

**B O A R D O F S T U D I E S**  
NEW SOUTH WALES

**2001**

**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, 15, 19 and 21

**Total marks – 100**

**Section I** Pages 2–23

**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 25–34

**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   
*correct* ↙

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1 Lipstick manufacturers usually choose colourings that are insoluble in water.

What is one advantage of colourings that are insoluble in water?

- (A) The colouring is more easily washed out of clothes.
- (B) The colouring is less easily wiped off by licking.
- (C) The lipstick is less likely to melt in hot weather.
- (D) The lipstick is less toxic.

2 The diagram shows the cleaning instructions on a paint tin.



Based on the information given on the label, what is the solvent used in this paint?

- (A) Alcohol
- (B) Detergent
- (C) Soap
- (D) Water

3 The instructions on the label of a medicine bottle state: 'Shake well before use'.

Based on the instructions given on the label, what type of substance is this medicine?

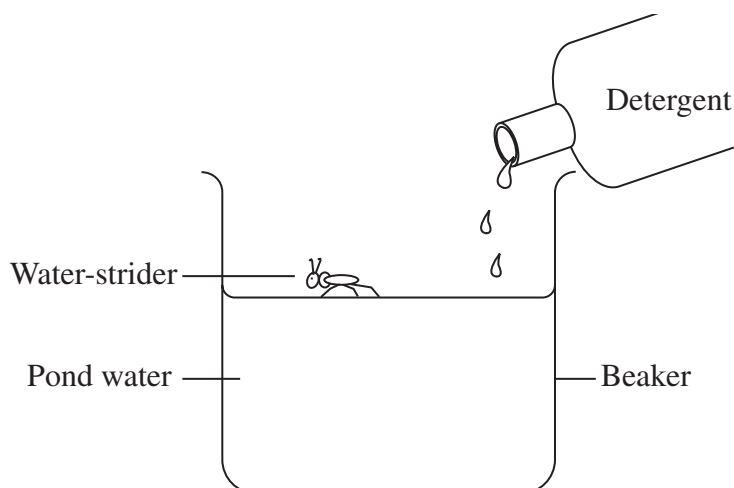
- (A) Colloid
- (B) Cosmetic
- (C) Solution
- (D) Suspension

- 4 The diagram shows information on the label of a face-wash product.



What is the likely pH range of this product?

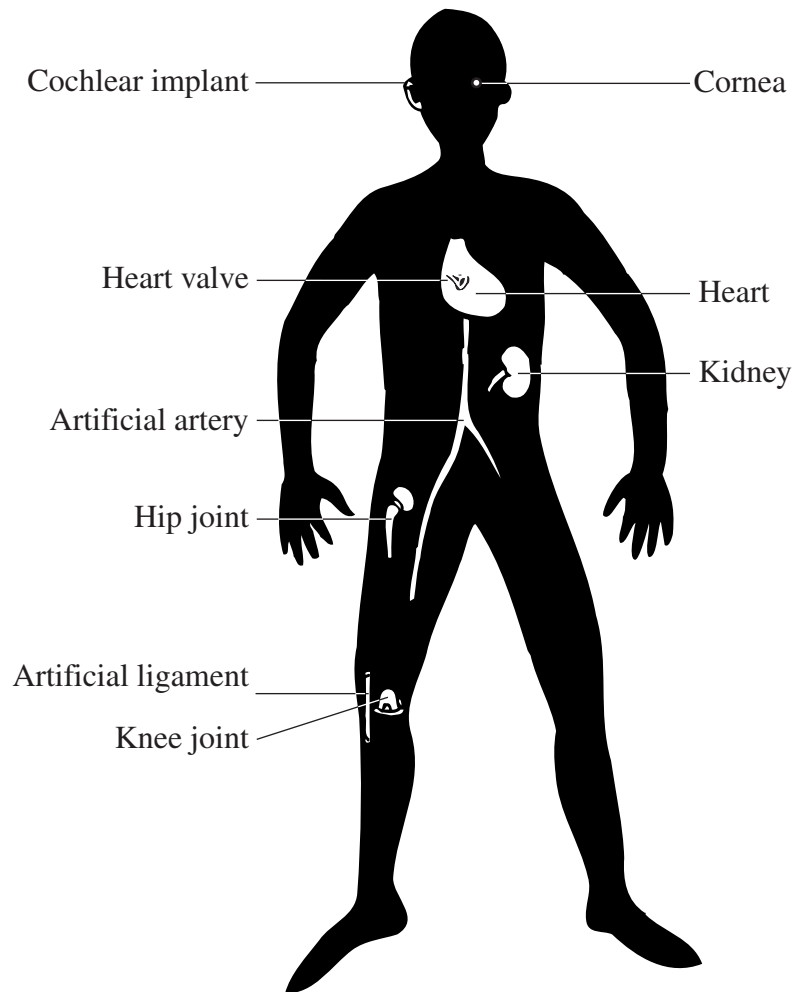
- (A) pH 6.3–6.5  
(B) pH 6.9–7.1  
(C) pH 7.5–7.7  
(D) pH 7.9–8.1
- 5 Detergent changes the surface tension of water. A student investigated how changing the surface tension affected the ability of a water-strider insect to walk on pond water.



