BOARD OF STUDIES
NEW SOUTH WALES

2012

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 13, 15, 17, 19 and 21

Total marks – 100

Section I Pages 2–24

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 25–30

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 Which of the following vitamins is water soluble?

(A) Vitamin A

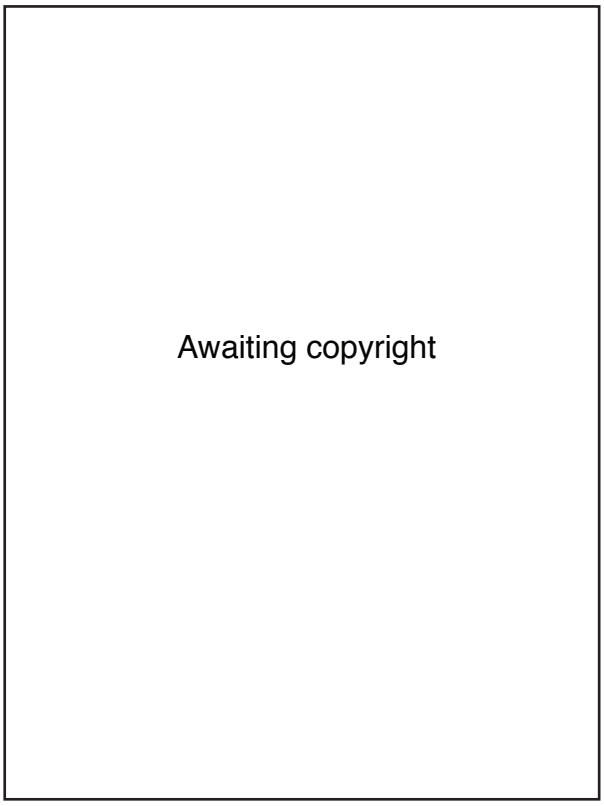
(B) Vitamin C

(C) Vitamin D

(D) Vitamin K

2 The diagrams show a chicken bone before and after being treated with a substance.

Before treatment



After treatment

What substance was used to treat the bone?

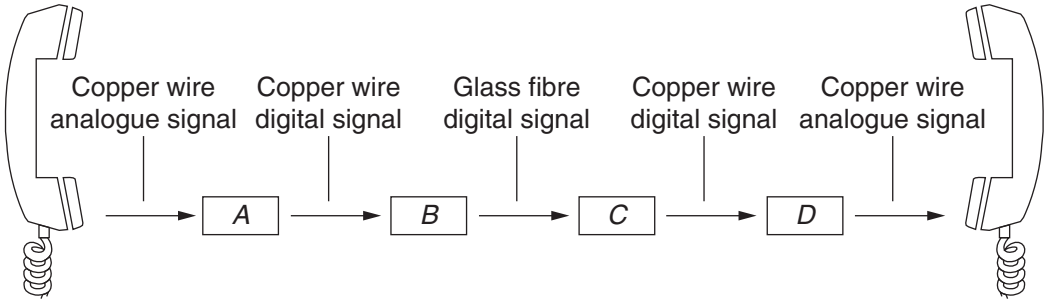
(A) Acid

(B) Alcohol

(C) Silicone

(D) Water

3 The diagram represents a land-connected phone system. A voice signal is transmitted from left to right.



At what point does a conversion of electrical energy to light energy take place in this system?

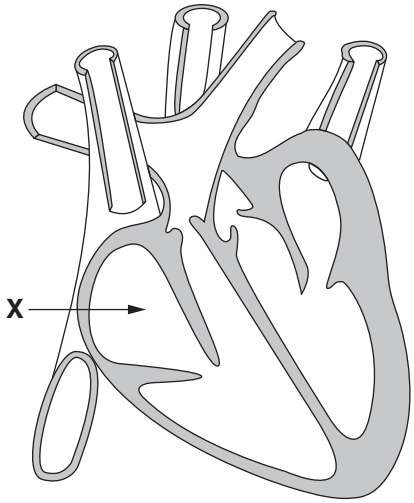
(A) *A*

(B) *B*

(C) *C*

(D) *D*

4 The diagram represents a human heart.



What is the function of the part labelled **X**?

