

# Senior Science

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## General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using black pen
- Draw diagrams using pencil
- NESA approved calculators may be used

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## Total marks: 100

### **Section I – 75 marks** (pages 2–24)

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 – 25 marks** (pages 25–35)

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

**Section I**  
**75 marks**

**Part A – 20 marks**

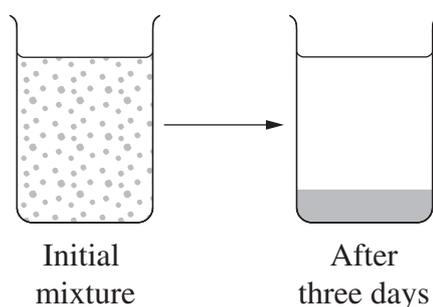
**Attempt Questions 1–20**

**Allow about 35 minutes for this part**

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

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- 1 A student ground a solid into a powder and mixed it with water. The mixture was left to stand for three days.



Which of the following had the student made?

- A. Colloid
  - B. Emulsion
  - C. Surfactant
  - D. Suspension
- 2 What is the purpose of an artificial lung?
- A. To supply the blood with oxygen and nutrients
  - B. To remove carbon dioxide from the blood and replace it with oxygen
  - C. To supply the blood with oxygen and circulate the blood around the body
  - D. To remove carbon dioxide from the blood and circulate the blood around the body

- 3 Which row in the table correctly matches the communication device with the part of the electromagnetic spectrum that it uses?

	<i>Communication device</i>	<i>Part of the electromagnetic spectrum</i>
A.	Mobile phone	Microwaves
B.	Satellite	X-rays
C.	Optical fibre	Radio waves
D.	TV remote control	Gamma rays

- 4 What is the purpose of an artificial pacemaker?

- A. To reduce the build-up of plaque
- B. To prevent the formation of blood clots
- C. To bypass the heart during heart surgery
- D. To ensure that the heart maintains a regular rhythm

- 5 Which of the following describes healthy human skin?

- A. It is covered in bacteria and fungi and has a neutral pH.
- B. It is covered in a wide variety of bacteria and has a pH less than 7.
- C. It secretes oil which is a natural surfactant and has a pH greater than 7.
- D. It helps maintain a constant body temperature and has a pH that kills bacteria.

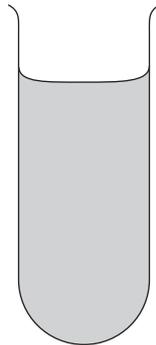
- 6 Which of the following makes use of the transmission of light through optical fibres?

- A. Pacemaker
- B. Artificial lens
- C. Keyhole surgery
- D. Cochlear implant

- 7 In addition to reducing friction, what is a function of cartilage in joints?

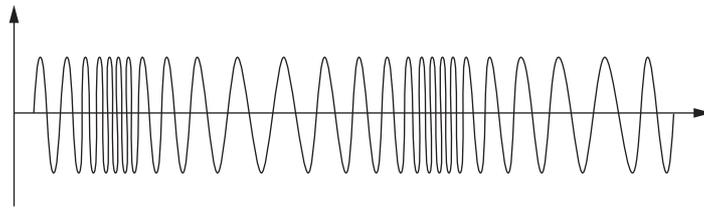
- A. To produce synovial fluid
- B. To provide shock absorption
- C. To connect bones to muscles
- D. To connect the bones to each other

- 8 Home satellite dishes point towards a fixed position because
- A. some satellites orbit Earth once every day.
  - B. some satellites in high orbits pass this position regularly.
  - C. some satellites in low orbits pass this position every ninety minutes.
  - D. some satellites transmit signals that are reflected from fixed towers to home satellite dishes.
- 9 The diagram shows the meniscus of water in a test tube.



- Which of the following accounts for the formation of the meniscus?
- A. The water molecules are equally attracted to the glass and other water molecules.
  - B. The water molecules are repelled by the glass and attracted to the air above the surface.
  - C. The water molecules at the surface are more attracted to other water molecules than they are to the glass.
  - D. The water molecules at the surface are more attracted to the glass than they are to other water molecules.
- 10 Different methods may be used to communicate distress from a ship at sea.
- Which of the following includes one verbal and one non-verbal method of communication?
- A. Launching distress rockets and sounding a fog horn
  - B. A distress call by a radio operator and sending up a distress flare
  - C. An emergency whistle and emitting orange smoke from a canister
  - D. Flying distress flags and sending an SOS distress signal using a flashing light

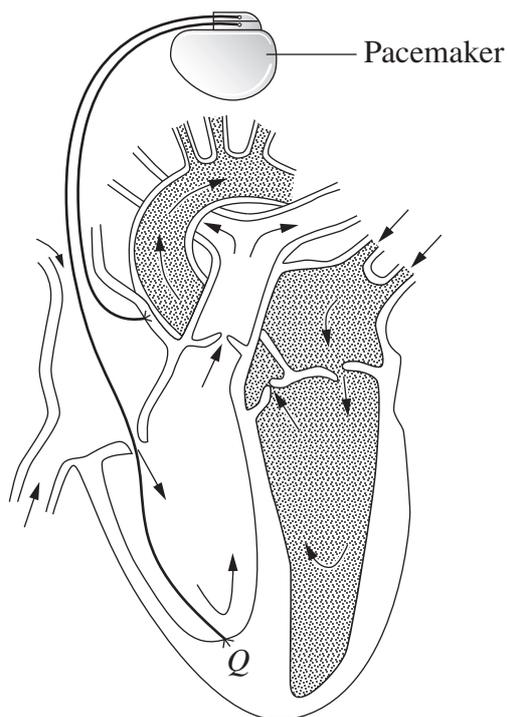
11 The diagram shows the waveform of a signal.