The student used a control in this investigation. How would the control have been different from the set-up shown in the diagram?

- (A) A pin replaced the water-strider.  
(B) A small pond replaced the beaker.  
(C) Water replaced detergent in the bottle.  
(D) Detergent replaced pond water in the beaker.

- 6 The diagram shows some replacement parts of the human body.

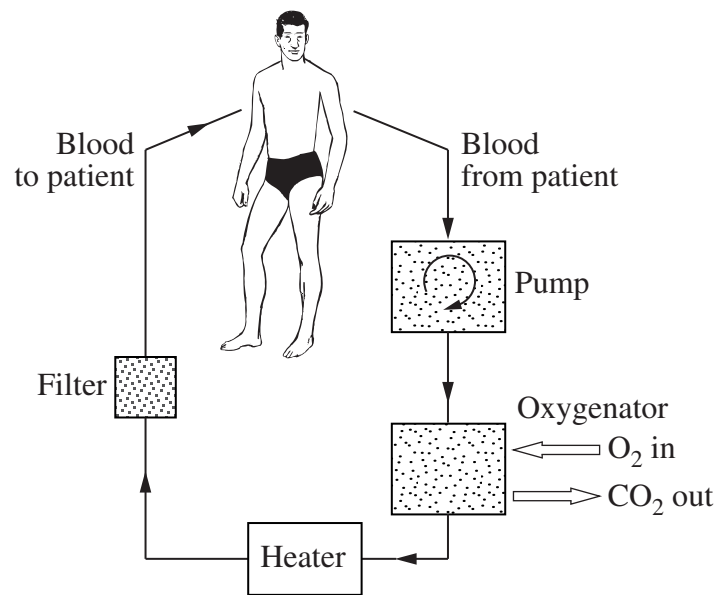


What is common to all of these replacements?

- (A) They are more durable than the original organs and body parts.
  - (B) They require organs donated by people.
  - (C) They perform the functions of the body parts they replace.
  - (D) They perform better than the original, undamaged body part.
- 7 Dentures and artificial heart valves are examples of biomedical devices. What is one reason that dentures have been successfully used for a much longer time than artificial heart valves?
- (A) People are more concerned with their appearance than with heart disease.
  - (B) The function of teeth is easier to copy than the function of the heart.
  - (C) Toothaches are more common than heart attacks.
  - (D) Heart attacks are more life threatening than toothaches.

- 8 Which one of the following medical techniques is classified as minimally invasive?
- (A) X-rays
  - (B) Ultrasound
  - (C) Keyhole surgery
  - (D) Magnetic resonance imaging (MRI)

- 9 The diagram represents a heart–lung machine.



Which part of the heart–lung machine carries out the function of the alveoli?

- (A) Pump
- (B) Oxygenator
- (C) Heater
- (D) Filter

- 10** Facsimile (fax) machines send images of written material over the telephone. The page is first scanned with a beam of laser light. The reflected light is then converted by a photodiode.

Into what form of energy does the photodiode convert light?

