BOARD OF STUDIES
NEW SOUTH WALES

2011 Senior Science HSC Examination
'Sample Answers'

When examination committees develop questions for the examination, they may write 'sample answers' or, in the case of some questions, 'answers could include'. The committees do this to ensure that the questions will effectively assess students' knowledge and skills.

This material is also provided to the Supervisor of Marking, to give some guidance about the nature and scope of the responses the committee expected students would produce. How sample answers are used at marking centres varies. Sample answers may be used extensively and even modified at the marking centre OR they may be considered only briefly at the beginning of marking. In a few cases, the sample answers may not be used at all at marking.

The Board publishes this information to assist in understanding how the marking guidelines were implemented.

The 'sample answers' or similar advice contained in this document 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:

UHMWPE is a low-friction material and this makes it suitable because the hip joint must move freely.

Answers could include:

High elasticity, which allows it to regain its shape after withstanding heavy loads

Question 21 (b)

Sample answer:

Teenagers' bones are still growing and the uncemented implants have a rough surface, which allows the bones to grow into the implant.

Question 22

Sample answer:

Tablets can be absorbed at different parts of the digestive system. They can be quickly absorbed into the bloodstream.

Subdermal implants release their medication over a longer period of time and release it at a more constant rate.

Question 23

Sample answer:

Microwaves travel through the atmosphere and through space and are therefore useful in communicating with satellites, which are located in space.

Microwaves have a relatively high frequency and can therefore carry a large amount of information.

Answers could include:

Microwaves have a relatively short wavelength, so a relatively small dish can be used to focus the waves.

Question 24 (a)

Sample answer:

- Wear safety goggles.
- Choose two indicators, one that changes at pH 5 and one that changes at pH 7.
- Add 10 mL *Bubbles Liquid Soap* to two test tubes.
- Add some of the first indicator to one test tube.
- Add some of the second indicator to the other test tube.
- Compare the results to the colour chart.
- Repeat.

Answers could include:

Using a universal indicator or using a pH probe

Question 24 (b)

Sample answer:

No, it is not a valid claim because the pH needed to be slightly less than 7.

Answers could include:

pH 4, 5 or 6

Question 24 (c)

Sample answer:

Beauty is not a measurable quantity.

Question 25 (a)

Sample answer:

Plaque can block blood passing through blood vessels and therefore prevent oxygen reaching the heart muscle.

Question 25 (b)

Sample answer:

A diet that is low in fat and high in fibre. Surgeons can use ablation to physically remove plaque during surgery.

Answer could include:

Angioplasty, which does not remove the plaque but makes the lumen of the blood vessel wider.

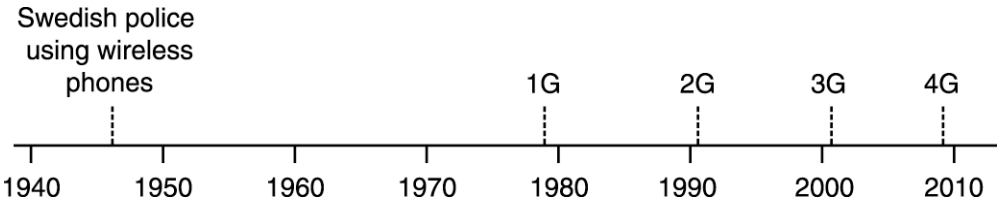
Question 25 (c)

Sample answer:

Check if the author is reputable, eg government or education, and also check how old the website is, ie the date published or last modified.

Question 26 (a)

Sample answer:



Question 26 (b)

Sample answer:

Mobile phones have had a large impact on society. They have created new employment opportunities, which benefits the economy of the state or country. They have allowed people to access emergency services in isolated areas. Members of the community can respond appropriately to emergencies in isolated areas because information can be disseminated rapidly to large numbers of people. Mobile phones have created new social networking structures that affect the lives of large numbers of people.