Which of the following best describes this signal?

- A. Analogue FM
- B. Analogue AM
- C. Digital FM
- D. Digital AM

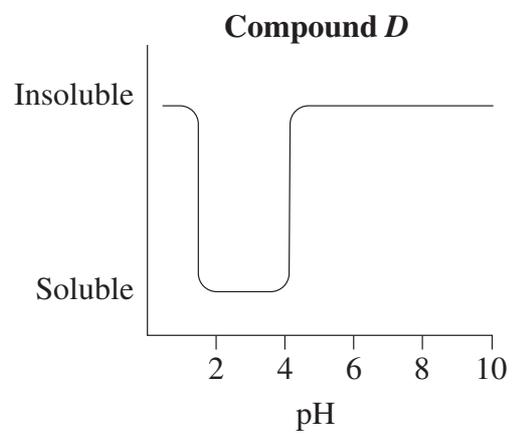
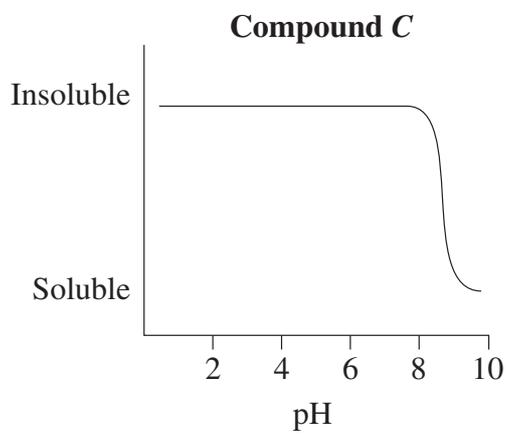
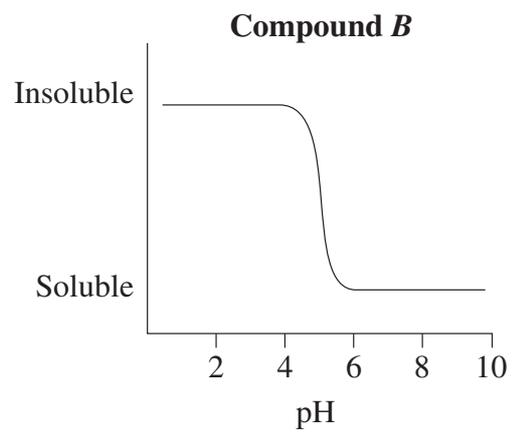
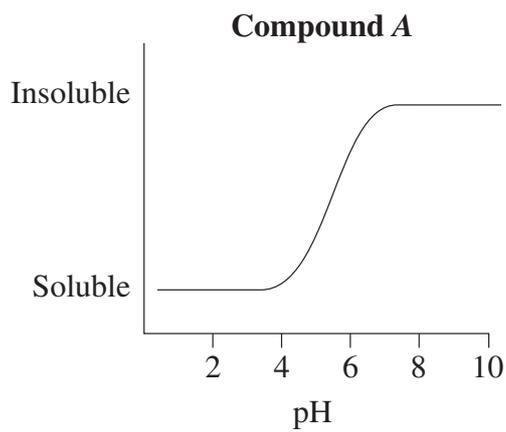
12 The diagram shows a heart pacemaker, including its connections to the heart.



What will happen as a result of a pulse being applied to the heart via electrode *Q*?

- A. Blood will fill the chambers of the heart.
- B. The muscles surrounding the atria will contract.
- C. The muscles surrounding the ventricles will relax.
- D. Blood will be pumped around the body and to the lungs.

13 The graphs show the solubility of four solid compounds at different pH levels.



Which compound could be used to coat a drug to prevent it from being absorbed in the stomach but allowing it to be absorbed in the small intestine?

- A. A
- B. B
- C. C
- D. D

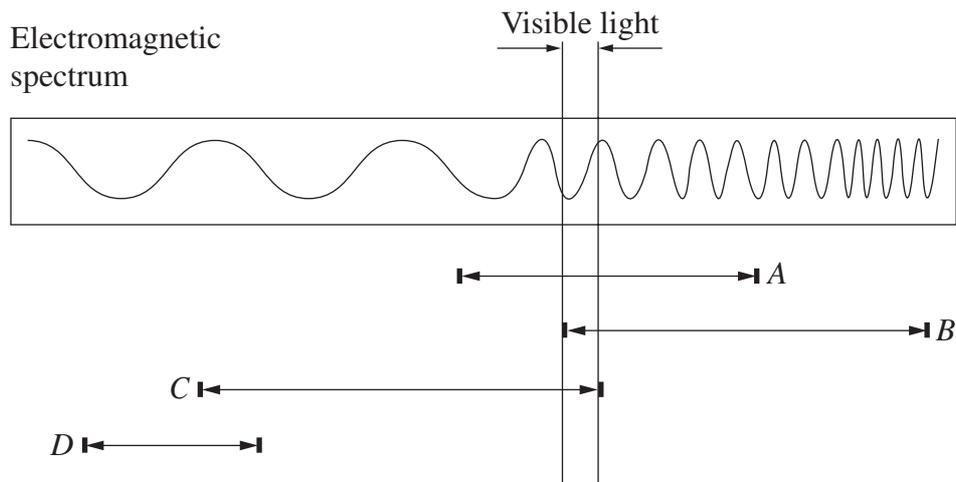
14 Information about medical diagnostic techniques is shown.