- (A) Chemical
- (B) Electrical
- (C) Light
- (D) Sound

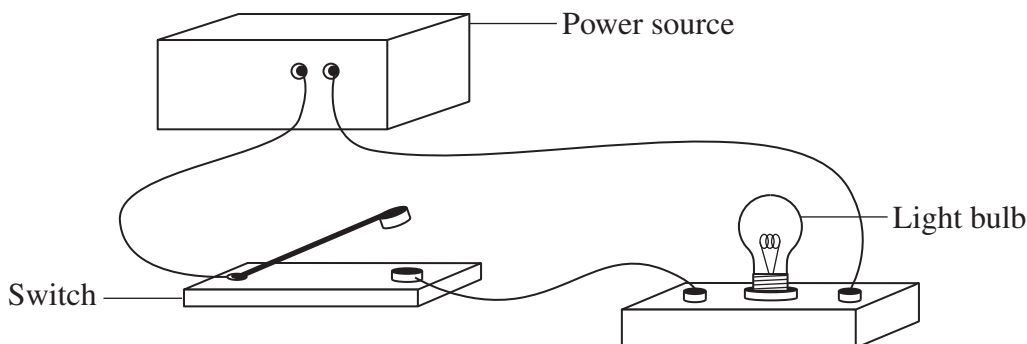
- 11** Which is the correct classification of the information systems shown in the table?

	<i>Verbal</i>	<i>Electronic</i>	<i>Long distance</i>
(A)	Sign language	Mobile phone	Sign language
(B)	Fax	Sign language	Fax
(C)	Sign language	Road signs	Road signs
(D)	Mobile phone	Fax	Mobile phone

- 12** What is one disadvantage of using microwaves compared to AM radiowaves for communication?

- (A) Microwaves travel more slowly.
- (B) Microwaves require longer antennas.
- (C) Microwaves require line-of-sight reception.
- (D) Microwaves carry fewer conversations in the same bandwidth.

- 13 The diagram shows a circuit that can be used to code a message. The coded message consists of a series of flashes of light.



In Morse code, the message consists of a series of *dots* (short flashes) and *dashes* (long flashes). In binary code the message consists of a series of *ones* (light on) and *zeros* (light off).

The table shows some letters in the alphabet coded in Morse code and in binary code.

<i>Letter</i>	<i>Morse code signal</i>	<i>Binary code signal</i>
a	dot dash	0 1 0 0 0 0 1
i	dot dot	0 1 0 0 1 0 0 1
k	dash dot dash	0 1 0 0 1 0 1 1
m	dash dash	0 1 0 0 1 1 0 1

What would a person notice if these letters were coded into Morse code and into binary code?

- (A) The binary code for letters ‘k’ and ‘m’ would be the same.  
 (B) In the binary code, each letter would be made of signals of equal length.  
 (C) Each letter in Morse code would consist of more light flashes than in binary code.  
 (D) In Morse code, each letter would have light flashes of equal length.
- 14 What is the sequence of energy transformations that occurs from the moment people speak into their mobile telephones until the message leaves the phone?
- (A) sound → kinetic → electrical → electromagnetic  
 (B) sound → potential → electromagnetic → kinetic  
 (C) sound → electromagnetic → potential → electrical  
 (D) sound → electrical → kinetic → electromagnetic



15 The diagram shows information about the electromagnetic spectrum.

Frequency (Hz)			Wavelength (m)
$10^{22}$			$10^{-14}$
$10^{21}$			$10^{-13}$
$10^{20}$	gamma rays	X-rays	$10^{-12}$
$10^{19}$			$10^{-11}$
$10^{18}$			$10^{-10}$
$10^{17}$			$10^{-9}$
$10^{16}$	ultraviolet radiation		$10^{-8}$
$10^{15}$			$10^{-7}$
$10^{14}$	VISIBLE LIGHT		$10^{-6}$
$10^{13}$	infra-red radiation		$10^{-5}$
$10^{12}$			$10^{-4}$
$10^{11}$	microwaves	EHF	$10^{-3}$
$10^{10}$		SHF	$10^{-2}$
$10^9$	television	radio frequencies	radar
$10^8$			
$10^7$	AM radio communications	VHF	1
$10^6$		HF	$10^1$
$10^5$		MF	$10^2$
$10^4$		LF	$10^3$
$10^3$			$10^4$
$10^2$			$10^5$
$10^1$			$10^6$
1			$10^7$
			$10^8$

Which of the following statements is correct?

