

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

2010 HSC Senior Science Sample Answers

This document contains ‘sample answers’, or, in the case of some questions, ‘answers could include’. These are developed by the examination committee for two purposes. The committee does this:

- (a) as part of the development of the examination paper to ensure the questions will effectively assess students’ knowledge and skills, and
- (b) in order to provide some advice to the Supervisor of Marking about the nature and scope of the responses expected of students.

The ‘sample answers’ or similar advice are not intended to be exemplary or even complete answers or responses. As they are part of the examination committee’s ‘working document’, they may contain typographical errors, omissions, or only some of the possible correct answers.

Section I, Part B

Question 21 (a)

Sample answer:

Colloids have uniform particles and can contain an emulsifier. They only settle into layers slowly. Suspensions settle into layers quickly. Suspensions have two or more layers and do not contain an emulsifier.

Answers could include:

A table showing differences
Reference to particle size.

Question 21 (b)

Sample answer:

Colloid

Question 21 (c)

Sample answer:

It doesn't separate upon standing so there is no need to shake it before use.

Answers could include:

- Consumers may prefer the texture/appearance of a colloid more than a suspension based dressing
- Longer shelf life.

Question 22 (a)

Sample answer:

pH is a measure of the acidity or alkalinity of a substance.

Answers could include:

$$\text{pH} = -\log[\text{H}^+]$$

Question 22 (b)

Sample answer:

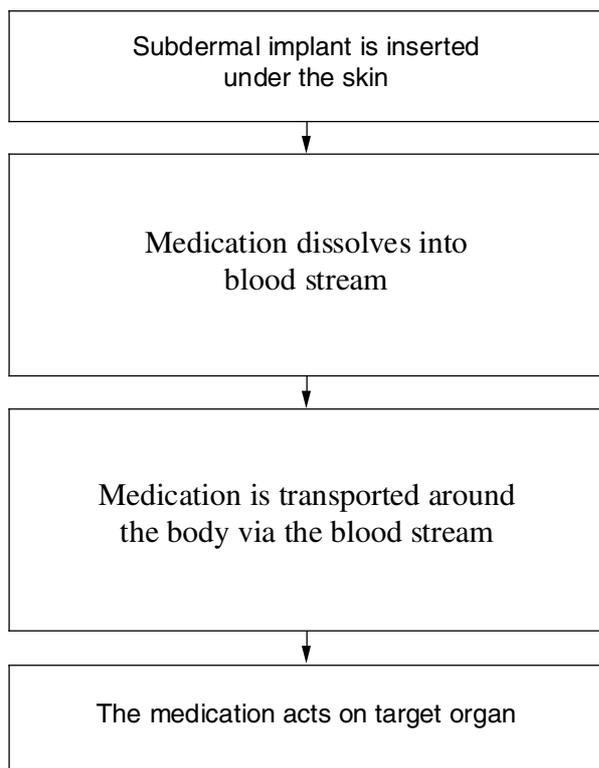
pH meter or universal indicator (not general 'indicator').
Data logger with pH probe.

Question 22 (c)***Sample answer:***

Skin: pH 5.5 to prevent the colonisation of microflora

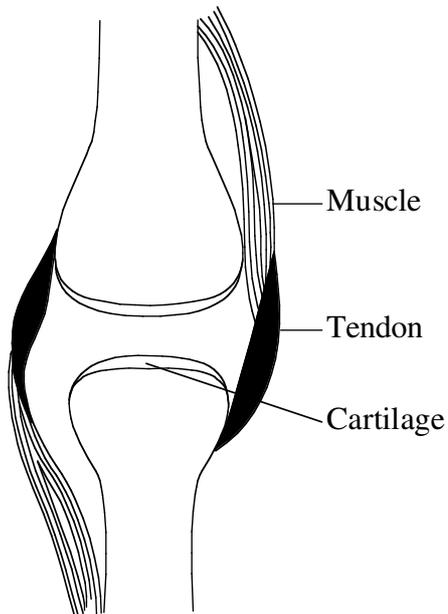
Stomach: pH 2–3 to enable enzymes (proteases) to digest protein and to kill bacteria

Small intestine: pH 8 to help neutralise the stomach acid and allow the digestive enzymes to break down food.