	<b>Diagnostic technique</b>			
	<i>Magnetic resonance imaging (MRI)</i>	<i>Thermography</i>	<i>Ultrasound</i>	<i>X-ray</i>
<i>Effective depth penetration (cm)</i>	50	1	20	50
<i>Smallest structure visible (cm)</i>	0.1	2.0	0.2	0.2
<i>Other information</i>	Object being imaged must be stationary for 10 minutes	No identified risks	Image can be viewed as the scan is being done	Produces poor images of soft tissue

Which diagnostic technique would be most suitable to produce an image of a faulty valve in the heart of a young child?

- A. Magnetic resonance imaging (MRI)
- B. Thermography
- C. Ultrasound
- D. X-ray

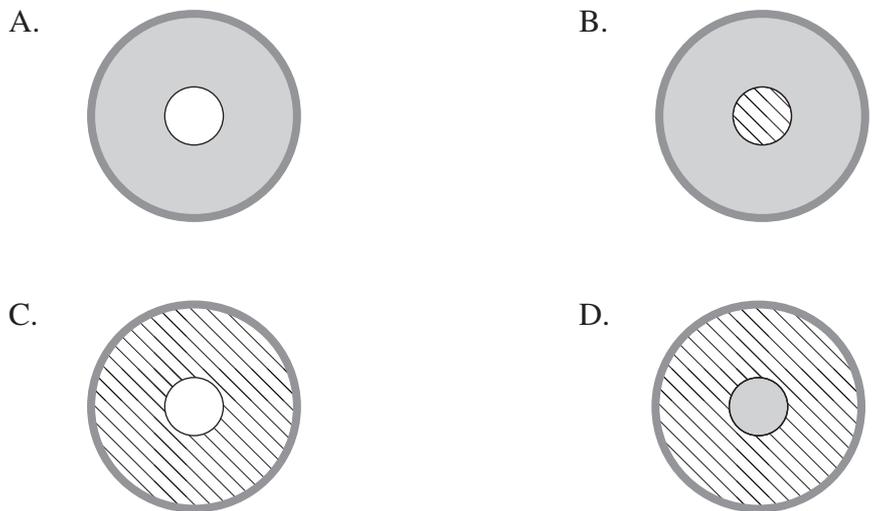
15 The diagram shows ranges of wavelengths in the electromagnetic spectrum.



Which range shows ALL of the wavelengths used in communication technologies?

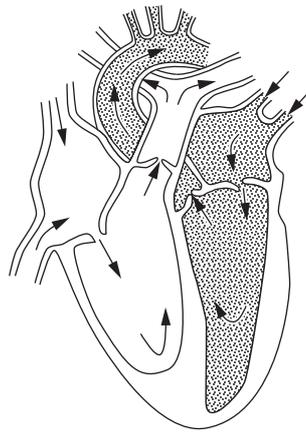
- A. A
- B. B
- C. C
- D. D

16 Which diagram best shows the structure of an optical fibre?



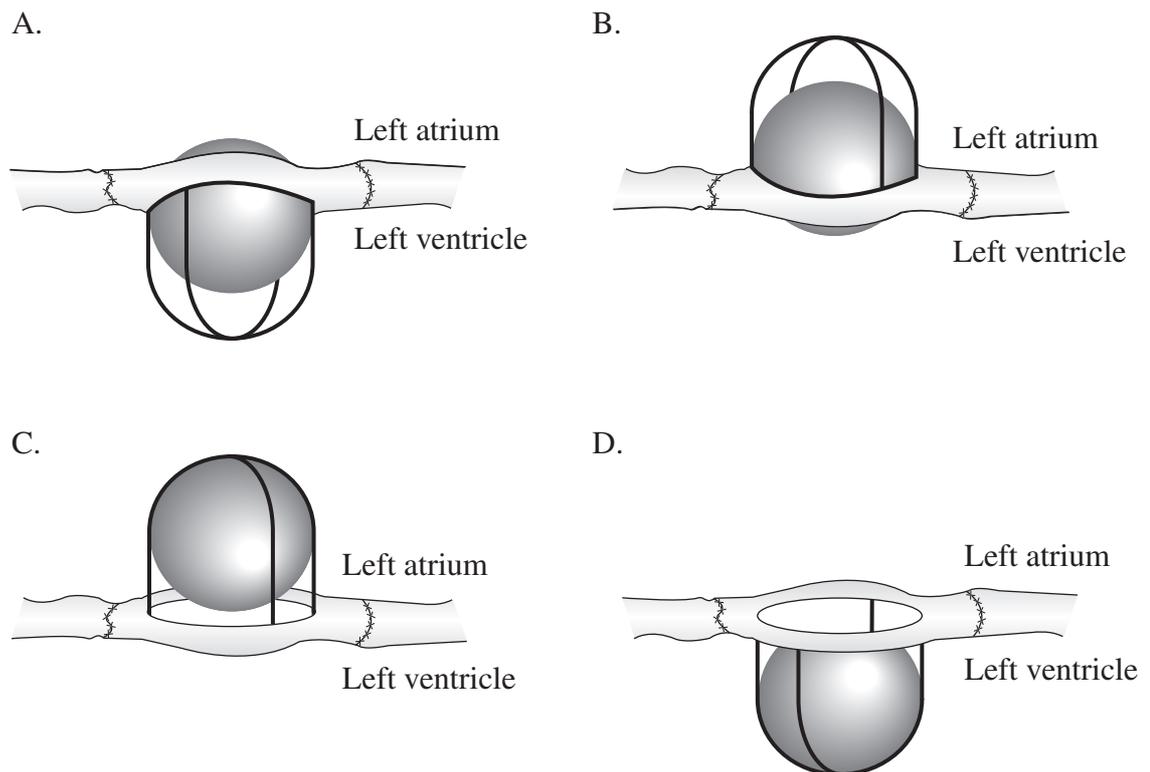
Key	
Air	Opaque layer
High refractive index glass	Low refractive index glass

