BOARD OF STUDIES
NEW SOUTH WALES

2011

HIGHER SCHOOL CERTIFICATE EXAMINATION

Senior Science

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using black or blue pen
  Black pen is preferred
- Draw diagrams using pencil
- Board-approved calculators may be used
- Write your Centre Number and Student Number at the top of pages 9, 11, 13, 15 and 17

Total marks – 100

Section I Pages 2–18

75 marks

This section has two parts, Part A and Part B

Part A – 20 marks

- Attempt Questions 1–20
- Allow about 35 minutes for this part

Part B – 55 marks

- Attempt Questions 21–30
- Allow about 1 hour and 40 minutes for this part

Section II Pages 19–30

25 marks

- Attempt ONE question from Questions 31–35
- Allow about 45 minutes for this section

Section I
75 marks

Part A – 20 marks
Attempt Questions 1–20
Allow about 35 minutes for this part

Use the multiple-choice answer sheet for Questions 1–20.

---

1 What is the role of cartilage in synovial joints?

(A) To lubricate the joint

(B) To give shape to the joint

(C) To act as a shock absorber

(D) To join two bones together

2 A specific diagnostic technique was used to make the image of the chest region shown.

What is an advantage of this diagnostic technique?

(A) It does not require surgery.

(B) It allows doctors to see soft tissue.

(C) It allows doctors to see blood flow.

(D) It gives the patient a mild dose of radiation.

3 Which of the following correctly relates the biomaterial to the biomedical device?

	Biomaterial	*Biomedical device*
(A)	Ceramic	Artificial finger joint
(B)	Teflon®	Artificial hip joint
(C)	Pyrolytic carbon	Artificial valve
(D)	Silicone	Crown for a tooth

4 Which of the following correctly classifies the three mixtures?

	Salad dressing	*Whisked eggs*	*Mayonnaise*
(A)	Foam	Foam	Suspension
(B)	Foam	Emulsion	Suspension
(C)	Suspension	Foam	Emulsion
(D)	Suspension	Emulsion	Emulsion

5 Which of the following identifies two safety precautions that should always be followed when using solvents?

(A) Wear gloves and keep solvents away from naked flames.

(B) Use a face mask and keep solvents out of the reach of children.

(C) Keep solvents away from naked flames and ensure good ventilation.

(D) Keep solvents out of the reach of children and only use them outdoors.

6 A heart medication has a coating which breaks down in acidic conditions.

In which part of the digestive system will the coating break down?

(A) Mouth

(B) Stomach

(C) Small intestine

(D) Large intestine

7 What is the role of natural microflora found on the surface of human skin?

(A) To release pleasant odours

(B) To keep the skin soft and flexible

(C) To engulf bacteria which cause disease

(D) To help to maintain a slightly acidic pH

8 Which feature of the lungs allows for the efficient exchange of gases?

(A) The lungs are small and dense.

(B) The alveoli are round and spongy.

(C) The alveoli are moist, thin and have a large surface area.

(D) The lungs are surrounded by an extensive network of veins.

9 Why are humectants, such as glycerine, used in body soaps?

(A) To make the soaps pH neutral

(B) To inhibit the growth of bacteria

(C) To make the soaps smell pleasant

(D) To prevent the soaps from drying out

10 Which type of coding is used to store musical information on a CD?

(A) Analogue

(B) Digital

(C) AM

(D) FM

11 Which of the following technological advances has contributed to the development of pacemakers?

(A) Increased battery life

(B) The development of Teflon®

(C) Improved cholesterol-lowering drugs

(D) The development of angioplasty techniques

12 A new type of fibre-optic cable was developed to transfer data. A student designed an experiment to determine whether the new cable improved the data transfer rate.

What would be the controlled variable in the experiment?

(A) The amount of data transferred

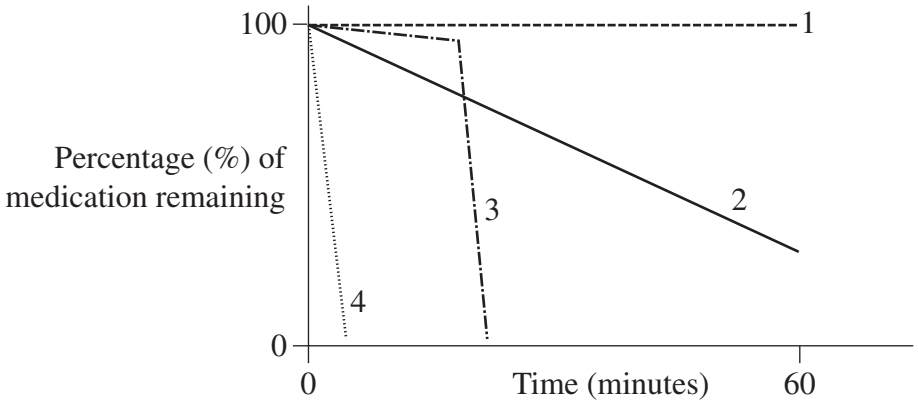
(B) The old type of fibre optic cable

(C) The repetition of the experiment

(D) The new type of fibre optic cable

Use the information provided and the graph shown to answer Questions 13–14.