Question 23 (a)***Sample answer:***

Question 23 (b)**Sample answer:**

Doctors may prescribe medication in the form of a subdermal implant due to the solubility of the medication. Some medications will degrade in stomach acid or under the action of stomach enzymes, so they cannot be given orally. Certain medications may need to be released continuously and a subdermal implant is used instead of consistently taking oral medication.

Question 24 (a)**Sample answer:****Question 24 (b)****Sample answer:**

Cartilage provides a smooth frictionless surface within the joint reducing wear and tear of the bone.

Tendons provide a connection between the muscle and bone allowing movement of the joint when muscles contract and relax.

Question 25**Sample answer:**

Use P for the shaft and ball and Q for the socket. P has high tensile strength that is needed for the bone replacement, but its friction doesn't matter. Q has low friction that is needed as the joint moves, but its strength doesn't matter.

Question 26***Sample answer:***

A wide range of technologies in medicine and communication use energy in the form of electromagnetic waves. Before these devices could be developed it was first necessary to understand how these EM waves could be transmitted safely, received by the devices and modulated to carry different types of information. Electromagnetic waves have the same properties; they all travel at the speed of light in straight lines and can be reflected and refracted. EM waves differ only in their energy carrying capacity, wavelength and frequency. These differences make them useful in a range of devices.

Lower energy radio waves can be used over long distances to safely carry radio and television signals. Microwaves with smaller wavelengths and higher energy are used in mobile phone communications. They are transmitted over short distances to relay stations or to satellites. Higher energy X-rays are used in medicine for medical imaging and the even higher energy gamma rays are used for the treatment of cancer but have little usage in communications because their high energy carrying capacity makes them dangerous.

NOTE:

Students could also refer to non EMR energy forms such as ultrasound imaging and treatment or electrical transfer of signals in landlines and light along optical fibres.

Question 27***Sample answer:***

Mobile phones and fax machines are technologies used for communication.

The advantage of having different types of technologies include:

- Availability and back-up: For instance if you travel with a mobile phone you may not get coverage and will need to use a landline for verbal communication.
- Format of message: A fax machine gives a hard copy of a document that can be stored. It can also transmit diagrams, plans etc using the landline network which has a wide area of coverage.

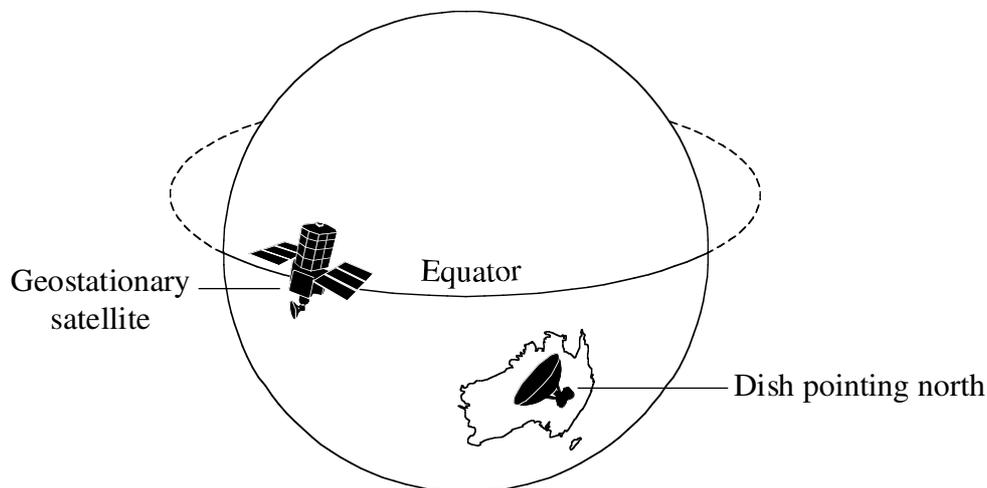
Question 28 (a)***Sample answer:***

The satellite must orbit directly above the equator and have an orbit period that matches the Earth's rotation (1 day).

