BOARD OF STUDIES
NEW SOUTH WALES

2006

HIGHER SCHOOL CERTIFICATE EXAMINATION

Senior Science

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using black or blue pen
- Draw diagrams using pencil
- Board-approved calculators may be used
- Write your Centre Number and Student Number at the top of pages 13, 17, 21 and 25

Total marks – 100

Section I Pages 2–25

75 marks

This section has two parts, Part A and Part B

Part A – 15 marks

- Attempt Questions 1–15
- Allow about 30 minutes for this part

Part B – 60 marks

- Attempt Questions 16–26
- Allow about 1 hour and 45 minutes for this part

Section II Pages 27–37

25 marks

- Attempt ONE question from Questions 27–31
- Allow about 45 minutes for this section

Section I
75 marks

Part A – 15 marks
Attempt Questions 1–15
Allow about 30 minutes for this part

Use the multiple-choice answer sheet.

Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

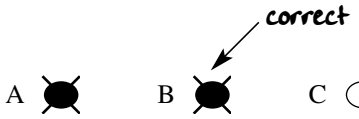
Sample: 2 + 4 = (A) 2 (B) 6 (C) 8 (D) 9

A ○ B ● C ○ D ○

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

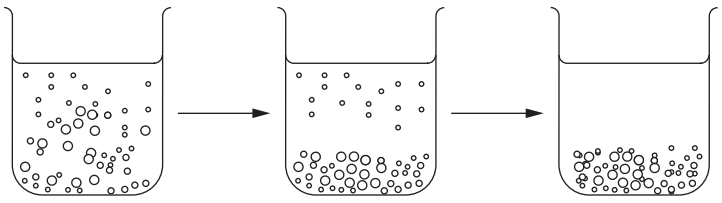
A ● B ⊗ C ○ D ○

If you change your mind and have crossed out what you consider to be the correct answer, then indicate the correct answer by writing the word **correct** and drawing an arrow as follows.



A ⊗ B ⊗ C ○ D ○

1 A student observed the appearance of a mixture for five minutes and recorded the following results.



Initial mixture After 1 minute After 5 minutes

From the results, what type of mixture was being observed?

(A) Colloid

(B) Solution

(C) Solvent

(D) Suspension

2 Which alternative correctly describes the conditions inside the named part of the digestive system?

	Part of digestive system	*pH*	*Acidity*
(A)	Stomach	Low	High
(B)	Small intestine	Low	High
(C)	Stomach	Low	Low
(D)	Small intestine	High	High

3 A student wished to determine whether a skin cosmetic was compatible with his skin. He tested both his skin and the cosmetic with different strips of pH test paper.

The range of colours and the pH at each colour are represented by the key. The results of the student's investigations are also given.

Key

pH	*Colour of pH test paper*
5	
6	
7	
8	
9	

Results of student's investigation

pH test paper after testing cosmetic

pH test paper after testing students skin

Which of the following would be the best conclusion the student could draw about the compatibility of the cosmetic with his skin?

(A) The cosmetic is compatible because it has the same pH as the student's skin.

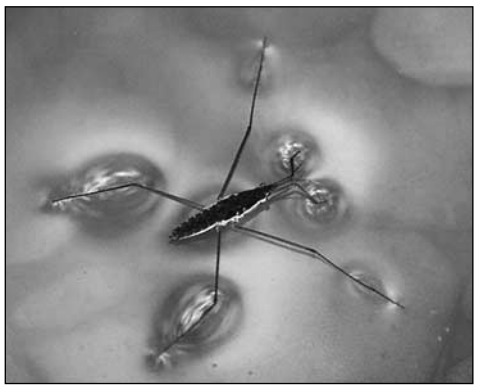
(B) The cosmetic is compatible because it has a higher pH than the student's skin.

(C) The cosmetic is incompatible because it has a lower pH than the student's skin.

(D) The cosmetic is incompatible because it has a higher pH than the student's skin.

4 Water striders are insects that can be observed to walk on water.

Water strider



Charles Schurch Lewallen

What happens to the insect when detergent is added to the water?

(A) It slips on the detergent.

(B) It sinks because of a decrease in the surface tension.

(C) It sinks because of an increase in the meniscus around its legs.

(D) It continues to walk on water because the surface tension does not change.

5 The use of cardio-pulmonary resuscitation (CPR) on an unconscious heart-attack patient can keep the person alive, even if the person's heart has ceased beating.

Which statement correctly compares the concentrations of gases in normal room air with those of the air breathed into the lungs of the patient?

