

2009 HSC Biology

Sample Answers

This document contains 'sample answers', or, in the case of some questions, 'answer may include'. These are developed by the examination committee for two purposes. The committee does this:

- (a) as part of the development of the examination paper to ensure the questions will effectively assess students' knowledge and skills, and
- (b) in order to provide some advice to the Supervisor of Marking about the nature and scope of the responses expected of students.

The 'sample answers' or similar advice, are not intended to be exemplary or even complete responses. They have been reproduced in their original form as part of the examination committee's 'working document'. While the handwritten notes have been typed for legibility, no further editorial change or addition has occurred.

Section I, Part B

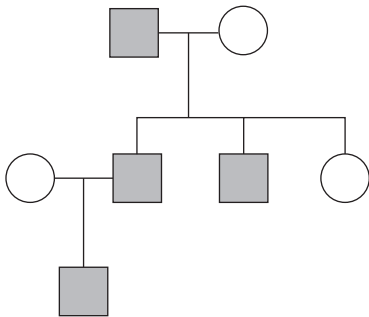
Question 16

Sample answer:

<i>Pathogen</i>	<i>Distinguishing characteristic</i>	<i>Disease caused by this type of pathogen</i>
Bacteria	DNA not enclosed by a nuclear membrane	Whooping cough
Fungi	Have a cell wall but never contain chlorophyll	Tinea
Protozoans	Single cell, eucaryotic organism	Malaria

Question 17 (a)

Sample answer:

**Question 17 (b)**

Sample answer:

Showing written information in the form of a diagram allows relationships to be easily seen.

Question 17 (c)

Sample answer:

The student's conclusion might not be valid.

The pattern shown by the pedigree could occur if the condition was a dominant condition and affected individuals were heterozygous for the condition.

Question 18

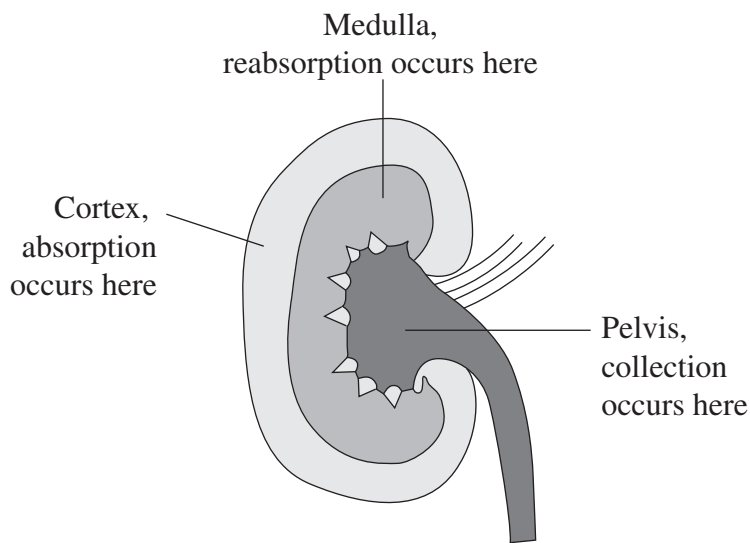
Sample answer:

Procedures need to be implemented to destroy the pathogens and to prevent the disease being passed from person to person.

Correct storage, preparation and handling of food can limit the spread of the disease, eg keeping food covered can prevent the pathogens from settling on the food.

Boiling water or treating it with chemicals such as chlorine will destroy any pathogens in the water.

Personal hygiene practices, such as washing hands, and covering the mouth and nose when coughing and sneezing, also limit the spread of the pathogens from person to person.