Question 28 (b)

Sample answer:

Geostationary satellites are in orbit so that they maintain a fixed position over the earth's equator. Dishes that communicate with geostationary satellites must always point towards the satellite. Since the equator is north of Australia, a dish in Australia must point north to communicate with a geostationary satellite.



NOT TO SCALE

Question 29

Sample answer:

<i>Changes to improve validity</i>	<i>Changes to improve reliability</i>
<ul style="list-style-type: none"> • Use devices, which can interfere with the radio sound. • Select AM and FM stations that all play music 	<ul style="list-style-type: none"> • Repeat the procedure using several radio stations at different frequencies • Repeat several times for each station to establish consistent results

Question 30

Sample answer:

Artificial heart valves allow people to live longer and lead more productive lives. Cochlear implants allow people who were profoundly deaf to gain some sense of hearing. This means that they can participate more in ordinary human activities, which is important because they can be more productive in their own lives. Advances like the heart valves allow people to live longer, which are good for them, but may be a problem for society. An increasing aged population means greater need for support, such as pensions, which is important in meaning the society has to devote more money to the welfare of the elderly.

Section II

Question 31 (a) (i)

Sample answer:

Polymerisation is the process of joining monomers together to form polymers.

Question 31 (a) (ii)

Sample answer:

Cotton absorbs dye better than fur, while fur is a better heat insulator than cotton.

Answers could include:

Hair, fur, silk, linen. Similarities and differences.

Question 31 (b) (i)

Sample answer:

There will be nowhere to put waste, so householders will have to deal with their own wastes. Increase cost to the council in shipping waste elsewhere.

Question 31 (b) (ii)

Sample answer:

The council could introduce separate bins to encourage recycling of materials such as plastics, glass, and paper. This is a good idea as it reduces the need for landfill, meaning the tip could stay open longer.

Answers could include:

Composting organic waste.

Question 31 (c) (i)

Sample answer:

Nylon shrivelled but wool smoked/smouldered.

Answers could include:

References to flammability, melting, shattering when frozen.

Question 31 (c) (ii)***Sample answer:***

Production of dangerous fumes/gases would be managed by performing the investigation under a fume hood, which would draw fumes away from the experimenter. Danger of burns would be managed by using appropriate tongs, which would prevent experimenter contacting hot materials.

Answers may include:

Risks relevant to investigation in 31 (c) (i).

Question 31 (d)***Sample answer:***

Advances in polymer technology and research into the properties of natural and synthetic polymers have benefitted society by making bank notes more durable and secure. The advantages to society are significant in that the polymer developed confers useful properties such as resistance to damage (tearing, dirt and sweat) and incorporation of mechanisms to minimise the risk of illegal use (counterfeiting).

Significant benefits to society are that the polymer properties allow bank notes to remain secure and clean for longer. Potential uses of this polymer could be the protection of other paper-based documents such as passports and legal documents.

Question 31 (e)***Sample answer:***

Plastics are synthetic polymers that have different properties that make them extremely useful in different situations. Plastics can be rigid which makes them useful for water pipes and car bumper bars. Silicones are mouldable and can be used as breast implants, to replace cartilage in joints, and for sealing tiles on walls and floors.

Nylon is lightweight and durable which makes it useful in angioplasty. Many plastics are durable and quite cheap which makes them attractive for consumers. Unfortunately plastics are non-biodegradable, which is potentially detrimental when they are thrown away – put into landfill. Plastics also require the use of fossil fuels for their manufacture and that adds to greenhouse gases.