(A) To hold blood temporarily

(B) To pump blood to the body

(C) To pump blood to the lungs

(D) To prevent blood flowing in the wrong direction

5 What causes a healthy human heart to beat regularly?

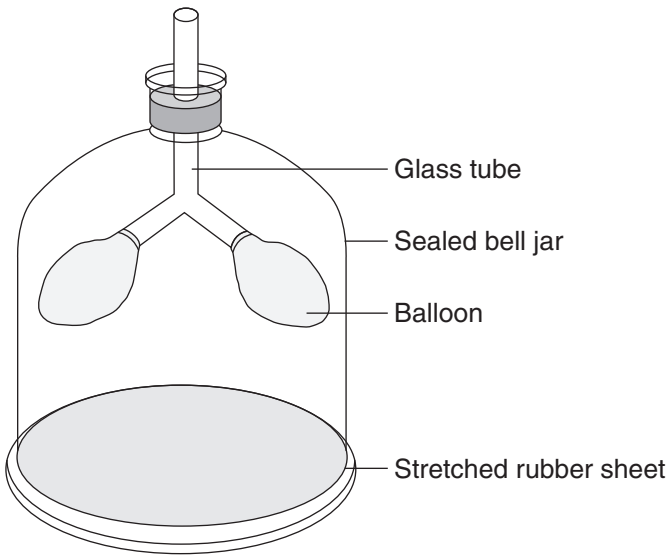
(A) Nerve impulses from the brain

(B) Specialised tissues in the heart

(C) Hormones present in the blood

(D) Electrical signals from the spinal cord

6 This apparatus was used to model the process of breathing.



Which statement relates the use of this model to the process of inhaling?

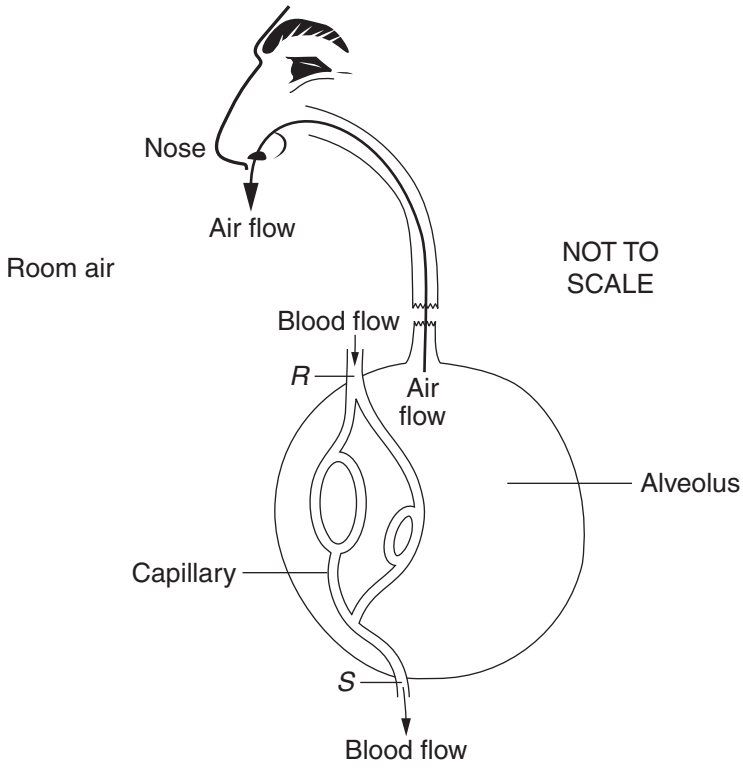
(A) Pushing the stretched rubber sheet upward causes the balloons, representing the lungs, to inflate.

(B) Pulling the stretched rubber sheet downward causes the balloons, representing the lungs, to inflate.

(C) Blowing air into the glass tube inflates the balloons causing the stretched rubber sheet to move downward.

(D) Sucking air out of the glass tube causes the stretched rubber sheet to move upward, representing the contraction of the diaphragm.

7 The diagram represents part of the respiratory system of a person exhaling.



Which statement is correct?