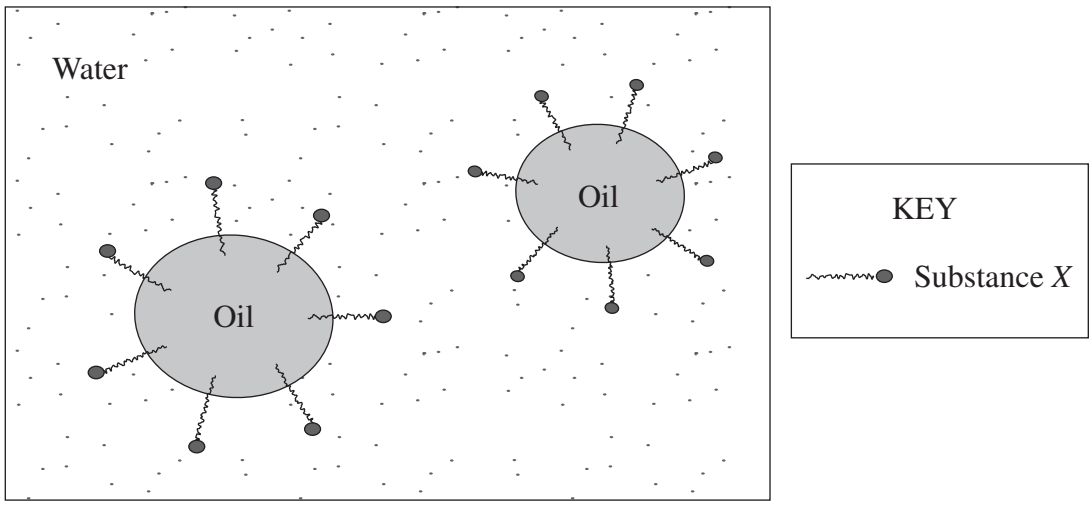
(A) In normal room air there is a lower concentration of oxygen.

(B) In normal room air there is a lower concentration of carbon dioxide.

(C) In normal room air there is a greater concentration of carbon dioxide.

(D) There is no difference in the concentrations of oxygen and carbon dioxide.

6 The diagram shows what happens when a mixture of water, oil and a third chemical substance, *X,* are shaken together.



Which alternative best describes the action of substance *X* in this mixture?

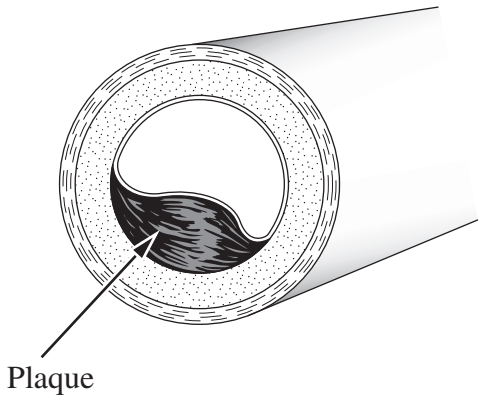
(A) It dissolves the oil.

(B) It lubricates the oil.

(C) It emulsifies the oil.

(D) It biodegrades the oil.

7 This diagram shows a common problem in human arteries.



Which of the following would be used to treat this condition?

(A) Angioplasty

(B) Artificial valve

(C) Magnetic resonance imaging

(D) Thermography

8 For which application is ultrahigh molecular weight polyethylene (UHMWPE) best suited?

(A) To make an artificial heart valve

(B) To make a replacement lens for the eye

(C) As a replacement for the synovial fluid in a joint

(D) As an alternative to cartilage on the surfaces of a ball-and-socket joint

9 What is the function of a heart pacemaker?

(A) To stimulate the arteries

(B) To produce a regular electrical impulse

(C) To prevent the blood from flowing in the wrong direction

(D) To increase the concentration of carbon dioxide in the blood

10 In summarising the types of joints in the human body, a student produced the following table. Two pieces of information are missing from the table; these are labelled *X* and *Y*.

Type of joint	*Movement allowed*	*Location in human body*
Ball-and-socket	*X*	Hip
Hinge	Movement in one plane only	*Y*
Double-hinge	Movement in two perpendicular planes	Base of thumb
Sliding	Movement in two perpendicular planes	Wrist bones
Pivot	Rotational movement	Part of elbow joint (radius-ulna joint)

Which correctly identifies *X* and *Y*?

(A) *X*: movement in two perpendicular planes
Y: knee

(B) *X*: movement in two perpendicular planes
Y: shoulder

(C) *X*: movement in one plane only
Y: knee

(D) *X*: movement in one plane only
Y: shoulder

11 When transmitting information as a series of ones and zeroes using digital technologies, a method is used to check that the information received is the same as the information transmitted.

In this method, extra bits, called parity bits, are added to the transmitted information.

A parity bit is set to 0 if the number of ones in four bits of the code is even, and to 1 if the number of ones is odd.

> For example,
> If the coded information is
> 1000 0000
> the added parity bits are
> 10

Which of the following would be the parity bits for the code 1001 1101?

(A) 23

(B) 11

(C) 01

(D) 10

12 During your study of Information Systems you performed a first-hand investigation to compare the quality of reception of AM and FM radio waves.

Which row in the table correctly identifies the independent variable, dependent variable and one controlled variable used in this investigation?

	Independent variable	*Dependent variable*	*Controlled variable*
(A)	Type of radio wave	Amount of static	Volume setting
(B)	Quality of reception	Type of radio wave	Distance from transmitter
(C)	Type of radio wave	Atmospheric conditions	Volume setting
(D)	Atmospheric conditions	Quality of reception	Type of radio wave

13 Mary in Melbourne had a telephone conversation with Sam in Sydney using land-connected telephones. The information travelled between the two cities through an optical fibre. Within each city, the information travelled through copper wires.

Which best summarises the energy transformations that resulted in the sound of Mary's voice being heard by Sam?