- (A) Television uses higher frequencies than AM radio.
- (B) Radar uses shorter wavelengths than visible light.
- (C) Visible light includes wavelengths between  $10^{14}$  and  $10^{15}$  m.
- (D) Communication technologies can only use waves with frequencies in the range of  $10^4 - 10^{14}$  Hz.

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Centre Number

Section I (continued)

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Student Number

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 (6 marks)

Medications are most conveniently taken by mouth.

- (a) Outline the role of the circulatory system in the treatment of disease when using medications taken by mouth. 2

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- (b) Discuss problems associated with taking medications by mouth. 4

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**Question 17** (6 marks)

You have performed an investigation to compare the solubility of different types of tablets and capsules.

**6**

Assess the validity of the conclusions you drew from this investigation.

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**Question 18** (3 marks)

Explain ONE advantage of a colloid compared to another type of suspension. In your answer, refer to a specific colloid.

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Centre Number

Section I – Part B (continued)

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**Marks**

**Question 19** (7 marks)

Discuss the biodegradability of soaps and soapless detergents.

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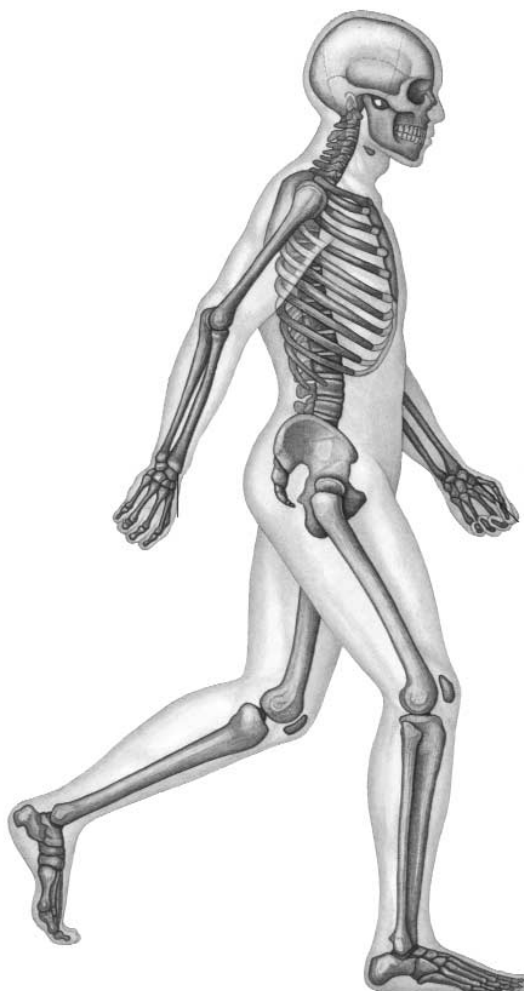
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**Question 20** (2 marks)

Label ONE pivot joint and ONE hinge joint on the diagram.

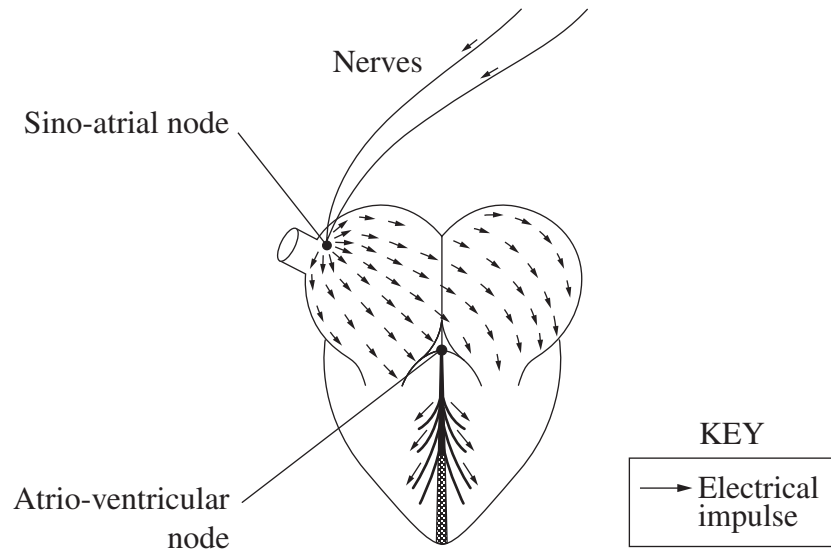
2





**Question 21** (6 marks)

The sino-atrial node controls the rhythmic contractions of the heart by sending out tiny electrical impulses, as shown in the diagram.



