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Notes from the Examination Centre

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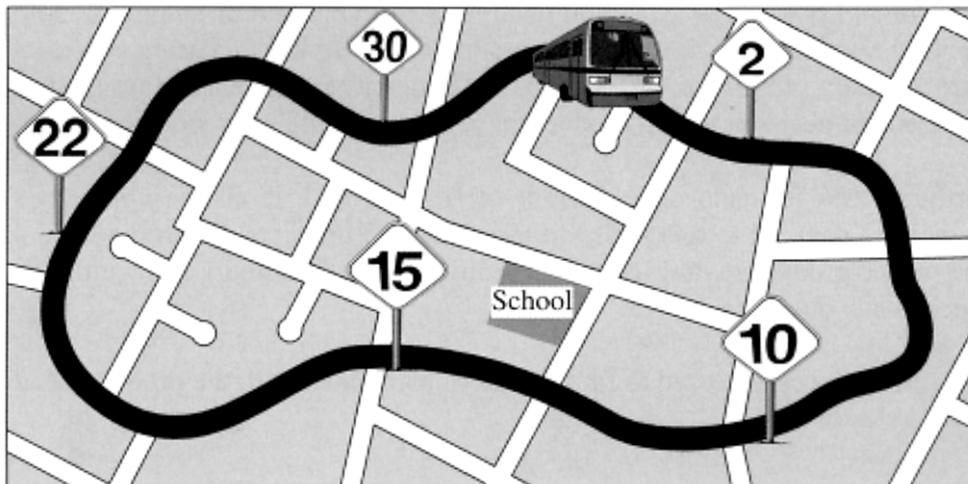
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1999 Higher School Certificate Applied Studies Notes from the Examination Centre

Question 1 – Applications of Computer-controlled Systems

- (a) The article below [please see examination paper] describes a cruise control system for a motorcycle. It comes direct from the manufacturer's publicity information.
- Describe the functions of TWO sensors that are present in the cruise control system.
 - Describe the functions of TWO actuators that are present in the cruise control system.
 - Is the system, as described, an open loop feedback control system or a closed loop feedback control system? Give reasons for your choice of classification for the system.
 - Discuss ONE social implication that might arise from the use of such a cruise control system.
- (b) The diagram below shows a messaging system for passengers awaiting the arrival of the bus in a small town.



The bus continuously travels the loop road as shown above. There are five bus stops in the route. At each bus stop a sign displays the expected arrival time, in minutes, of the bus. The position of the bus is monitored by sensors at each stop and this information is sent to a central computer which computes the times for display on the signs.

- Describe an algorithm that would need to be implemented in the central computer in order to calculate the expected arrival times.
- What are the TWO advantages of using such a system?
- Suggest TWO ways the system can be changed to make the predictions of time more accurate.

- (c) *Choose one working model of a computer-controlled system you have assembled. Do NOT use the systems described in either part (a) or part (b).*
- (i) *Name the system.*
 - (ii) *Discuss the needs and conditions that gave rise to the system you studied.*
 - (iii) *Draw and label a block diagram of the system. On the diagram, identify ONE sensor and ONE actuator (effector).*
 - (iv) *Describe the principles behind the working of the sensor and the actuator (effector) identified in part (iii).*
 - (v) *Discuss ONE implication, to the real world, of the use of systems such as the one you have assembled.*

Specific Comments

- (a)
 - (i) Well answered.
 - (ii) Candidates could name an actuator but had difficulty describing its function.
 - (iii) Many candidates could not distinguish between an open loop feedback control system and a closed loop feedback control system.
 - (iv) Candidates gave implications that might arise from the use of a cruise control system but they needed to support their answer with social implications.
- (b)
 - (i) The algorithm was poorly described. Candidates need more assistance to understand the term ‘algorithm’ and its application.
 - (ii) Well answered
 - (iii) Well answered.
- (c) Many candidates could not distinguish between a system that may contain a computer chip and a system that is computer controlled. Candidates had difficulty interpreting this question and they need to focus on what the question is asking them to discuss. Also, some candidates are unsure of the principles behind the working of an actuator and a sensor.

Exemplary response

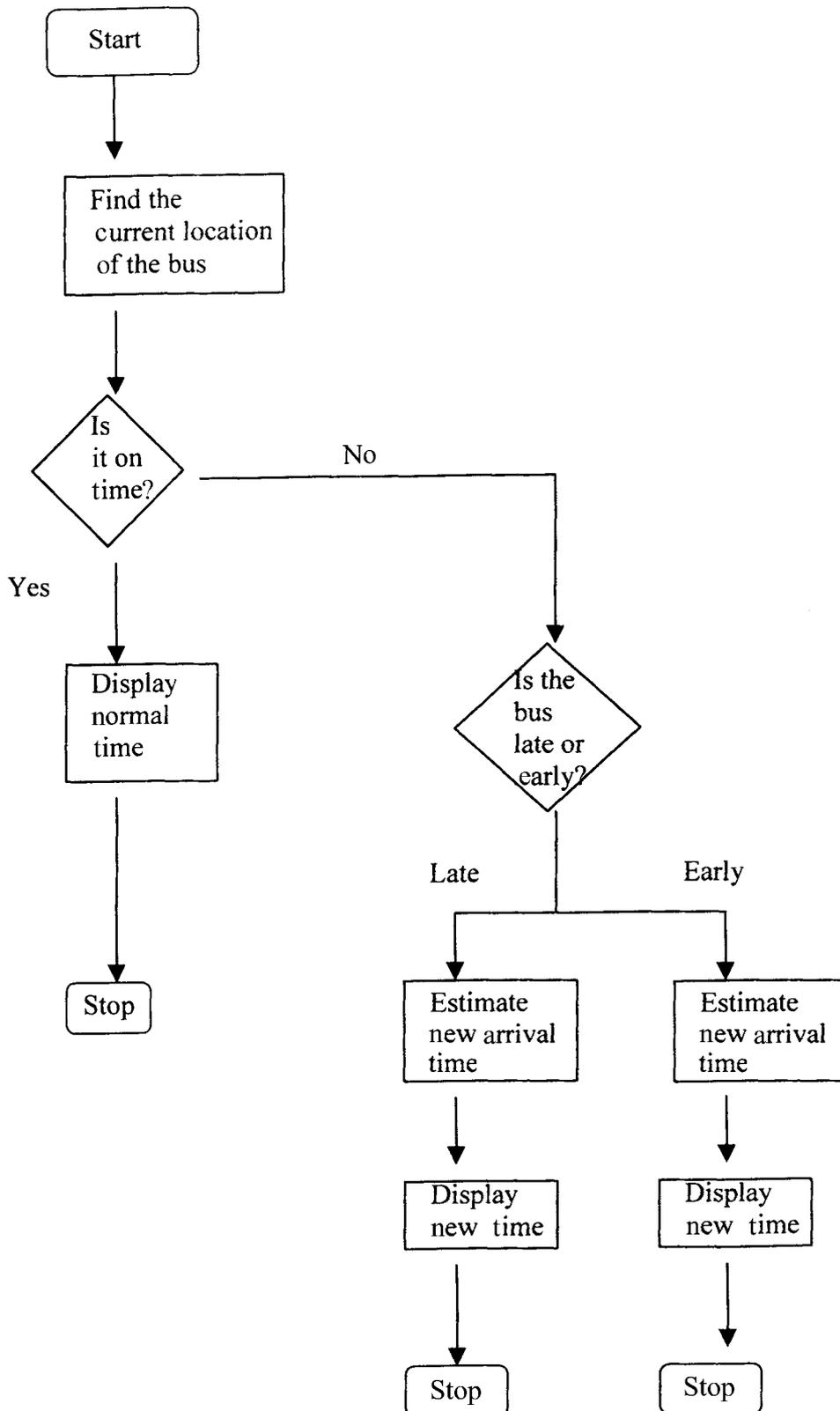
- (a) (i) The speed sensor has the function of sensing how fast the bike is going so that the computer can slow or speed up the bike.

The hand brake sensor is a sensor which detects when the lever hand brakes are being applied and tells the control system so that it can disengage the cruise control, and slow the bike.

- (ii) Two actuators in the system are the brake actuator and the throttle actuator. The brake actuator, when told the speed is higher than required, brakes the bike to its correct velocity. The throttle actuator accelerates the bike when needed to obtain the velocity required.

- (iii) The easy rider cruise control system is a closed loop feedback control system, because it gets feedback from the system sensors and then the microprocessor coordinates an appropriate action. Also, the system repeats operations and actions to achieve the purpose of the system.
 - (iv) There are both social advantages and disadvantages. The advantages listed that it reduces stress and fatigue. It also has a downside because it is easier for the rider to lose concentration because he/she is no longer concentrating on the speed and also they may take more risks because they feel they can ride for longer periods of time and this could cause accidents because although the bike has a computer control system for the speed it isn't totally automated because the rider must still steer. So this relaxed attitude could have devastating social implications if the riders abused it.
- (b) (i) The bus would stop and the sensors would tell the central computer where the bus is. The computer would calculate the time until arrival based on data entered previously. The computer would then tell the signs what time to light up for the people to see.

Answer as a diagram:



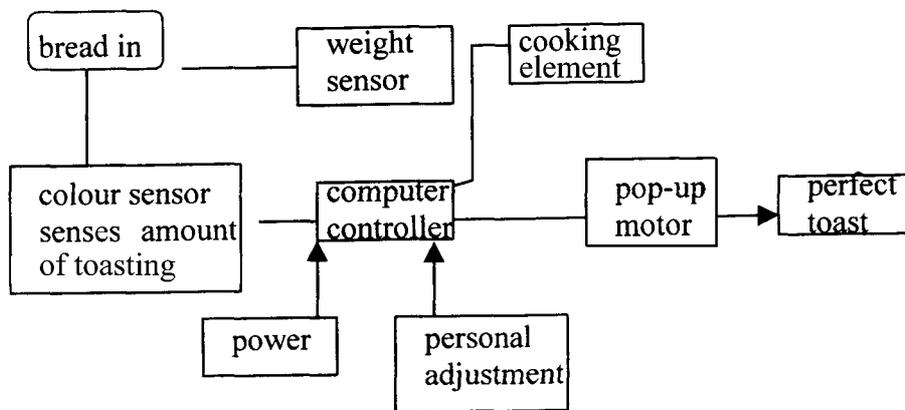
- (ii) There would be less complaining from people to be picked up because they would know when the bus is arriving. Another advantage of the system is that it isn't necessary for people to look up the timetable, which at times can be confusing. Everyone knows what time the bus will arrive.