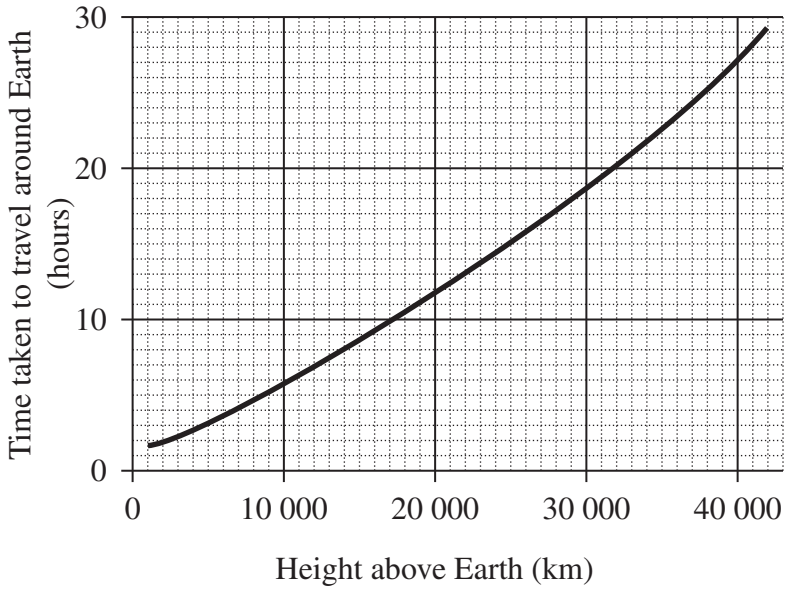
(A) sound → light → sound

(B) sound → electrical → sound

(C) sound → electrical → light → electrical → sound

(D) sound → electromagnetic radiation → light → electromagnetic radiation → sound

14 The graph shows the relationship between the time taken for satellites to travel around Earth and their height above Earth.



Which statement best applies to a satellite at a height of 20 000 km?

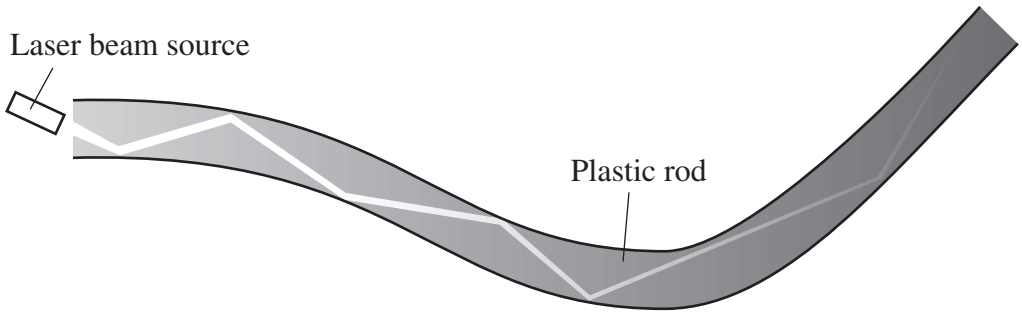
(A) The time it takes to travel around Earth would be suitable for a geostationary satellite.

(B) Its height above Earth would need to be greater if it were going to be used as a geostationary satellite.

(C) Its height above Earth would need to be less if it were going to be used as a geostationary satellite.

(D) The time it takes to travel around Earth is double the time taken by a geostationary satellite.

15 This diagram accurately represents a photograph of a bent, solid, transparent plastic rod approximately 30 cm in length. A laser beam was shone in the end of the rod at the left. The path of the beam is visible through the rod. This can be used to demonstrate the transmission of light through an optical fibre.



Which alternative contains TWO observations that can be made from this diagram?

(A) The rod must not be bent too much and light can travel through the rod in both directions.

(B) Total internal reflection takes place in the fibre and the beam becomes more faint as it travels through the rod.

(C) Some of the light passes through the sides of the fibre and the speed of light becomes slower the further it travels through the plastic rod.

(D) The angle of reflection is not always equal to the angle of incidence and the light reflects from the sides more often when it is closer to the source.

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Senior Science

Centre Number

Student Number

Section I (continued)

Part B – 60 marks
Attempt Questions 16–26
Allow about 1 hour and 45 minutes for this part

Answer the questions in the spaces provided.

Marks

Question 16 (3 marks)

A wide range of cleaning products contain surfactants.

(a) Define *surfactant*. **1**

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(b) Explain the role of emulsifying agents used in cleaning products. **2**

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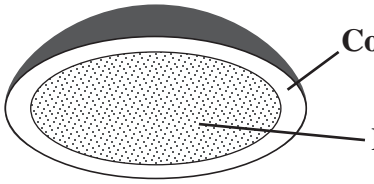
Marks

Question 17 (6 marks)

Read the information about enteric-coated tablets.