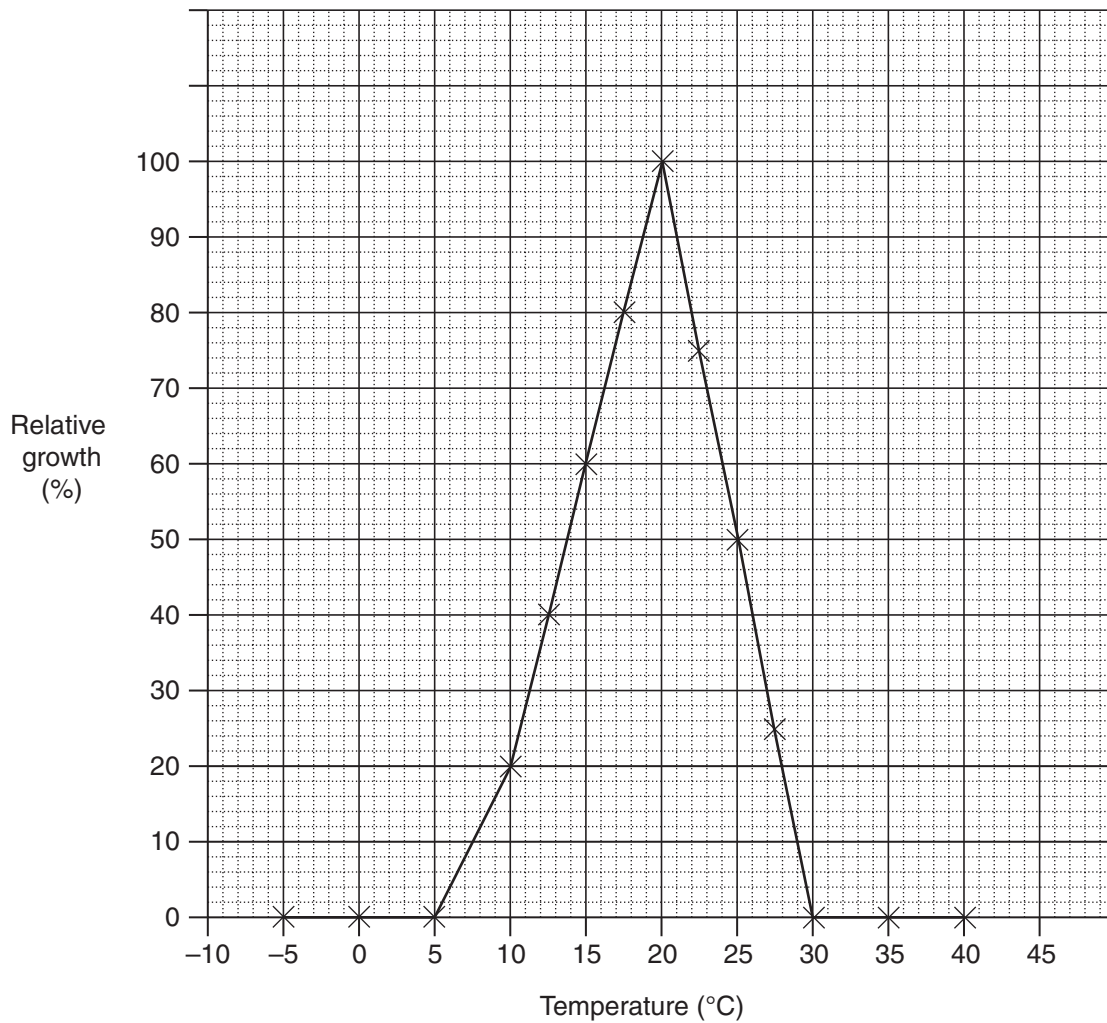
Question 19***Sample answer:*****Question 20 (a)*****Sample answer:***

Rose plants were examined for the presence of sucking insects, such as aphids, on the shoots; and for fungal diseases like black spot.

The selected specimens were examined using hand lenses and stereomicroscopes and drawings were made of the aphids and some affected leaves.

Question 20 (b)***Sample answer:***

We wore thick gardening gloves to protect against thorns sticking into our hands.