Although there are significant disadvantages to the environment by using plastics, the versatility of plastics encourages society to continue using them and therefore producing them.

Answers could include:

Plastics are synthetic polymers. Variations in properties such as strength, flexibility and elasticity allow a range of uses for society.

Nylon is a suitable material for use in kidney dialysis.

Softer plastic such as polyethylene is used to make plastic bags.

Question 32 (a) (i)***Sample answer:***

Food colouring

Answers could include:

- Anticaking agent
- Tartrazine
- Students can name a 'group' or class of additive or give a specific name
- Most preservatives are in the '200' group

Question 32 (a) (ii)***Sample answer:***

Food additives are substances used in food in small quantities for a specific purpose. Preservatives are food additives that act to prolong the shelf life of the food by killing or inhibiting the growth of microorganisms. Benzoic acid is an example of a preservative. Other food additives, such as food colouring, do not stop microbes and only act to change or enhance the colour.

Question 32 (b) (i)***Sample answer:***

The microbes growing on the jam make it unfit for human consumption.

Question 32 (b) (ii)***Sample answer:***

The cook should ensure that they sterilize the jars and lids used to store the jam and seal it while the jam is very hot. This will ensure that there are no microorganisms in the jar and will increase the shelf life and hence reduce wastage, which is a good idea.

Question 32 (c) (i)***Sample answer:***

Nitrates and nitrites have greater solubility in water than sulfites.

Answers could include:

Solubilities (g/100g water):

Sodium nitrate 92, sodium nitrites 85, sodium sulfite 30.

Question 32 (c) (ii)***Sample answer:***

Nitrates and nitrites are used in cured meats such as salami. They must undergo a chemical change in the food and therefore must be dissolved. They also stabilise the colour of these products. Although sulfites are less soluble they are used in a powder form, which is finely divided in the ingredients such as sausage mince. They dissolve sufficiently rapidly to allow for the conversion to SO_2 , which is the actual preservative.

Question 32 (d)***Sample answer:***

Scientific investigation of preservation methods has made a significant positive impact on society. The scientific research involves ways to reduce or eliminate bacterial growth in foodstuffs, which directly contributes to a safer food supply and therefore a healthier society. Kurth's work contributed to this by developing a new method of preservation, which effectively kills bacteria while not affecting the flavour or appearance of a high value product.

Question 32 (e)***Sample answer:***

Food additives are substances added to food in small quantities for a particular purpose. There are many types of food additives.

Australian food laws have placed restrictions on the types and amounts of additives that can be added to foods and the foods to which they can be added. There are other laws, which govern how these additives once added, must be identified on the food's label.

The use of additives is controlled to ensure that:

- the amounts used remain within safe limits
- they are not used to mask poor manufacturing standards or faults
- they do not disguise food that are unfit for human consumption by hiding off odours and colours

Some additives could be toxic if used in high amounts, for instance Vitamin A, which may be added to increase the nutritional value of breakfast cereals is very toxic in high doses. The additives must be labelled using defined standards. This ensures the consumer can make informed choices when buying foods with additives. Consumers may wish to avoid certain additives for identified health risks such as allergies, or may simply decide to avoid additives for ethical/health reasons, eg artificial colours and flavours. People could be placed at unnecessary risk if they consume food not labelled correctly or clearly.

The control and labelling of the additives in food is very important as it protects the food supply and allows consumers to make informed choices.

Question 33 (a) (i)***Sample answer:***

Arteries, veins and capillaries

Question 33 (a) (ii)***Sample answer:***

- Veins have valves, whereas capillaries do not contain valves.
- Veins have a larger blood carrying capacity than capillaries.

Question 33 (b) (i)***Sample answer:***

If some antibiotics don't kill the bacteria, people could get very sick and possibly die from an incurable bacterial infection.

Answers could include:

Antibiotic resistance.