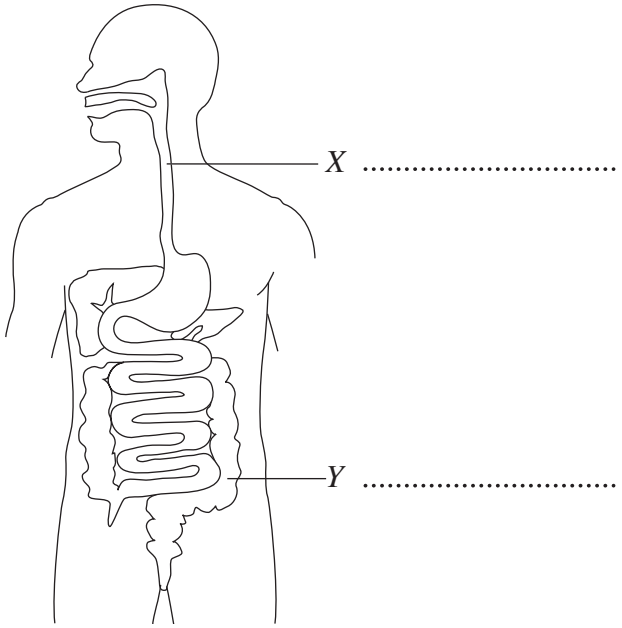
Cross-section of an enteric-coated tablet



Coating – breaks down rapidly at a pH greater than 6.0
– breaks down slowly at a pH lower than 5.0

Drug – destroyed by acid

(a) (i) Identify the parts of the digestive system labelled *X* and *Y*. **2**



(ii) On the diagram, draw the path taken by the enteric-coated tablet from the mouth to the part of the digestive system where most of the drug is absorbed. **1**

(b) Identify the site of absorption of the drug, and justify your choice. **3**

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Marks

Question 18 (6 marks)

(a) (i) Identify a vitamin that dissolves in water. **1**

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(ii) Identify an external medication in which alcohol is the solvent. **1**

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(b) Explain why knowledge of the solubility of materials is important to the way medications are administered. **4**

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Marks

Question 19 (5 marks)

You carried out a first-hand investigation to make two colloids using eggs.

(a) Recount how you made these two colloids. **3**

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(b) Use labelled diagrams to contrast the arrangement of the components in each of these colloids. **2**

Marks

Question 20 (5 marks)

Discuss the positive impacts on society of the development of biomaterials and biomedical devices. **5**

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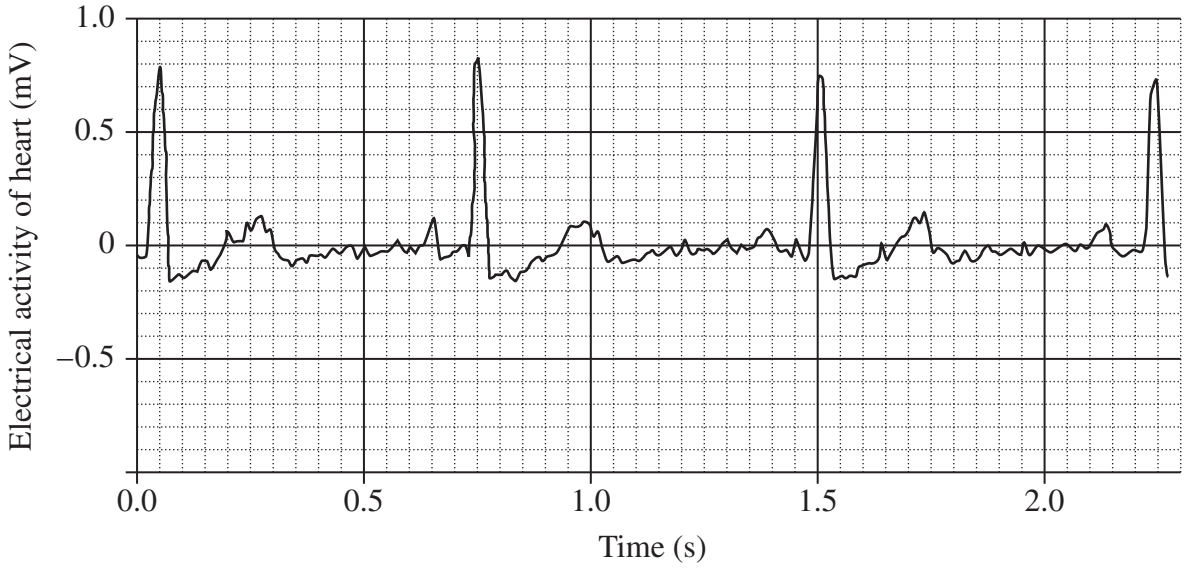
Marks

Question 21 (7 marks)

A voltage sensor for measuring the electrical activity of the heart was connected to a data logger. The electrodes from the sensor were connected to a student, and the electrical activity of her heart was recorded after she had been resting for an hour. This graph of her heart activity was obtained.



(a) Using the peaks greater than 0.5 mV, calculate the average time taken per heartbeat. (Show all working.) **2**

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(b) The peaks greater than 0.5 mV are produced by the electrical activity of the ventricles of the heart. **2**

Describe the functions of the left and right ventricles.

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Question 21 continues on page 19

Marks

Question 21 (continued)

(c) If the student exercised vigorously for five minutes before more measurements of her heart activity were taken, the height of the peaks in the graph may vary slightly. **1**

Predict another difference that would be observed in the graph of her heart activity obtained immediately after the student exercised.

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(d) Explain why vigorous exercise produces a change in the activity of the heart. **2**

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End of Question 21

Please turn over

Marks

Question 22 (8 marks)

Researchers at a biomaterials laboratory have developed a new plastic called plaso-SK3.