Question 21 (a)*Sample answer:***Question 21 (b)***Sample answer:*

Wheat grows at temperatures between 5°C and 30°C.
Maximum growth occurs at 20°C.

Question 22***Sample answer:***

<i>T-lymphocyte</i>	<i>Role</i>
Killer	Destroys invading pathogen
Suppressor	Suppress T and B cell activity when needed
Memory	Remain in body to commence a rapid immune response on reinfection

Question 23 (a)***Sample answer:***

If this technology is used by most of the population, the gene would be removed from the population.

Question 23 (b)***Sample answer:***

A reproductive technology that would affect evolution is cloning. In the example of Bt cotton all the individuals are clones, therefore they all have the same genotype. If this species of cotton is resistant to a particular insect pest it could lead to the evolution of a new species of pest that the Bt cotton is not resistant to. If a disease emerged that killed the Bt cotton, all the cotton would be destroyed because of lack of genetic variation.

Question 24 (a)

Sample answer:

- A dependent variable is heart rate
- Independent variable is the room temperature

Answer could include:

A dependent variable is sweating

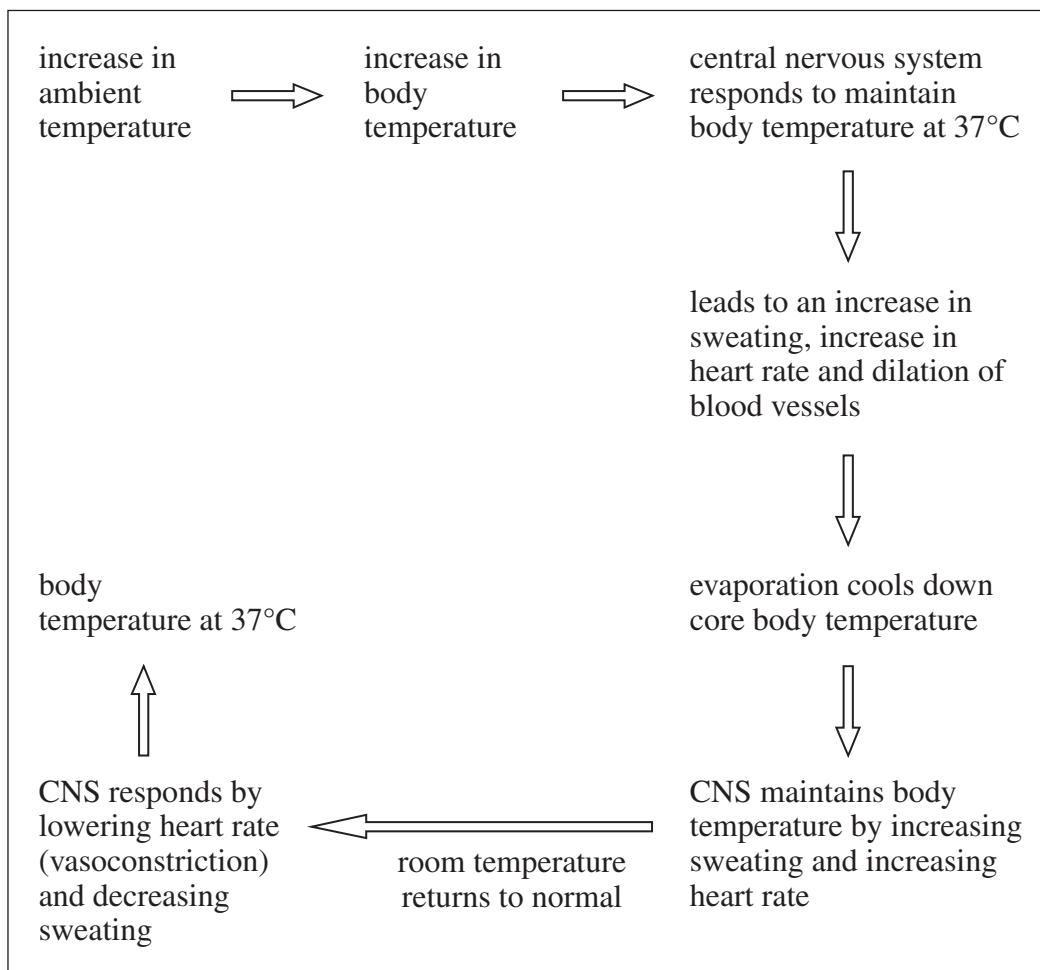
Question 24 (b)

Sample answer:

The nervous system.