17 The mitral valve in the human heart is between the left atrium and the left ventricle.



A person with an artificial mitral valve was found unconscious and so cardiac compression was commenced.

Which diagram correctly shows the valve during compression of the heart?



- 18 The table shows data for the rate of blood flow to some parts of the body at rest and during strenuous exercise.

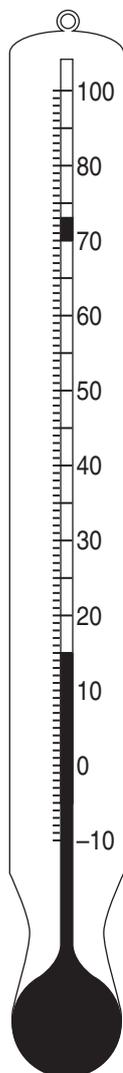
<i>Body part</i>	<i>Blood flow at rest</i> (mL/min)	<i>Blood flow during strenuous exercise</i> (mL/min)
Brain	700	750
Heart	200	750
Liver	1350	600
Muscles	750	12 500
Whole body	5000	17 800

What percentage of blood is going to the muscles during strenuous exercise?

- A. 15%
- B. 66%
- C. 70%
- D. 82%

- 19 An investigation was carried out to measure how quickly substances dissolve at different temperatures.

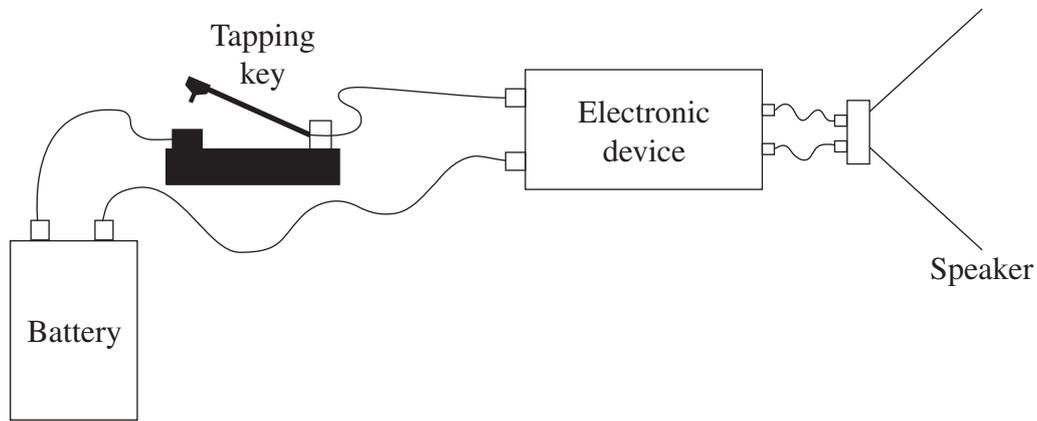
The thermometer used for the investigation was faulty because a small part of the liquid column had become detached and stuck near the 70°C mark. In all other respects the thermometer was responding normally to changes in temperature. The diagram shows the thermometer when the room temperature was 18°C.