- (a) Name the device that can perform the role of the sino-atrial node. 1

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- (b) Explain the problems that result when the sino-atrial node does not perform normally. 5

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Section I – Part B (continued)

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Student Number

**Marks**

**Question 22** (7 marks)

- (a) Explain ONE effect of a build-up of plaque in blood vessels on the flow of blood. **2**

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- (b) Compare the advantages and disadvantages of TWO treatments available to a patient suffering from the effects of a build-up of plaque in their arteries. **5**

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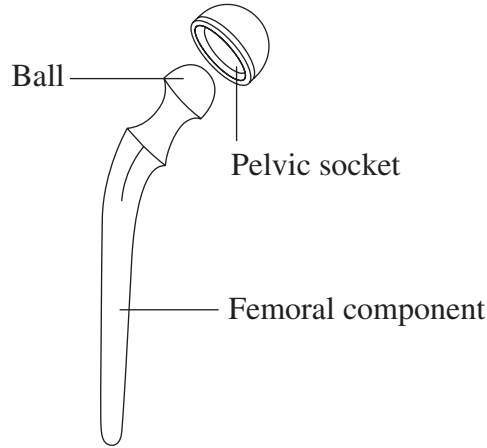
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**Question 23** (5 marks)

The diagram shows an artificial hip. Often a superalloy metal is used to make these parts.



- (a) Describe TWO properties of the superalloy that make this metal suitable for use as a replacement for bones in the joint. **2**

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- (b) Explain why artificial joints need to have the ball and socket covered in polyethylene. **3**

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Centre Number

Section I – Part B (continued)

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Student Number

**Marks**

**Question 24** (3 marks)

Mobile phones use microwaves. Describe the properties of microwaves that make them useful in mobile phone communication. **3**

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**Question 25** (7 marks)

(a) When a television signal reaches your house it passes from the aerial, through the television, to your eye. Construct a flowchart to show the sequence of events in the transfer of this message. On your flowchart, indicate the energy transformation occurring at each stage, and label ONE place where decoding occurs. **3**

**Question 25 continues on page 22**

Question 25 (continued)

- (b) During the 1940s, radio was the main form of electronic mass communication in Australian homes. Now televisions are common. Analyse the impact of this change in mass communication on society. **4**

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**End of Question 25**

**Question 26** (8 marks)

You have carried out an investigation in which you observed the transmission of light through an optic fibre, and compared it with another material such as nylon or glass. Write a scientific report on this investigation.

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Your report should include:

- your method, including a diagram;
- an outline of the observations you made;
- an analysis of your results; and
- your conclusions.

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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.

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

**Question 27 — Polymers (25 marks)**

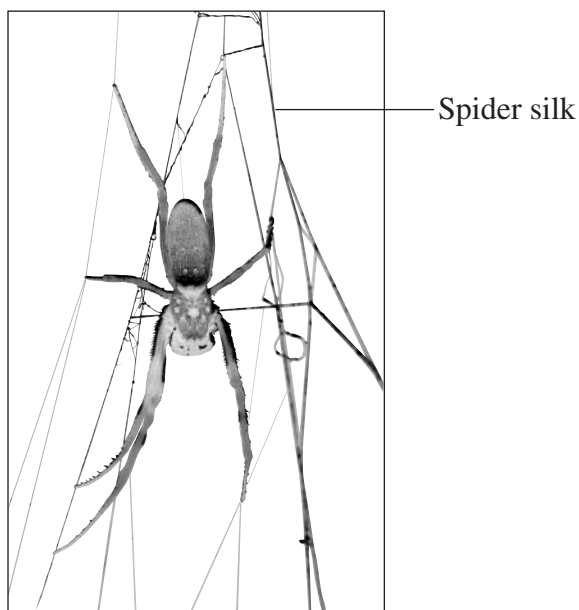
(a) Modern society uses many different natural and synthetic polymers.

(i) What is a *polymer*? **1**

(ii) Describe a property of ONE natural polymer that makes the polymer suitable for a specific purpose. **2**

(b) The table compares some of the properties of spider silk, Kevlar and steel.

