BOARD OF STUDIES
NEW SOUTH WALES

2013

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, 17 and 19

Total marks – 100

Section I Pages 2–19

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 21–27

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.

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1 What is the function of an artificial heart valve?

(A) It prevents the backflow of blood.

(B) It filters cholesterol from the blood.

(C) It produces a regular electrical impulse.

(D) It allows blood to move from the ventricle to the atrium.

2 Which of the following is an emulsion?

(A) Alcohol

(B) Mayonnaise

(C) Shaving foam

(D) Salad dressing

3 Which problem can be treated by using a pacemaker?

(A) A hole in the heart

(B) An irregular heartbeat

(C) High blood pressure

(D) Plaque in the arteries

4 How is information transfer similar in televisions and land-connected telephones?

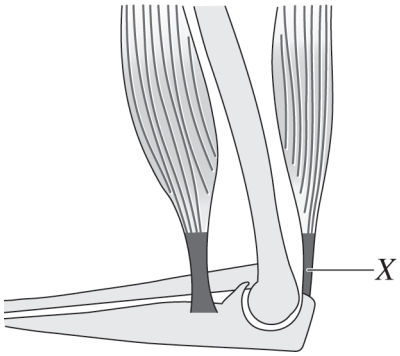
(A) Electrical energy is converted to sound energy.

(B) Electrical energy is transmitted through satellites.

(C) Light energy is amplitude modulated in copper wires.

(D) Electromagnetic waves are converted into sound energy.

5 What is structure *X* in the elbow joint shown?



(A) Bone

(B) Cartilage

(C) Muscle

(D) Tendon

6 What is an advantage of a colloid?

(A) It provides a uniform texture.

(B) Layers can be formed quickly.

(C) It allows oils to dissolve in water.

(D) Layers can be placed one on top of the other.

7 Why does the human stomach produce chemicals which lower the pH?

(A) To assist in the breakdown of fats

(B) To assist in the breakdown of protein

(C) To neutralise the saliva from the mouth

(D) To neutralise juices from the small intestine

8 In which part of the digestive system are enteric-coated tablets absorbed?

(A) The mouth

(B) The oesophagus

(C) The small intestine

(D) The large intestine

9 Which properties make UHMWPE a suitable material to replace cartilage?

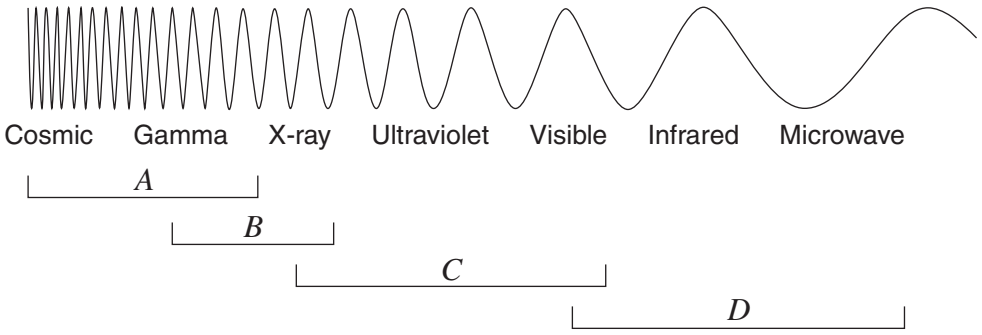
(A) Biocompatibility and durability

(B) Low molecular weight and high friction

(C) Low shock absorbance and high strength

(D) Good electrical conductivity and imperviousness to water

10 Which types of waves are used for communication?



(A) *A*

(B) *B*

(C) *C*

(D) *D*

11 Some pure vitamin E was added to oil and the mixture was stirred.

Which of the following would have occurred?

(A) A clear solution formed.

(B) A cloudy mixture formed.

(C) The vitamin E floated at the top.

(D) The vitamin E sank to the bottom.

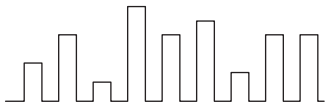
12 Smartphones can transmit and receive different types of information, including sound, images and text.

Which of the following represents the coded information sent by a smartphone?

(A) 

(B) 

(C) 

(D) 

13 A metal needle was lowered carefully into a glass of water where it remained floating.

A single drop of liquid was then added carefully to the water. The needle sank almost immediately.