Question 24 (c)

Sample answer:



Question 25 (a)***Sample answer/Answer could include:***

- The redness and swelling are caused by inflammation response at the site of the injury
- Phagocytosis could occur at the site of the injury
- Cell death could seal off the pathogen at the site of the injury
- Increased activity in the lymph system in the arm

Question 25 (b)***Sample answer:***

At the site of the injury, the defence barrier of the skin has been broken, allowing bacteria to enter the body. The antibiotics will stop these bacteria from multiplying.

Question 26***Sample answer:***

Homeostasis involves maintaining a constant internal environment to maintain metabolic functions. This is difficult if there are large variations in salt concentration. In organisms that use osmoregulation, other physical or chemical conditions are varied to compensate for the variations in salt concentration so the metabolic functions are maintained.

Question 27***Sample answer:***

Since the Y-chromosome carries significantly fewer genes compared to the X-chromosome, for a male to inherit a sex-linked phenotype, he would only require a single X-linked recessive gene whereas a female would need to inherit recessive genes on both X-chromosomes in order to inherit a sex-linked phenotype. Example: red–green colour blindness. A boy could be born with red–green colour blindness even though neither parent may have the condition.

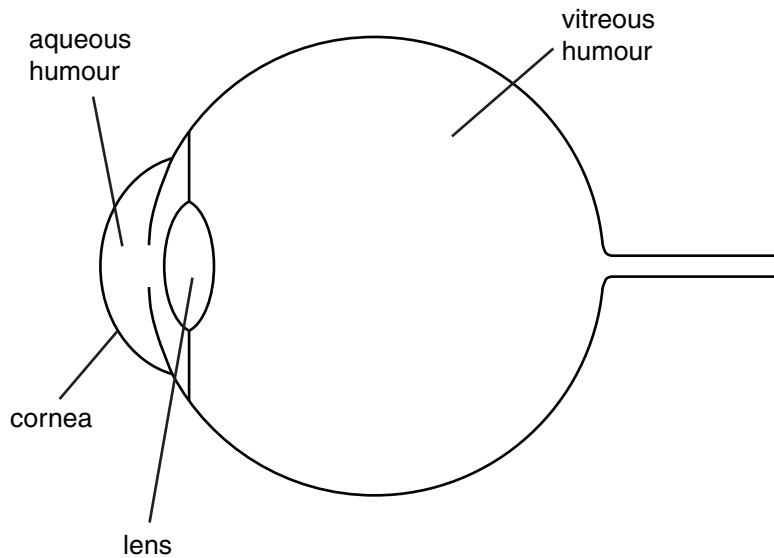
During sexual reproduction, new combinations of genes are brought together. The most suitable combinations will survive and will be passed on to future generations. When genes are being copied, mistakes (mutations) are made in the process and new genes or combinations of genes can be generated in the process. These can be passed on to offspring, giving them characteristics different from their parents. Example: Peppered moth. Dark coloured peppered moths appeared in the population due to a mutation.

The environment can affect the way in which genes are expressed so that an individual's phenotype is affected by environmental conditions. Example: malnutrition can lead to individuals being shorter in height compared to their genetic potential.

Section II

Question 28 (a)

Sample answer:



Question 28 (b) (i)

Sample answer:

An artificial lens can replace a cloudy lens in the eye.