A student added four different types of medication to 200 mL of water: a tablet, a slow-release tablet, an enteric-coated tablet and a capsule. The amount of tablet or capsule remaining after each minute was measured and calculated as a percentage. A graph of the results is shown.



13 Which line on the graph shows the results for the enteric-coated tablet?

(A) 1

(B) 2

(C) 3

(D) 4

14 What is the dependent variable?

(A) pH of solvent

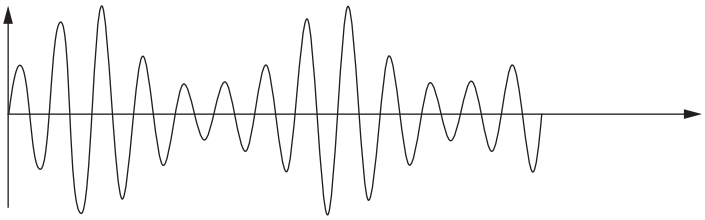
(B) Amount of water

(C) Type of medication

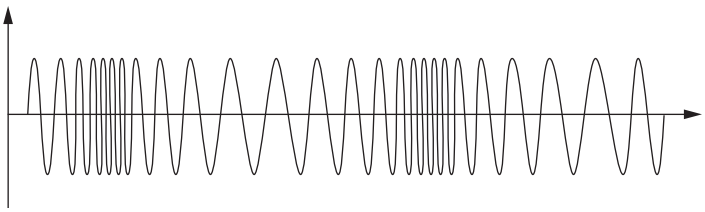
(D) Percentage of medication remaining

15 Which graph shows an amplitude modulated (AM) wave?

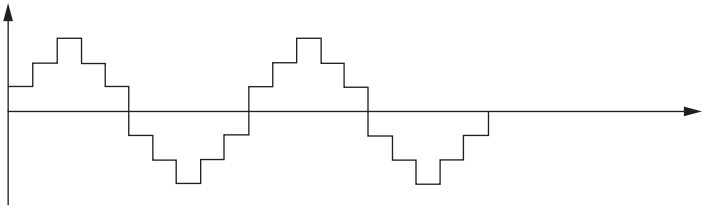
(A)



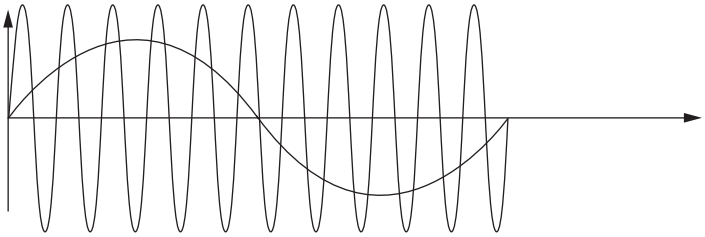
(B)



(C)



(D)



16 A student observes that the satellite dishes on two houses next to each other point in two different fixed directions.

Which statement is consistent with this observation?

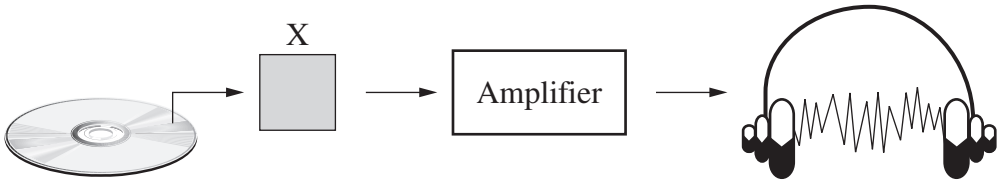
(A) One satellite dish is for sending signals and the other is for receiving signals.

(B) The satellite dishes point toward satellites above different parts of the equator.

(C) The satellite dishes rotate to track satellites orbiting above the equator.

(D) One satellite dish is pointing at a geostationary satellite and the other is pointing at a low Earth-orbiting satellite.

17 The diagram shows parts of the system used when listening to music from a CD.



What is the energy transformation that takes place at X?

