

2009 HSC Senior Science Sample Answers

This document contains 'sample answers', or, in the case of some questions, 'answer may 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 responses. They have been reproduced in their original form as part of the examination committee's 'working document'. While the handwritten notes have been typed for legibility, no further editorial change or addition has occurred.

Section I, Part B

Question 16 (a)

Sample answer:

Hip

Question 16 (b)

Sample answer:

Y is cartilage. It acts as a shock absorber or reduces friction between bones.

Question 17 (a)

Sample answer:

As the rubber sheet is pulled down, there is a decrease in pressure inside the bell jar, which causes the balloons to inflate.

Question 17 (b)

Sample answer:

Models are simplification of reality – this model does not show flexible ribs. Models can be used to help understand systems in nature.

Question 18 (b)

Sample answer:

The skin provides an unbroken, watertight barrier that prevents bacteria and other foreign bodies entering the body. Surgery breaks this barrier and without special care will allow for bacteria to get in and cause infection.

Question 19***Sample answer:***

The information given shows that optical fibre is much faster than copper wire. Only 1.5Mb/s can be carried by the copper wire compared to the 2500Mb/s carried by the optical fibre. This makes the optical fibre suitable for transferring large amounts of data.

Both types of carries are secure because data is digitally encoded and therefore not able to be read by those who may attempt to obtain external devices to detect signal. Speed is the determining factor not security.

Question 20***Sample answer:***

Soaps and soapless detergents are both cleaning products which are used to remove dirt/oil from a variety of surfaces. They both foam in water and act by reducing surface tension.

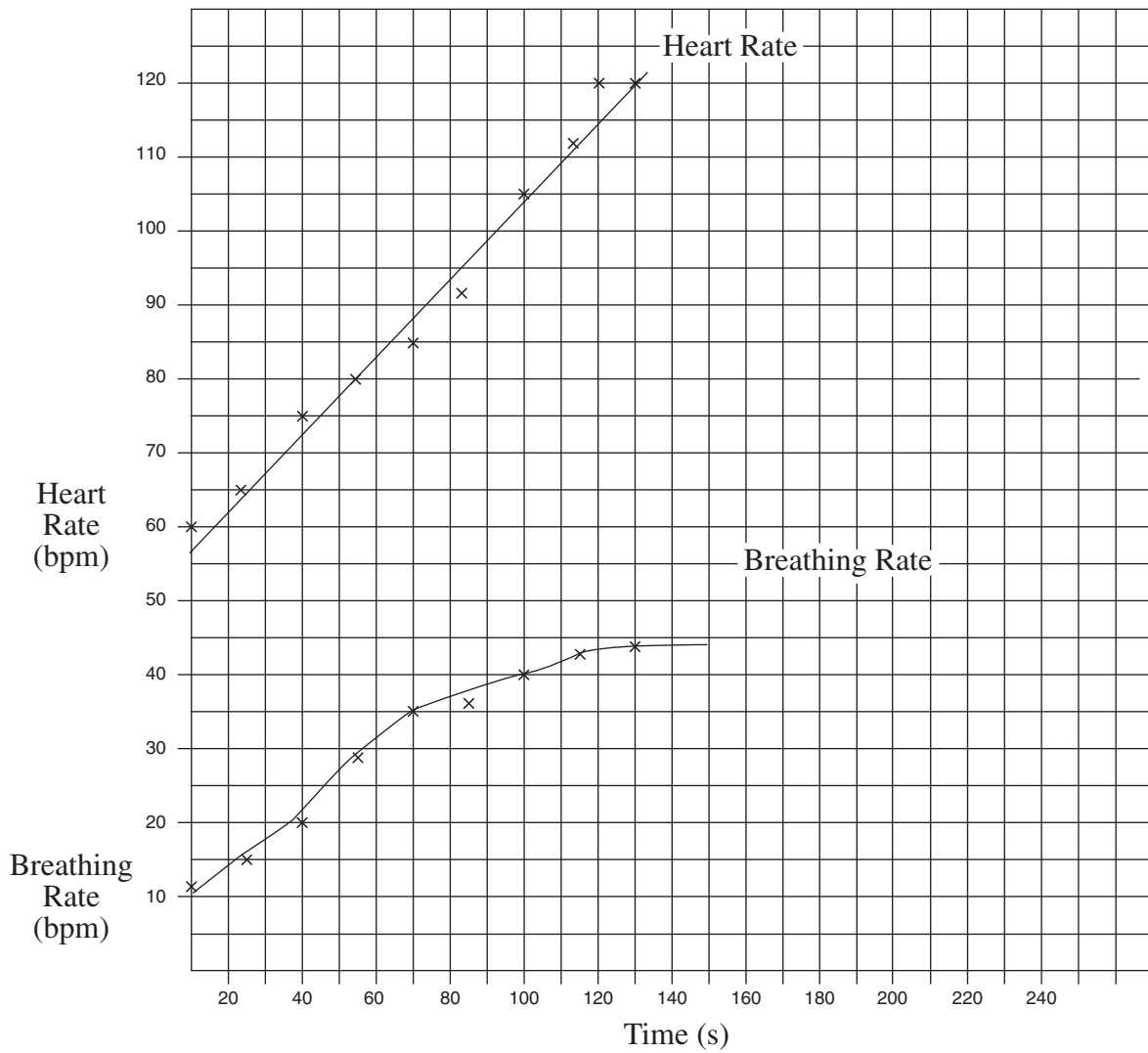
Soap and soapless detergents must be biodegradable. That is they must breakdown in the environment. Soaps tend to be made using naturally occurring oils such as olive oil, whereas soap less detergents use oils derived from crude oil. Because of this soaps tend to breakdown more quickly.