(iii) In order to make the system more accurate it would be better to link it with the town's central computer so as to find out what the traffic is like at certain places. If there is an accident the system would be able to display a more accurate reading of delay times. There could also be a button installed at each station for passengers to press if they plan to get on the bus. This would give more accurate data on the time of the journey.

(c) (i) Computer control system for toasting perfect coloured bread.

(ii) The timers in the toasters weren't accurate enough because to get perfect toast depends on many different things and a timer can't produce perfect toast so there was a need for the amount of toasting to be monitored and so used to produce perfect toast.

(iii)



(iv) Sensor – the weight sensor to sense when bread has been entered into the toaster.
 – the photoreceptor senses the colour that the bread has turned and effectively senses degree of toasting.

Actuator – is the cooking element which cooks the bread.

(v) The system runs on or is powered by electricity. This contributes to a problem of energy waste and the consequences of making electricity are the pollutants released. For example, CO₂, creates a greenhouse effect. CO₂ created from burning coal.

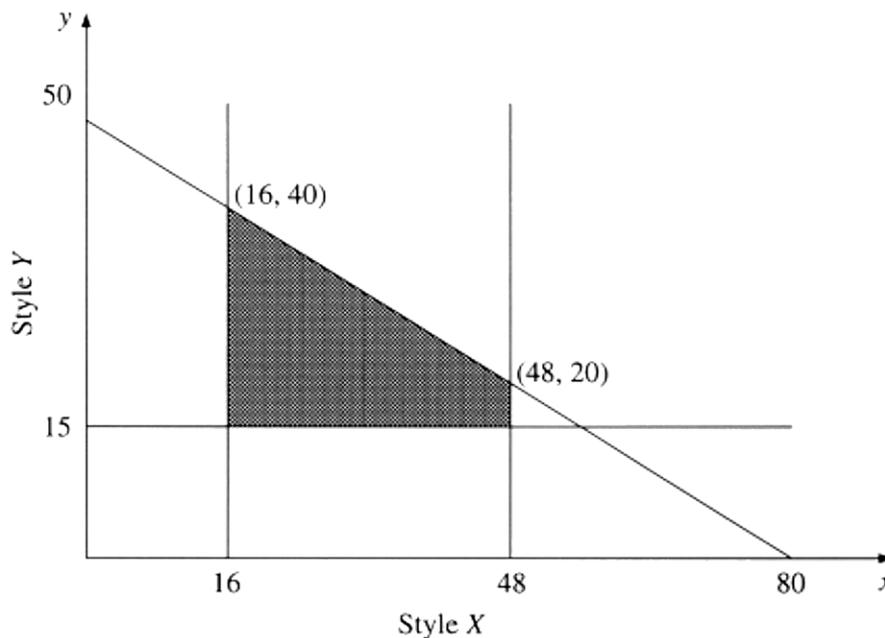
Question 2 – Applied Mathematical Skills

- (a) *A small manufacturing company specialises in the production of two styles of frames designed to hold filters for air-conditioner units.*

A profit of \$17 is made on each unit of Style X. A maximum of 80 units can be made if all resources are committed to production of Style X. Existing contracts require the daily production of 16 units. Limited market demand has resulted in a management decision to cap production of Style X at 48 units per day.

A profit of \$24 is made on each unit of Style Y and, if all the company's resources are devoted to this style, no more than 50 units can be produced in a single working day. Existing contracts require that a minimum of 15 units be produced each day.

The graph below can be used to find the profit associated with the production of the two styles of frames.

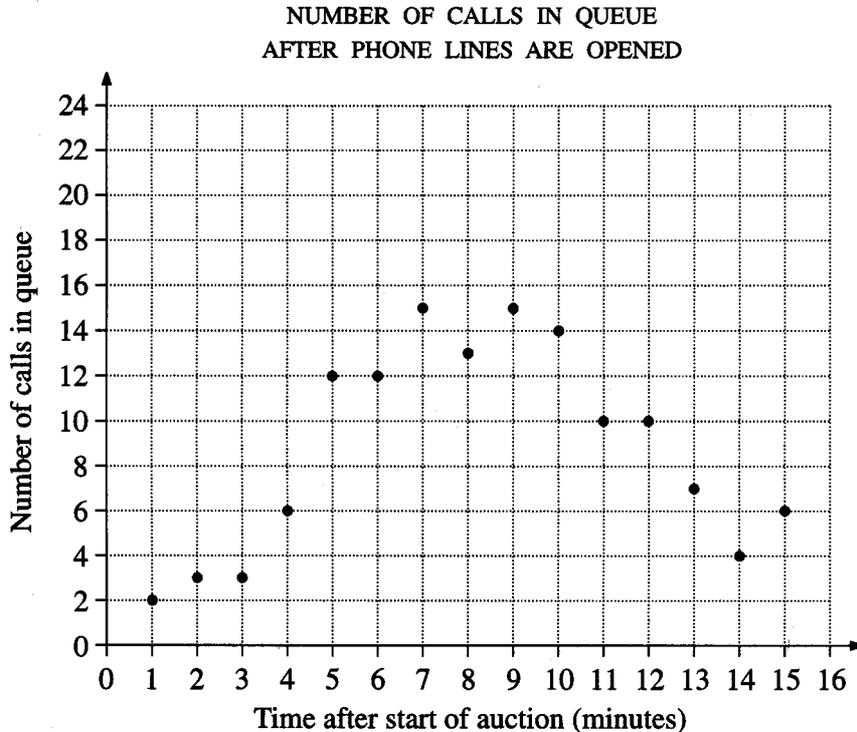


- (i) *Write down the equation in terms of x and y for the profit (P).*
- (ii) *What is the maximum profit that can be made under the given constraints? Show all necessary working.*
- (iii) *The company decides to have a maintenance day. On this day, production is restricted to the minimum production levels. What profit will the manufacturing company earn on the maintenance day?*

- (b) A radio station conducts a call-in radio auction for a local charity.

When a call is made it is acknowledged and placed in a queue. Some time later, the call is answered by an operator and the bid is taken.

The radio station monitors the number of calls in the queue at one minute intervals. This is shown in the graph below.



- (i) How many phone calls were in the queue 3 minutes after the phone lines had been opened?
- (ii) What was the increase in the number of calls in the queue between 4 and 5 minutes?
- (iii) Give TWO reasons that might explain what happened to the number of calls in the queue between 7 and 9 minutes.
- (iv) The number of calls in the queue was the same at 11 and 12 minutes. Give TWO reasons that may explain this.
- (c) A country has an annual inflation rate of 50%. It is expected that this rate of inflation will continue unchanged, The price of goods can be calculated using the formula

$$A = P \left(1 + \frac{r}{100} \right)^n$$

where *A* is the price after *n* years
P is the original price
r is the annual rate of inflation
n is the number of years.

- (i) A CD currently costs \$29.50 in this country. After ONE year it will cost \$44.25.

What will it cost, to the nearest cent, after:

1 two years?

2 three years?

- (ii) Graph the results from part (i), putting time (Year 1, Year 2, Year 3) on the horizontal axis and cost on the vertical axis.
- (iii) Using the graph in part (ii), discuss the nature of the increase in the cost of the CD.
- (d) (i) State ONE of the underlying principles of the Malthusian Law of Population Growth.
- (ii) State ONE of the underlying principles of the Logistic Law of Population Growth.
- (iii) Explain why the Malthusian Law and the Logistic Law of Population Growth only explain population changes under ideal circumstances.

Specific Comments

- (a) This question was well answered by the candidates. Most candidates either knew how to do the question or not, however, there was an opportunity for candidates who struggled with this part to still gain some marks. When the questions say 'show all necessary working', candidates should show the substitutions for part (ii).
- (b) Parts (i) and (ii) were answered very well from the majority of candidates. However, for part (iii), quite a few candidates failed to mention a reason for both the decrease and increase in the number of calls in the queue. For part (iv), candidates should have related their answer back to the operator.
- (c) This part was well answered. Some of the candidates substituted the given values into the formula to work out the rate of inflation, even though it was already given in the first sentence. Calculator errors were prominent, even after the candidates showed proper working out. Some candidates did not give their answers to part (i) correct to the nearest cent, despite being asked to do so.
- (d) Most candidates answered parts (i) and (ii) well. However, on the whole, part (iii) was poorly answered. Candidates needed to state why each law explains population changes under ideal circumstances separately, as well as show the link between the two laws. Some Candidates simply defined each law and gave examples or talked about the two laws in the same context and hence made incorrect statements about one of the laws.

Exemplary response

- (a) (i) $P = 17x + 24y$

- (ii) From the graph the points (16,40), (48,20), (16,15) and (48,15) are suitable. By looking at the graph we know that the points (48,15) and (16,15) will NOT give us the maximum profit.

Test (16,40)

$$\begin{aligned} P &= 17 \times 16 + 24 \times 40 \\ &= \$1232 \end{aligned}$$

Test (48,20)

$$\begin{aligned} P &= 17 \times 48 + 24 \times 20 \\ &= \$1296 \end{aligned}$$

Therefore the maximum profit is \$1296.

(iii) Minimum profit will occur at (16,15)

$$\begin{aligned} P &= 17 \times 16 + 24 \times 15 \\ &= \$632 \end{aligned}$$

(b) (i) 3 calls

(ii) A difference of 6 calls

(iii) After 7 minutes no one else may have decided to ring up so the operator had a chance to catch up.