Question 28 (b) (ii)

Sample answer:

People who have their sight restored by cataract removal and lens implants will be able to see better and will therefore have more avenues of employment open to them. They will be less likely to be dependent on their families. There would also be a decrease in welfare payments by the government.

Question 28 (c)

Sample answer:

The action potential is the firing of a neurone. It is an all or nothing response– the neurone either fires or it does not. The stimulus needs to be strong enough to initiate the action potential. If the stimulus is below the threshold intensity for the neurone, there will not be an action potential generated.

Question 28 (d) (i)***Sample answer:***

Accommodation is important because it allows the eye to focus on objects that are at different distances from the eye. This means that distant and close objects can be seen clearly.

Question 28 (d) (ii)***Sample answer:***

Accommodation can be modelled by the use of two types of lens. A fat convex lens will have a short focal distance while a thinner convex lens has a long focal distance. Near objects will be focussed with the fat convex lens while distant objects will be focussed with a thinner convex lens. Accommodation is the focussing of objects at different distance and this happens because of the change in shape (curve) of the convex lens.

Question 28 (e)***Answers could include:***

Hearing is a multi step process involving collecting and focussing the sound (external ear), transferring the sound to vibrations in the tympanic membrane, amplifying this vibration through the ossicles, and then separating high and low frequencies to different neurons in the cochlea where they convert the vibrations into electrical signals then chemical signals in the brain. Where the tympanic membrane has been broken, it can be repaired or the sound amplified using a hearing aid. A hearing aid can also reduce background noise by filtering. This helps to separate frequencies in the organ of Corti and the cochlea (hair cells). The bionic ear is a cochlear implant which bypasses many of the initial steps in hearing and transfers soundwaves via the implant into electrical signals that directly stimulate the auditory nerve. Its fidelity is inferior to normal hearing but the processing neurons in the brain learn to discriminate the signals allowing relatively normal hearing.

Question 29 (a) (i)***Sample answer:***

Restriction enzyme

Question 29 (a) (ii)***Sample answer:***

Ligases follow foreign DNA with similar 'sticky' ends to those of cut plasmids to be joined together to form recombinant DNA.

Question 29 (b) (i)***Sample answer:***

Yoghurt

Question 29 (b) (ii)***Sample answer:***

It has been understood for thousands of years that the process of fermentation could produce useful products. However, the discovery that particular microbes caused fermentation allowed a scientific approach to fermentation to take place.

For example: Pasteur's discovery that bacteria caused wine to become sour allowed the development of procedures to reduce contamination or to remove the bacteria by pasteurisation.

Question 29 (c) (i)***Sample answer:***

Messenger RNA and transfer RNA.

Question 29 (c) (ii)***Sample answer:***

At location 1, the genetic information in DNA is coded into mRNA so that it can be moved out of the nucleus into the cytoplasm. At location 2, the mRNA attaches to a ribosome. tRNA brings amino acids to the ribosome to form the polypeptide according to the pattern of bases on the mRNA.

Question 29 (d) (i)***Sample answer:***

- Obtain a sample of split peas
- Blend the sample with a small amount of salt
- Strain the pea mixture, then add detergent and stand for 10 minutes
- Pour some of the pea mixture into a test tube, add some meat tenderizer, then mix gently
- Pour alcohol slowly into the pea mixture, then look for a white substance in the alcohol

Question 29 (d) (ii)***Sample answer:***

I would look for a white, stringy substance that forms on the bottom of the alcohol layer.

Question 29 (e)***Answers could include:***

There is a variety of biotechnology applications that produce many different products that are useful to humans. Two examples are the production of monoclonal antibodies and the production of insulin. Monoclonal antibodies can be produced by fusing single antibody-forming cells to tumour cells grown in culture. The resulting cell can produce large quantities of identical antibody molecules. The fused cell can be cultured industrially to produce large quantities of monoclonal antibodies. Normally, antibodies are produced in individuals reacting to something foreign in the blood. Monoclonal antibodies are useful to humans for the treatment of disease or the identification of foreign substances in blood. They can be prepared before they are needed and given when needed.