Soap and soapless detergents cause similar environmental effects in that they reduce the surface tension of natural water bodies such as creeks which effect many plants and animals detrimentally. For instance, insects which normally skim on the surface will sink.

Soapless detergents, in particular can be used to help clean up oil spills after a shipping disasters. This is beneficial as it helps reduce the impact of such events.

Question 21 (a)

Sample answer:



Question 21 (b)

Sample answer:

Heart rate increases over time due to the need for more oxygen/glucose to be transported to cells.

Question 22 (a)*Sample answer:*

$$S = d/t$$

$$300\,000 = \frac{36000}{t}$$

$$t = 0.12 \text{ s}$$

Question 22 (b)*Sample answer:*

The optical fibre is faster than the satellite link. This is multiplied by the fact that a message must travel to and from the satellite – the optical fibre takes $2 \times 0.05\text{s}$ to get message back, the satellite takes $4 \times 0.12\text{s}$.

Delays experienced due to signal travel time are insignificant with an optical fibre but long enough to cause confusion in a two way conversation using the satellite.

(NB: Do not carry through error from part (a) if response gives plausible answer for part (b) based on answer for part (a).)

Question 23 (a)*Sample answer:*

The dependent variable is the number of drops.

Question 23 (c)*Sample answer:*

The addition of detergent reduces the surface tension of the water. This in turn reduces the size of the water drops which means more drops are needed to fill the measuring cylinder to the 1ml mark.

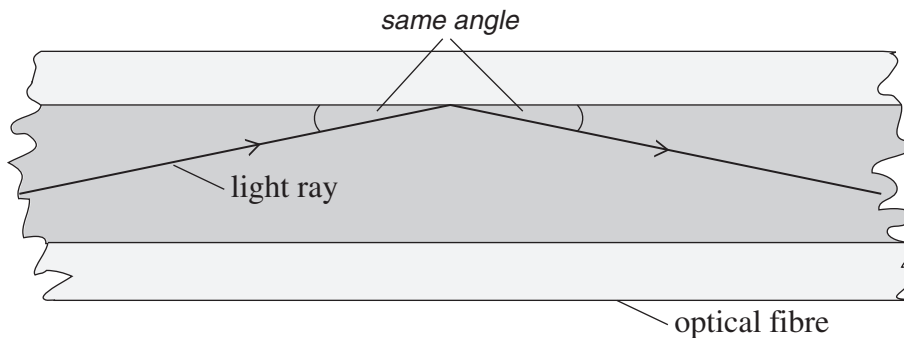
Question 24 (a)

Sample answer:

Optical fibres are transparent and flexible.

Question 24 (b)

Sample answer:



Question 25 (a)

Sample answer:

| | |
|--------------------|---|
| Prosthetic limbs | Knowledge of how muscles and nerves work so that the limb can interact with the part of the body it is connected to |
| AM/ FM radio | Knowledge of electromagnetic waves so that radio waves could be used to carry information |
| Subdermal implants | Knowledge of the solubility of drugs so that the release of the drug into the body can be controlled |

Question 25 (b)

Sample answer:

Prosthetic limbs:

Working out how to connect a computer chip in the limb to the nervous system/ brain of the wearer so the limb can move more precisely.

Question 26***Sample answer:***

- X-ray: This test would not be useful as x-ray images only detect solid objects like bones inside the body and the problem is in the soft tissue
- Ultrasound: This test would be the one the doctor should use as ultrasound imagery shows soft tissues which is what Tracy's small intestine is.

Magnetic Resonance Imaging (MRI): This test is NOT to be done. The strong magnetic field used in an MRI would physically remove the pacemaker from Tracy's body, which would cause her heart to stop functioning.

Question 27***Sample answer:***

The document is scanned by a beam of light along very thin lines. The light reflects differently from different marks on the page. The reflected light is detected by a photocell. The photocell converts the incident light into electrical voltages. This signal carries information along a copper wire. For optical fibre, the electrical energy is converted to light for transmission, and the signal is digitally encoded.