What type of liquid was added?

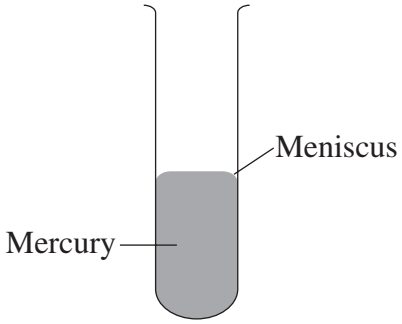
(A) Acid

(B) Lubricant

(C) Solvent

(D) Surfactant

14 The element mercury is shown in a test tube.



What causes the meniscus to have this shape?

(A) Density

(B) Solubility

(C) Surface tension

(D) Emulsifying agents

15 Interruptions to the normal rhythm of the heart may lead to

(A) a lack of oxygen to the brain.

(B) a build-up of plaque in the arteries.

(C) a decrease in carbon dioxide in the blood.

(D) an increase in blood volume in the capillaries.

16 Which statement makes a correct comparison between the use of an optical fibre and a copper wire for communication?

(A) Both the optical fibre and copper wire transmit signals using electromagnetic waves.

(B) It is cheaper to send the same amount of data through a copper wire than through an optical fibre.

(C) More data can be transmitted per second through an optical fibre than through a copper wire.

(D) Electromagnetic waves are emitted from the optical fibre making the data less secure than data transmitted through the copper wire.

17 Why is alcohol, rather than water, used as a solvent in cosmetics and external medications?

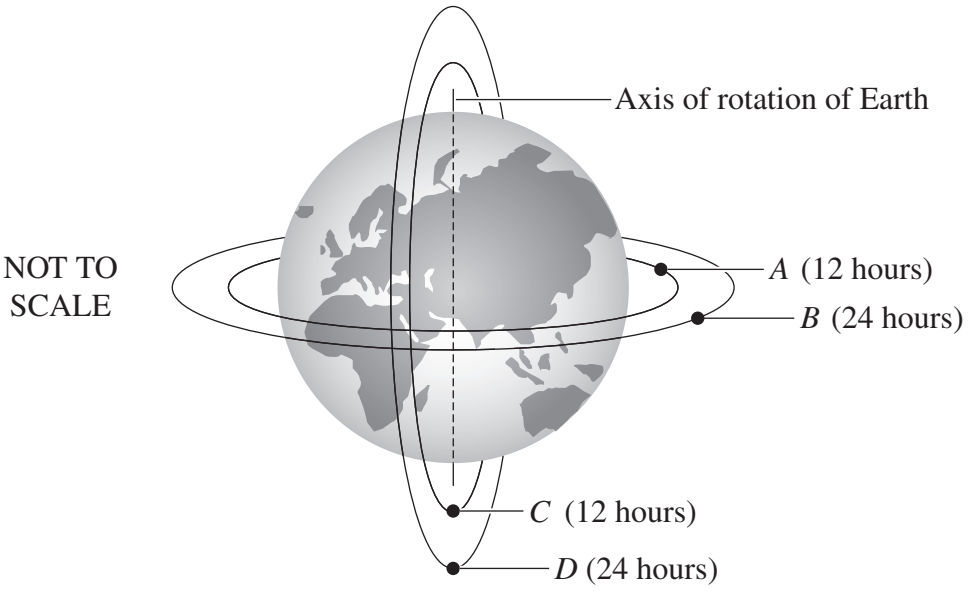
(A) Alcohol evaporates at a faster rate than water.

(B) Alcohol forms a lower pH solution than water.

(C) Alcohol is a polar substance, whereas water is non-polar.

(D) Alcohol is non-polar and can dissolve some substances that water cannot.

18 The diagram represents four possible satellite orbits.



The time it takes for each satellite to orbit Earth is shown.

Which satellite would be most suitable for continuous communication to a fixed point on Earth?

(A) *A*

(B) *B*

(C) *C*

(D) *D*

19 What is the main feature of information systems?

(A) Data flows in opposite directions.

(B) Information is carried through optical fibres.

(C) Images and text are transmitted electronically.

(D) Components that do different tasks work together.