Question 27 (a)

Sample answer:

- Verbal — speaking on the telephone
- Non-verbal — gestures on TV

Question 27 (b)

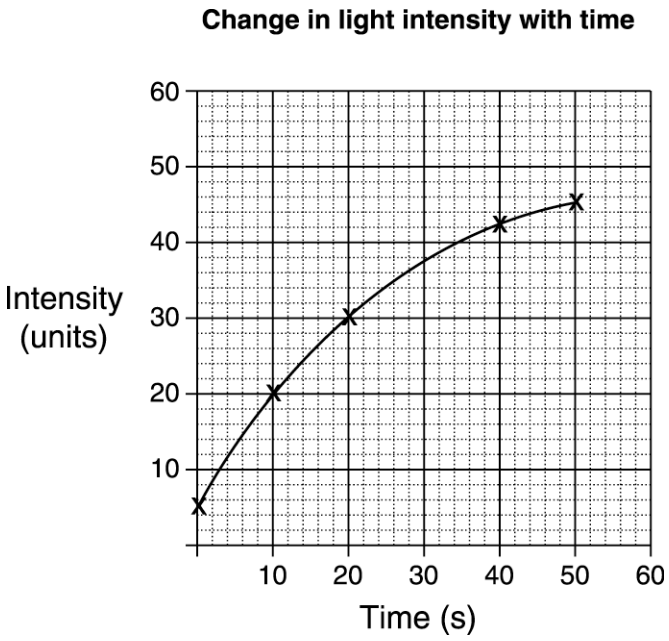
Sample answer:

Land-connected telephone systems convert sound energy to electrical energy and back to sound energy. They can be used to talk to people over short or long distances, or they can be used to call for help if required.

Television systems convert light energy and sound energy to electrical energy and then electromagnetic energy and then back to electrical energy and finally light and sound energy. They can be used for entertainment or learning, eg by showing documentaries.

Question 28 (a)

Sample answer:



Question 28 (b)

Sample answer:

It is a suspension, because the chemical settled over time and increasingly allowed light to pass through the water and reach the sensor.

Question 29

Sample answer:

The teardrops are molecules of the emulsifier. The other two components of the mixture are immiscible liquids. One end of the emulsifier is attracted to one of the liquids and the other end is attracted to the other liquid. Agitation disperses one of the components in the other with emulsifier molecules surrounding small droplets of one component. The droplets remain dispersed because they are not attracted to each other.

Answers could include:

- Large circles can be oil and surrounding fluid can be water.
- One end of the teardrop is hydrophilic and the other is lipophilic.
- Labels on the diagram can show the relationships in the diagram.

Question 30

Sample answer:

Artificial joints are designed to replicate the smooth movement and the range of movement of natural joints. Understanding how normal joints move allows artificial joints to be designed to mimic the natural process. For example, an artificial hip joint is designed to have a ball and socket to allow independent movement in two planes, as well as some rotation. Since the natural hip joint has to withstand high forces, artificial hip joints are made of materials that have a high compressile strength, such as titanium and ceramics.

Pacemakers are designed to provide stimulus that causes the heart to beat regularly at an appropriate rate, as determined by the level of exercise. The design of this device relied upon understanding that the SA node provides an electrical stimulus, causing the heart muscle to contract at a rate dependent upon other internal stimuli. Again, pacemakers need to be composed of biocompatible materials.

Artificial heart valves are designed to replicate the unidirectional control of blood flow through the heart. There are a number of different ways in which this can be replicated, such as a ball and cage, tilting disc or bileaflet valve. These all allow blood to flow in only one direction and they try to minimise turbulence, which is almost nonexistent in natural valves.

All of the above examples must take into account an understanding of the chemical environment of the body, so that they can withstand the rigors involved. This means that the materials chosen must be biocompatible, remain inert and be durable in the body.

Section II

Question 31 (a) (i)

Sample answer:

A polymer is a large molecule made up of repeating units of smaller molecules. A synthetic polymer does not exist naturally but is manufactured by humans.

Answers could include:

A synthetic polymer is manufactured using smaller molecules extracted from coal, petroleum and natural gas.