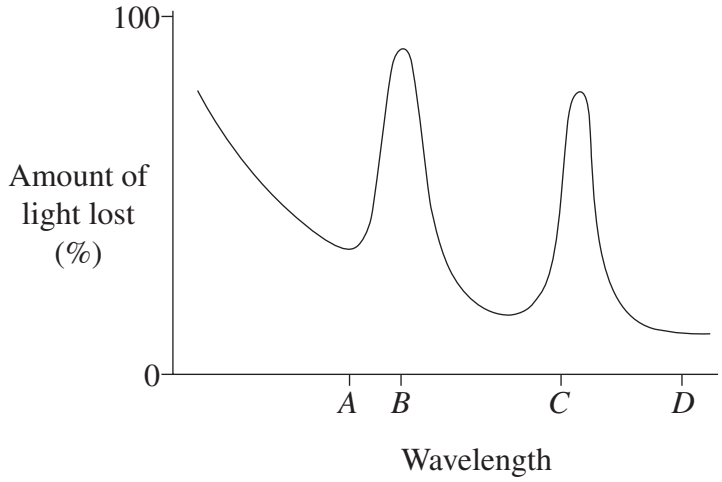
(A) Digital to sound

(B) Light to electrical

(C) Sound to electrical

(D) Microwaves to sound

18 An optical fibre allows most of the light that it carries to pass through it. However, some of the light is lost as it travels through the fibre. The graph shows the relationship between the amount of light lost and the wavelength of the light.



Which wavelength is best for transmitting light through this optical fibre?

(A) *A*

(B) *B*

(C) *C*

(D) *D*

19 Glass can be used in optical fibres because of its refractive index. The refractive index of a medium is calculated using the formula shown.

$$\text{Refractive index} = \frac{\text{Speed of light in a vacuum}}{\text{Speed of light in the medium to be tested}}$$

Medium	*Speed of light* (km/s)
Glass	200 000
Air	299 910
Vacuum	300 000

What is the refractive index of glass?

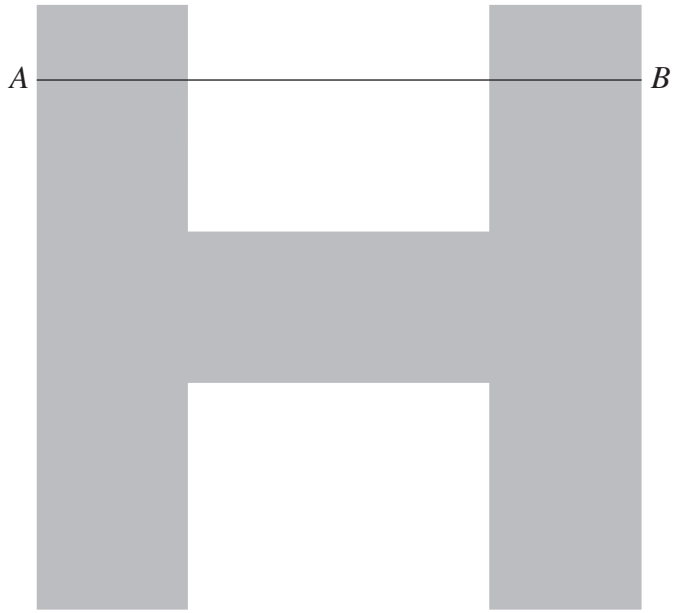
(A) 0.67

(B) 0.9997

(C) 1.0003

(D) 1.5

20 The line *AB* represents a part of the process of scanning the letter 'H' by a fax machine.



Which digital code best represents the part of the letter 'H' scanned along the line *AB*?

(A) 11000011

(B) 11100111

(C) 11011

(D) 101

Centre Number

Student Number

Section I (continued)

Part B – 55 marks
Attempt Questions 21–30
Allow about 1 hour and 40 minutes for this part

Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.

Question 21 (4 marks)

(a) Other than its biocompatibility, why is UHMWPE suitable for use in a hip joint? **2**

.....

.....

.....

(b) A teenager had a hip replacement. The implant was not cemented in. **2**

Justify the decision to use an uncemented implant.

.....

.....

.....

.....

.....

.....

Question 22 (3 marks)

Tablets and subdermal implants are two methods of administering medication. **3**

Propose advantages for each of these methods.

.....

.....

.....

.....

.....

.....

.....

.....

Question 23 (4 marks)

Justify the use of microwaves for communication using satellites. **4**

.....

.....

.....

.....

.....

.....

.....

.....

Question 24 (7 marks)

The manufacturer of *Bubbles Liquid Soap* claims its product is slightly acidic.

(a) Propose a method to test this claim. **4**

.....

.....

.....

.....

.....

.....

.....

.....

(b) The result of a valid experiment determined that this soap had a pH of 7. **2**

Explain whether the manufacturer is making a valid claim.

.....

.....

.....

.....

(c) This manufacturer also claims that *Bubbles Liquid Soap* makes the skin more beautiful. **1**

Outline the difficulty of testing this claim.

.....

.....