20 The following data were collected about heart rate and exercise from a large number of participants.

Group number	*Age (years)*	*Sex*	*Average weight (kg)*	*Average resting heart rate before exercise (beats/min)*	*Average resting heart rate after two minutes of exercise (beats/min)*
1	25	Male	75	70	130
2	25	Female	65	75	140
3	45	Male	85	75	150
4	45	Female	85	80	160
5	65	Male	80	75	145
6	65	Female	80	85	150

Which statement is consistent with the data?

(A) Females have a greater increase in heart rate than males after exercise.

(B) The younger a person is, the greater the increase in heart rate after exercise.

(C) The more a person weighs, the greater the increase in heart rate after exercise.

(D) The lower the resting heart rate, the greater the increase in heart rate after exercise.

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 (7 marks)

(a) Identify TWO roles of the skin. **2**

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(b) Explain ways in which the natural pH of the skin is maintained. **3**

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(c) Outline TWO advantages of subdermal implants. **2**

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Question 22 (5 marks)

(a) Draw a table to identify a function of each of the following structures. **3**

- Trachea
- Alveoli

(b) A patient requires a lung transplant. **2**

Describe the role of a life support system that would be required during this operation.

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Question 23 (4 marks)

(a) Explain ONE advantage of biodegradable shampoos. **2**

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(b) Universal indicator solution can be used to determine different pH levels. The pH is determined by comparing the colour of the solution to the universal indicator chart. **2**

Why is it a problem to use universal indicator solution to measure the pH of some shampoos?

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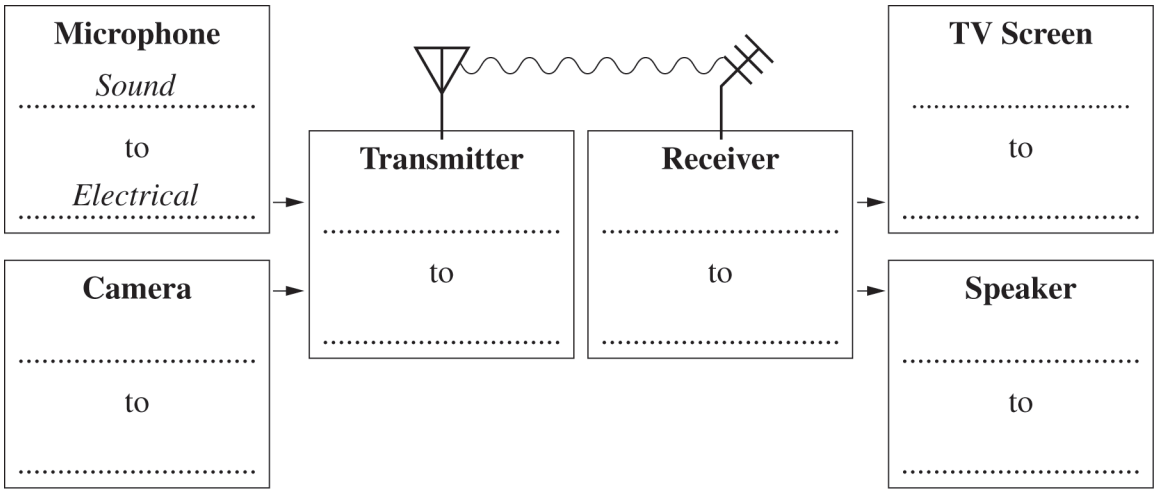
Question 24 (4 marks)

Identify the energy transformation that occurs at each component of this system. The microphone component is completed. **4**



Question 25 (4 marks)

Explain how THREE different biomaterials can help to maintain humans as functioning organisms. **4**

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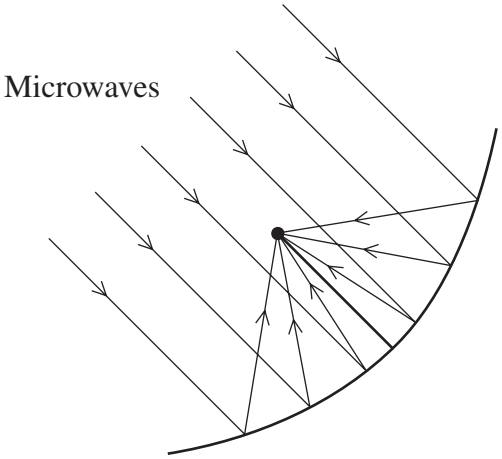
Question 26 (7 marks)

(a) Microwaves travel in straight lines, as shown in the diagram.