Question 31 (a) (ii)

Sample answer:

Both polystyrene and polyethylene are synthetic polymers made from smaller molecules derived from the petrochemical industry. Polystyrene, in the form of foam, can be a good insulator of heat, while polyethylene is not usually made into a foam and is therefore not a good insulator of heat. Polyethylene can be made to be ultra-high density, such as Spectra fibres, whereas polystyrene cannot.

Question 31 (b)

Sample answer:

The manufacturer's claim is not correct. The plate is made from a thermoplastic, which softens when heated. Thermoplastics are easier to recycle because they can be re-moulded into new items. The plate could only be totally recycled if it has no additives. Additives such as stabilisers cannot be recycled; if they are present, the plate cannot be totally recycled.

Answers could include:

- Stabilisers – used to prevent degradation of polymer by UV light
- Plasticiser – prevents the plate being too rigid; maintains flexibility
- Fire retardant – prevents the plate igniting when heated

Question 31 (c) (i)

Sample answer:

Playdough can be formed by mixing flour, water and salt. The ingredients are heated for some minutes and then kneaded into a dough.

Question 31 (c) (ii)

Sample answer:

Kevlar is the material that is best for a mountain bike, because it is stronger than PVC and Lycra and maintains its shape better than Spectra. A mountain bike needs to be strong and to maintain its shape, because it has to take bumps and knocks as it is ridden along bush tracks.

Question 31 (d) (i)

Sample answer:

The use of plastics has created a demand for them, which has resulted in new industries in manufacturing, transporting and selling plastics. New industries create new employment opportunities.

Question 31 (d) (ii)

Sample answer:

Biodegradability is the ability of a material to be decomposed easily by microorganisms. Before 1950, the wooden items in a kitchen would be biodegradable but the metal items would not be. After 1950, the kitchen items would be less biodegradable because they would be mostly made from synthetic polymers, which microorganisms do not easily decompose.

Question 31 (e)

Sample answer:

Developments in polymer science have led to many more plastic products being produced and with more variety, due to the development of plasticisers, stabilisers and fire retardants. This has led to plastics becoming cheaper, and plastic items becoming common in everyday life. However, the problems due to these developments include increased pollution of the environment from solid plastics and increased production of carbon dioxide, which has led to global warming/climate change. It also has contributed to the depletion of the raw material required for the production of polymers.

Synthetic polymers are not biodegradable. Therefore, they do not decompose readily and they remain in the environment for longer. Plastics can cause the death of sea animals that swallow plastic items thinking they are food. In some places, there is insufficient space for landfills and plastics accumulate in large unhealthy piles. Additives put in plastic items can leach out, polluting soils and waterways. When waste plastics are burnt, they release toxins and greenhouse gases.

Some of these problems are beginning to be overcome through the recycling of plastics. If more plastics are collected for recycling, fewer are put into landfills, become pollutants in waterways and oceans, or are burnt. However, not all the plastic in an item can be totally recycled, so there is always some plastic left.

Making plastics from monomers sourced from natural products such as glucose or maltose produces biopolymers. Biopolymers are being used in packaging, but their shorter lifespan has not seen them being used for furniture or kitchen items.

Question 32 (a) (i)

Sample answer:

Sulfur dioxide and sodium benzoate

Answers could include:

- Citric acid
- Sulfites

Question 32 (a) (ii)

Sample answer:

Canning involves cooking foods inside sealed cans. This creates a sterile environment to prevent the growth of microorganisms and therefore increases shelf life.

Freezing involves keeping food at a temperature that is too low for any microorganisms that were present in the food to grow. This increases the shelf life of the food.

Answers could include:

- Drying
- Boiling
- Irradiation
- Pickling
- Salting
- Vacuum packing

Question 32 (b)

Sample answer:

Colouring agents are used to change the colour of food, which makes it look more appealing to the consumer. Flavouring agents preserve or improve flavour and are added to increase marketability to the consumer. Humectants are added to retain moisture so that the food will not dry out. This makes the food more palatable. All of these additives make the consumer more likely to want to eat the food.