Two students thought that plaso-SK3 would dissolve more quickly in acid than in water.

(a) Design a first-hand investigation that the students could safely perform to test this hypothesis. **6**

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(b) Explain ONE benefit of the students' working together to test their hypothesis. **2**

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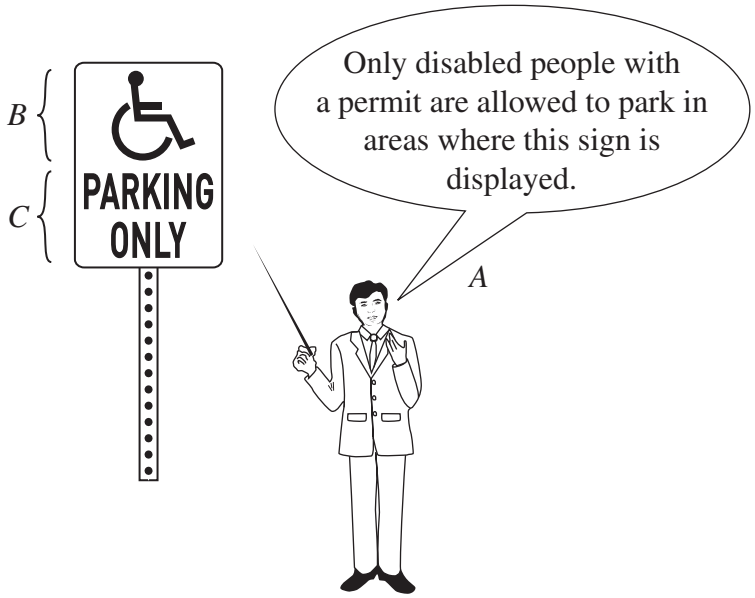
Marks

Question 23 (3 marks)

This question refers to the cartoon below. **3**



Two students discussing the forms of communication in this cartoon correctly identify that the information labelled *C* is a verbal form of communication.

Draw a table to classify the information identified by the letters *A* and *B* in this cartoon as verbal or non-verbal.

End of Question 23

Question 24 (6 marks)

In August 2005, hurricane Katrina, a severe storm, struck New Orleans, a major city in the southern United States of America. After the hurricane, satellite phone sales increased, as reported in this newspaper article.

Satellite Phone Sales Boom

In the days and weeks following hurricane Katrina sales of satellite phones have rocketed. A satellite phone company representative said that the number of phones sold in the month following the storm was more than 2000, compared to the normal monthly number of sales of around 20.

Coordination of rescue efforts was frustrated by the inability to communicate. Many telephones, including most mobile phones, were not working due to line breaks, destruction of base stations, or power failures. In a number of cases, reporters were asked to brief public officials on the conditions in areas where information was not reaching them any other way.

Amateur radio operators provided some emergency communications as well as helping to answer health and welfare enquiries.

All local television stations were disrupted, but the news crews moved quickly to locations in nearby cities. Local newspaper producers closed down. Broadcasting and publishing on the Internet became an important means of distributing information to evacuees and the rest of the world.

Satellite phones send communications signals direct to satellites orbiting the Earth. These signals are re-transmitted to ground-based stations, which may be up to thousands of kilometres from the satellite phone. The ground-based stations are connected to mobile and land-connected telephone systems.

Question 24 continues on page 23

Marks

Question 24 (continued)

(a) With reference to the newspaper article, discuss the advantages of using a range of information systems. **4**

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(b) Propose reasons why employees of a company searching for minerals in remote areas of central Australia must use satellite phones to make telephone contact with their head office in Sydney. **2**

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End of Question 24

Marks

Question 25 (4 marks)

The photograph shows a satellite dish on a house in Australia. This dish points upward, in a northerly direction. It receives signals from a satellite orbiting Earth.

(a) Identify ONE satellite used to transmit live telecasts to Australia. **1**

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(b) Outline ONE reason a communication satellite would have a number of different aerials. **1**

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(c) Relate the fixed direction of the satellite dish to the direction in which the satellite orbits Earth. **2**

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Centre Number

Student Number

Section I – Part B (continued)

Marks

Question 26 (7 marks)

Technological advances have enabled human communication to change from methods that were mainly used over short distances, to a range of systems that allows worldwide communication to occur. **7**

Analyse the relationship between the development of worldwide communication systems and the changes that these systems have produced in society.

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Senior Science

Section II

25 marks
Attempt ONE question from Questions 27–31
Allow about 45 minutes for this section

Answer the question in a writing booklet. Extra writing booklets are available.

		Pages
Question 27	Polymers	28–29
Question 28	Preservatives and Additives	30
Question 29	Pharmaceuticals	31–32
Question 30	Disasters	33–35
Question 31	Space Science	36–37

Marks

Question 27 — Polymers (25 marks)

(a) Synthetic polymers have different uses based on their properties.

(i) Identify ONE petrochemical source from which synthetic chemicals are made. **1**

(ii) Identify a synthetic polymer, and relate its use to a property of the polymer. **3**

(b) A group of students carried out an investigation at home to determine which natural fibre would absorb the most water.

The students completed a report on their investigation.

Absorbency of Natural Fibres

Aim

To compare the mass of water absorbed by cloths made from different natural fibres.