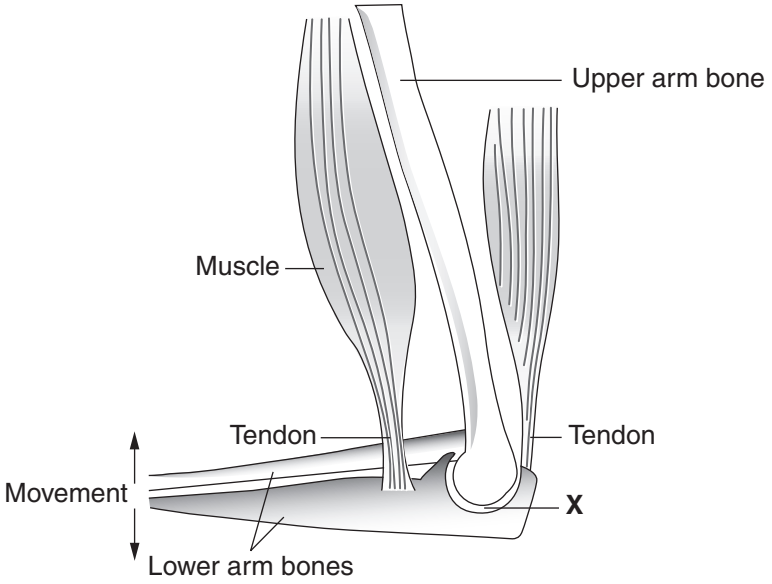
(A) The oxygen concentration in the room air is less than the oxygen concentration in the alveolus.

(B) The oxygen concentration at *R* is greater than the oxygen concentration at *S*.

(C) The carbon dioxide concentration at *S* is less than the carbon dioxide concentration at *R*.

(D) The carbon dioxide concentration in the room air is greater than the carbon dioxide concentration in the alveolus.

8 This diagram shows a joint **X** within the human elbow and the movement this joint allows.



What type of joint is **X**?

(A) Ball and socket

(B) Sliding

(C) Pivot

(D) Hinge

9 A mixture consists of liquids that remain suspended for more than two months.

What type of mixture is this?

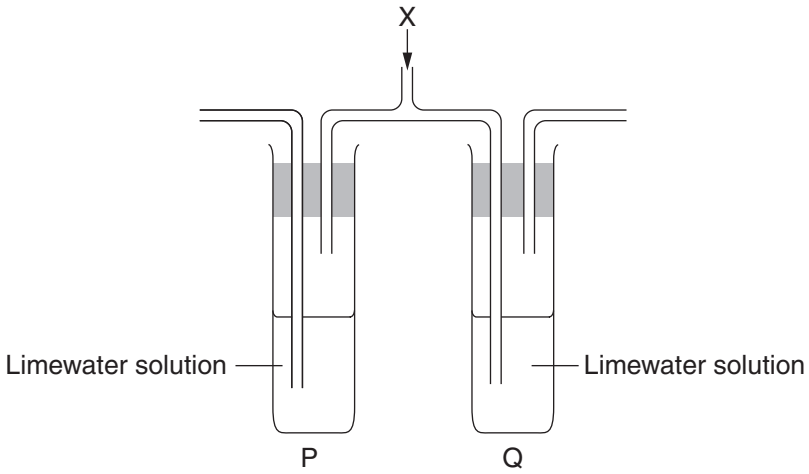
(A) Emulsion

(B) Foam

(C) Solution

(D) Suspension

10 When a mixture of gases containing carbon dioxide is bubbled through a limewater solution, a suspension is formed causing the solution to turn milky in appearance. The more carbon dioxide in the gas mixture, the greater the milkiness of the limewater solution.



A person put a clip on his nose to block gas flow through it. He then sealed his lips over the tube X and slowly breathed in and out.

What would be observed?

(A) The limewater in P and Q will turn milky at the same rate.

(B) The limewater in P and Q will remain unchanged.

(C) The limewater in P will turn milky first.

(D) The limewater in Q will turn milky first.

11 Why are all geostationary satellites located 35 800 km above the Earth's equator?

(A) This is the maximum distance for live satellite broadcasts before transmission time delays become unacceptably long.

(B) Satellites above the equator can transmit signals to both the northern and southern hemispheres.