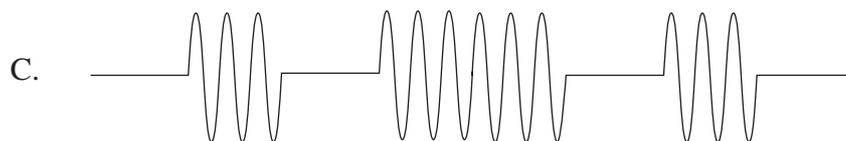
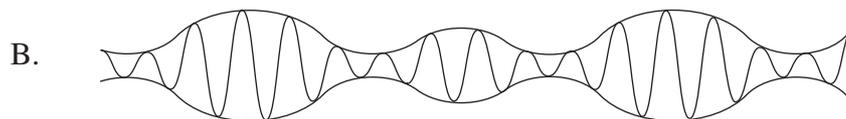
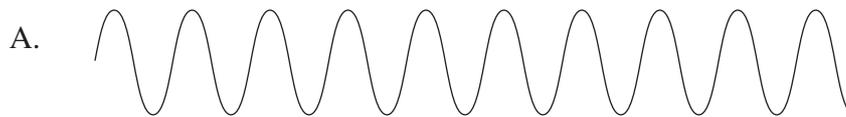
- Which statement is correct about the investigation carried out using this thermometer?
- A. The investigation is valid because the thermometer is responding normally to temperature changes.
  - B. The investigation is reliable because consistent results can be obtained when the experiment is repeated.
  - C. The investigation is invalid because correct temperature readings can only be deduced if the temperature is 73°C.
  - D. The experiment is unreliable unless the person recording the measurements adds 3°C to each of the temperatures observed.

- 20 A tapping key is a spring-loaded switch that can be turned on by pressing it down and turned off by releasing it.

A battery is connected to a circuit consisting of a tapping key, an electronic device and a speaker which produces a sound of constant frequency and volume only when the tapping key is pressed down.



Which diagram represents a coded signal that could be produced by the speaker, using this apparatus?



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HIGHER SCHOOL CERTIFICATE  
EXAMINATION

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Centre Number

Senior Science

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Student Number

Section I Part B  
Answer Booklet

55 marks

Attempt Questions 21–30

Allow about 1 hour and 40 minutes for this part

**Instructions**

- Write your Centre Number and Student Number at the top of this page.
- Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.
- Extra writing space is provided at the back of this booklet. If you use this space, clearly indicate which question you are answering.

Please turn over

**Question 21** (5 marks)

A student planned a first-hand investigation into the rates at which tablets and enteric-coated tablets dissolve in the different conditions that are found in the human digestive tract.

- (a) Identify a variable that needs to be kept constant in this investigation. **1**

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- (b) Outline the steps the student should perform in carrying out this investigation. **4**

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**Question 22** (5 marks)

Pyrolytic carbon is a biocompatible material that is used in artificial body parts.

- (a) Identify TWO properties of pyrolytic carbon other than biocompatibility that make it suitable for use in artificial heart valves. **2**

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- (b) Explain, in terms of its properties, why pyrolytic carbon is used in artificial heart valves. **3**

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**Question 23** (6 marks)

Describe how detergents work by relating their properties to their uses.

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**Question 24** (4 marks)

(a) Outline a use for a geostationary satellite.

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(b) What **THREE** criteria must be met for a satellite to be geostationary?

**3**

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**Question 25** (5 marks)

A student carried out the following procedure and made observations of the changes that occurred.

- Place six egg whites in a mixing bowl.
- Using an electric beater set on its maximum speed, whisk the egg whites for five minutes.

*Observations*

Initially the egg whites were liquid, colourless and transparent. After whisking the egg whites for five minutes, the resulting white mixture could be drawn up into a peak that maintained its shape. The final volume of the mixture was significantly greater than the volume of the original egg whites.

- (a) Justify ONE safety precaution the student would need to take in carrying out this procedure. **2**

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- (b) Explain ONE feature of the mixture that resulted when the egg whites were whisked. In your answer, identify the type of mixture formed. **3**

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**Question 26** (6 marks)

Contrast the impact that television and mobile phones have each had on the way society communicates.

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**Question 27 (5 marks)**

- (a) The frequencies of AM radio waves differ from those of microwaves. **2**

Outline how the difference in their frequencies determines the way each is used in communication systems.

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- (b) A first-hand investigation is to be carried out to compare the quality of reception of AM and FM radio stations. **3**

Certain variables need to be kept constant for the investigation to be valid.

Identify TWO of these variables and outline how they could be kept constant.

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**Question 28** (5 marks)

Some joint diseases can be treated by removing the damaged joint and bones and replacing them with an artificial implant.

- (a) Identify the TWO methods by which the artificial implant can be fixed into place. **1**

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- (b) Outline an advantage and a disadvantage of each of these methods. **4**

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**Question 29** (6 marks)

The use of non-invasive and minimally invasive medical techniques has contributed to our understanding of how the body works.

**6**

Justify this statement using examples of each technique.

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**Question 30** (8 marks)

A group of students prepared several mixtures of oil in water using different oils. All liquids were at room temperature throughout the experiment. After shaking each mixture, the students measured the time the oil stayed suspended until it separated from the water. Oil A stayed in suspension for 15 minutes before separating from the water. Oil B stayed in suspension for 40 minutes and Oil C for 1.5 hours.