Then in the next minute more people decided to ring.

(iv) Maybe one person rang as the operator finished with another caller keeping the number constant.

The number of people calling in was equal to the number of bids being taken by the operator.

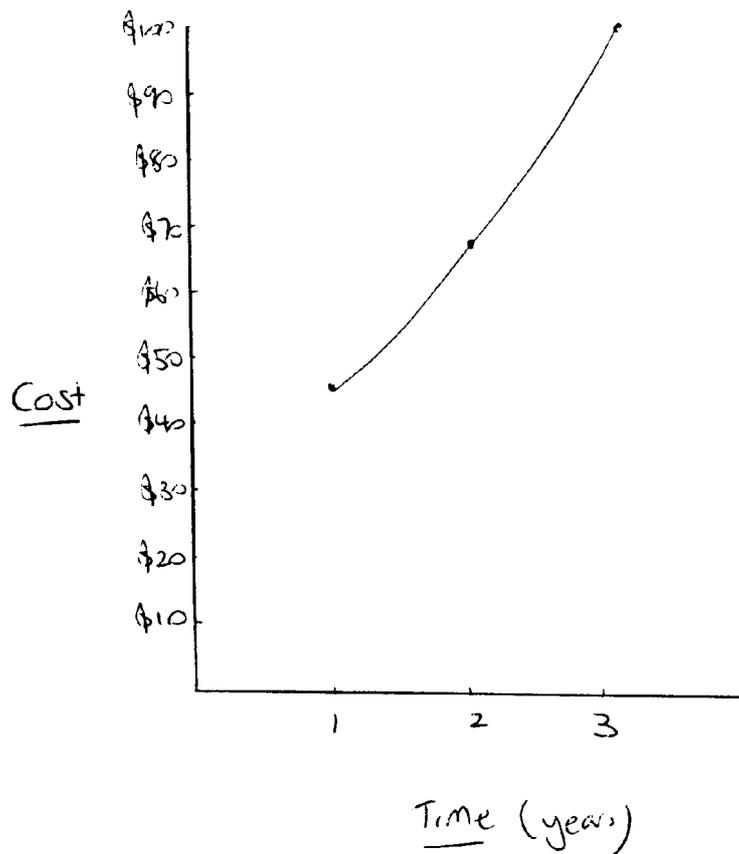
(c) (i) For the second year

$$\begin{aligned} A &= \$29.50(1 + 0.5)^2 \\ &= \$66.38 \end{aligned}$$

For the third year:

$$\begin{aligned} A &= \$29.50(1 + 0.5)^3 \\ &= \$99.56 \end{aligned}$$

(ii)



(iii) The cost of the CD is increasing at an increasing rate.

- (d) (i) In the Malthusian Law population increases exponentially or increases at an increasing rate.
- (ii) In the Logistic Law population increases at an increasing rate at first but after time starts to increase at a decreasing rate. It has a ceiling point.
- (iii) Both laws only explain population changes when we make many assumptions about factors such as food supply, size of population, diseases etc.

Malthusian Law doesn't include these factors as it is exponential all the time. Not affected by outside factors.

Logistic Law on the other hand includes all these factors which decrease the rate of increase of the population. They have a limiting affect on the growth.

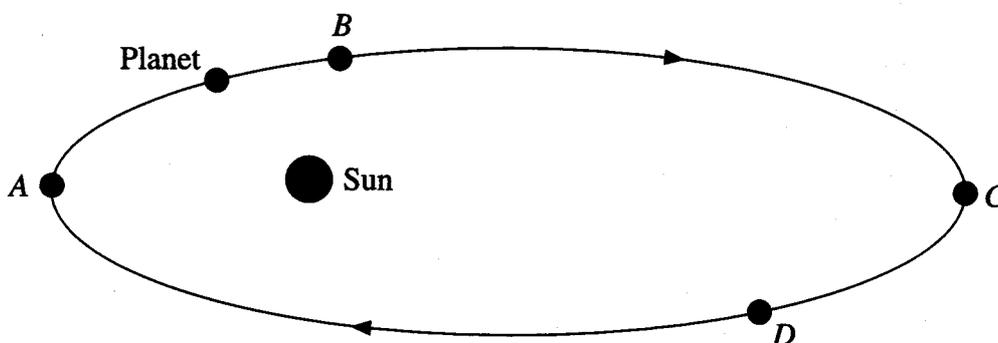
Question 3 – Mathematical Ideas

(a) *Plato's model of the solar system (Plato, 400 BC) fixed the Earth at the centre. The celestial bodies: Moon, Sun, Venus, Mercury, Mars, Jupiter and Saturn, were placed in order of distance from the Earth. It was believed that these celestial bodies orbited the earth in circular paths.*

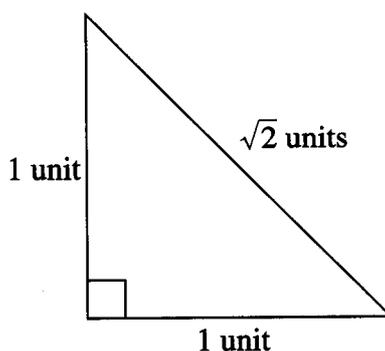
- (i) *Draw a sketch of Plato's model of the solar system. Label your diagram.*
- (ii) *Give ONE reason why the Moon was placed closer to the Earth than the Sun in Plato's model.*
- (iii) *Compare and contrast the solar system models of Plato and Copernicus.*

(b) *Kepler (1571-1630) established that all planets move in elliptical orbits.*

The diagram below shows the path of a planet about its sun. The four points A, B, C and D are positions in the orbit of the planet.



- (i) *What word is used to describe the position of the sun?*
 - (ii) *At which point, A, B, C or D, is the planet moving slowest? Explain your answer.*
- (c) *The Pythagoreans (Pythagoras, 530 BC) knew that a right-angled isosceles triangle with sides of length 1 unit had a hypotenuse of length $\sqrt{2}$ units. This is shown in the diagram below.*

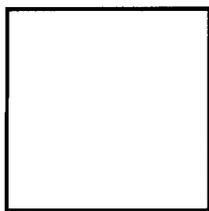


- (i) *Inscribe a square in a circle of radius 1 unit and hence deduce that*

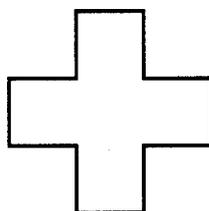
$$\pi > 2\sqrt{2}.$$
- (ii) *Explain why inscribing an octagon in a circle would give a better approximation of π than that found in part (i).*
- (iii) *What would be the dimensions of a square in which the circle in part (i) could be inscribed?*

- (iv) A recent approximation of π was found to be accurate to millions of decimal places. Give an example of a practical situation where this degree of accuracy is necessary.
- (d) The first three steps in the construction of a fractal pattern based on squares are drawn below.

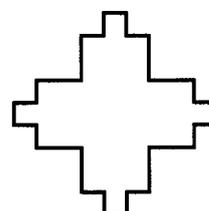
Original shape



Stage 1



Stage 2



- (i) Describe how the next stage (Stage 3) in the pattern would be generated.
- (ii) The area of each stage in the generation of a fractal is given by the formula

$$A_n = A_{n-1} - 2^{n+1} \left(\frac{S}{3^n} \right)^2$$

- where
- n is the stage of fractal generation
 - S is the length of sides of the original shape
 - A_n is the area of the fractal at stage n
 - A_{n-1} is the area of the fractal at stage $(n - 1)$
 - A_0 is the area of the original shape.

Given that $S = 9$ cm, calculate the area of the fractal at Stage 2.

- (e) (i) In Euclidean geometry, what is an axiom?
- (ii) Give an example of an axiom which, while true in Euclidean geometry, is NOT true in non-Euclidean geometry. Give sufficient detail to explain your answer.