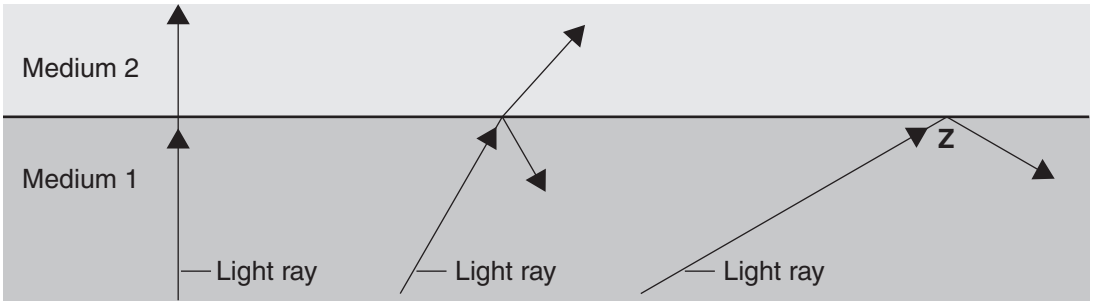
(C) At this altitude, the satellite can transmit signals to a maximum area of the Earth's surface.

(D) At this altitude, the time it takes for the satellite to orbit the Earth is one day.

12 Which medical technique is correctly matched with its advantages and a disadvantage?

	Medical Technique	*Advantages*	*Disadvantage*
(A)	X-ray	• Can show breaks in bones • Minimally invasive	• Requires a strong magnetic field
(B)	Ultrasound	• Can produce images of soft tissues • Non-invasive	• Provides limited detail
(C)	Keyhole surgery	• Causes minimal tissue damage • Minimally invasive	• Requires a general anaesthetic
(D)	MRI	• Can image blood flow • Non-invasive	• Damages living tissue

13 The diagram shows scientific principles that can be used in communication.



What is the name of the scientific principle that **Z** represents?

(A) Refraction

(B) Binary transmission

(C) Total internal reflection

(D) Absorption of radio waves by the ionosphere

14 A knee joint has been damaged and requires a replacement.

What material would be most suitable to replace this joint?

(A) Pyrolytic carbon

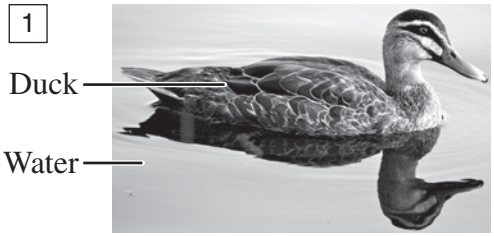
(B) Silicone

(C) Superalloy

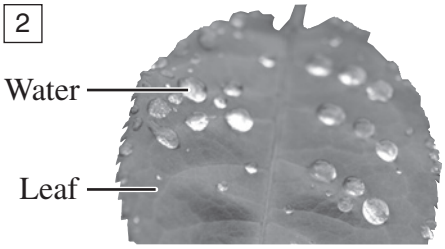
(D) Teflon®

15 Which TWO of the following are examples of the effects of surface tension?

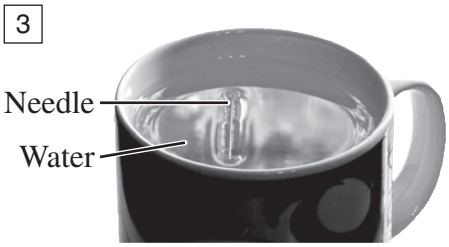
1



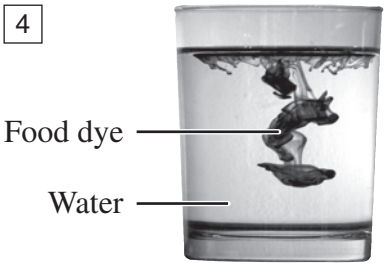
2



3



4



(A) 1 and 2

(B) 1 and 3

(C) 2 and 3

(D) 2 and 4

16 One function of the small intestine is to break down

(A) bacteria.