BLANK PAGE

Question 25 (7 marks)

(a) How can a build-up of plaque in the walls of blood vessels cause a heart attack? **2**

.....

.....

.....

.....

(b) Describe ways in which plaque in blood vessels can be eliminated or altered. **3**

.....

.....

.....

.....

.....

.....

(c) One method of determining the reliability of the information about heart disease is to check the consistency of the information from different sources. **2**

What other methods could be used to ensure that the information from secondary sources is reliable?

.....

.....

.....

.....

Question 26 (7 marks)

The information provided is a summary of the history of the mobile phone.

> In 2009, advances in mobile phone technology made it possible to make voice calls using internet connections. This was the beginning of the 4G network. In 1946 Swedish police began using wireless phones. However, it was not until 1979 that the system called 1G allowed people to use phones anywhere in a city. In 1991 the 2G network started in Finland. It allowed text messages to be sent. Ten years later, the 3G network brought the streaming of radio, TV and MMS to mobile phones.

(a) Draw a timeline showing these events. **3**

(b) Assess the impact that the use of mobile phones has on society. **4**

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Question 27 (6 marks)

(a) Outline ONE verbal and ONE non-verbal form of communication that can be transmitted over long distances. **2**

.....

.....

.....

(b) What are the energy transformations and applications of TWO information systems? **4**

.....

.....

.....

.....

.....

.....

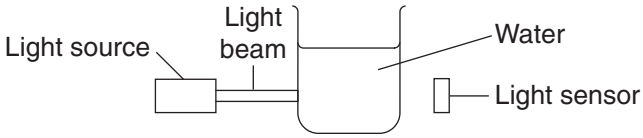
.....

.....

.....

Question 28 (6 marks)

The apparatus shown was used to investigate a process that takes place in a mixture.



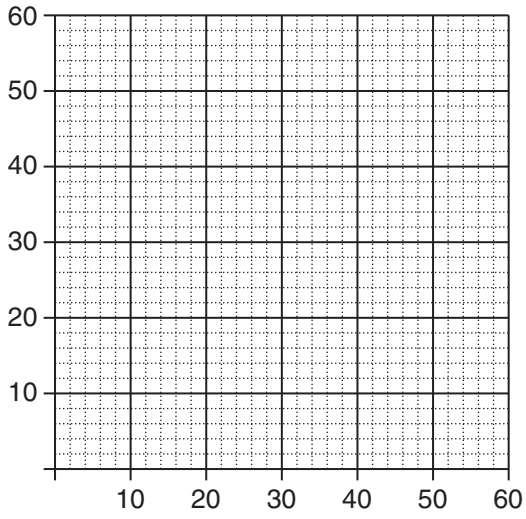
Light was transmitted through a beaker of water. The intensity of the light was measured and found to be 50 units.

A teaspoon of a solid chemical was then stirred into the water. The light intensity was measured again over a period of 50 minutes. The results are shown in the following table.

Time (minutes)	0	10	20	40	50
Light intensity (units)	5	20	30	43	45

(a) Draw a graph to show the relationship between time and light intensity in this investigation. **3**

Change in light intensity with time



(b) What type of mixture could account for these results? Justify your answer. **3**

.....

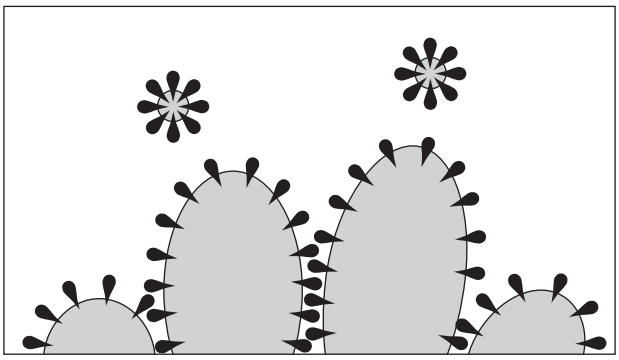
.....

.....

.....

Question 29 (3 marks)

The diagram represents a part of the process by which an emulsion is formed. **3**



Explain the formation of an emulsion with reference to the diagram.

.....

.....

.....

.....

.....

.....

Question 30 (8 marks)

How has an understanding of how the body works contributed to the development of biomedical devices? Use examples to support your answer. **8**

Senior Science

Section II

25 marks
Attempt ONE question from Questions 31–35
Allow about 45 minutes for this section

Answer parts (a)–(c) of the question in Section II Answer Booklet 1.
Answer the remaining parts of the question in Section II Answer Booklet 2.
Extra writing booklets are available.