Procedure

(1) Three pieces of cloth, each the same size, were cut; one of them from a woollen jumper, one from a cotton place-mat and the third from a silk tie.

(2) Kitchen scales were used to measure the mass of the cloth made of wool.

(3) This mass was recorded in a table.

(4) The woollen cloth was soaked in water.

(5) Any excess water from the woollen cloth was gently squeezed out.

(6) The same kitchen scales were used to measure the mass of the woollen cloth and the absorbed water.

(7) The mass of the cloth and absorbed water was recorded in the results table.

(8) The mass of water absorbed by the cloth was calculated.

(9) The procedure was repeated using the cotton and silk cloths.

Results

Cloth	*Size of cloth* (cm × cm)	*Mass of cloth* (g)	*Mass of cloth and absorbed water* (g)
Wool	10 × 10	25	40
Cotton	10 × 10	50	190
Silk	10 × 10	30	70

Conclusion

Cloth made from cotton is the most absorbent and cloth made from wool is the least absorbent.

Question 27 continues on page 29

Question 27 (continued)

(i) Explain ONE way the students could have improved the accuracy of their measurements. **2**

(ii) Evaluate the validity of the students' conclusion. **4**

(c) Assess the impacts of the use of plastics on society and the environment. **7**

(d) The Student Representative Council of a school believed that too much plastic was being thrown away by the students and teachers.

(i) Outline a procedure to safely determine the amount of plastic material being thrown away. **4**

(ii) Describe the coding system developed by industry to identify plastics, and explain how this system aids the recycling of plastics. **4**

End of Question 27

Marks

Question 28 — Preservatives and Additives (25 marks)

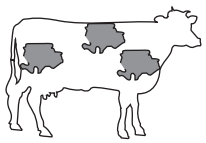
(a) Food additives are substances that can be added to food products to achieve a specific purpose. Sometimes they have more than one effect.

(i) Identify ONE food additive. **1**

(ii) Identify a different food additive, outline its specific purpose and identify another effect of this additive. **3**

(b) This label was taken from a bottle of cream.

UHT
THICKENED CREAM



NO PRESERVATIVES ADDED

INGREDIENTS: Cream, Milk solids, Emulsifiers (322, 401, 410, 412, 415, 433, 450, 471), Sucrose

Milk Fat – 35%

Contains Soy Lecithin

(i) Outline THREE reasons for using codes on this label. **3**

(ii) Explain why there is no need to add preservatives to this product. **3**

(c) Analyse how food preservation techniques have changed with our increased understanding of food spoilage. **7**

(d) (i) Solubility is an important chemical property. Outline a procedure to safely compare the solubility of nitrates and nitrites. **4**

(ii) Explain the ways in which microbial contamination risks can be minimised during the preparation of food. **4**

End of Question 28

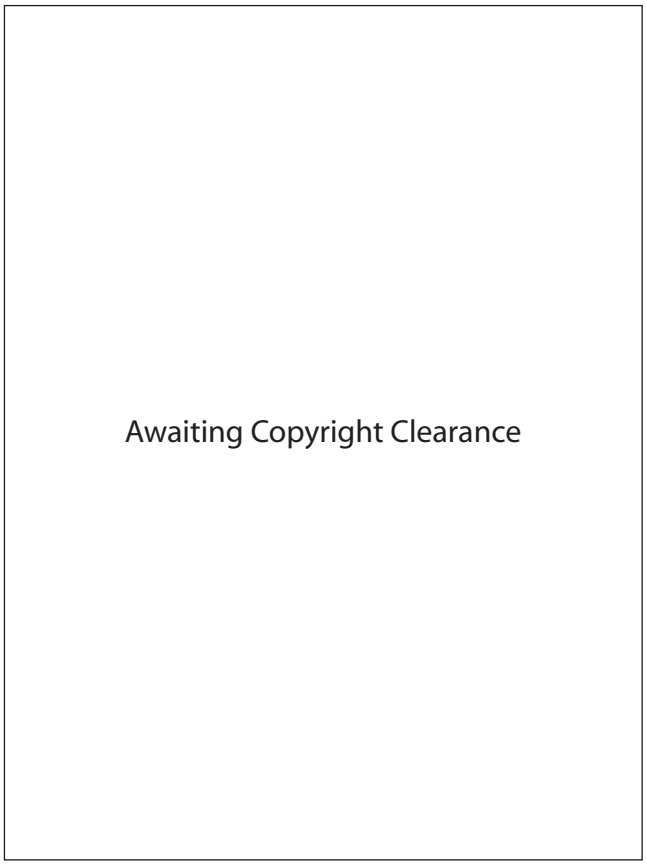
Marks

Question 29 — Pharmaceuticals (25 marks)

(a) (i) Identify ONE component of the central nervous system. **1**

(ii) Compare the responses of muscles and glands as effectors. **3**

(b) (i) The diagram shows a blood vessel network in the body. **3**



Identify the type of blood vessel labelled *X* in this diagram. Describe TWO differences between this blood vessel and capillaries.