Question 33 (b) (ii)***Sample answer:***

Reduce the amount of antibiotics given to people so bacteria will be less likely to build resistance to any particular antibiotic. This is important so we have medicines to fight diseases.

Question 33 (c) (i)***Sample answer:***

Agar plate inoculated with soil showed growth of colonies of bacteria.
Agar plate inoculated with air showed fewer colonies of bacteria.

Answers could include:

Agar plates swabbed with water or food.

Question 33 (c) (ii)***Sample answer:***

1. The agar plates were sealed and not reopened. This prevented any microorganisms that had grown from escaping and infecting anyone.
2. All students washed their hands with antibacterial soap after agar plates were inoculated to reduce the risk of spreading bacteria to anyone.

Answer could include:

Autoclaving plates

Incubating plates at temperature less than human body temperature.

Question 33 (d)***Sample answer:***

Eccles' work showed that the transmission of impulses at the synapse between nerve cells was a chemical rather than an electrical process. His work was extremely important, as this has allowed for research into chemicals that can block this transmission and therefore help to treat pain. This has the social benefit of allowing people with conditions that were previously debilitating to live and work relatively normal lives.

Question 33 (e)***Sample answer:***

The nervous system is composed of the CNS and PNS. Together they control and coordinate our bodily activities. Sense organs (ears, eyes, nose, tongue and skin) receive information from our environment and pass the information via sensory neurones to the CNS.

Interneurons are connecting neurones in the CNS that then transmit the impulse to a motor neurone. The motor neurone carries information from the CNS to a muscle or a gland.

Between the neurones are synapses, which are small gaps. The signal crosses the synapse with the release of a chemical messenger (neurotransmitter) into the synaptic gap and stimulates a new impulse in the adjoining neurone.

Pain receptors are found in all parts of the body except the brain. These receptors are free nerve endings which are highly sensitive to chemicals (prostaglandins) released by cells when they are injured. From these nerve endings an impulse travels along the PNS then to the CNS where there are two possible pathways. One pathway transmits up to the brain where the brain will interpret the feeling as pain. A second pathway is the reflex response where the sensory neurone travels to the spinal cord and a motor neurone carries an impulse to an effector (muscle or gland) to give us a quick response to reduce the pain eg knee-jerk response.

Question 34 (a) (i)***Sample answer:***

Red Cross

Answers could include:

St Vincent de Paul, Salvation Army, Uniting Care, but does NOT include police, fire brigade, ambulance, SES or RFS.

Question 34 (a) (ii)***Sample answer:***

The SES and RFS are both mainly volunteer services. They both serve the community within NSW. Both the SES and RFS are responsible for operations during different disasters. The SES operates during floods and storms. The SES may also be involved in road accident rescue in rural areas. The RFS is responsible for fire suppression and protection.

Question 34 (b) (i)***Sample answer:***

The workers left the building and went home, which meant no one knew where they were and therefore time would be spent looking for them possibly endangering others.

Question 34 (b) (ii)***Sample answer:***

Display posters in workplace instructing workers to assemble in specified area when evacuation alarm sounds. This should ensure that safety of all people can be accounted for.

Question 34 (c) (i)***Sample answer:***

The dry leaves burnt quickly with a large smoky flame. They were easily burnt. The fresh leaves took much longer to ignite. Some did not ignite at all and when they did ignite the leaves burnt slowly with little or no flame and little smoke.

Question 34 (c) (ii)***Sample answer:***

The results showed that dry leaves burnt quickly and with a greater intensity therefore posing a bushfire threat in rural areas. This information could be used to implement plans to clear bushland areas of dry leaves in hotter months and perform controlled back burns to reduce the risk of bushfires.

Question 34 (d)***Sample answer:***

Andrew Sullivan's work helps scientists to understand more about how bushfires behave and this information can be used to educate communities in high-risk areas and can help to reduce damage to property and life.

This research on fuel availability and dynamics could also help predict likely areas where bushfire may occur, helping to give early warning to residents and information of early evaluation. This early warning and prevention of damage is a major social contribution as it helps communities manage damage therefore reducing financial and environmental costs.