Question 31 — Polymers (25 marks)

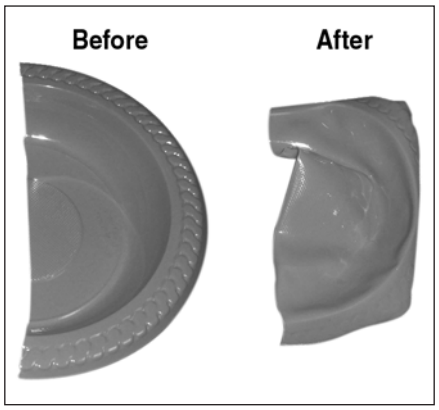
Answer parts (a)–(c) in Section II Answer Booklet 1.

(a) (i) Define the term *synthetic polymer*. **1**

(ii) Compare and contrast polystyrene with polyethylene. **3**

(b) A manufacturer of a plastic plate claims its plastic is totally recyclable. An experiment was carried out to see the effect of boiling water on the plastic.

The photograph shows part of a plastic plate before and after it was placed in boiling water for 10 minutes.



Evaluate this manufacturer's claim that this plastic is totally recyclable. **4**

(c) (i) What are the steps taken to make a natural polymer? **2**

(ii) The table compares properties of different polymers. **3**

Polymer	*Strength*	*Cost*	*Ability of material to maintain its shape after stretching*
Spectra®	High	High	Moderate
Kevlar®	High	High	High
PVC	Low	Low	Low
Lycra®	Low	Low	High

Which of these polymers would be most suitable to use for the frame of a mountain bike? Justify your choice.

Question 31 continues on page 21

Question 31 (continued)

Answer parts (d)–(e) in Section II Answer Booklet 2.

(d) The widespread use of plastics for kitchen items began around 1950. Prior to this, most kitchen items were made of wood and metal.

(i) How has the use of plastics been beneficial for society? **2**

(ii) In terms of biodegradability, compare and contrast kitchen items made before and after 1950. **3**

(e) Polymer science has developed products over the last 50 years that provide many benefits to society, but also create their own problems. **7**

Explain how problems associated with these products have been minimised or eliminated.

End of Question 31

Question 32 — Preservatives and Additives (25 marks)

Answer parts (a)–(c) in Section II Answer Booklet 1.

(a) (i) Identify TWO additives specifically used to increase shelf life. **1**

(ii) How do TWO physical preservation techniques increase the shelf life of food? **3**

(b) Justify the use of additives in foods for THREE purposes other than for preservation. **4**

(c) Students investigated the effect of temperature on the growth of microorganisms. They conducted an experiment to grow mould on pieces of bread. At the end of the experiment they recorded the following results.

Bread sample	*Temperature* (°C)	*Water* (mL)	*Percentage of bread covered by mould* (%)
1	0	0	0
2	5	2	20
3	25	4	12
4	65	6	0

(i) Calculate the change in the dependent variable when the quantity of water changes from 2 to 4 mL. Show your working. **2**

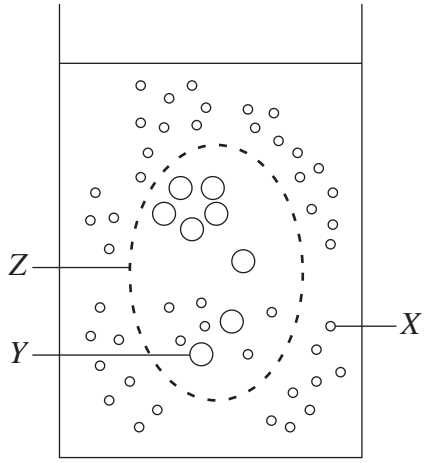
(ii) Propose THREE improvements to the experimental design of this investigation that would produce valid results. **3**

Question 32 continues on page 23

Question 32 (continued)

Answer parts (d)–(e) in Section II Answer Booklet 2.

(d) The diagram shows a model of osmosis.



(i) Identify components *X*, *Y* and *Z*. **2**

(ii) Explain the process of osmosis with reference to this model. **3**

(e) Explain how an understanding of food spoilage has influenced government regulation of labelling in the food industry. **7**

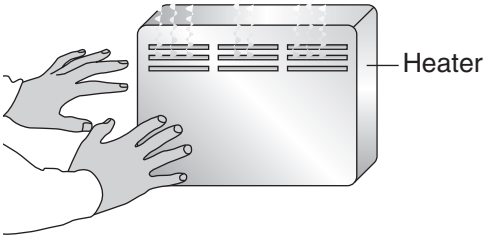
End of Question 32

Question 33 — Pharmaceuticals (25 marks)

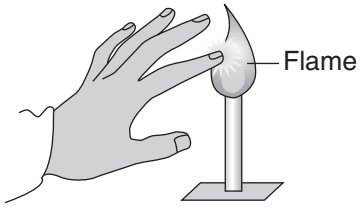
Answer parts (a)–(c) in Section II Answer Booklet 1.