	<i>Spider silk</i>	<i>Kevlar</i>	<i>Steel</i>
Relative weight	ultra-light	light	heavy
Relative strength	100	5	1
Relative elasticity	high	low	low



(i) How many times stronger than Kevlar is spider silk? **1**

(ii) Scientists predict that spider silk will be mass produced in the near future and will replace other materials. Kevlar is presently made into ropes for towing cars. **3**

Using the information in the table, explain whether spider silk would make a suitable alternative to Kevlar for ropes for towing cars.

**Question 27 continues on page 27**

## Question 27 (continued)

- (c) The plastics industry has developed a coding system that labels objects with a number from 1 to 7. 5

<i>Code</i>	<i>Type of plastic</i>
1	Polyethylene-terephthalate (PET)
2	High-density polyethylene (HDPE)
3	Polyvinylchloride (PVC)
4	Low-density polyethylene (LDPE)
5	Polypropylene (PP)
6	Polystyrene (PS)
7	All others: eg polyamide, acrylic, polyurethane

Assess the value of using this coding system in reducing the impact of synthetic polymers on the environment.

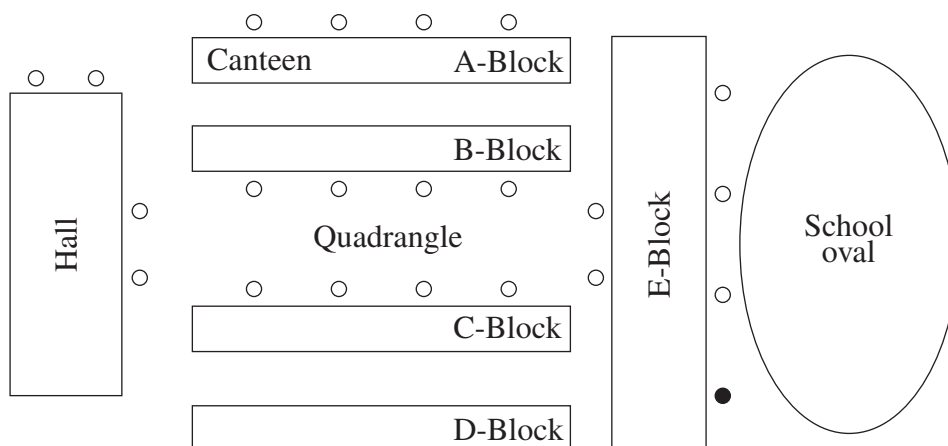
- (d) During your study of Polymers, you investigated the effect of temperature on polymers.
- (i) Explain why you selected a particular piece of equipment to test the effect of temperature on polymers. 2
- (ii) Summarise the results of your experiment. 4

**Question 27 continues on page 28**

Question 27 (continued)

- (e) The environment group of a school was concerned about the amount of plastic material thrown out each day by students. The group wanted to devise ways to reduce the waste. It wanted to know if the plastic material was brought to the school by the students or was purchased from the school canteen. 7

The group analysed the waste from one garbage bin on the oval side of E-block.



- Garbage bins not analysed
- Garbage bin analysed

For one month, the waste plastic in the garbage bin was collected and analysed each Monday at recess. Each week the group found that the garbage bin contained twice as much school-generated waste as home-generated waste.

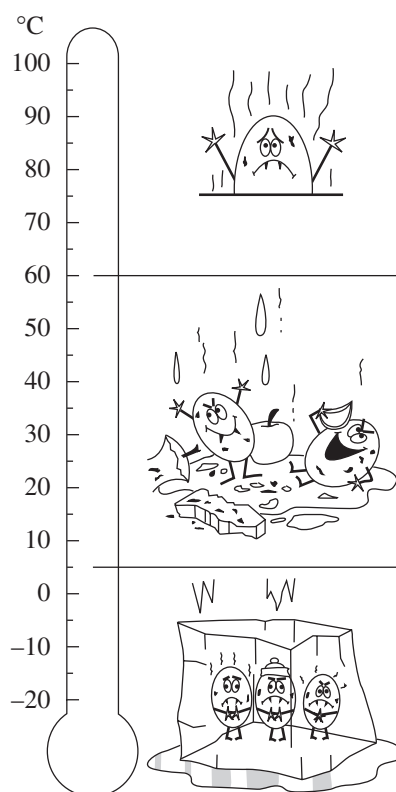
Analyse the accuracy and reliability of this investigation, and suggest ways of improving the investigation.