What other property of microwaves allows the dish shown in the diagram to collect information? **1**

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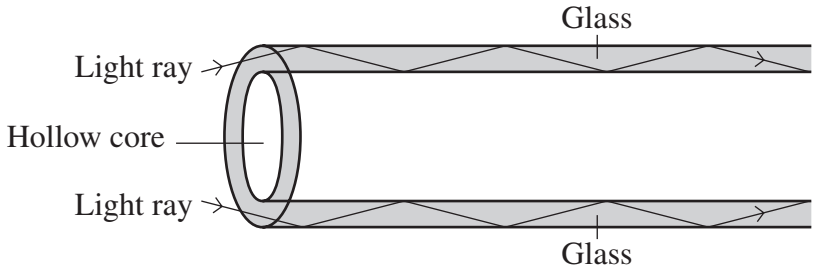
Question 26 continues on page 14

Question 26 (continued)

(b) A student drew the following diagram to show the transmission of light through an optical fibre. Assess the accuracy of the diagram. **3**



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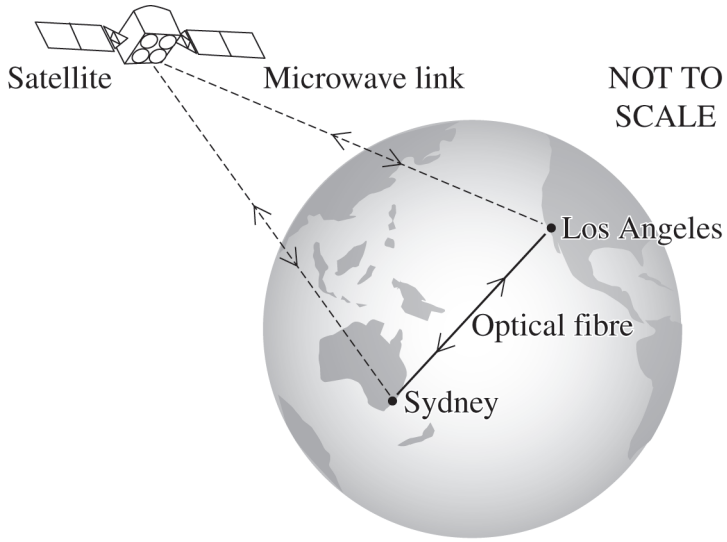
Question 26 continues on page 15

Question 26 (continued)

(c) Compare and contrast the two communication systems shown in the diagram. **3**



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End of Question 26

Question 27 (4 marks)

Research into both heart transplants and artificial hearts has resulted in significant developments. **4**

Outline ONE development and its effect both on the individual and on society.

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Question 28 (4 marks)

Explain how electricity is used in a biomedical technology and in a communication technology. **4**

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Question 29 (8 marks)

(a) A student conducted a first-hand investigation five times using the same method. **1**

How would the student know if this investigation was reliable?

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(b) Identify a first-hand investigation where a data logger may be used and state an advantage of using the data logger. **2**

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(c) What is the difference between destructive and non-destructive testing of materials? Support your answer with examples. **2**

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(d) Explain why models are used in science. Include an example in your answer. **3**

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Section I – Part B (continued)

Question 30 (8 marks)

Assess the contribution of scientific advances to the development of chemicals, biomaterials and communications. In your answer, include an example from each of these three areas. **8**

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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 parts (d)–(e) of the question in Section II Answer Booklet 2.
Extra writing booklets are available.

Pages

Question 31 — Polymers (25 marks)

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

(a) (i) Identify TWO synthetic polymers. **2**

(ii) Outline a property and a use of each of the TWO polymers named in part (i). **2**

(b) A fire-retardant polymer has been developed for use on fabrics.

You have been asked to design a first-hand investigation to determine the effectiveness of the fire-retardant polymer.