Insulin can be produced by using recombinant DNA technology to insert the human insulin gene into *E. coli* which is then grown in industrial fermenters. The insulin produced can then be separated, purified and packaged for use. Insulin is used as a treatment for diabetes. Insulin produced by animals can cause an adverse reaction in some people. Genetically engineered insulin is more useful to humans because it is produced from a human gene so the adverse reactions are minimised. Also, the insulin can be produced in large quantities in controlled conditions.

Question 30 (a) (i)*Sample answer:*

A, B, O.

Question 30 (a) (ii)*Sample answer:*

AOxBO



OO

Question 30 (b) (i)*Sample answer:*

- Dolly the sheep

OR

- If one cow in a herd produced more milk than the others, it could be cloned to produce a herd of cows that all produce more milk.

OR

- When a fertilized egg is split at the two cell stage and the embryos develop separately

Question 30 (b) (ii)*Sample answer:*

Society benefits from this use of cloning in this example because large numbers of identical cloned animals can be produced in less time than it would take to use selective breeding. This leads to increased production more quickly and at lower costs.

Question 30 (c)*Sample answer:*

At location 1, the DNA unzips and is copied to form mRNA. mRNA is able to leave the nucleus and move into the cytoplasm. At location 2, it attaches to a ribosome. tRNA brings amino acids to the ribosome according to the pattern of bases on the mRNA. At location 3, the polypeptide chain is formed, then released for further processing to form proteins.

Question 30 (d)***Sample answer:***

Linked genes are those that found on the same chromosome. As a result, their inheritance patterns do not follow the same pattern as genes located on different chromosomes. To explain the inheritance of linked genes, I would prepare two plasticine models of the meiosis of two chromosomes. I would choose differently coloured pieces of plasticine to represent two different genes.

On one model I would place the coloured pieces on the same chromosome. The model would show meiotic division including crossing over. The gametes in model would show Mendelian inheritance ratios of the two genes.

On the other model I would place the coloured pieces on the same chromosome close together. The model would also show meiotic division including crossing over, but where the genes stay on the same chromosome. Here, the gametes will show a different inheritance ratio of the two genes.

The gametes in the two models would be examined to compare the inheritance of linked genes with non-linked genes.

Question 30 (e)***Answers could include:***

Gene therapy can be used to correct genetic disorders in individuals. This is done by replacing a defective gene with a functional one. The genetic error needs to be identified before it can be corrected and genetic mutations can often allow the identification of how genes become defective. A base substitution can lead to a protein that is less functional. The defect could be on one chromosome so it might have only a minor effect. Therefore, to correct it could be to apply the gene therapy to the stem cells to generate fully functional proteins.

Mutations could also be a frame shift which leads to lack of a protein. In this case it is important to replace the functional gene with therapy.

Question 31 (a)**Sample answer:**

<i>Classification level</i>	<i>Human classification</i>	<i>Identifying features</i>
Order	Primate	Opposable thumb
Family	Hominid	Bipedal
Genus	Homo	Relatively large brain size

Question 31 (b) (i)**Sample answer:**

Fossils can be given a relative age according to the rock strata in which they are formed.

Question 31 (b) (ii)**Sample answer:**

Fossils are very rare and difficult to find. Most fossils of human ancestors are not complete skeletons, there are missing parts. Soft tissue is not usually fossilised. Fossils can only provide part of the story. Even when complete skeletons are found there can be difficulties establishing the exact age of the fossils. The fossils can be interpreted in different ways by different scientists.