**End of Question 27**

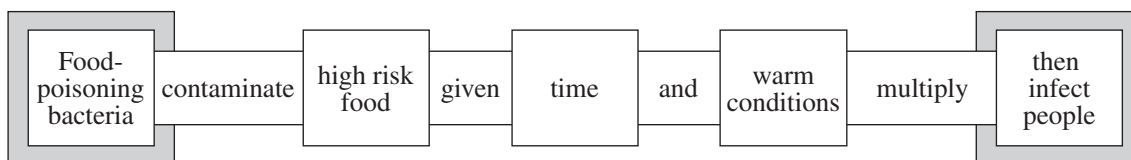
**Question 28 — Preservatives and Additives (25 marks)**

- (a) (i) Identify ONE process that can be used to physically preserve food. 1
- (ii) Describe how this process preserves food. 2
- (b) The diagrams show the effect of temperature on the bacteria that cause food-poisoning and the food-poisoning chain.

**Effect of temperature on food-poisoning bacteria**



**The food-poisoning chain**



- (i) Foods are sometimes kept warm at approximately 55°C. What is ONE problem associated with this practice? 1
- (ii) Explain how you could break the food-poisoning chain to prevent food-poisoning. 3

**Question 28 continues on page 30**

	<b>Marks</b>
Question 28 (continued)	
(c) Identify and explain the important steps leading to the discovery of the antibiotic, penicillin.	<b>5</b>
(d) (i) Outline an investigation in which you determined the pH of a range of consumer products.	<b>3</b>
(ii) Explain how pH might influence the activity of microorganisms during the manufacture of these products.	<b>3</b>
(e) The National Food Authority uses codes as alternatives to the names of preservatives and additives on labels.	<b>7</b>

Assess the need for labelling of additives and preservatives.

**End of Question 28**

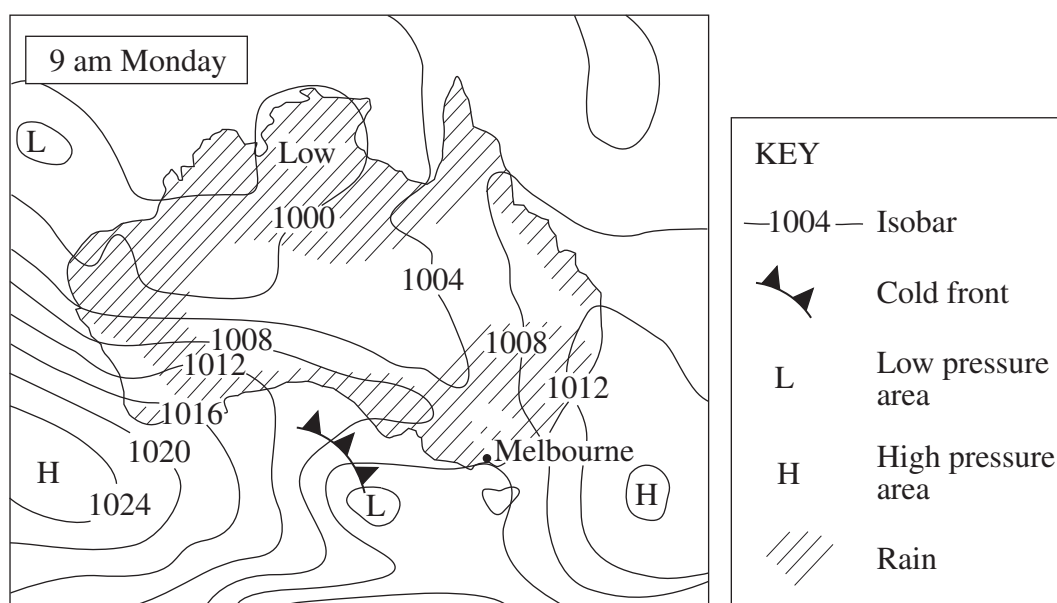
**Question 29 — Pharmaceuticals (25 marks)**