(i) State a hypothesis for the investigation. **1**

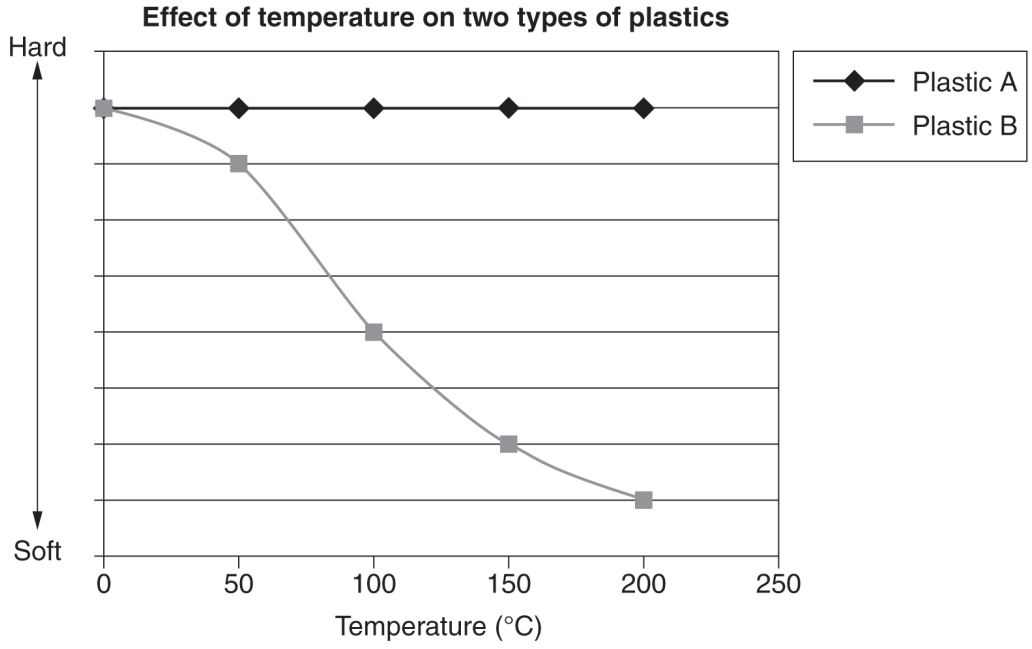
(ii) Propose a method for the investigation. **4**

(iii) Outline a risk assessment for the investigation. **2**

(c) Draw a labelled diagram to represent the process of polymerisation. **3**

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

(d) The graph shows the effect of temperature on two different types of plastics. **4**



Compare and contrast the TWO types of plastics that are represented by the data shown in the graph. Include an example of each type of plastic.

(e) Analyse the effects of scientific developments on the properties and uses of polymers. **7**

Question 32 — Preservatives and Additives (25 marks)

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

(a) (i) Identify TWO common microbes that cause food spoilage. **2**

(ii) Explain an advantage of irradiation as a preservation technique. **2**

(b) A preservative has been developed for use in bottled juices.

You have been asked to design a first-hand investigation to determine the effectiveness of the preservative.

(i) State a hypothesis for the investigation. **1**

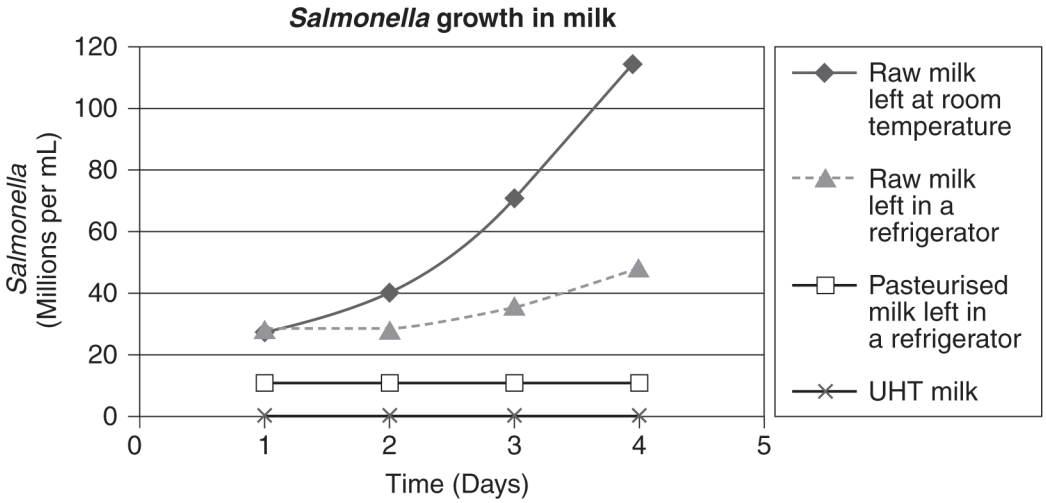
(ii) Propose a method for the investigation. **4**

(iii) Outline a risk assessment for the investigation. **2**

(c) Draw a labelled diagram that represents the process of osmosis. **3**

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

(d) The graph shows the growth of *Salmonella* in milk under different conditions. **4**



Compare and contrast the THREE preservation techniques shown in the graph.