(ii) Account for the advantage of using the circulatory system to transport pharmaceuticals around the body. **3**

Question 29 continues on page 32

Question 29 (continued)

(c) Explain the action of aspirin, and assess its impacts on society. **7**

(d) (i) Identify TWO antibiotics, other than penicillin, and the mode of action of each antibiotic. **4**

(ii) In your study of Pharmaceuticals you planned and performed a first-hand investigation to culture bacteria at different temperatures. **4**

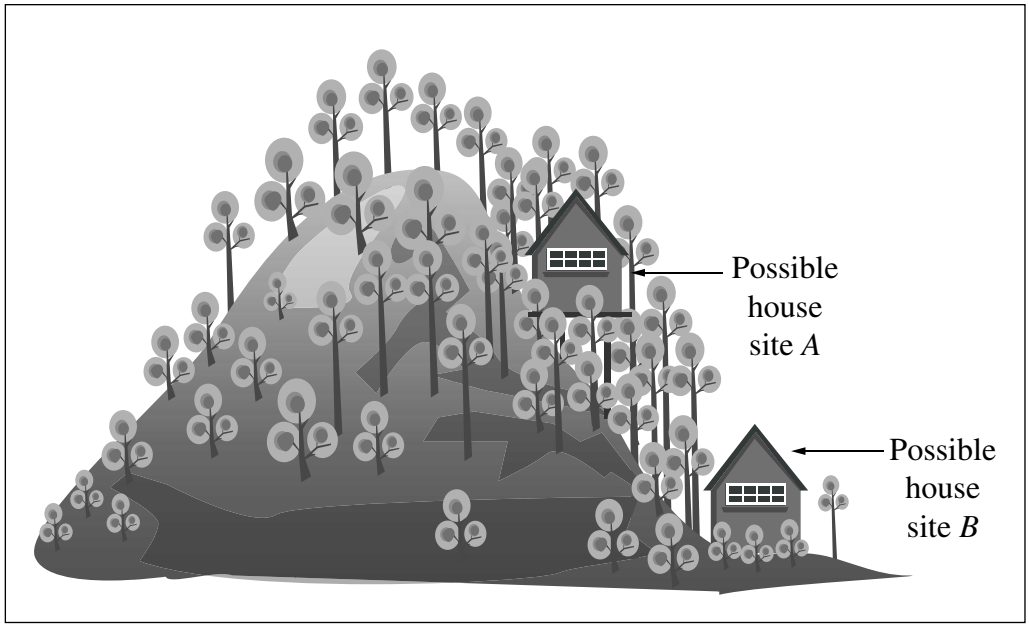
Analyse the risks involved in culturing bacteria from your surroundings.

End of Question 29

Marks

Question 30 — Disasters (25 marks)

(a) John wished to build a house on his new bushland property, at a site with the least risk from bushfire. This is a sketch John made to consider two possible house sites.



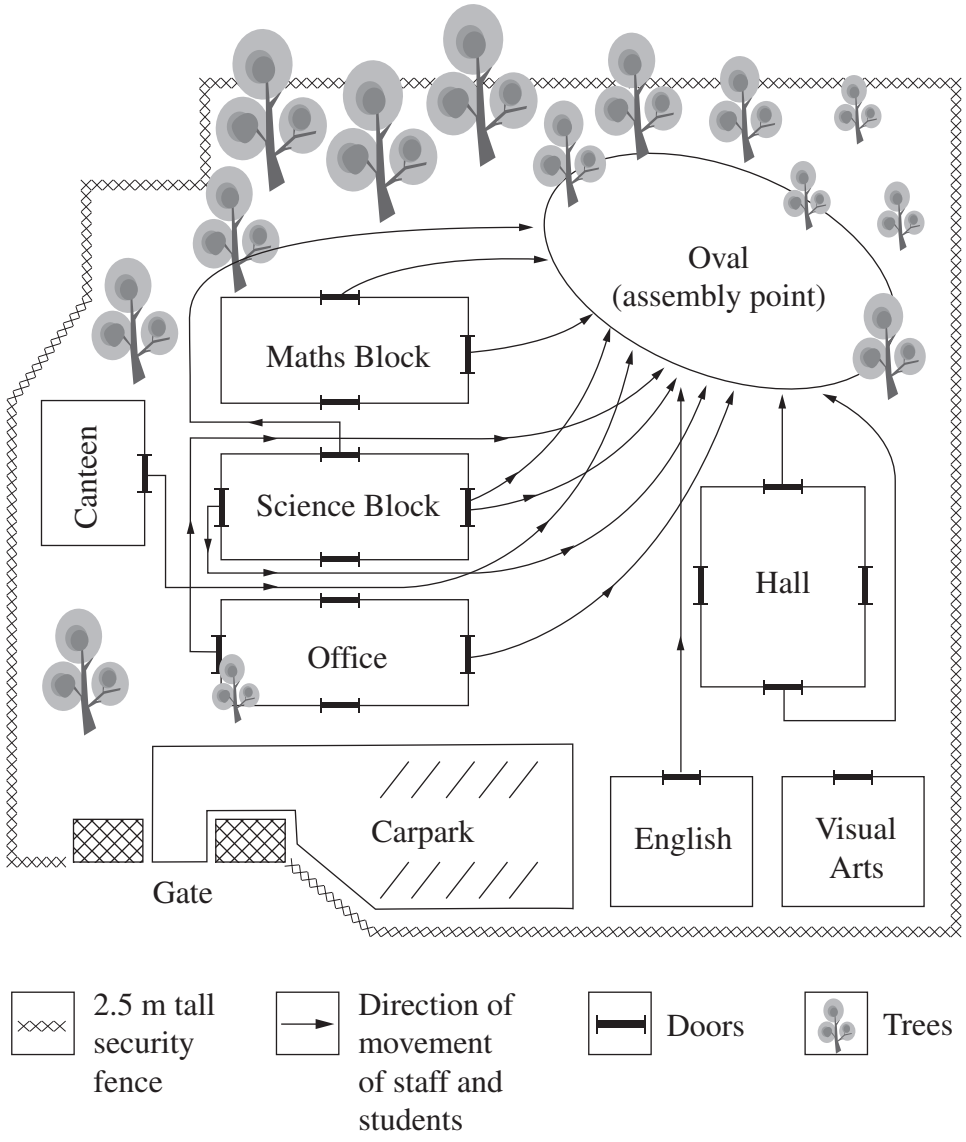
(i) Identify ONE factor that can affect the speed of a bushfire approaching John's house if he built it at site *A*. **1**