- (a) (i) Identify ONE type of blood vessel found in the human circulatory system. **1**
- (ii) Compare the blood-carrying capacity of this type of vessel with that of a different type of blood vessel. **2**
- (b) Using a diagram, explain how a nerve impulse travels along a reflex arc. **4**
- (c) Identify and explain the important steps in the development of aspirin. **5**
- (d) A person's reaction time is the time between the person receiving a stimulus and producing a response.
- (i) Describe a first-hand investigation that you undertook to compare the reaction times of a number of people. **3**
- (ii) Account for any differences that were found. **3**
- (e) There is considerable evidence to suggest that many bacteria are becoming resistant to penicillin. **7**

Analyse a range of actions that may be useful in the future to minimise the risks posed by this resistance to penicillin.

**Question 30 — Disasters (25 marks)**

- (a) (i) Identify ONE Australian disaster where nature and human activity have combined to produce the disaster. 1
- (ii) Describe how the human activity contributed to this disaster. 2
- (b) The diagram shows a weather map indicating atmospheric conditions over Australia.



- (i) What is the lowest air pressure indicated by an isobar on this map? 1
- (ii) The Bureau of Meteorology predicted the weather in Melbourne for Tuesday morning as ‘Cooler conditions with strong south-westerly winds and rain’. 3
- Using the information from the map, suggest why this prediction was made.
- (c) During your study of Disasters, you have examined an evacuation drill procedure. 5

Assess the strengths and weaknesses of this procedure in the case of a fire.

**Question 30 continues on page 33**



Question 30 (continued)

- (d) During your study of Disasters, you carried out a first-hand investigation to construct an alarm or safety device.
- (i) Describe how the device you built works. **2**
  - (ii) Evaluate the effectiveness of your device, including improvements you could have made to its design. **4**
- (e) During a period of heavy rain, a river in a country area has risen significantly. The weather bureau predicts at least another week of heavy rain. Towns and farms near the river are at great risk of being flooded, which could have disastrous results. **7**

Analyse the role that emergency services could play in preventing such a disaster, or minimising its impact.

**End of Question 30**

**Please turn over**

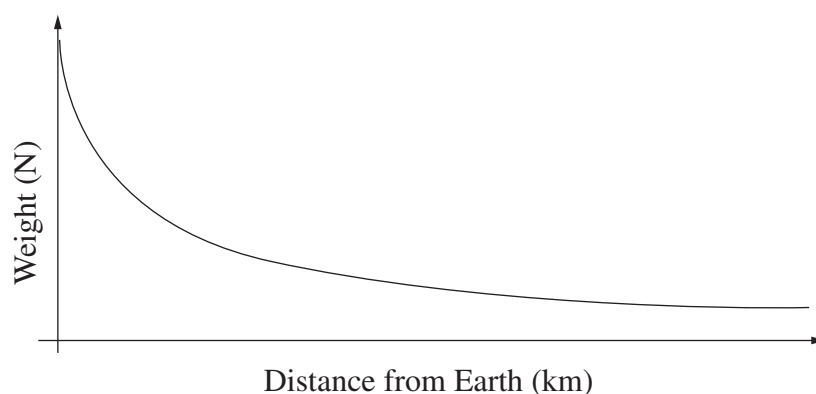
**Question 31 — Space Science (25 marks)**

(a) Astronauts who spend long periods of time in orbiting space stations can experience short-term and long-term effects on body functions.

(i) Identify ONE effect that long periods spent in space can have on the health of astronauts. **1**

(ii) Describe what can be done to overcome the effect identified in part (i). **2**

(b) The weights of astronauts were measured at different distances from the Earth. The results for one astronaut are shown in the graph.



(i) Describe what happened to the weight of the astronaut. **1**

(ii) It is often said that astronauts in orbit experience weightlessness. Discuss why micro-gravity would be a more appropriate term to describe this effect. **3**

(c) Discuss how ONE technology developed in the last thirty years has increased our understanding of space. **5**

(d) During your study of Space Science, you carried out an investigation to demonstrate why a large booster rocket is required during lift-off, but not to re-enter the Earth's atmosphere.

(i) Identify the equipment you used. **1**

(ii) Justify the appropriateness of your plan and explain how the accuracy and reliability of your investigation could be improved. **5**

(e) Assess the value of continuing the space program. **7**

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