(e) Preservation techniques have been used by different cultures around the world since ancient times. **7**

Analyse the effectiveness of a range of preservation techniques used by different cultures.

Question 33 — Pharmaceuticals (25 marks)

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

(a) (i) Identify TWO causes of inflammation. **2**

(ii) Explain an advantage of the inflammation response. **2**

(b) An antibiotic has been developed.

You have been asked to design a first-hand investigation to determine the effectiveness of the antibiotic.

(i) State a hypothesis for the investigation. **1**

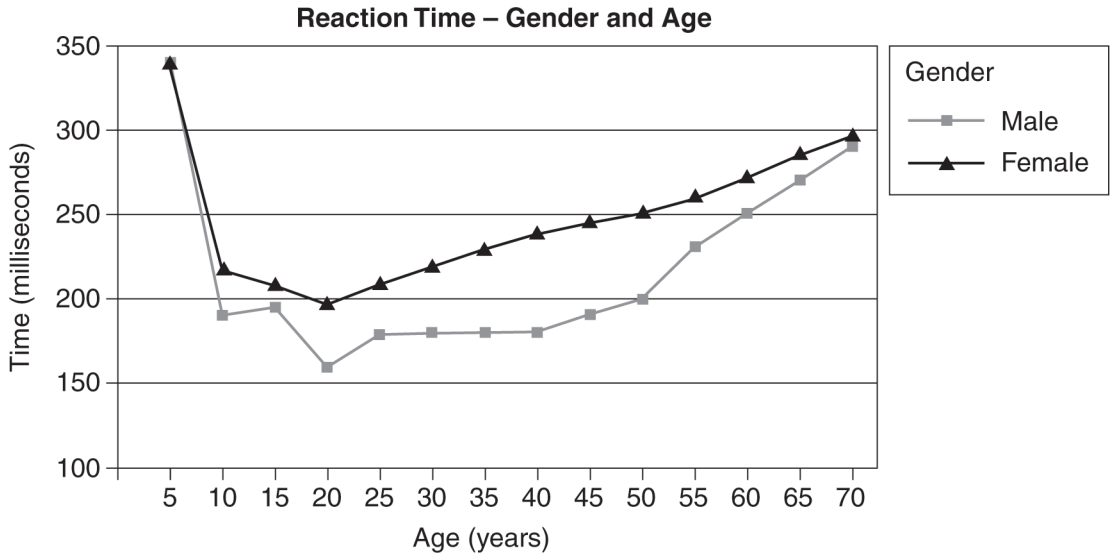
(ii) Propose a method for the investigation. **4**

(iii) Outline a risk assessment for the investigation. **2**

(c) Draw a labelled diagram of the central nervous system. **3**

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

(d) Males and females of different ages were exposed to a loud noise. They responded to the noise by pressing a button. The graph shows their reaction times. **4**



Compare and contrast these reaction times according to age and gender. In your answer, outline the sequence of events in the body that would occur, regardless of age and gender, between hearing the loud noise and pressing the button.

(e) Analyse the effects of scientific developments on the treatment of illnesses using pharmaceutical substances. **7**

Question 34 — Disasters (25 marks)

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

(a) (i) Identify TWO types of earthquake waves. **2**

(ii) Contrast the properties of the waves identified in part (i). **2**

(b) A fire-retardant substance has been developed for use in protective clothing for the Rural Fire Service.

You have been asked to design a first-hand investigation to determine the effectiveness of the fire-retardant substance.