Question 34 (e)***Sample answer:***

Changes in air pressure over the land can cause natural disasters such as floods, thunderstorms and hail. A cold front is caused by warm air rising which then condenses forming clouds. When the cold front is fast moving, heavy rain, hail and thunderstorms occur, which can lead to damage to property by falling trees, or being cut off from essential services like electricity. Floods can also occur which can not only damage property, but also threaten human life.

Changes in the air pressure over the ocean can cause tropical cyclones. Cyclones occur when fast rising warm air is replaced by cooler air, causing strong winds as well as warm air condensing, causing clouds. Tropical cyclones can be disastrous if they reach land, where the strong winds can tear off roofs and overturn cars. Heavy rainfall can cause flash flooding, which may lead to loss of life.

To reduce damage to property and lessen the loss of life during a tropical cyclone or thunderstorm, it is important to monitor these changes in atmospheric pressure. Scientists measure atmospheric pressure using digital barometers and can observe changes with satellite images. Daily changes can be recorded and analysed. If significant changes occur in atmospheric pressure that would suggest an impending natural disaster, local authorities could be alerted. This could lead to organisation of evacuation or protection of an area to reduce the potential damage and loss of life. It could also be used to alert emergency services to be on standby for persons requiring assistance because of the disaster.

Question 35 (a) (i)***Sample answer:***

Life support systems and pacemakers.

Question 35 (a) (ii)***Sample answer:***

Equipment originally used to communicate between space stations and the Earth is now used by doctors to reprogram a pacemaker without surgery.

Question 35 (b) (i)***Sample answer:***

When in space the astronaut's muscles become significantly weaker. This causes problems when the astronaut returns to Earth and does not have the strength to do normal activities such as walking.

Question 35 (b) (ii)***Sample answer:***

One strategy that is useful for maintaining muscle in space is a regular exercise program. Part of this program is strapping the body to an exercise bike and peddling for a certain time period each day. This would allow astronauts to retain leg muscle mass.

Question 35 (c) (i)***Sample answer:***

The Saturn V spacecraft used a multistage rocket during lift off. Upon re-entry an ablative material in the nose cone protected astronauts from extreme heat.

Question 35 (c) (ii)***Sample answer:***

One advantage of using a space shuttle instead of the Saturn V is the space shuttle can be reused many times. A disadvantage is that the shuttle does not have an effective ejection system and is therefore less safe than the Saturn V.

Another disadvantage is that when reusing a vehicle there is a greater chance of the parts failing in future missions.

Question 35 (d)***Sample answer:***

McClure-Griffith's work gathers information about the nature of the universe using radio telescopes. One benefit to society of this work is that it would allow detection of radio signals from organisms or civilisations outside Earth. This causes us to be outward looking as a species; not just focusing on issues on Earth, and may in future allow people to make contact with extra-terrestrials, and perhaps gain knowledge or information not available on Earth.

Answers could include:

Work such as McClure-Griffith's makes little contribution to society. The radio telescopes and other equipment cost a great deal of money to build and maintain, and the discoveries are of no interest except to other astronomers. In social terms, the money would be better spent in other areas of society such as hospitals, transport and schools. Appropriate reference to any scientific work related to space.

Question 35 (e)***Sample answer:***

Many important strategies are used to ensure the safety and good health of astronauts. They include animals being sent into space before humans to ensure that similar organisms could withstand the stress of lift-off and in orbit. Also food is heat sterilised and vacuum-sealed to ensure that it is safe to eat.

Materials used in the construction of the shuttle must be carefully selected to ensure that it remains intact during lift-off and therefore many structural parts are reinforced with material that is strong enough to withstand the large forces experienced during lift-off. Ceramic tiles on the base of the shuttle absorb heat generated during re-entry, which allows conditions inside the craft to remain at safe temperatures.