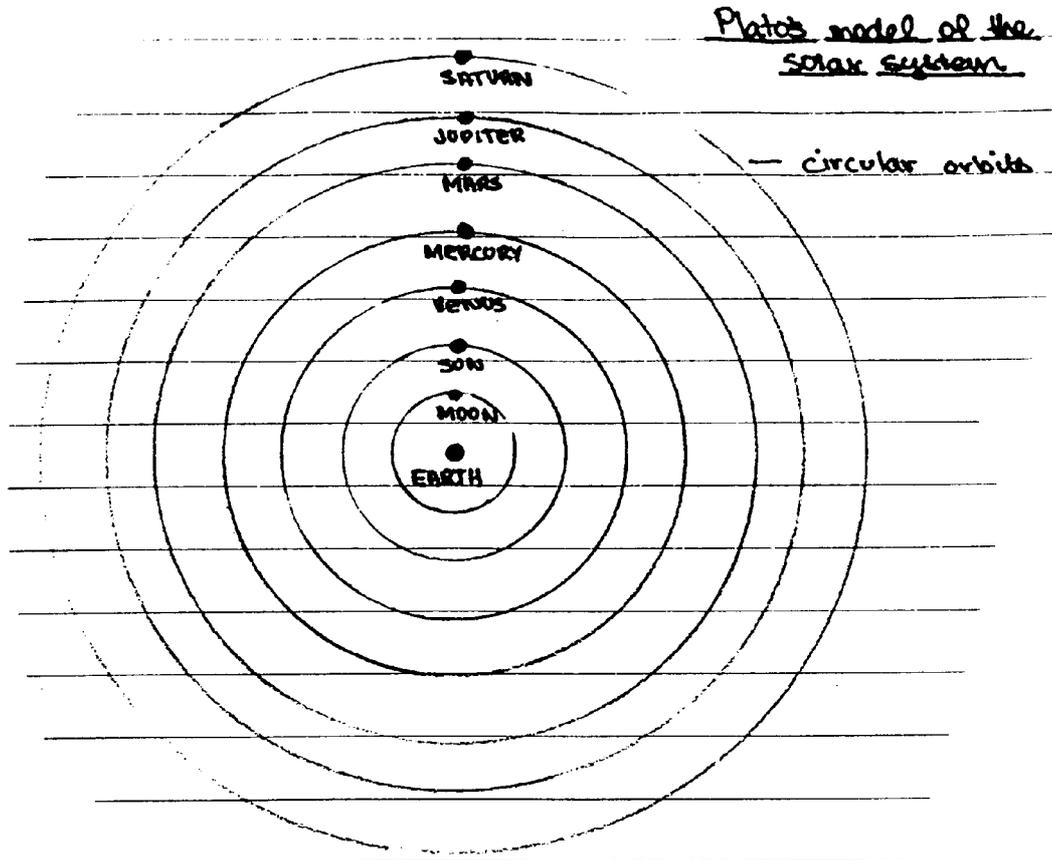
Specific Comments

- (a) This part was well answered. However, some candidates, when answering part (i), failed to place the planets in the correct order. In part (iii), a number of candidates could not compare the models of Plato and Copernicus.
- (b) Candidates had difficulty describing and labelling the motion of the planets and the position of the sun in Kepler's model of the solar system. Some candidates needed to revise Kepler's Second Law, the Law of Areas, to be able to better answer part (ii).
- (c) This question was poorly answered. In part (i) many candidates could not use their compass to inscribe a square in a circle of radius 1 unit and deduce that $\pi > 2\sqrt{2}$. Part (iii) was well answered. Some candidates could not give any examples of practical situations where a high level of accuracy for π is necessary.
- (d) Part (i) was poorly answered. Most candidates stated how fractals are formed, rather than how the actual fractal in Stage 3 would be generated. In Part (ii), most candidates substituted into A_2 well, but couldn't continue to find ' A_1 ' once they had written ' $A_2 = A_1 - 8$ '.

- (e) Most candidates were able to state what an axiom was, and were able to give an example of a result or property which, while true in Euclidean Geometry, is not true in non-Euclidean Geometry. However, they were not able to answer part (ii) in relation to an axiom.

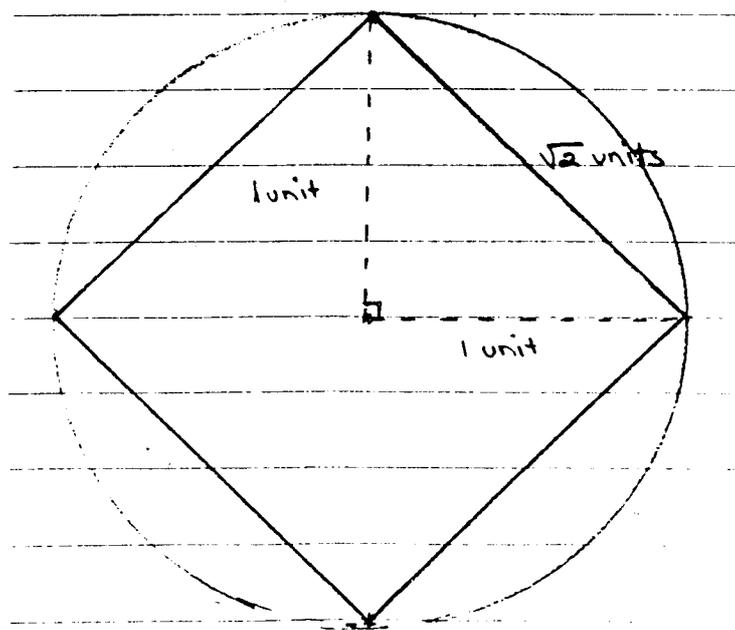
Exemplary response

- (a) (i) Earth in the centre with planets in order given.



- (ii) Moon blocks out the sun in an eclipse.
- (iii) Copernicus believed in a heliocentric model.
Plato believed in a geocentric model.
- (b) (i) Focus
- (ii) Point C
Planets move slowest when they are furthest away from the sun (Kepler's law).

- (c) (i) Circle with square inscribed inside.



$$C = 2\pi$$

$$\text{length of arc} = \frac{2\pi}{4}$$

$$= \frac{\pi}{2}$$

$$\frac{\pi}{2} > \sqrt{2} \therefore \pi > 2\sqrt{2}$$

- (ii) The sides of the inscribed octagon are closer to the circumference therefore closer in length to the arc.
- (iii) Square with side length 2 units.
- (iv) Deep space exploration.
- (d) (i) Divide each outer line into thirds. Remove a square with side length equal to one third the side length of the outer squares from each corner.
- (ii) $A_1 = A_0 - 2^2 \left(\frac{9}{3^1}\right)^2 = 9^2 - 4 \times 3^2 = 81 - 36 = 45 \text{ cm}^2$
- $A_2 = A_1 - 2^3 \left(\frac{9}{3^2}\right)^2 = 45 - 8 \times 1^2 = 37 \text{ cm}^2$
- (e) (i) An axiom is a logically self evident assumption.
- (ii) Name axiom.

Explanation of the non-Euclidean geometry case.

Question 4 – Science and Medicine

(a) *Diagnostic techniques routinely used in medical practice include:*

- *radioisotopes*
- *ultrasound*
- *X-rays and CAT scans.*

(i) *Name the technique you have studied in detail.*

(ii) *Describe how an understanding of basic scientific principles led to the development of this technique.*

(iii) *Explain how and why the range of applications of this technique has grown from its introduction to the present day.*

(iv) *Give ONE advantage and ONE limitation of this technique.*

(v) *A doctor claims to be able to match the diagnostic value of this technique much more cheaply.*

Discuss TWO ways you could investigate the doctor's claim.

(b) *Choose ONE case study from the following list:*

- *asthma* • *diabetes* • *smallpox*
- *anaemia* • *malaria* • *tuberculosis*

(i) *Name the medical condition you have studied.*

(ii) *Describe how careful observation or experimentation led to the identification of the factor(s) contributing to this condition.*

(iii) *Briefly trace the history of the development and testing of effective and safe pharmaceuticals for this condition.*

(iv) *An advertisement has appeared in your local newspaper claiming an effective, ecologically sensitive, natural herbal remedy for the treatment of the condition you have chosen.*

1 *Some market research reveals skyrocketing sales. Why do you suppose people buy this product in the absence of any credible testing?*

2 *You decide to examine the claims made for the herbal remedy. Outline TWO crucial aspects of the design of a suitable trial.*

(c) *A large-scale trial was conducted on a new drug claimed to be effective against hay fever. Six thousand people were split into three groups (A, B and C). Each group received different treatment. Each person was asked to report severe hay fever symptoms prior to the treatment, for three weeks while receiving the treatment, and for one week after treatment.*

The results appear in the table below.

PERCENTAGE OF SUBJECTS REPORTING SEVERE SYMPTOMS

Group	Before treatment	Week 1 of treatment	Week 2 of treatment	Week 3 of treatment	After treatment
Group A (pills containing sugar only)	92	85	83	80	90
Group B (pills containing sugar and drug only)	91	40	29	18	92
Group C (no treatment)	98	95	96	94	96

- (i) State TWO conclusions that can be drawn from these results. Explain your answers.
- (ii) People in both Groups A and B were all told they were receiving the new drug. In fact, this was not true for Group A. Give ONE reason for conducting the experiment in this way.
- (iii) The doctors who administered the drug and analysed the results also did not know which people were in Group A or Group B. Give ONE reason for this experimental design.
- (iv) Suggest ONE improvement you could make to the experimental design.

Specific Comments

- (a)
 - (i) All candidates identified a technique from the list given.
 - (ii) Few candidates had background knowledge of the stages in the improvement and perfection of the technique. Most candidates neglected to explain the notion of development from principles to technique. There was also a fair degree of confusion when explaining scientific principles across the diagnostic techniques, for example, X-rays deemed as infra-red or light waves.
 - (iii) In general the majority of candidates were unable to provide a historical or sequential timeframe to demonstrate the development of their chosen diagnostic technique.
 - (iv) Candidates often gave the uses of the technology and not an advantage of using the technology. Answers were too broad, for example 'X-rays allow us to see bones'.
 - (v) Candidates generally ignored scientific method and did not relate the question to concepts such as blind, double blind, or clinical and pre-clinical trialling. Candidates who did provide one answer had difficulty providing a second response.
- (b)
 - (i) All candidates were able to name a medical condition from the list given.
 - (ii) Most candidates gave detailed descriptions of the symptoms of the disease rather than linking them with observations, research and testing.

- (iii) Many candidates simply identified general testing methods for drugs without actually referring to the pharmaceuticals involved in a particular condition. They did not give a historical component or developmental time span in their answer.
- (iv)
 - 1 Well answered as most candidates were able to give a plausible explanation.
 - 2 The majority of candidates misinterpreted the question and did not outline any scientific methodology in the question.
- (c) (i) Nearly all candidates were able to gain marks by interpreting the table. A broad range of answers was acceptable.
- (ii) The majority of candidates answered this question correctly. The concepts of bias and placebo was well understood.
- (iii) Most candidates demonstrated an understanding of this experimental design.
- (iv) Most candidates were able to suggest an improvement to this experimental design.