Question 32 (c) (i)

Sample answer:

12 – 20 = –8%

OR

20 – 12 = 8%

Question 32 (c) (ii)

Sample answer:

Each piece of white bread should be the same size. The water should be the same amount (since the temperature should be varied). The temperatures used should be closer together and should not jump from 25°C to 65°C without testing some temperatures in between.

Question 32 (d) (i)

Sample answer:

X = water
Y = sugar or glucose or starch
Z = semi-permeable membrane

Question 32 (d) (ii)

Sample answer:

Osmosis is the movement of water from a high water concentration to a low water concentration though a semi-permeable membrane.

In this model, the water has a high concentration outside the semi-permeable membrane and will therefore move inside, as it is small enough to fit through the pores.

Question 32 (e)

Sample answer:

Microbes such as bacteria, moulds and fungi are responsible for food spoilage. When the environmental conditions such as temperature and pH are optimal, microbial growth is maximised. The microbes use the food as their energy source. One of the aims of the ANZFA is to promote the supply of safe and wholesome food to the community. Labelling – such as storage conditions, eg store below 5°C; additives/ingredients for people who are sensitive or allergic to the contents; and date marking, eg use by 20/5/11 – improved the safe supply of food to consumers.

Answers could include:

- Pasteur
- Natural preservatives
- Negative labelling
- Microbes
- Allergies due to food labelling

Question 33 (a) (i)

Sample answer:

Brain and spinal cord

Question 33 (a) (ii)

Sample answer:

The two nerve pathways are similar in that they both involve neurons, including receptors and sensory neurons. However, the 'finger in Bunsen flame' situation causes a response that involves nerves in a reflex arc, where the signal is sent to the spinal cord and then a response is immediately sent along a motor neurone to effectors – muscles to cause the finger to be removed from the Bunsen. Later, a message is sent to the brain to inform it of this. In comparison, in the 'person warming hands' situation, the warmth is detected and a message is sent to the spinal cord and the brain, but no immediate message may be sent to the effectors to move the hands away.

Question 33 (b)

Sample answer:

The heart pumps blood in a closed circuit around the body through the arteries, capillaries and veins. Pharmaceutical substances absorbed into the blood are therefore transported rapidly to all parts of the body. They are transferred to tissues/organs through capillary walls. The pharmaceutical substance recirculates continuously, which is an advantage because it makes the drug effective for extended periods of time. Depending on the type of pharmaceutical substance, when it passes from the blood to tissues it may affect specific parts of the body, or all parts.

Question 33 (c) (i)

Sample answer:

As temperature is slowly increased, the rate of reproduction will increase. However, once the temperature becomes too high, the rate of reproduction will rapidly decrease and the bacteria will die.

Question 33 (c) (ii)

Sample answer:

Penicillin functions by preventing a bacterium from producing new cell walls while dividing. The bacterium then dies. Thus, since *Bacteria X* divides very rapidly (once every 20 minutes), each *Bacteria X* would need to produce new cell walls during division. Therefore, penicillin stops this occurring and is effective against this bacteria. However, since *Bacteria Y* takes a long time to divide (16 hours), this form of antibiotic would not be very effective against this bacterium.

Question 33 (d) (i)

Sample answer:

The area might become red, swollen, itchy, hot or painful.

Question 33 (d) (ii)

Sample answer:

The advantages are that white blood cells can reach the area more quickly and easily and therefore produce a more rapid response. The heat from increased blood flow to the area can also attract antimicrobial agents. However, the disadvantages include causing allergic reactions such as a runny nose, watery eyes and hives. It can also cause very high fevers that can lead to death.

Question 33 (e)

Sample answer:

The quality of life for many people has been improved by the introduction of pharmaceuticals. For example, some painkillers work by reducing the effect of prostaglandin. This means there is less pain, along with decreased fever and inflammation. This allows people to continue working and to live a normal life, despite nuisances such as headaches. Similarly, anti-inflammatory pharmaceuticals (which decrease blood vessel dilation, white blood cell numbers at the site of injury, and metabolic rate) allow people with hayfever symptoms, such as a runny nose, watery eyes, itches and hives, to live a normal life.