- (a) What procedures would need to be followed for a valid comparison to be made of the behaviour of these three mixtures? 3

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- (b) Present the data in a table. 2

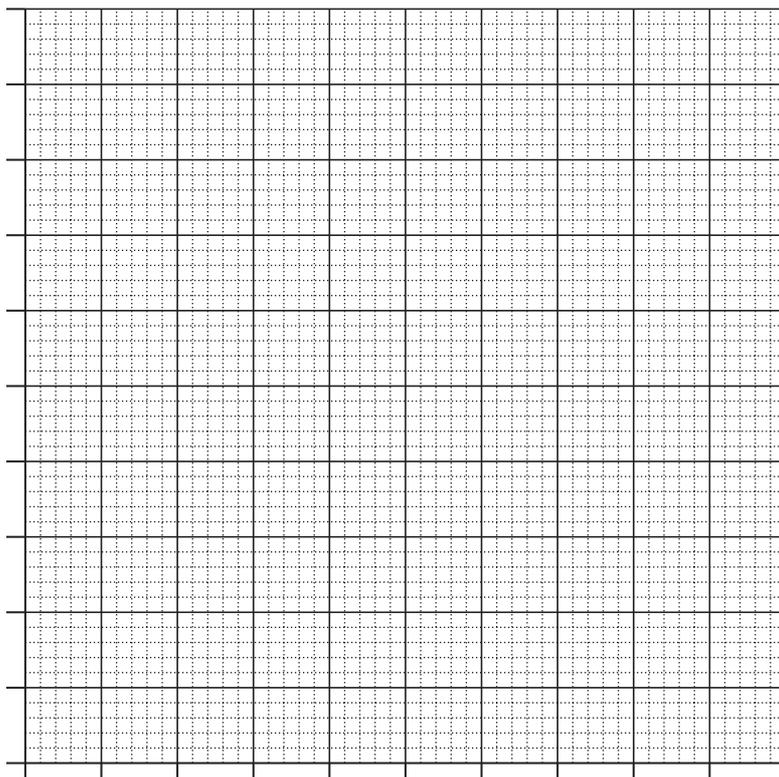
**Question 30 continues on page 23**

Question 30 (continued)

(c) Draw an appropriate graph that illustrates this data.

3

Do NOT write in this area.



**End of Question 30**



## Senior Science

### Section II

**25 marks**

**Attempt ONE question from Questions 31–35**

**Allow about 45 minutes for this section**

Answer parts (a)–(e) of one question in the Section II Writing Booklet. Extra writing booklets are available.

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	Pages
Question 31 Polymers .....	26–27
Question 32 Preservatives and Additives .....	28–29
Question 33 Pharmaceuticals .....	30–31
Question 34 Disasters .....	32–33
Question 35 Space Science .....	34–35

**Question 31 — Polymers (25 marks)**

Answer parts (a), (b) and (c) of the question on pages 2–4 of the Section II Writing Booklet. Start each part of the question on a new page.

- (a) (i) Name a synthetic polymer. 1
- (ii) Outline how a use of this synthetic polymer is related to its properties. 3

- (b) A student created a model of a synthetic polymer as shown by the sequence of images.

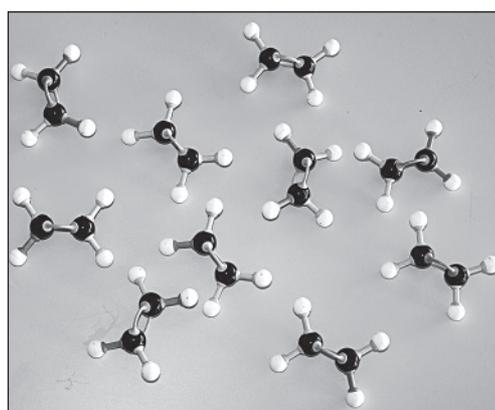


Image 1

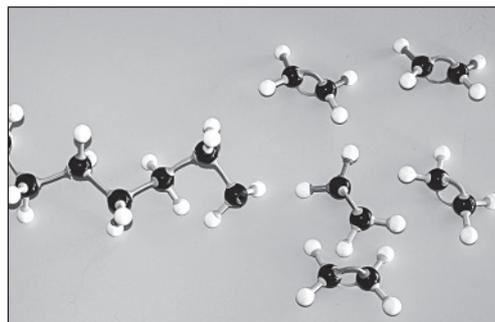


Image 2

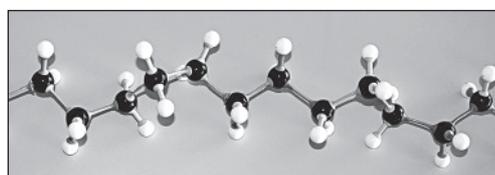


Image 3

- (i) Outline the process shown by the sequence of images. 2
- (ii) Discuss the implications of using petroleum as a source of raw materials to produce synthetic polymers. 4
- (c) Explain problems associated with recycling plastics. 4

**Question 31 continues on page 27**

Question 31 (continued)

Answer parts (d) and (e) of the question on pages 6–8 of the Section II Writing Booklet. Start each part of the question on a new page.

- (d) A student gathered information from secondary sources to describe the coding system developed by industry for plastics. An example of this code is shown.