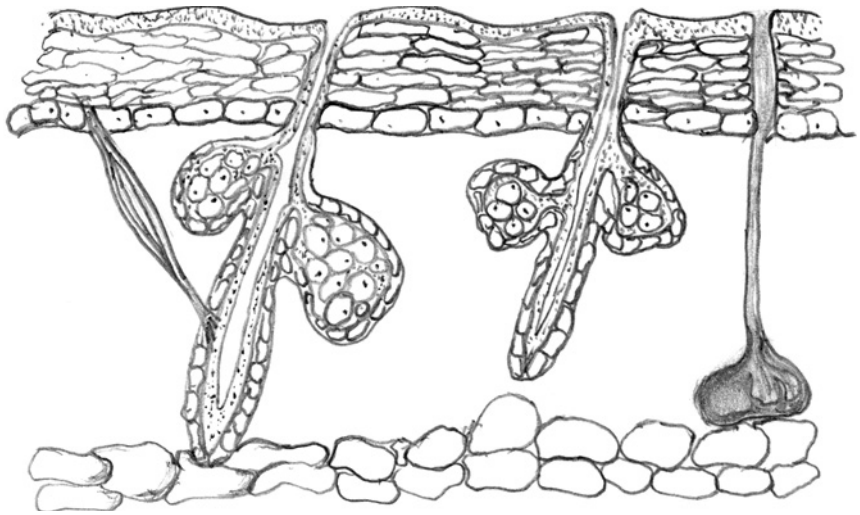
(B) fats.

(C) glucose.

(D) vitamins.

17 A tissue sample was observed through a microscope.

A student recorded the observation as a diagram.



What tissue is represented by the diagram?

(A) Capillary network

(B) Muscle

(C) Bone

(D) Skin

18 Which of the following is a *hypothesis*?

(A) Plastic bags degrade more quickly than paper bags.

(B) Do plastic bags degrade more quickly than paper bags?

(C) Determine whether plastic bags degrade more quickly than paper bags.

(D) Plastic bags are made from synthetic polymers and therefore do not degrade quickly.

19 Types of electromagnetic radiation and their wavelength ranges are shown.

Type of Electromagnetic Radiation	*Wavelength Range* (mm)
Visible light	0.00039 – 0.00073
Infra-red	0.00075 – 1
Microwave	1 – 500
Radio wave	>500

All electromagnetic waves travel at the speed of $3 \times 10^8 \, m \, s^{-1}$. The following formula shows the relationship between their speed, wavelength and frequency.

$$\text{Speed} = \text{Frequency} \times \text{Wavelength}$$

What type of electromagnetic wave has a frequency of 6.34×10^8 Hz?

(A) Visible light

(B) Infra-red

(C) Microwave

(D) Radio wave

20 When a TV interviewer in Sydney conducts a live interview with a person in New York, a satellite is used. The signals transmitted via the satellite travel at a speed of $3 \times 10^8 \, m \, s^{-1}$ between the two cities. A person watching the interview observes a noticeable delay in the communication process.

When a person in Sydney talks to a person in New York by phone, the signals pass through optical fibres between the two cities, travelling at a speed of $2 \times 10^8 \, m \, s^{-1}$, and there is no noticeable delay in the communication process.

Why is the delay noticeable in the TV interview but not in the phone conversation?

(A) The phone signals travel more efficiently through optical fibres than electromagnetic waves do through a vacuum.

(B) Computers in phone systems make the process faster than satellite systems.

(C) Satellites move so fast that the TV signals take time to catch up with them.

(D) The phone signals travel less distance than the TV signals.

BLANK PAGE

Senior Science

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 (6 marks)

(a) How would you investigate the transmission of light through an optical fibre? **2**

.....

.....

.....

.....

(b) What are the similarities and differences between communication using optical fibres and communication using microwaves? **4**

.....

.....

.....

.....

.....

.....

.....

.....

Question 22 (5 marks)

(a) State TWO properties of silicone that make it useful in bionic implants. **2**

.....

.....

(b) Explain TWO safety precautions that need to be taken when conducting an experiment to test the properties of silicone. **3**

.....

.....

.....

.....

.....

.....

Centre Number

Student Number

Section I – Part B (continued)

Question 23 (5 marks)

Explain how cardiopulmonary resuscitation works to keep a patient alive. **5**

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Question 24 (8 marks)

Exercise causes a person's heart rate to increase. Age affects the amount by which the heart rate increases.

(a) Write a method for an investigation to test the effect of age on the change in heart rate caused by exercise. **4**

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(b) How would you analyse the data from the investigation? **3**

.....

.....

.....

.....

.....

.....

(c) Propose another factor that could influence the change in heart rate caused by exercise. **1**

.....