Exemplary response

- (a) (i) Ultrasound is the technique that was studied in detail.
 - (ii) Through knowledge that sound waves can be reflected, ultrasound came about. When a high frequency sound wave was ‘launched’ it was possible to measure the time taken for the wave to hit the object and reflect back. This gave an idea of distance travelled by the wave and the size of the object targeted when multiple waves were sent.
 - (iii) First used in Naval Aviation in the form of ‘sonar’, to measure distance to enemy ships and to monitor the vessel’s territory. Now used to examine a growing foetus in the womb, to detect any abnormalities, eg damage of the spine, deformation of limbs, irregular heart beat.
 - (iv) One advantage of ultrasound is that it can be used to detect abnormalities in a foetus, (still in the womb) and as proved recently, surgery could be performed in the womb if needed. One limitation of this technique is that the mother needs to have a full bladder for the image of the baby to be clear on the sonagram (monitor).
 - (v) Clinical trials need to be taken to ensure that there were no damaging effects on the patients. This would include involving several groups of volunteers, or testing apes or other animals, and measure/metering any side effects. If the clinical trials prove successful, continual monitoring of the patients must be carried out to see if there are any long term side effects.
- (b) (i) Asthma is the medical conditions studied.
 - (ii) People complained of tightness of the chest, coughing and wheezing, and shortness of breath. These were all upper respiratory aggravations. It was noted that in springtime, due to the extra pollen and dust in the air, the symptoms became worse. People also complained of difficulties of breathing after exercise, which suggested there were ‘trigger

factors' which cause the bronchial tubes to contract, thus making it harder for air to get to the lungs.

- (iii) It was noticed that during an asthma attack, the mucous lining of the bronchial passages became inflamed, and the blood vessels of the bronchial passages constricted, thus causing breathing difficulties for the patient. Bronchodilators such as Salbutamol, which had been through clinical trials, and inhalation were tested, and were successful. However some individuals had adverse side effects from this treatment. Another treatment was put through clinical trials where the patient was injected with steroids such as Cortisone, yet this produces some adverse side effects also, so treatment is individualised. A new method being trialled now is the daily administration of bronchodilators in the hope that long term this will cause the bronchi to become less sensitive. Allergic asthmatics have had long term desensitisation programs organised for them over the past twenty-three years.
- (iv) 1 Presently other remedies seem to be more popular. People are acknowledging only the claim that it works and aren't considering the side effects, which may not be printed in the advertisement.
2 To examine the claims made:
Two or more groups would be needed, with as many people in each group as possible. This way, we can monitor the effects over a larger field, and therefore obtain a better conclusion for the product.
Both the tester and patient need to be unaware of whether they're receiving the drug or a placebo. This process is known as 'double blind testing'. (Human interference of the experiment may result in the alteration of the results.)
- (c) (i) Group B's percentage of severe hay fever reports seemed to decrease whilst taking the treatment. This would suggest that the drug was effective. Group B's results show that the drug was only effective when used regularly. After the treatment finished, the percentage of severe hay fever reports resumed to the number before treatment started. This would suggest that the drug was not a cure.
(ii) The experiment was conducted this way to prove that the patient's attitude affects the severity of their condition. If they believe they're being treated properly, the severity of their illness may be reduced. This could be explained with the term 'mind over matter'.
(iii) Again, the attitude of the doctors may influence the results. This 'double blind testing' is to ensure that the doctor does not 'persuade' the patient to feel a certain way, or change the results to suit the hypothesis.
(iv) To improve the experimental design tests would need to be taken throughout the year, not just over a five week treatment. This way we can observe whether changing weather patterns affect the patient's symptoms.

Question 5 – Scientific Research

You have studied at least TWO specific examples in the following list of Australian research programs.

- A project associated with CSIRO's Australia telescope
 - Antarctic research projects involving ice-core studies
 - The bush-fly control program
 - The crown of thorns starfish research project
 - Gene mapping and/or transgenic animals
 - Methods of assessing and monitoring corrosion
 - Studies involving health and food additives
 - The Synroc project
 - A sewage treatment project
 - A project to develop alternative energy sources
- (a) (i) Write down the name of ONE project, with a brief summary of the aim(s) of the project.
- (ii) Discuss the appropriateness of the use of a 'control' in the project.
- (iii) Discuss the results of the research and its practical implications.
- (iv) Explain whether the results of the project led to conclusions that were unexpected at the beginning of the project.
- (b) From the above list, select ANOTHER research project.
- (i) Name the project and describe the problem(s) being investigated.
- (ii) Describe ONE method of scientific research that was applied to the project.
- (iii) Give ONE reason for the design of the research project.
- (iv) What further study or work is being done to improve understanding of the problem?
- (c) Write a brief account of a scientific research project that you performed. In your account you must answer the following questions:
- (i) What was the problem?
- (ii) What literature did you review before designing the research project?
- (iii) What variable(s) and control(s) were used?
- (iv) What was your conclusion?
- (v) What further experiments or improvements to the experiment do you suggest?
- (d) It has been suggested that a driver's reaction time may affect his or her chance of being involved in a car accident.
- (i) State ONE hypothesis that could be tested regarding driver reaction times and car accidents.
- (ii) Describe an experiment or study that could be undertaken and test your hypothesis. In your description, include:

- 1 the variables that could be measured or controlled;
- 2 the controls used;
- 3 the methods of carrying out the experiment or study.

Specific Comments

Candidates found the following aspects of Question 5 most difficult:

- to discuss the appropriateness of the use of a control in the project studied (part (a)(ii)).
- to explain unexpected conclusions (part (a)(iv)).
- to produce a qualitative scientific research project. Some candidates could not refer to specific literature reviewed prior to designing their research project (part (c)(ii)).
- applying the basic terminology of scientific research to a hypothetical experiment (part (d)).

Most candidates understood the main aims or problems being addressed in the two specific research projects they studied.

Exemplary response

- (a) (i) The Crown of Thorns Starfish Research project aimed to determine whether disruptive weather conditions caused an increase in Crown of Thorns Starfish (COTS) outbreaks. And whether COTS outbreaks are caused from human activities such as pollution, overfishing and tourism. Other areas investigated were whether frequent COTS outbreaks are healthy for the reef.
- (ii) Scientists compared brood stocks taken from COTS in the 1960's to compare the genes of present day COTS infestations with those in the 1960's to determine if past and present outbreaks are derived from the same source area. This will help researchers to determine whether COTS outbreaks are cyclic and occur from the same population.
- (iii) That juvenile COTS feed on algae and algae growth is produced by run off from the land. Therefore by improving the sewerage systems to prevent run off we decrease the amount of algae hence depriving the COTS from a source of food and thereby reducing the numbers of COTS.
- (iv) The results showed that juvenile COTS often hide underneath the coral until they have fully matured before they come out into the open. This showed that COTS infestations didn't just suddenly appear but had been building up for some time. This result was unexpected, as scientists didn't know how outbreaks occurred so suddenly.
- (b) (i) The Synroc project. The problem being investigated was how to store high level radioactive waste for a long time without the material breaking down before the radiation had decreased to safe levels.
- (ii) Leach testing. Synroc was placed under a high pressure with 300⁰C water sprayed continuously on it for several days. Results showed that Synroc was unaffected. Therefore Synroc should be able to withstand over 100 000 years of underground water leaching without decaying.

- (iii) Leach testing was used to prove that Synroc could withstand high-pressure water for many thousands of years without breaking down and releasing the radioactive waste.
 - (iv) Collaboration with other scientists in other countries to share information about other methods that have been employed to contain waste.
- (c)
- (i) Whether organic or synthetic fertilisers allowed plants to grow faster.
 - (ii) Books on types of fertilisers, encyclopedias, and books on farming techniques.
 - (iii) Independent variable – type of fertiliser organic (Blood and Bone) or synthetic (Osmocote). Dependent variable height of each plant. Controls – 4 plants no fertiliser, 4 with organic, 4 with synthetic. Same type of seeds. Same amount of fertiliser. Same amount of potting mix, same conditions eg sunlight, temperature. Same amount of water at same time and seeds were planted at the same depth. Height recorded at same time for next 14 days.
 - (iv) That organic fertilisers caused the plants to grow at a faster rate compared to the synthetic fertiliser and the control.
 - (v) Improvements could include to measure and water plants on weekends. Further experiment would be to use different types of organic and synthetic fertilisers with different species of plants.
- (d)
- (i) That people with fast reaction times don't have car accidents.
 - (ii) Random sample of 100 people. The age group 25-30 years old. Using the same type of car. Have each person travelling at 60 km/h before they have to stop suddenly. Record their reaction times and see whether they would have run into anything by drawing lines in the area to symbolise parked cars etc. The test would have to be done in the same conditions eg in the rain or in dry conditions with sun either in front or behind. The people would be from a specific age group to reduce age factor where reaction times may be slower in older people.

Question 6 – Significant Technological Achievements

This question must be answered in terms of two significant technological achievements from the following table.

Area	Technological achievement	
Agriculture	Farm implements	or Genetic engineering in farm animals
Electronics	Integrated circuits	or Use of fibre optics
Engineering	Pre-stressed structures and post-stressed structures	or Refrigeration
Food	Milk products	or Grape products
Manufacturing	Robotics in motor-car manufacturing	or Assembly-line production of whitegoods
Materials science	PET	or Solar cells
Textiles	'Superwash' wool	or Shuttleless looms
Transport	Electric trains	or Air-traffic control

- (a) From the table, select ONE technological achievement you have studied.
- Name the technological achievement.
 - Describe a practical investigation you have undertaken in relation to this technological achievement.
 - How did this practical experience help you to understand the underlying principles of the operation of the technological achievement?
 - Describe another investigation that may have allowed a further understanding of the technological achievement, if you had more resources and time.
- (b) From the table, choose ANOTHER technological achievement from a DIFFERENT area to part (a).
- Name the technological achievement.
 - Describe a practical investigation you have undertaken in relation to this technology.
 - How did this practical experience help you to understand the underlying principles of operation of the technological achievement?
 - Describe another investigation that may have allowed a further understanding of the technological achievement, if you had more resources and time.
- (c) In this part of the question, you will need to compare the two technological achievements you have selected for your answers to parts (a) and (b).
- Which do you think is the most important of the two technological achievements for people today? Explain your answer.

- (ii) Compare the effects of these two technologies on the production and distribution of goods or services.
- (iii) Compare the scientific understandings that existed at the time of the development of each of the technologies.
- (iv) Which technology has resulted in the greater advance in scientific understanding? Explain your answer.

Specific Comments

Many candidates had difficulty in clearly describing the underlying principles of the operation of the technological achievement. They also need to revise the scientific understandings that existed at the time of the development of the technological achievement. Candidates had a very good understanding of the advantages of the technological achievement and the effects on the production and distribution of goods or services.