However, pharmaceuticals can be used inappropriately. They can be taken in too high a dose, which can lead to temporary or permanent injuries, or even death. Also, if a child finds and consumes pharmaceuticals that they should not have, they can die. Illegal pharmaceuticals, taken because they produce a pleasurable experience for some people in the short term, can cause addiction, permanent mental illness, or even death. The inappropriate prescribing and non-completion of courses of antibiotics has led to the development of antibiotic-resistant bacteria. Most bacteria can now no longer be treated using simple penicillin, although in the past they were immediately killed this way. This is an increasing problem, as we race against bacteria to constantly produce new antibiotics to which they are not resistant.

Answers could include:

Pharmaceuticals can save lives through preventing or decreasing the likelihood of diseases such as high blood pressure and high cholesterol. Arteries function by carrying high-pressure blood away from the heart. However, if these arteries become clogged by plaque, the blood pressure in them increases and can cause the artery to snap, or can decrease oxygen flow to the heart and cause heart attack or blockages to other areas and thus cause strokes. However, with pharmaceuticals to reduce blood pressure and cholesterol, the above problems can be avoided or delayed, leading to lives being saved.

In addition, despite research, we are still unable to cure many diseases using pharmaceuticals. For example, despite now knowing about white blood cells and the causes of HIV/AIDS, we cannot cure this disease. Similarly, we understand much about how the brain and spinal cord function; however, we have not been able to provide drugs that can cure problems such as when the spinal cord is broken (eg paraplegia) or successfully treat some mental illnesses.

Question 34 (a) (i)

Sample answer:

A natural disaster is an event whereby a great loss of life, livelihood or the environment has occurred and the cause of this disaster is the environment or planet itself.

Question 34 (a) (ii)

Sample answer:

Thredbo landslide in July 1997. The landslide was the result of a leaking water pipe that was not correctly monitored and maintained, causing a road to collapse onto ski lodges. Gravity caused the landslide, but water from the leaking water pipe aggravated the situation.

Answers could include:

- Ash Wednesday bushfires, south-east Australia, February 1983
- Sydney bushfires, December 1993–January1994

Question 34 (b)

Sample answer:

1. Calculate the difference in arrival times of the P and S waves.
2. Use this time difference in the second graph to determine the distance of the epicentre from one station.
3. Using the distance from the epicentre as the radius, draw a circle around the station.
4. Collect the same information from at least two other stations and draw similar circles around these.
5. Where the three circles intersect is the epicentre of the earthquake.

Answers could include:

Diagrams to help explain the answer

Question 34 (c) (i)

Sample answer:

- Dry leaves burn faster than fresh leaves
- Pine leaves burn faster than eucalyptus leaves

Answers could include:

Fresh grevillea burns slower than fresh banksia; however, dry grevillea burns faster than fresh banksia.

Question 34 (c) (ii)

Sample answer:

The group of students should have used the same environmental temperatures for each type of leaf. Another improvement would be to ensure that the same mass of each leaf was used. The leaves should be left to dry for the same length of time before burning.

Question 34 (d) (i)

Sample answer:

As **Y** moves towards **X**, the strength of the wind will increase at **X**.

X will have an increase in rainfall.

Answers could include:

A calm day will become wet and windy.

Question 34 (d) (ii)

Sample answer:

Satellites can be used to take infrared images of clouds over the Earth's surface. These images can be used to monitor and track cyclones. People can be given several days' warning about the impending arrival and prepare for it. This was not the case 50 years ago. Another piece of technology is LIDAR, where laser light is used to detect the position of cloud cover and whether there is rain, hail or snow. This can be used to give people time to get inside, and to put cars under cover in the case of hail.

Question 34 (e)

Sample answer:

Controlled burning by skilled people during spring when the weather is mild is one way of minimising the effects of a bushfire. The fuel that has built up is burnt away under a controlled situation, so that if a bushfire comes there will be no fuel left for it to continue to burn.