(ii) John decided to build his house at site *B*. Explain precautions John could undertake to reduce the risk to his house. **3**

Question 30 continues on page 34

Question 30 (continued)

(b) The diagram shows the plan of evacuation procedures for a school in case of fire.



(i) Name an evacuation warning device appropriate for this school. **1**

(ii) Evaluate the effectiveness of this plan. **5**

(c) Technological developments have increased the ability of humans to predict the time, place and magnitude of disasters. **7**

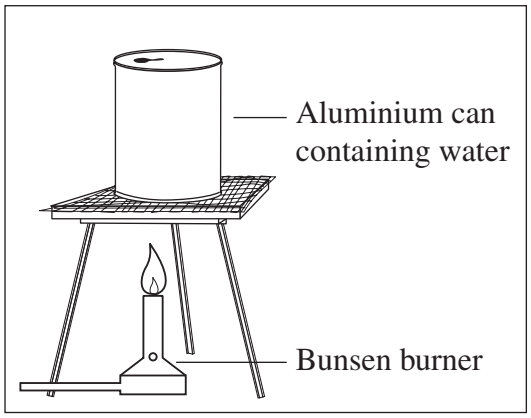
Assess the effectiveness of these developments.

Question 30 continues on page 35

Question 30 (continued)

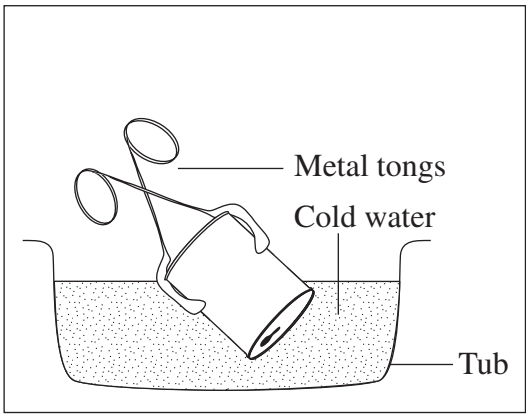
(d) Below is a student's description of an investigation carried out to demonstrate an effect of differences in air pressure.

Figure 1



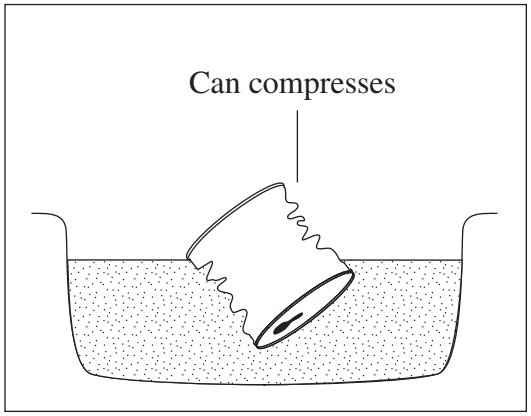
Aluminium can with water was heated over a Bunsen burner until the water boiled.

Figure 2



The can was then submerged in a tub of cold water.

Results



(i) Account for ONE safety precaution a student should follow when carrying out this investigation. **2**

(ii) Explain why the aluminium can compresses. **3**

(iii) Describe the role that differences in atmospheric pressure play in the formation of winds associated with tropical cyclones. **3**

End of Question 30

Marks

Question 31 — Space Science (25 marks)

(a) (i) Identify ONE space station that has been put into orbit around Earth. **1**

(ii) Outline how scientists have met THREE requirements needed to sustain human life for several months in a space station. **3**

(b) The following images show astronomical telescopes located in different parts of New South Wales.

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(i) Identify the type of telescope found at Siding Spring and account for its location. **3**

(ii) Compare the type of information gathered by the Narrabri telescope array with that from the telescopes at Siding Spring. **3**

Question 31 continues on page 37

Question 31 (continued)

(c) Evaluate Australia's involvement in astronomy and space exploration. Refer to specific examples in your answer. **7**

(d) (i) Identify TWO biological effects on humans, other than loss of muscle tone, related to long space missions. **2**

(ii) Explain exercises astronauts could use to maintain muscle tone during long space missions. In your answer, identify the muscle groups that benefit most from each type of exercise described. **6**

End of paper

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