Candidates need to recognise from the table which two significant technological achievements they have studied.

Exemplary response

- (a) (i) UHT (Ultra Heat Treatment) is the technological achievement that is used in milk products. It heats milk to 132⁰C for 2 seconds then cools it, this kills the bacteria and spores in the milk making it last longer and have a longer shelf life.
 - (ii) A practical investigation that I have undertaken in relation to UHT milk is a taste test of all types of milk, being skim, normal, UHT etc. This test was undertaken as the process of UHT kills bacteria in milk but also the nutrients and much flavour is lost compared to normal pasteurised milk. The test was to see if we could taste the difference as the names of the milk was not marked. The UHT was definitely picked as it was tasteless compared to milk heated to 72⁰C for 15 secs.
 - (iii) The practical milk tasting test helped me to understand that the principles of heating milk to 132⁰C for 2 secs definitely affected the taste. By killing bacteria in the high temperature, nutrients are also killed and the milk has a very different taste, compared to pasteurised milk which is heated at 72⁰C for 15 secs, and only kills some bacteria but not the nutrients. The flavours were very different and the taste test helped me to identify why UHT milk could last so long.
 - (iv) Another investigation would have been to actually heat and cool milk myself, testing at different temperatures and heating times, this would cost a lot and be time consuming. I would be able to test how killing bacteria also can kill nutrients, I could have heated, cooled and taste tested to try and find new solutions to the tastelessness of UHT milk.
- (b) (i) The technological achievement is pre- and post-stressed concrete in engineering. The reinforcing of concrete to increase tensile strength.
 - (ii) A practical investigation we undertook was actually constructing pre- and post-stressed concrete. We prepared moulds of both pre- and post-stressed concrete and when they

were dry we tested them with weights to see how they behaved. In concrete, tensile strength is normally very weak, the weights were placed on the concrete and they didn't break.

- (iii) This practical experience helped me to understand how the concretes worked. In the pre-stressed, the use of setting concrete over settle cable lines, helped me to see how the tensile strength was increased. In the post-stressed the setting of little pipes in concrete, then drying and putting steel lines through these ducts and pulling at one end, then filling with mortar under pressure helped me to understand the increased strength. These tests were only done on a small scale using wire and plastic tubing but they related to how the larger sizes operate. The adding of weights confirmed the results.
 - (iv) Another investigation that could be done to help me understand the strength of concretes would be to use full scale gear, or go to a facility that makes full scale pre- and post-stressed concrete. Then I would be able to see how the large jacks tension the steel through the concrete to increase tensile strength.
- (c)
- (i) I believe that the achievement in pre- and post-stressed concrete is most important to people today, as this achievement has led to the development of greater spans in buildings, new bigger bridges and buildings. Connecting people, expanding cities and creating living environments better than the past. It helps people a lot more than if a milk that lasts longer, which is only good for people who do not have refrigeration.
 - (ii) The effects the achievements have had on production is that stressed concrete has opened up new construction opportunities creating more jobs for people and growth of big business. UHT milk, if anything has created less jobs, because this new milk can last longer, making people buy fresh milk less.
 - (iii) At the time of UHT discovery, pasteurisation existed. This was heating to 72⁰C for 15 secs and cooling. This was a good method as taste was not destroyed but this milk didn't last very long because the bacteria spores were not killed. Reinforced concrete existed at the time of pre- and post-stressed discovery, but reinforcing concrete with steel didn't solve tension problems, pre and post stressed did as they increased the tensile strength of concrete structures.
 - (iv) UHT milk has resulted in the greatest advance in scientific understanding, the development of heating milk to 132⁰C for 2 secs and cooling, resulted in finding milk that lasted longer, this was then applied to other areas as beer, juice and fruit, giving more opportunities for consumers. They also discovered that heating like this and cooling kills bacteria but also nutrients affecting the taste, which has lead to research into finding ways to eliminate this, and other developments eg vacuum seals, sterilisation and biotechnology (reducing bacteria allows products to last longer.)

Question 7 – Statistical Methods

(a) (i) An advertisement states that three-quarters of doctors interviewed recommend Brand X in preference to Brand Y. Explain why this may be an example of the misuse of statistics.

(ii) Describe another way in which statistics may be misused. Give an example.

(b) A sample of 200 New South Wales residents is to be chosen for a survey.

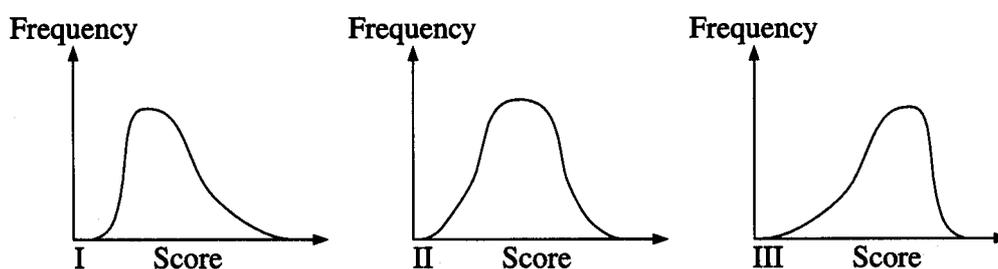
(i) Describe how the sample would be chosen using:

1 simple random sampling;

2 systematic sampling.

(ii) What effect would increasing the sample size have on estimating the population mean?

(c)



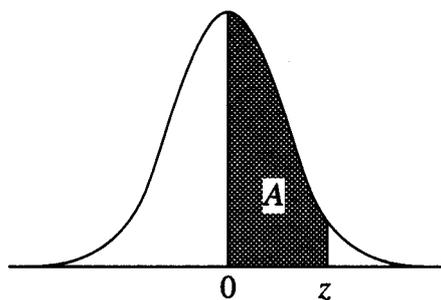
(i) Copy these diagrams into your Writing Booklet.

(ii) On each curve, clearly mark the positions of the mean and median.

(d) (i) Write down a set of seven numbers where the mode is less than the median AND the median is less than the mean, ie. $mode < median < mean$.

(ii) What would happen to the mean and standard deviation of your set of numbers if each value was multiplied by 3?

- (e) A vending machine dispenses soft drink automatically into a cup that holds at most 170 mL. The volume dispensed each time is distributed normally with a mean of 150 mL and standard deviation of 8 mL.



z	A
0	0
0.5	0.19
1	0.34
1.5	0.43
2	0.475
2.5	0.495
3	0.5

- (i) What is a z score and what is its purpose?
- (ii) Find the probability that a cup taken from the vending machine will contain:
- 1 less than 166mL;
 - 2 between 146mL and 162 mL.
- (iii) From 200 operations of the machine, how many individual cups are likely to overflow?

Specific Comments

All parts of Question 7 should have been accessible to a well prepared candidate. However, candidates either scored very well in this module or scored poorly. A reason for this may have been that some candidates attempted this question for the first time on the examination day and failed to prepare for it. As many parts of the question called for very specific knowledge and skills, such candidates invariably performed poorly.

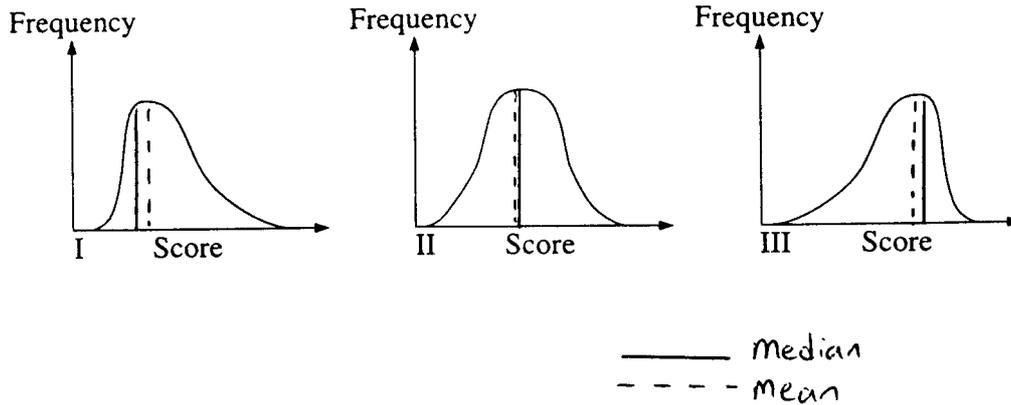
- (a) (i) Candidates generally answered this question very well.
- (ii) A lot of candidates answered the first part of the question well. However, they failed to give an example. Candidates need to read the question carefully.
- (b) (i) 1 Candidates failed to answer the question in relation to the situation that was presented, ie. *a sample of 200 residents is to be chosen, describe how the sample would be chosen*. A lot of candidates answered very generally or gave a definition.

- 2 Once again, candidates failed to answer the question in relation to the situation.
- (ii) This part was answered very well.
- (c) (ii) Most candidates did curve (II) correctly. However, marking in the positions of the mean and median on curves (I) and (III) was done very poorly.
- (d) (i) On the whole this question was answered very well.
- (ii) Most candidates realised that the mean and standard deviation of the scores would increase. However, very few candidates mentioned that both the mean and standard deviation are multiplied by three.
- (e) (i) Most candidates were able to define a z score, but very few candidates mentioned what its purpose was.
- (ii) 1 Candidates that attempted this question without having studied this topic answered very poorly. Candidates had difficulty in referring to the table to answer the questions.
 - 2 A lot of candidates found this part difficult. Once again they had difficulties in referring to the table.
- (iii) This part was answered poorly. Candidates need to know how to interpret z tables.