Question 31 (c)**Answers could include:**

Evidence for the 'Out of Africa' theory:

- Earliest human fossils are found in Africa
- Oldest *Homo sapiens* fossils found in Africa
- Transitional forms between pre-modern and modern *Homo sapiens* found in Africa
- Mitochondrial DNA evidence of a common ancestor
- Populations in Africa have the greatest genetic diversity which requires a long time to develop

Evidence for the 'multi regional' theory:

- In regions outside Africa, modern traits can be traced back to earliest *Homo sapiens* groups in the area
- Modern humans should appear in a number of places at about the same time

Question 31 (d) (i)**Answers could include:**

- *Ardipithecus ramidus* (*Australopithecus ramidus*)
- *Australopithecus afarensis*
- *Paranthropus robustus* (*Australopithecus robustus*)
- *Paranthropus boisei* (*Australopithecus boisei*)
- *Australopithecus africanus*
- *Homo habilis*
- *Homo ergaster*
- *Homo heidelbergensis*
- *Homo neanderthalensis*

Question 31 (d) (ii)**Answers could include:**

I would look for similarities and differences in:

- | | | |
|-------------------|---------------------|-------------------------|
| • Brain size: | <i>A. afarensis</i> | between 420cc and 490cc |
| | <i>H. habilis</i> | between 500cc and 800cc |
| • Age of fossils: | <i>A. afarensis</i> | 3.5 myo |
| | <i>H. habilis</i> | 1.6–1.8 myo |
| • Tooth size: | <i>A. afarensis</i> | small, unspecialised |
| | <i>H. habilis</i> | small, unspecialised |
| • Tools: | <i>A. afarensis</i> | no tools |
| | <i>H. habilis</i> | tool makers |
| • Social: | <i>A. afarensis</i> | lived in groups |
| | <i>H. habilis</i> | lived in groups |

Question 31 (e)**Answers could include:**

Fossil evidence is very useful in understanding the story of human evolution, but there are gaps in the fossil record and it can be difficult to date and interpret the fossil evidence. Evidence from other sources can help to add more detail and accuracy to the story. For example: studying DNA–DNA hybridisation can show the amount of similarity in the DNA of two species, showing how close they are in their evolution. Counting the number of differences in amino acids in haemoglobin between species can also indicate the amount of evolutionary similarity. Mitochondrial DNA can be used to give a ‘clock’ of evolution. Karyotype analysis compares the size, shape, number and banding patterns of chromosomes.

Question 32 (a)***Sample answer:***

Plants turn CO₂ into sugars using photosynthesis

Question 32 (b) (i)***Sample answer:***

Ingen-Housz

Question 32 (b) (ii)***Sample answer:***

Ingen-Housz showed that plants were able to purify the air when placed in the light, but were unable to purify the air when placed in the dark.

Question 32 (c) (i)***Sample answer:***

2 – stroma

Question 32 (c) (ii)***Sample answer:***

Feature 5 represents stacked membranes where chlorophyll traps the light energy and the energy is transferred to chemical energy as NADPH.

Feature 3 is where light energy is captured and transferred by electrons to form chemical energy as ATP.

Question 32 (d)***Answers could include:***

The leaves of the plants would be homogenized and then centrifuged to separate the organelles eg chloroplasts, that contain pigments. For each fraction, pigments would then be extracted using a solvent and their absorption measured using a spectrophotometer creating an absorption spectrum. If the spectrum showed that there were more than one pigment present (broad spectrum), the pigments could be separated by chromatography – spotted on paper and a solvent running over them separates the pigments. Electron microscopy of the fractions containing the pigments would indicate the location of the pigment.

Question 32 (e)***Answers could include:***

Van Niel thought the oxygen produced in photosynthesis came from water rather than carbon dioxide. This was later proven by Ruben who used the heavy form of oxygen ^{18}O in water to confirm that only $^{18}\text{O}_2$ was produced by photosynthesis and no ^{18}O was found in glucose. Similarly, ^{18}C has been used to show the carbons in glucose come from CO_2 (^{18}C is an isotope of C). ^3H (an isotope of H) in water has been used to trace ^3H across the thylakoid membrane and ^{32}P (an isotope of phosphorus) to show how ATP is formed in photosynthesis.