Centre Number

Student Number

Section I – Part B (continued)

Question 25 (4 marks)

Assess the impacts of pacemakers on society. **4**

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Question 26 (4 marks)

How do microflora inhibit the growth of disease-causing organisms? **4**

.....

.....

.....

.....

.....

.....

.....

.....

BLANK PAGE

Centre Number

Student Number

Section I – Part B (continued)

Question 27 (8 marks)

(a) Contrast the sound quality produced by AM and FM radio waves. **1**

.....

(b) Why are AM and FM radio waves used for different purposes? **4**

.....

.....

.....

.....

.....

.....

.....

.....

(c) Describe how electromagnetic waves can be modulated to produce AM and FM radio waves. **3**

.....

.....

.....

.....

.....

.....

.....

.....

Question 28 (3 marks)

Both electronic and non-electronic information systems are used to cover events such as the Olympic Games. **3**

What are the benefits of using each of these information systems to cover such events?

.....

.....

.....

.....

.....

.....

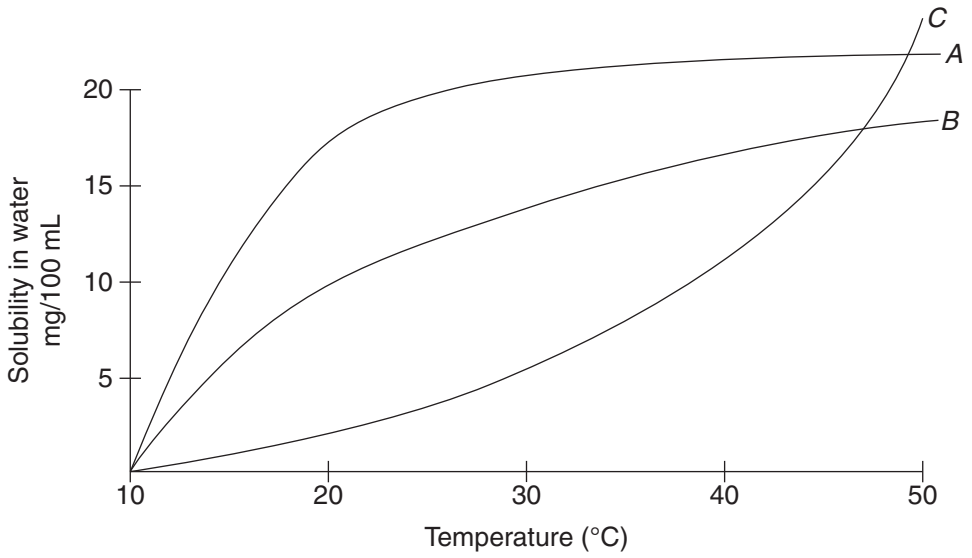
Question 29 (4 marks)

Please turn over

Question 29 (4 marks)

A company is developing a new medication. The medication must be stored as a solid. It must be dissolved in water to be swallowed and it must be absorbed rapidly in the stomach.

Consider the following information about three possible forms of the new medication, *A*, *B* and *C*.



	Form of medication		
	A	*B*	*C*
Absorption rate in the digestive system if pH < 7	Low	High	High
Absorption rate in the digestive system if pH > 7	High	Low	High

Question 29 continues on page 23

Question 29 (continued)

To be effective, at least 5 mg of the medication must be dissolved in 100 mL of tap water (20°C). This must be swallowed immediately so that it can be absorbed into the bloodstream as quickly as possible.

(a) Why would the company sell this medication as tablets rather than capsules? **1**

.....

.....

(b) Which form of the medication (*A*, *B* or *C*) is most suitable? Justify your choice. **3**

.....

.....

.....

.....

.....

.....

End of Question 29

Question 30 (8 marks)

Relate the properties of surfactants, emulsifiers and solvents to their uses on the body. Include examples in 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 parts (d)–(e) of the question in Section II Answer Booklet 2.
Extra writing booklets are available.

Page

Question 31 — Polymers (25 marks)

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

(a) Why is the future supply of synthetic polymers related to the production of petrochemicals? **3**

(b) An investigation was conducted to measure the elasticity of a polymer fibre. Different masses were hung on a 20 cm length of the fibre, and the extension of the fibre from its original length was measured and recorded. The results are shown in the table.