- (i) What are the purposes of these codes? **2**
- (ii) How can the student assess the reliability of information from secondary sources about the coding system? **3**
- (e) Assess how the use of natural polymers has influenced society. In your answer, refer to a range of properties of specific natural polymers. **6**

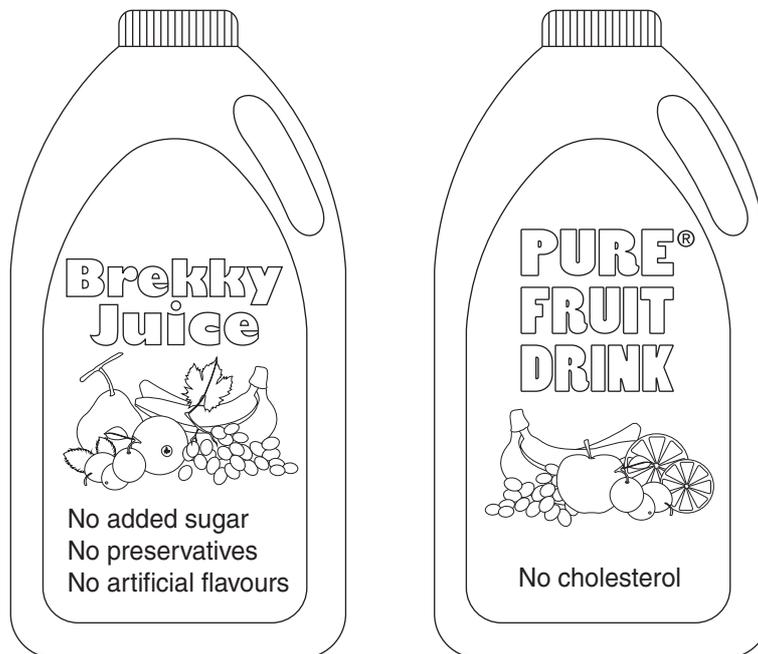
**End of Question 31**

**Question 32 — Preservatives and Additives (25 marks)**

Answer parts (a), (b) and (c) of the question on pages 2–4 of the Section II Writing Booklet. Start each part of the question on a new page.

- (a) (i) Identify a physical method of food preservation. **1**
- (ii) Describe how this method is able to preserve food. **3**

(b) Refer to the following diagram.



- (i) Outline the difference in the use of the words 'juice' and 'drink' in the above labels, as prescribed by the Australia New Zealand Food Standards Code. **2**
- (ii) Explain problems associated with negative labelling. **4**
- (c) Analyse the relationship between a cause of food poisoning, its symptoms and treatment. In your answer, identify a specific cause of food poisoning. **4**

**Question 32 continues on page 29**

Question 32 (continued)

Answer parts (d) and (e) of the question on pages 6–8 of the Section II Writing Booklet. Start each part of the question on a new page.

- (d) A student conducted research from secondary sources into food preservation techniques and found a reference to bacteriocins.
- (i) Define the term *bacteriocin*. **2**
  - (ii) How can the student assess the reliability of information from secondary sources about bacteriocins? **3**
- (e) Analyse the impacts that advances in both scientific understanding and technology have had on food preservation. **6**

**End of Question 32**

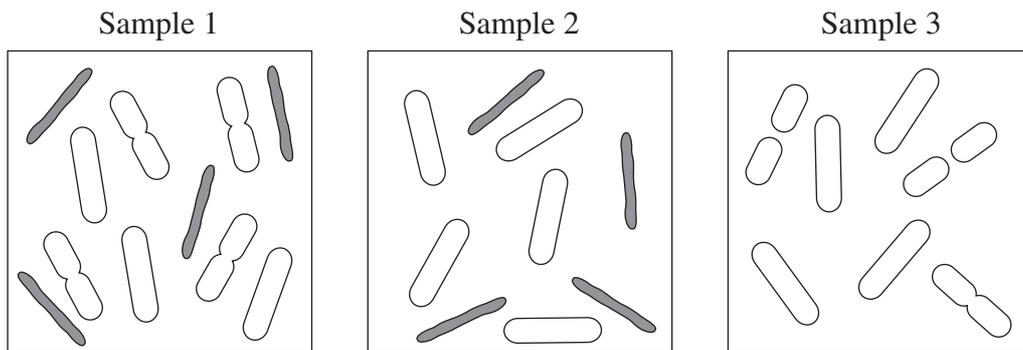
**Question 33 — Pharmaceuticals (25 marks)**

Answer parts (a), (b) and (c) of the question on pages 2–4 of the Section II Writing Booklet. Start each part of the question on a new page.

(a) A ball rolls in front of a moving car. The driver sees the ball and takes 0.21 seconds to respond by applying the brake.

- (i) What scientific term is given to this time interval? **1**
- (ii) Outline the differences between the driver's response and a reflex response. **3**

(b) All three diagrams show the same type of bacterium. These bacteria can be controlled by using penicillin.



**Key**

-  Live bacterium
-  Dividing bacterium
-  Dead bacterium

- (i) In which sample is the presence of penicillin most evident? State a reason for your answer. **2**
- (ii) Outline observations and inferences that were made surrounding the discovery of penicillin. **4**

(c) Explain how aspirin provides relief from pain. **4**

**Question 33 continues on page 31**

Question 33 (continued)

Answer parts (d) and (e) of the question on pages 6–8 of the Section II Writing Booklet. Start each part of the question on a new page.

