as double lines.

(b) The calculation of the magnification of the drawing was very well answered. Most candidates had drawn a line on their diagram, measured both dimensions accurately and carried out the calculation correctly. The common errors were not stating units, not rounding up the answer, or in giving the magnification a unit.

(c) The comparison of the trends shown by the graph was a demanding question. Many candidates worked very hard at their answers, but could not be awarded marks as they were not comparing the trends (as the question asked). The most commonly awarded mark was for the rates of both transpiration and absorption rising and then falling during the 24 hour period.

(d) The design of an experiment involving the use of a potometer also proved to be challenging. Many candidates appeared unfamiliar with the apparatus. Less able candidates simply explained the principles behind the use of the apparatus or explained the theory behind transpiration and how it might be affected by temperature. A few candidates attempted to investigate the effects of both temperature and humidity (on transpiration) at the same time. Points that need emphasising in teaching are that variables not under investigation must be kept constant, and that an investigation must be repeated to obtain reliable results.

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BIOLOGY

Paper 0610/63
Alternative to Practical

Key messages

- Candidates should ensure that they read the questions carefully before starting to answer. This is particularly important for any planning exercise that is required. Identification of the dependent (measured) and independent (changed) variables is vital before a plan is completed. Controlled variables must also be considered and included in a plan.
- Candidates should also try to match the answers they give with the number of marks available for each part of a question.
- Candidates should be familiar with the practical procedures indicated in the syllabus. This means that candidates are expected to be able to carry out these procedures safely, but also that they should be able to work safely and with competence on practical procedures that derive from learned methods.
- When asked about safety considerations, candidates should be able to identify a risk and also a method of reducing that risk.
- Mathematical calculations form an important part of the practical assessment. It is essential that candidates check all of their working carefully and take time to consider whether the resulting answer is realistic.

General comments

Generally candidates performed well throughout the paper, but certain areas proved more challenging than others. The identification of the controlled variables and possible sources of error was reasonably well done but constructing a table of results proved challenging for some candidates. The planning exercise was also well executed by the majority of candidates as was the drawing task. Plotting a line graph proved to be challenging for some candidates.

Comments on specific questions

Question 1

(a) (i) Almost all candidates correctly recorded the volume of the fruit juice collected. The most common error was to read 13 as 10.3, 18 as 15.6 and 7 as 5.4.

(ii) Many candidates correctly recorded the colour of the solution before it was heated. Some did not which made any analysis of the results more difficult and also made **1(a)(vi)** more challenging.

An infrequent error was to give a list of results instead of a table of results.

(iii) Almost all candidates gave the correct response. A few stated biuret.

(iv) Most candidates chose a suitable temperature for the Benedict's test, but a large number decided incorrectly that it should be 37°C.

(v) Most candidates gave suitable answers based on the results for a colour change.

(vi) This was a challenging question. However, many candidates did correctly identify that they had to look for a change in colour in the solution from before heating, not a change in colour from before adding juice. The most observant pointed out that the colour changed from blue to green or light blue even before heating.

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(b) Most candidates correctly identified a suitable controlled variable, usually the volume of juice or the volume of Benedict's solution.

(c) Some candidates gave suitable errors, but many quoted human errors, which were not accepted, such as parallax errors, inaccurate measurement of the volumes of the solutions or timing errors. As in previous series, candidates need to find a suitable improvement that will overcome the error.

(d) Almost all candidates were able to identify the biuret test as a method for testing for proteins.

(e) The planning exercise was well done by the majority of candidates, comparing favourably with previous series of the examination. Most identified two or more temperatures at which to test the juice (although the use of 'room temperature' should be discouraged), and many described how these temperatures would be maintained. The majority of candidates also described controlled variables such as the volume of juice or the time heated. Some chose to investigate vitamin C content in different fruits and simply repeated the previous practical activity rather than relating it to heating, this did not answer the question.

(f) The drawing of an orange section proved relatively straight-forward, but a significant number of candidates found drawing sharp clear lines with no shading challenging. A common error was the use of a compass to draw the outline which was not accepted.

Question 2

(a) (i) Almost all candidates correctly calculated the average root length from the data supplied in the table.

(ii) A large number of candidates were unable to identify the anomalous result from the table. A common error was to compare the data vertically in each column rather than in the horizontal rows for each concentration. Another error was to identify the mean values as anomalous rather than individual data points.

It is also important that the correct number of decimal places is given in the response. In this question values should have been given to one decimal place.

(iii) The plotting of the line graph proved challenging for a large number of candidates

Most were able to select a suitable scale for the two axes, although it should be noted that the plotting area should cover at least half of the grid area.

A common error when labelling the axes was the omission of 'percentage' from the auxin axis or 'average' from the root length axis.

The plotting of the points themselves was generally well executed, but the choice of scale sometimes made it difficult for candidates to plot accurately.

In this graph, the line could have been a line of best fit, or a ruled line joining each plotted point to the next plotted point. In either case the line should not have been extrapolated beyond the plotted points, and should have been smooth and unbroken.

(iv) Most candidates performed well, describing the shape of the line and identifying the point of highest root growth. The best responses made full reference to the data and quoted values with units.

(b) This question was well answered by the majority of candidates. A few found manipulation of the equation challenging. Rearranging formulae is an important skill as is the correct use of units and conversion from one unit of measurement to another. However, in this case most candidates chose suitable units or were able to convert from cm to mm correctly.

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