(a) (i) Identify TWO components of the central nervous system. **1**

(ii) Compare and contrast the nerve pathways in the following TWO situations. **3**



Person warming hands



Finger in Bunsen flame

(b) Analyse the role of the circulatory system in transporting pharmaceutical substances around the body. **4**

(c) (i) Outline the effect of ONE variable on the rate of reproduction of bacteria. **2**

(ii) The table shows the time taken for population numbers of two different bacteria to double.

	Bacteria X	*Bacteria Y*
Time for population to double in number	20 minutes	16 hours

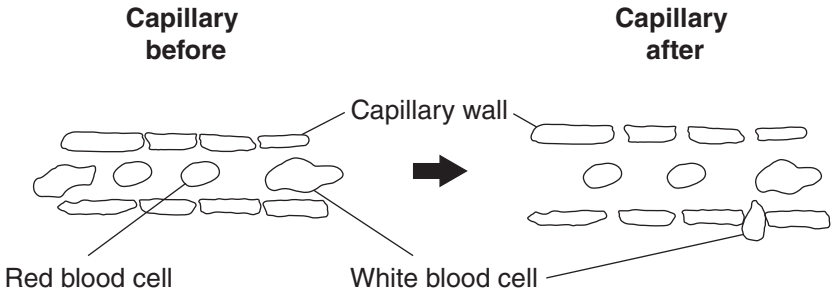
Why is penicillin effective against *Bacteria X* but not against *Bacteria Y*? **3**

Question 33 continues on page 25

Question 33 (continued)

Answer parts (d)–(e) in Section II Answer Booklet 2.

(d) The diagram shows a process affecting a capillary and its surrounding tissue.



(i) How would you know this process was occurring in your body? **2**

(ii) Outline the advantages and disadvantages of this process. **3**

(e) Explain a range of benefits and problems associated with the use of pharmaceuticals. **7**

End of Question 33

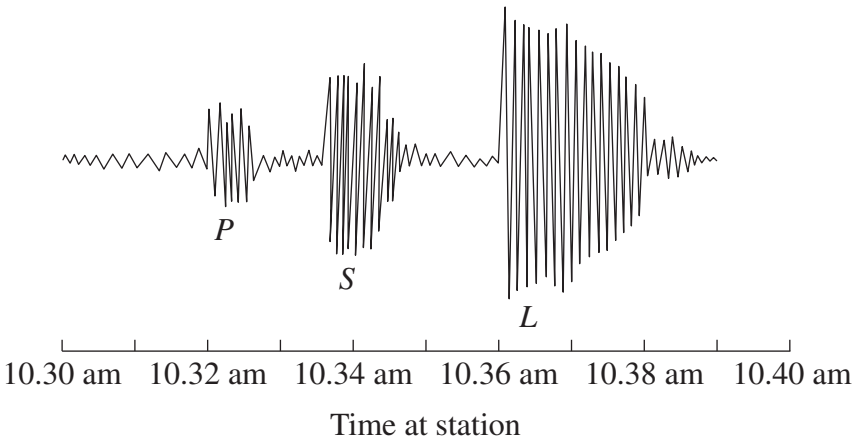
Question 34 — Disasters (25 marks)

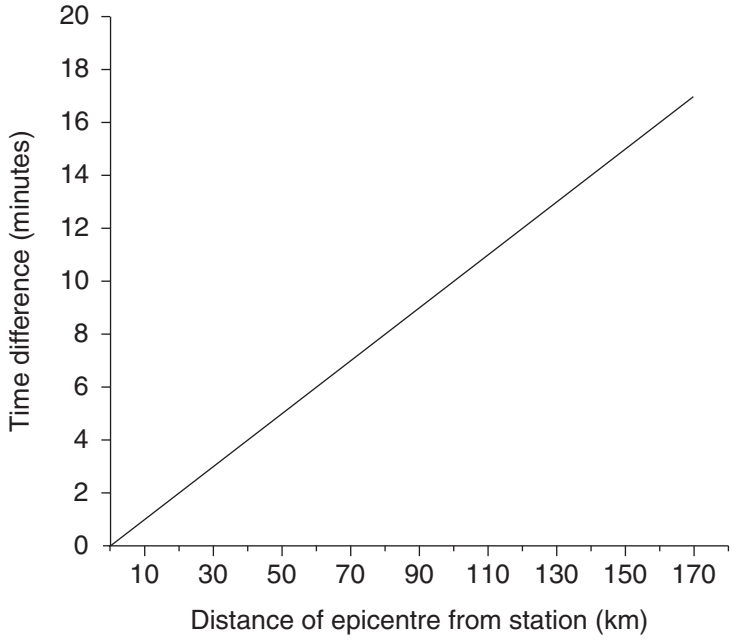
Answer parts (a)–(c) in Section II Answer Booklet 1.