Exemplary response

- (a) (i) This may be an example of misuse because the ad does not state how many were in the sample interviewed and whether it was random or not.
- (ii) Statistics may also be misused if a sample didn't truly represent the population it was suppose to. eg. questioning people about AIDS in a strong Christian community but implying their views as society's.
- (b) (i) 1 Simple random sampling would be chosen by randomly choosing names from an unmarked phone book from N.S.W. until the 200 had been surveyed.
- 2 Systematic sampling would be choosing every 10th person to walk into a supermarket from 100 towns in N.S.W beginning with the letter "m".
- (ii) Increasing the sample size would give the estimation of the population mean more accuracy.

(c) (i)



(ii) See diagram above.

(d) (i) Set of scores are 1,1,1,2,3,3,10

mode = 1 median = 2.5 mean = 3

(ii) New set 3,3,3,6,9,9,30

Both mean and standard deviation increase by a multiple of three.

(e) (i) A z score is how many standard deviations the particular score is from the average. The purpose is to compare two results to see in which test they performed better.

(ii) 1 Less than 166 ml means 2 standard deviations above the mean.

$$= 0.5 + 0.475$$

$$= 0.975$$

2 Between 146 ml and 162 ml means half a standard deviations below the mean to one-and-a-half standard deviations above the mean.

$$= 0.19 + 0.43$$

$$= 0.62$$

(iii) For the cup to overflow we need to have more than 170ml which means above 2.5 standard deviations from the mean.

$$= 0.5 - 0.495$$

$$= 0.005$$

$$\text{In 200 cups} = 200 \times 0.005$$

$$= 1 \text{ cup}$$

Question 8 – Technology and the Consumer

(a) A number of products are available that claim to control fleas on cats. The range of products includes liquid, tablet, collar, injection and powder.

The table below provides information including cost, mode of application, frequency of application, and packaging for the different alternatives.

	Liquid	Tablet	Collar	Injection	Powder
Cost	\$29.00 (for 4 applications)	\$10.90 (pack of 40 tablets)	\$4.80	\$68.00 (including consultation fee)	\$3.80 (for 10 applications)
Mode of application	Apply liquid on fur behind cat's neck	2 tablets taken with food	Placed around cat's neck	Injected into cat	Sprinkle on cat's coat and rub in
Frequency of application	Repeat monthly	Twice a week	Change every 5 months	Repeat every 6 months	Repeat weekly
Packaging	Cardboard backing moulded plastic cover	Plastic container	Cardboard backing moulded plastic cover	Plastic vial with syringe	Plastic shaker container

Assume that you own a cat.

- (i) List TWO factors that would influence your decision when selecting ONE of the above products.
 - (ii) Give ONE reason why there are so many different products that all claim to eliminate or control fleas.
 - (iii) Studies show that injection is the least preferred option for the control of fleas. Give TWO reasons for this finding.
- (b) You are considering manufacturing a new product to control fleas on cats. The product 'Flealess' is a full body coat that is worn by the cat.
- (i) Describe ONE test that you would conduct to assess your product against the products shown in the table above.
 - (ii) If the test results showed a market advantage for your product, how would you use this to advertise your product?

You have studied TWO consumer products from the following list:

- bicycle helmets.
- cameras
- cosmetics
- devices for heating water
- fertilisers
- hand-held, power driven tools

- *household cleaners*
 - *irons*
 - *portable music players*
 - *sewing machines*
 - *types of household insulation.*
- (c) (i) *Name ONE product from the above list.*
- (ii) *Describe the principles of operation for this product.*
- (iii) *Name ONE material used in producing this product.*
- (iv) *Give TWO reasons why the material named in part (iii) was an appropriate choice.*
- (d) *From the above list, select ANOTHER product.*
- (i) *Name this product.*
- (ii) *Describe how you evaluated this product in terms of the following criteria:*
- 1 *safety features;*
 - 2 *ease of use.*
- (iii) *Name ONE detrimental effect this product may have on the environment.*
- (iv) *What procedures are in place to alleviate this problem?*
- (e) *Compare and contrast the marketing strategies used to promote the product you named in part (c) and the product you named in part (d).*

Specific Comments

In general, candidates understood what was being asked of them. They attempted all sections of Question 8 with varying degrees of success.

- (a) (i) The majority of candidates listed two factors but could not relate them to a product in the table.
- (ii)-(iii) Well answered.
- (b) (i) The test was poorly explained. Candidates often did not name the test. Many tests did not follow scientific testing procedures. Controls, repetition or large samples were seldom mentioned.
- (ii) Candidates had difficulty linking their test to a market advantage and subsequent advertising.
- (c) (ii) Well answered. Some candidates could not discuss the principles of operation for the consumer product.
- (iii)-(iv) Some candidates described packaging rather than a material used to produce the product. Generally responses were well done.
- (d) (ii) Most candidates did not indicate how they had evaluated their chosen product, but simply gave features of safety and ease of use. Many did not provide comparisons of different brands of the consumer product.

(iii)-(iv) Well answered.

- (e) Some candidates need to revise specific marketing strategies which were used to promote the consumer product. Candidates need to be aware that 'compare and contrast' means describe both similarities and differences.

Exemplary response

- (a) (i) The cost and also the ease of use would mean I would choose a collar.
- (ii) There are a large number of products because of the diversity of cats. Some may be unresponsive to certain treatments or some cats may prefer a particular form, eg some cats may not be able to swallow a tablet.
- (iii) An injection is a costly alternative compared to the other products and also the cat will need to see the Vet which some owners may see as time consuming.
- (b) (i) I would get a hundred flea ridden cats and split them into 6 groups. I would then administer the 5 treatments correctly over a six week period. The sixth group I would use the coat and compare all products for results.
- (ii) I would advertise my product as the most reliable method of flea control in cats.
- (c) (i) Cosmetics / Mascaras
- (ii) Mascaras use chemicals such as iron oxide, bees wax, petroleum distillates and panthenol to enhance and intensify the length and colour of a persons eyelashes. Liquid varieties contain alcohol, oil glycerides and water which are blended to prevent leakage when it comes into contact with liquids. Waterproof varieties use natural bees wax and artificial waxes to prevent mascara from smudging and running when in contact with water, while the cream varieties use nylon and rayon fibres to length and stick to the lashes, adding volume and extra length to them. All use dyes and natural pigments to produce earthy colours, while white pigments and blue oils produce lighter, blue shades and cochineal (beetles blood) is used for red exotic shades. All use panthenol to condition and protect lashes when they are enhanced and look shinier.
- (iii) Panthenol.
- (iv) Because it is a main ingredient used in most generic and exclusive brands which protect and strengthen lashes by conditioning. Then, making the product safer and better for eyes. It is also used for extra gloss and shine, creating the illusion of smoother, longer lashes. It is appropriate for the function intended.
- (d) (i) Household cleaners – detergents.
- (ii) We bought five different types of detergents and evaluated both safety and ease of use in comparison to each other.

- 1 For safety features – we considered that safety features for detergents included cautions to keep out of reach of children and also what to do if the detergents were swallowed. Another safety feature was a taste deterrent and also the use of biodegradable packaging so as not to contribute to landfills.
 - 2 Ease of Use – we evaluated this feature in terms of how easy the detergent was to use and rated the detergents in accordance to their easy access ie. pop up lids that are easy to open with wet hands. Also in terms of their weight.
- (iii) Some detergents are yet to be made with biodegradable materials. This leads to clogging up of the water systems and destruction of plant life.
- (iv) Detergents are now being made with both biodegradable materials and packaging.
- (e) The marketing strategies for lipstick involve endless campaigns of beautiful women with luscious lips to try and entice other women to their products. Also with lipsticks marketing strategies usually include famous faces to further encourage buyers. Detergent strategies are less elaborate and usually involve commercial advertising the environmentally safe detergents and ease of use and effectiveness. Both lipsticks and detergents are typically aimed at the female audience and both promote items which will invariably increase your quality of lifestyle. Lipsticks, through their appeal to men, and detergents through their effectiveness and germ killing ability.

Question 9 – Technology of Communication Systems

- (a) *Pheromones are substances released by one animal and detected by another, causing some sort of physiological reaction. Pheromones are identified through smell.*

Trout are acutely sensitive to some pheromones even in extremely low concentrations.

- (i) *When would pheromones play an important role in communication between trout?*
 - (ii) *A predator of trout is known to produce the same pheromone as is secreted by the female trout. Explain why this may occur.*
 - (iii) *Humans are able to communicate using a wider range of senses.*
 - 1 *Give ONE reason why communicating with pheromones is not as reliable for humans as for trout.*
 - 2 *Give ONE reason why humans make more use of other senses to communicate.*
- (b) *Telephone, television, radio and computer networks are examples of communication systems that require electricity.*
- (i) *Describe a simple communication system (other than pheromones) that does not use electricity. Your answer should include:*
 - *its main purpose*
 - *how the system operates*
 - *one limitation of the system.*
 - (ii) *Imagine a futuristic communication system not dependent upon electricity, in which signals are sent instantaneously across the universe.*

Discuss ONE positive and ONE negative social implication of this communication system.

(c) Select ONE of the communication systems below:

- telephone
- television
- radio
- computer networks.

- (i) Name the system you have studied and refer to it in answering the remainder of part (c).
- (ii) Explain how data is coded in the system.
- (iii) List and describe any specialised equipment needed for decoding the transmitted data.
- (iv) Name TWO sources of noise in this system.
- (v) What effects would the collapse of this communication system have on society?
- (vi) Identify ONE recent technological advance in the system you have studied.
- (vii) Describe ONE benefit that resulted from the adoption of the technological advance you identified in part (vi).

Specific Comments

- (a)
 - (i) Well answered.
 - (ii) Candidates needed to state a reason similar to ‘lures (male) trout’ or ‘in order to catch or kill’ or ‘survival skill’ in their responses.
 - (iii)
 - 1 Many candidates failed to see a connection between pheromones and a human’s inability to smell pheromones when compared to trout.
 - 2 Many candidates successfully mentioned the use of two or more senses combined as a better way to communicate.
- (b)
 - (i) Many candidates incorrectly identified morse code as a communication system without electricity. Candidates were vague in addressing the main purpose and how the system operates, but were more successful in clearly describing a limitation. Candidates needed to identify encoding/decoding in the identified system.
 - (ii) There were a wide range of answers, but candidates needed to outline how it would affect society.
- (c)
 - (ii) Many candidates could not clearly explain the coding of their selected system.
 - (iii) Candidates needed to be more specific when answering questions on computer networks.
 - (iv) Many candidates successfully answered one correct source of noise but had difficulty identifying a second.