- (d) A student gathered information from secondary sources relating to the physiological responses to physical trauma.
- (i) Outline the process by which physical trauma to soft tissue results in swelling of the injured area. **2**
  - (ii) How can the student assess the reliability of information from secondary sources about responses to physical trauma? **3**
- (e) Analyse the relationship between the way the body works and the circulation of a range of chemicals in the bloodstream. **6**

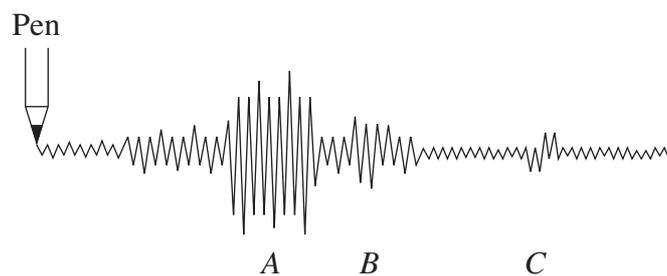
**End of Question 33**

**Question 34 — Disasters (25 marks)**

Answer parts (a), (b) and (c) of the question on pages 2–4 of the Section II Writing Booklet. Start each part of the question on a new page.

- (a) (i) What feature is represented by isobars on a weather map? **1**
- (ii) Describe how tropical cyclones form. **3**

(b) The diagram shows a pen recording the vibrations associated with an earthquake.



- (i) On the diagram, three types of earthquake waves are indicated by *A*, *B* and *C*. **2**
- In your writing booklet, write on separate lines the letters *A*, *B* and *C*. Identify each type of wave indicated by these letters.
- (ii) Explain how the arrival time of different types of earthquake waves can be used to locate the earthquake's epicentre. Your answer may include a labelled diagram. **4**
- (c) Explain the uses of both back-burning and controlled burns. **4**

**Question 34 continues on page 33**

Question 34 (continued)

Answer parts (d) and (e) of the question on pages 6–8 of the Section II Writing Booklet. Start each part of the question on a new page.

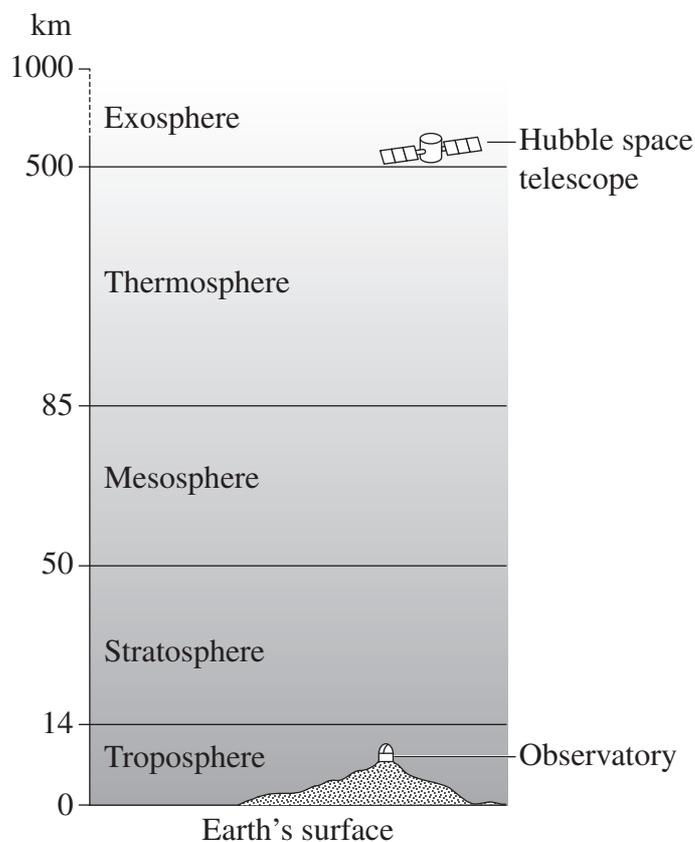
- (d) A student gathered information from secondary sources to create a database of natural disasters that have occurred within Australia since 1970.
- (i) What types of information, other than the name of the disaster, should the student have gathered? **2**
  - (ii) How can the student assess the reliability of information from secondary sources about disasters? **3**
- (e) Analyse how a range of technologies contributes to the prediction of natural disasters. **6**

**End of Question 34**

**Question 35 — Space Science (25 marks)**

Answer parts (a), (b) and (c) of the question on pages 2–4 of the Section II Writing Booklet. Start each part of the question on a new page.

- (a) (i) Identify ONE spin-off from space research. **1**
- (ii) Compare the current use of this spin-off with its original use. **3**
- (b) The diagram shows information about Earth’s atmosphere.



- (i) Describe how Earth’s atmosphere is maintained in place. **2**
- (ii) Explain why optical telescopes are usually located either on high mountains or placed in orbit around Earth. Refer to the diagram in your answer. **4**
- (c) How have space programs contributed to society? Support your answer with **THREE** examples. **4**

**Question 35 continues on page 35**

Question 35 (continued)

Answer parts (d) and (e) of the question on pages 6–8 of the Section II Writing Booklet. Start each part of the question on a new page.

- (d) A student gathered information from secondary sources on precautions necessary to protect astronauts from radiation in space.
- (i) Justify ONE precaution taken to protect astronauts from radiation in space. **2**
  - (ii) How can the student assess the reliability of information from secondary sources about protection from radiation? **3**
- (e) Explain how advances in technology have been fundamental in ensuring both the continuation of space programs and the development of space vehicles. **6**

**End of paper**

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