(i) State a hypothesis for the investigation. **1**

(ii) Propose a method for the investigation. **4**

(iii) Outline a risk assessment for the investigation. **2**

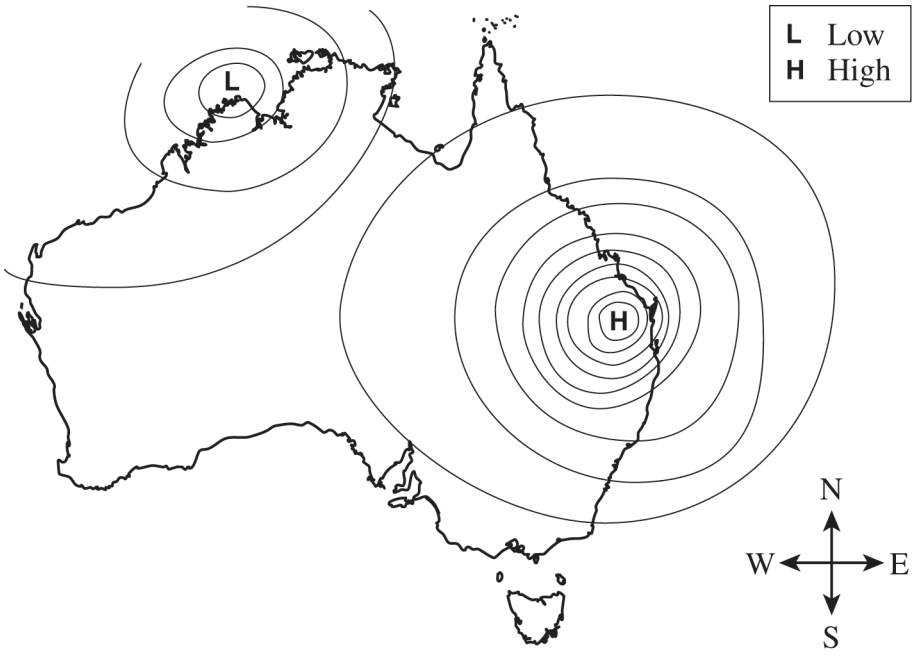
(c) Draw a labelled diagram of a working alarm or safety device. **3**

Question 34 continues on page 26

Question 34 (continued)

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

(d) The weather chart shows the isobars associated with the weather for a day in January 2013. **4**



Analyse how short-term conditions caused by the weather pattern shown can combine with long-term weather patterns to produce a high bushfire risk.

(e) Analyse the effects of technology on the prediction of weather patterns. **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 space stations that have been used in space. **2**

(ii) Explain ONE requirement for sustaining human life on a space station. **2**

(b) A thermal material has been developed for use in a spacesuit.

You have been asked to design a first-hand investigation to determine the effectiveness of the spacesuit in protecting the wearer from extreme temperatures.

(i) State a hypothesis for the investigation. **1**

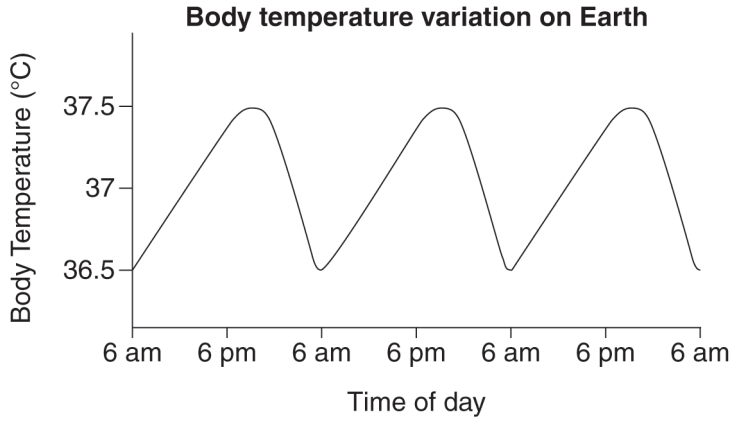
(ii) Propose a method for the investigation. **4**

(iii) Outline a risk assessment for the investigation. **2**

(c) Draw THREE labelled diagrams demonstrating the relative distances between particles in solids, liquids and gases. **3**

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

(d) This graph shows the normal variation of a person's body temperature on Earth. **4**



Identify the type of cycle shown by the graph and explain how the negative effects of space travel on this cycle can be minimised.

(e) Analyse the effects of technology on the collection of information about our solar system, galaxy and deep space. **7**

End of paper

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