Mass (g)	*Extension* (cm)
100	2.0
200	4.2
400	7.8
500	10.1

(i) Graph these measurements on the grid provided. **3**

(ii) Show clearly how to use this graph to predict the extension that would be produced by hanging a 300 g mass on the same fibre. State the predicted extension in your answer and show your working on the graph. **2**

(c) How are the properties of natural polymers related to their uses? **4**

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

(d) (i) In gathering and processing information about the recycling of plastics, how did you ensure that the information was valid? **3**

(ii) Describe the issues involved with the recycling of plastics. **3**

(e) Account for the widespread use of plastics in society. **7**

Question 32 — Preservatives and Additives (25 marks)

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

(a) Why is it unnecessary to add preservatives to cheeses and yoghurts? **3**

(b) An investigation was conducted to measure the rate of reproduction at different temperatures of bacteria that cause food spoilage. The bacteria were grown on a nutrient gel, beginning with a colony 1 mm in diameter at each temperature tested. The rate of reproduction was determined by measuring the diameter of the bacterial colony after 5 days. The results are shown in the table.

Temperature (°C)	*Diameter of colony* (mm)
10	2.0
15	4.2
25	7.8
30	10.1

(i) Graph these measurements on the grid provided. **3**

(ii) Show clearly how to use this graph to predict the diameter that the colony at a temperature of 20°C would have reached after 5 days. State the predicted diameter in your answer and show your working on the graph. **2**

(c) Explain the effects of negative labelling of food products. Include examples in your answer. **4**

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

(d) (i) In gathering and processing information about preservation techniques used by different cultural groups, how did you ensure that the information was valid? **3**

(ii) Describe a benefit and a problem involved in using food additives. Include examples in your answer. **3**

(e) How has an understanding of the conditions under which microorganisms grow and reproduce contributed to the development of food preservation techniques? **7**

Question 33 — Pharmaceuticals (25 marks)

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

(a) Why is it beneficial to have a range of antibiotics available? **3**

(b) An investigation was conducted to measure the rate of reproduction at different temperatures of bacteria that cause disease. The bacteria were grown on a nutrient gel, beginning with a colony 1 mm in diameter at each temperature tested. The rate of reproduction was determined by measuring the diameter of the bacterial colony after 5 days. The results are shown in the table.

Temperature (°C)	*Diameter of colony* (mm)
10	2.0
15	4.2
25	7.8
30	10.1

(i) Graph these measurements on the grid provided. **3**

(ii) Show clearly how to use this graph to predict the diameter that the colony at a temperature of 20°C would have reached after 5 days. State the predicted diameter in your answer and show your working on the graph. **2**

(c) How are differences between arteries and capillaries related to their functions? **4**

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

(d) (i) In gathering and processing information about the components of the circulatory system, how did you ensure that the information was valid? **3**

(ii) Describe how the circulatory system is involved in fighting bacteria. **3**

(e) How has the work of TWO scientists contributed to an understanding of the causes and prevention of disease? **7**

Question 34 — Disasters (25 marks)

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

(a) Why is radar an important technology for monitoring weather? **3**

(b) An investigation was conducted to measure the speed of P waves through the Earth's crust. The time taken for P waves to reach recording stations at different distances from an earthquake epicentre was determined. The results are shown in the table.

Distance of recording station from epicentre (km)	*Time taken for P waves to reach the recording station* (s)
200	20
400	42
800	78
1000	101

(i) Graph these measurements on the grid provided. **3**

(ii) Show clearly how to use this graph to predict the time that it would take P waves to reach a recording station 600 km from the epicentre. State the predicted time in your answer and show your working on the graph. **2**

(c) Describe how human activities contribute to the effects of disasters and how they reduce the effects of disasters. Refer to TWO different types of disasters in your answer. **4**

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

(d) (i) In gathering and processing information about types of native vegetation that promote the spread of bushfires, how did you ensure that the information was valid? **3**

(ii) Describe an energy transfer and an energy transformation associated with bushfires. **3**

(e) Evaluate the contribution of scientific advances to the prediction of earthquakes. **7**

Question 35 — Space Science (25 marks)

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

(a) Why are booster rockets used during lift-off of some rockets? **3**

(b) Space scientists conducted an investigation to model the effects of the force of gravity on satellites of different masses at the same fixed distance from the Earth. The results are shown in the table.