(a) (i) Define the term *natural disaster*. **1**

(ii) Identify a specific Australian disaster and explain how it resulted from both natural and human activity. **3**

(b) These graphs were used by scientists at one monitoring station. This and other data were used to help locate the epicentre of an earthquake.





How would scientists locate the epicentre of an earthquake using the type of information presented above? You are not required to calculate the location of the epicentre. **4**

Question 34 continues on page 27

Question 34 (continued)

(c) A group of students conducted an experiment to compare the time taken for different types of leaves to burn.

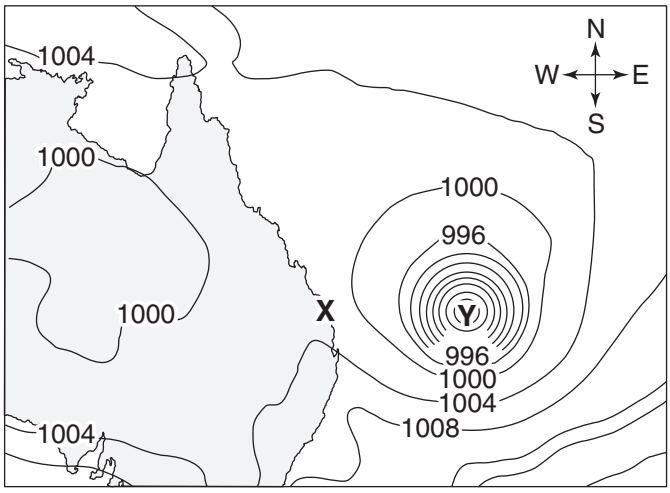
		Time taken to burn (s)	
Leaf type	*Environmental temperature* (°C)	*Fresh*	*Dry*
Eucalyptus	20	6.2	2.1
Pine	20	5.3	1.4
Banksia	30	7.1	2.5
Grevillea	30	8.2	1.9
Wattle	40	6.4	1.2

(i) State TWO conclusions from these results. **2**

(ii) Propose THREE improvements to the experimental design of this investigation that would produce valid results. **3**

Answer parts (d)–(e) in Section II Answer Booklet 2.

(d) The diagram shows a weather map for north-eastern Australia.



(i) Describe the changing weather conditions at location **X** as **Y** moves towards the west. **2**

(ii) How have improvements in technology led to improved weather predictions? **3**

(e) Bushfire season in Australia is November to February. Explain a range of strategies that can be taken prior to this season to minimise the effect of bushfires. **7**

End of Question 34

Question 35 — Space Science (25 marks)

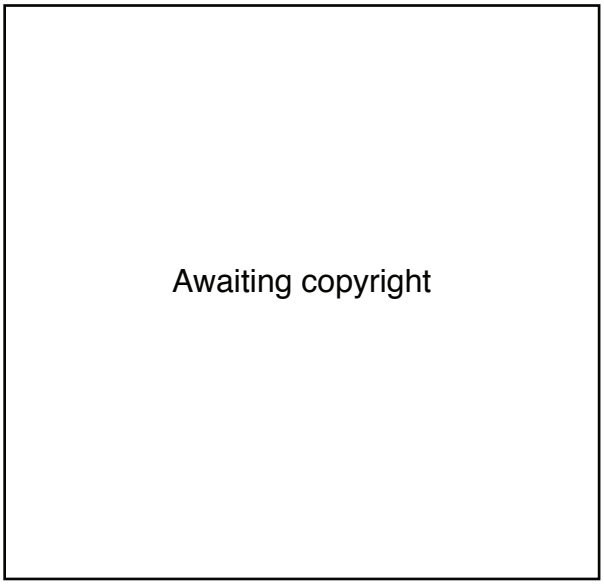
Answer parts (a)–(c) in Section II Answer Booklet 1.

(a) (i) Identify TWO situations on Earth in which a person could experience weightlessness. **1**

(ii) 'The International Space Station orbiting Earth is weightless.' **3**

Why is this statement true?

(b) In the diagram, three components of the Space Transportation System are labelled. **4**

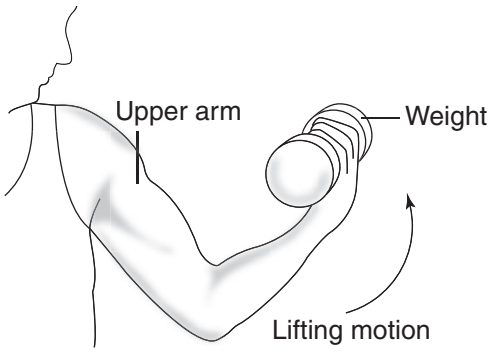


Justify the need for all THREE components in the Space Transportation System.