- (v) Candidates listed what would happen if the system collapsed but needed to revise the significant effects on society. For example, reduced emergency services may result in increased loss of life.
- (vi) Candidates confused the internet and the telephone communication system.
- (vii) Well answered.

Exemplary response

- (a)
 - (i) When the trout are ready to mate.
 - (ii) To attract a male trout to the predator in order to eat it. The male trout thinks the predator is a female ready to mate and is attracted to the predator, but instead is probably eaten.
 - (iii)
 - 1 Humans don't have a sense of smell as powerful or defining as the trout, and thus communicating with pheromones is ineffective in humans.
 - 2 Their other senses are more reliable and have adapted to our methods of communication and our environment such as sight and sound.
- (b)
 - (i) Smoke signals - the main purpose is to communicate short messages which are for a broad audience usually in times of trouble, or even in times of battle. The system operates by creating a fire, generating smoke and covering or directing the smoke in a pattern which represents a message. One limitation of the system is when it is raining or there are no materials to light a fire with.
 - (ii) Positive – the information is sent much faster and thus messages could be received quicker, in times of emergency and in isolated areas. One negative implication is that signals may be sent by accident and signals may be picked up in areas where they are not meant to be received eg by an 'enemy'.
- (c)
 - (i) telephone
 - (ii) Data is coded by the transmitter or microphone in the handset. Sound waves vibrate a thin metal diaphragm which in turn compresses a small box containing carbon granules. The varying compressions (caused by the vibrations) on the carbon granules alter the current passing through the wire leaving the telephone. The varying current is passed as electrical pulses down the line to the receiving telephone.
 - (iii) The speaker or receiver in the handset of the receiving telephone acts as the decoder. As the pulses of electrical current reach the telephone they move into electromagnets which touch a thin metal diaphragm. The electrical pulses in the electromagnets cause the diaphragm to vibrate, reproducing the sound waves produced by the person on the other telephone.
 - (iv) Noise can come from lightning, and can be created by the electrical system itself.

- (v) People would not be able to communicate quickly and easily with others. Response times in emergency situations would increase, people would lose touch with family and friends, especially if they live far away. News would travel slowly, businesses would lose money, countries would lose contact with each other, and crime rates would increase. Mail and radio would become major ways to communicate.
- (vi) The introduction of Silicon Chips. The computerisation of the telephone system.
- (vii) Phones have become smaller and cheaper.

Question 10 – The Environment

- (a) *Some agriculturally important plant species have been genetically engineered to produce a bacterial toxin effective against many insect pests. Such genetically manipulated organisms (GMOs) pass on this insect resistance to successive generations of plants.*

Other agricultural experiments are directed towards creating genetically manipulated cereal crops (eg. wheat) which are capable of using nitrogen from the atmosphere.

- (i) *Explain how and why the cultivation of GMOs with bacterial toxin may lessen the various negative impacts of chemical pesticides on the environment.*
 - (ii) *Explain how and why the cultivation of cereal crops that can use nitrogen from the atmosphere may lessen the various negative impacts of synthetic nitrogen-based fertilisers on the environment.*
 - (iii) *Soil salination is a problem in Australia. Suggest TWO possible ways other types of genetic manipulation of organisms might be used to reduce soil salination problems.*
 - (iv) *Despite the apparent environmental benefits of genetically manipulated organisms in agriculture, many environmental activists are alarmed at the environmental release of such genetically manipulated organisms. Give TWO possible reasons for such concern.*
- (b) *You have undertaken research and prepared an environmental report on an issue of local significance.*
- (i) *What was the issue of local significance that you identified?*
 - (ii) *Describe the methods you used to investigate this issue.*
 - (iii) *Discuss the findings of your research.*
 - (iv) *Discuss how the local issue relates to ONE of the global issues you have studied.*
 - (v) *Discuss TWO changes you might suggest in individual or community behaviour that might lessen the environmental impact of the local issue you have studied.*
- (c) *Australia has the second highest per capita production of greenhouse gases of any country in the world.*
- (i) *What are greenhouse gases and why are they an important global issue?*
 - (ii) *Australia did not fully agree with recent proposals to reduce greenhouse gas emission.*
 - 1 *Suggest TWO possible reasons for the Australian decision.*
 - 2 *Suggest ONE way that countries like Australia could reduce greenhouse emissions.*

Specific Comments

- (a) (i) Many candidates displayed a lack of understanding of the basic requirements of plants. Some candidates confused the meaning of ‘how’ and ‘why’. Some candidates rewrote the question as their answer.
- (ii) Candidates found this question very difficult because they confused the meaning of ‘how’ and ‘why’.
- (iii) This question was answered poorly. Most candidates whilst displaying a degree of familiarity with the problem of soil salination were unable to link this to the notion of genetically manipulated organisms.
- (iv) Some candidates could only provide one correct response. Some candidates could not see any reason for concern at the environmental release of genetically manipulated organisms.
- (b) (i) The research assignment needs to be an environmental report. Although there were no marks given to this question many local issues investigated were too broad. For example a study of air pollution resulted in findings that were too general and difficult to apply to the specifics of the questions.
- (ii) Many candidates only stated one method and gave little description.
- (iii) Most candidates reported two findings but in some cases the findings were too general. For example, ‘The water was dirty’. This type of response often relates back to their original research area being too general.
- (iv) Candidates are still unable to relate their issue globally.
- (v) This question was generally answered well with the better candidates being able to distinguish between an individual and a community response.
- (c) (i) Many candidates could not distinguish between the greenhouse effect and ozone depletion. Some candidates mixed the two issues together. Some candidates confused the effects of ultraviolet and infrared waves. Some candidates did not show any understanding of the global implications of greenhouse gases.
- (ii) Well answered. Candidates provided sound economic and political responses.

Exemplary response

- (a) (i) The cultivation of GMOs can lessen the impact of pesticides as not as many pesticides will be needed. The plants will be resistant to many of its pests, so the farmer won’t need to worry about killing those pests because they won’t be eating his crop and they will soon die from lack of food. Other pests will go elsewhere looking for food. Less pesticides means less toxins going into the food chain and soil and therefore less negative impacts.
- (ii) The cereal crops that are capable of nitrogen fixing will not need the extra fertiliser containing nitrogen as they already can receive the amount they need from a less damaging source. If the plants don’t need nitrogen to be supplied, they don’t need fertiliser therefore less fertiliser in the environment and less negative impact from it.

- (iii) GMOs could be used to make plants resistant to salt affected areas, so the once wasted cropland can again be used, or they can be given longer larger roots so they can get down into the water table and soak up all the water and release it back into the atmosphere so that the water table never rises and therefore neither does the salt resulting in no more salinity problems.
 - (iv) Many environmental activists believe you shouldn't play around with nature, everything is made for a reason, and if it can't survive that way then it shouldn't survive at all. They also feel that once you start messing with the genes of one thing, something else might eat it, and then its genes might be altered, and a whole race of monster organisms could be created, and no one will be able to stop them.
- (b)
- (i) Water pollution in Cooper Creek.
 - (ii) I tested various components of the water such as faecal coliforms, phosphorus and nitrogen levels as well as pH. I tested three different areas within the site once a week for three weeks.
 - (iii) Wet weather events have caused large fluctuations in the level of faecal coliforms in the water. However, according to ANZECC guidelines, all levels of faecal coliforms, phosphorus, nitrogen and pH can be considered acceptable in regards to primary contact and recreation. However, for the protection of aquatic life, the nitrogen and phosphorus levels are higher than acceptable levels.
 - (iv) Cooper Creek is one of the main tributaries to the Reed Catchment and the Burns River, the Burns River flows out into the Pacific Ocean. In this sense, water pollution is a global issue.
 - (v) The substances found in the water contributing to the high levels of phosphorus and nitrogen can be found in detergents. The act of washing a car on a street, rather than on the lawn, can significantly contribute to the chemical contamination of Cooper Creek. Cars should be washed on lawns instead of in streets and driveways. The use of fertilisers in the semi-rural areas adjacent to Cooper Creek also adds to nutrient levels in the water. Individuals can reduce the amount of fertilisers used to an absolute minimum and also install logs around the property to reduce the amount of nutrient carrying water that runs off the property.
- (c)
- (i) Greenhouse gases are gases which find their way up to the upper atmosphere and behave like glass ie this blanket of gas is transparent to UVB rays from the sun. When the shortwave radiation reached earth, it is absorbed and reemitted as long wave radiation (heat). This heat cannot pass through the blanket of greenhouse gases and heat is trapped in the atmosphere. This greenhouse effect contributes to global warming and the shifting of climatic zones all over the world. Global warming causes the oceans to warm and expand (as well as melting polar ice caps) which would raise the sea level and cause flooding of any low lying areas.

- (ii) 1 Economic – Australia insisted that reduction in the recent proposals would have a too significant impact on the Australian economy and that the economic situation took precedence over the environmental one.

Political – a marginal parliamentary seat has a high percentage of coal miners and workers. The reduction to the greenhouse gas emissions would mean less demand for fossil fuels such as coal and reducing the viability of coal mining operations. This would eventually mean unemployment in that marginal seat and voters being dissatisfied with their member's party's decision. The loss of the seat could occur.

- 2 Alternative energy sources such as solar, wind, tidal can allow power to be produced without the need to burn fossil fuels such as coal, oil and gas. However, the production of electricity from alternative sources is limited by the capital outlay required and the size of already existing competitors. This can be overcome by government assistance into alternative energy production through subsidies.