Mass (kg)	*Force on satellite* (N)
100	2.0
200	4.2
400	7.8
500	10.1

(i) Graph these measurements on the grid provided. **3**

(ii) Show clearly how to use this graph to predict the force that would act on a 300 kg satellite at the same distance from the Earth. State the predicted force in your answer and show your working on the graph. **2**

(c) Why are optical telescopes built on high mountains? **4**

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

(d) (i) In gathering and processing information about why animals were sent into space before humans, how did you ensure that the information was valid? **3**

(ii) Describe how time spent in space affects human health. **3**

(e) How have developments in technology in Australia and other countries contributed to our understanding of the universe? **7**

End of paper

BLANK PAGE

BLANK PAGE

BOARD OF STUDIES
NEW SOUTH WALES

2012
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) .....

.....

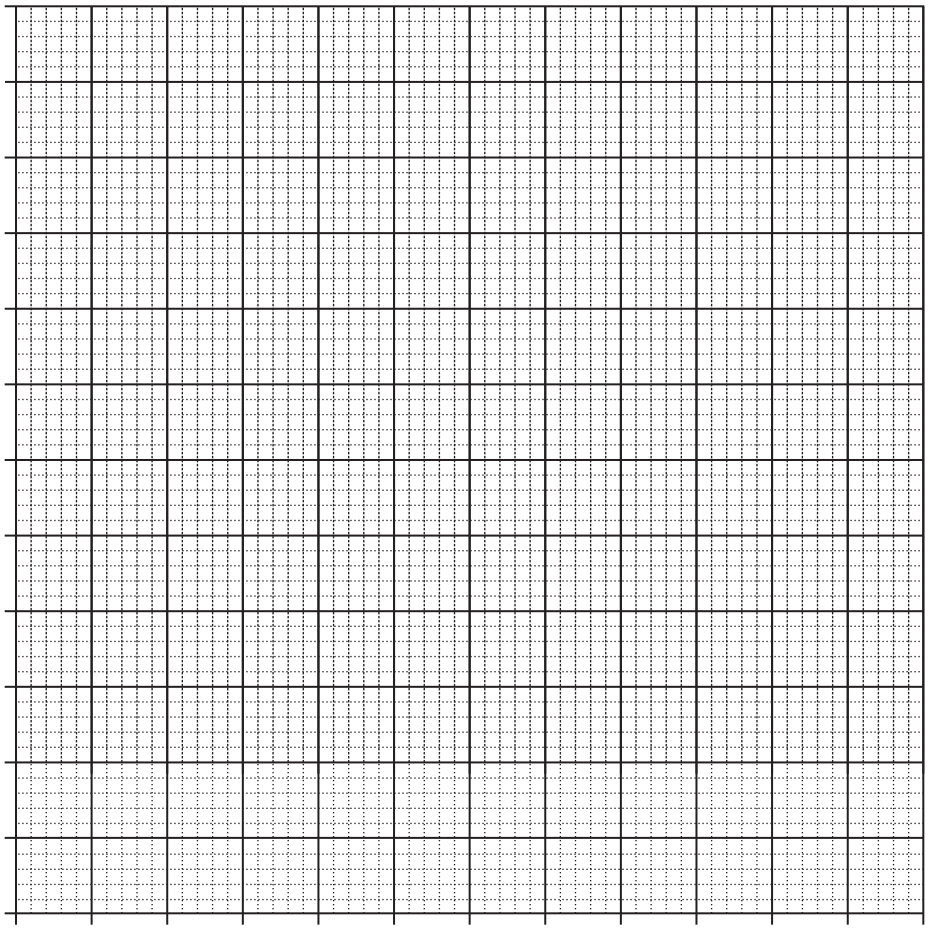
.....

.....

.....

.....

(b) (i)



(b) (ii) .....

.....

(c) .....

.....

.....

.....

.....

.....

.....

.....

BLANK PAGE

BOARD OF STUDIES
NEW SOUTH WALES

2012
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

(d) (i) .....

.....

.....

.....

.....

.....

.....

(ii) .....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(e) .....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

BLANK PAGE