Question 35 continues on page 29

Question 35 (continued)

(c) A group of students designed an experiment to measure the change in muscle strength of men and women during long periods in space. Muscle strength was determined by measuring the maximum weight the astronaut could lift immediately before and immediately after their trip in space.



Astronaut	*Gender*	*Time in space (days)*	*Muscle strength (% of initial strength)*
1	Male	30	90
2	Male	30	95
3	Male	40	80
4	Female	40	65
5	Female	40	70

(i) State TWO conclusions from these results. **2**

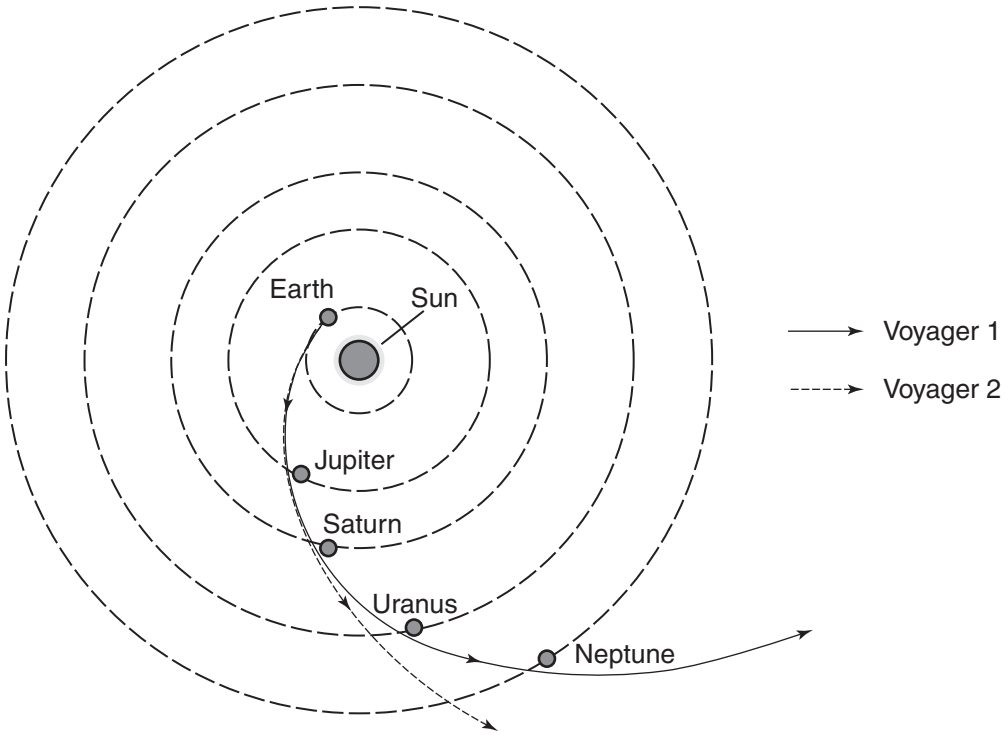
(ii) Propose THREE improvements to the experimental design of this investigation that would produce valid results. **3**

Question 35 continues on page 30

Question 35 (continued)

Answer parts (d)–(f) in Section II Answer Booklet 2.

(d) The diagram shows the path taken through the solar system by Voyager 1 and Voyager 2 space probes.



What information did the Voyager space probes collect that increased our knowledge of the universe? **2**

(e) What improvements in technology have led to improved quality of information about the universe? **3**

(f) How have a range of problems faced by humans travelling in space been minimised or eliminated? **7**

End of paper

BOARD OF STUDIES
NEW SOUTH WALES

2011
HIGHER SCHOOL CERTIFICATE
EXAMINATION

Centre Number

Student Number

Question Number

Senior Science

Section II Answer Booklet 1

Instructions

- Answer ONE question from Questions 31–35 in this booklet and in the Section II Answer Booklet 2
- Write your Centre Number and Student Number at the top of this page
- Write the question number in the space provided

(a) (i) .....

.....

.....

(ii) .....

.....

.....

.....

.....

.....

.....

(b) .....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(c) (i) .....

.....

.....

.....

.....

(ii) .....

.....

.....

.....

.....

.....

.....

.....

BLANK PAGE

BOARD OF STUDIES
NEW SOUTH WALES

2011
HIGHER SCHOOL CERTIFICATE
EXAMINATION

Centre Number

Student Number

Question Number

Senior Science

Section II Answer Booklet 2

Instructions

- Answer ONE question from Questions 31–35 in this booklet and in the Section II Answer Booklet 1
- Write your Centre Number and Student Number at the top of this page
- Write the question number in the space provided

Clearly indicate which question part you are answering.

BLANK PAGE