There are also many things a homeowner can do in order to minimise the effects of a bushfire. These include regular removal of dried grasses, leaves and branches from around the house and from the guttering. Again, this removes the fuel that keeps the bushfire burning. Homeowners could also plant fire-retardant trees between the house and the bush to slow the fire down. It would also be a good idea to have a flowing source of water that can be used to keep the house and its surroundings damp and wet, which will also slow the fire's progress.

Answers could include:

- Bushfire evacuation plan
- Bushfire survival kit
- Building materials of house
- Sprinklers in lawn

Question 35 (a) (i)

Sample answer:

- Falling freely on a steep roller-coaster ride
- Being inside a plane carrying out special manoeuvres (parabolic arc trajectory) to produce weightlessness

Answers could include:

- Jumping in the air on a trampoline
- Jumping from a diving board
- BUT NOT floating in water

Question 35 (a) (ii)

Sample answer:

The ISS orbiting the Earth is weightless because gravity is acting on it and there is no other significant force. Therefore, it is falling freely toward Earth's centre, which makes it weightless.

Answers could include:

- ISS is accelerating towards Earth's centre
- BUT NOT 'there is no force of gravity' (because it is almost the same as it is on Earth's surface) or 'forces on the ISS are balanced'.

Question 35 (b)

Sample answer:

The solid rocket boosters provide the large thrust required for the first two minutes to accelerate the large mass of the vehicle, which is mainly the fuel in the external tank and the shuttle itself.

The external fuel tank provides liquid fuel storage for the orbiter's engines, which is mainly required for the climb against gravity after the solid rocket boosters separate until the shuttle reaches orbit.

The orbiter's function is to carry the crew and payload, allowing for their safe return.

Answers could include:

The orbiter is needed to provide the conditions necessary to keep the crew alive in orbit and to return them safely to Earth.

Question 35 (c) (i)

Sample answer:

- The longer males spend in space, the greater the loss of muscle strength.
- For the same time in space, females generally lose more muscle strength than men.

Question 35 (c) (ii)

Sample answer:

- The men and women should use the same arm.
- They should do the same activities while they are in space.
- They should obtain more data about each gender, such as a greater range in the time spent in space for both genders.

Question 35 (d)

Sample answer:

Voyager I collected photographs that showed details of the surface of Saturn's moon Titan.

Answers could include:

- Current Voyager investigations of the heliosheath, solar wind and ultraviolet stellar objects
- Voyager II discovered details about Uranus's faint rings and its magnetic field

Question 35 (e)

Sample answer:

Telescopes with larger mirrors have provided better-quality information about the universe because they can be used to detect fainter and more distant objects, providing a more detailed picture of the universe.

The development of radio telescopes improved the information quality by providing additional data from radio sources in the universe, which optical telescopes cannot detect.

Answers could include:

- Space telescopes
- Spectrometry improvements
- Use of CCDs

Question 35 (f)

Sample answer:

Humans require oxygen to breathe and an atmosphere from which the carbon dioxide that is breathed out is removed. A sealed spacecraft that does not allow gases to leak into space makes this possible. Oxygen is carried on board in cylinders to replenish that breathed by the astronauts. Carbon dioxide is chemically removed.

Food must be provided in quantities and of types suitable for consumption in a weightless environment. All food is carried from the Earth. It is often in tubes to prevent it from being spilled while it is being consumed.

Astronauts must be protected from dangerous radiation and extreme temperatures. Shielding that blocks radiation and insulation that prevents heat from entering or leaving the spacecraft protect the astronauts from these hazards.

Decline in muscle tone and strength is a problem for astronauts spending extended periods in space. Exercise machines that are effective in weightless environments and exercise programs that astronauts follow to maintain muscle strength and tone have overcome these problems.

Answers could include:

- Communication – microwave use
- Energy supply – fuel cells, solar panels
- Disruption to circadian rhythms – set sleep cycles/hours