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

The triangles indicate that the materials are recyclable. The numbers indicate the type of polymer/plastic.

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

PVC stabilisers include heavy metals and chlorine, which can be released during recycling process. Heavy metals can poison people, and chlorine can contaminate other polymers, so PVC recycling must be kept separate from people and other plastics. This makes PVC recycling more difficult and expensive and less viable compared to other polymers.

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

| <i>Household waste</i> | <i>Percent (%)</i> |
|------------------------|--------------------|
| Recyclable | 55 |
| Kitchen waste | 20 |
| Garden waste | 15 |
| Plastic bags | 10 |

Question 28 (c)***Answers could include:***

Polyurethane; polyester; epoxy resins

Question 28 (d) (i)***Sample answer:***

Polyester has high melting point; good resistance to solvents; crease resistant; low moisture absorption.

Question 28 (d) (ii)***Sample answer:***

Different polymers have different properties. Blending polymers gives the useful properties of both polymers. Cotton has good moisture absorption and can be easily dyed, which is not true for polyester. Cotton creases easily, but polyester is crease resistant. A cotton polyester blend can be dyed and is crease resistant. This increases its usefulness.

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

Micro-organisms break down (decompose) material into simpler chemicals. These are then recycled in the ecosystem (taken up by other organisms).

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

Expose the new polymer to a natural environment. After some time measure how much the polymer has decomposed (or the type and amount of substances it has released into the environment) and compare this with a second of the polymer kept in controlled conditions.

Question 28 (g)***Answers could include:***

Such a ban would mean that no new synthetic polymers could be made. This would impact on everyday life in many ways. There would be no plastic drink bottles or food wraps. This would mean an increase in glass or metal containers for food. Food might go off more easily, or not be able to be transported long distance. There would also need to be an increase in recycling of existing polymers and/or investigations of new natural polymers. This would make a huge difference to everyday life, because many ordinary activities would be much less convenient.

Question 29 (a) (i)***Sample answer:***

This type of labelling is called negative labelling.

Question 29 (a) (ii)***Sample answer:***

By law, preservatives are not allowed to be used in canned food. This is because preservatives could be used to mask or compensate for faulty processing. Claiming that canned food contains no preservatives is an irrelevant claim because no canned food would have it anyway.

Question 29 (b)***Sample answer:***

| <i>Preservatives in liquid medicines</i> | <i>Percent %</i> |
|--|------------------|
| Methylparaben | 45 |
| Sodium benzoate | 30 |
| Sodium metabisulfite | 15 |
| Benzoic acid | 10 |

Question 29 (c)***Answers could include:***

- Bacteriocin
- Salt
- Naturally occurring acid (eg lemon juice, vinegar)
- Alcohol

Question 29 (d) (i)***Sample answer:***Possible similarities include:

- Packaging maintains sterility by preventing bacteria getting on/in food

Possible differences include:

- Canned food sterilized after sealing, foil pouches – food sterilized then packed into sterile packs and sealed

Question 29 (d) (ii)***Sample answer:***

Canned food and foil pouches have impacted on society in many ways.

1. Providing a safe food supply and therefore increasing nutritional status of consumers. These types of packages contain food that is sterile and can maintain food in a fresh form unless damaged or opened.
2. The variety of food can be increased. Packaging allows seasonal food to be available all year round and this prevents wastage and increases consumer choice.

Flexible pouches are much lighter than cans, however cans protect soft food better.

Question 29 (e) (i)***Sample answer:***

Severe difficulty in breathing due to anaphylaxis can be treated by injecting with adrenaline from an EpiPen[®]. Rash on body – give antihistamine.

Question 29 (e) (ii)***Sample answer:***

Food allergies can be tested and identified in a number of ways. One method is to provide a ‘food challenge’. This way is to remove all sources of suspected allergies from the diet and then reintroduce each suspected food one at a time, until an allergic response is triggered. Since all other sources of the allergen have been eliminated the response can be directly linked to the food. If the food allergy is severe there should be appropriate medical facilities available.

Question 29 (f)***Answers could include:***

In the past, the cause for food spoilage was unknown and often in the realm of superstition. Scientists conducted controlled experiments that directly linked food spoilage to the presence of bacteria. This meant that manufacturer's, home cooks and commercial chefs understood that to prevent food spoilage they must prevent the growth of bacteria and other micro-organisms. Food preparation is made safer by our knowledge by simple actions such as:

- Frequent hand washing to prevent initial contaminations from the human body
- Cold storage to slow down growth of micro-organisms
- Cooking to correct temperatures to kill micro-organisms

Question 30 (a) (i)

Sample answer:

Bacillus bacterium

Question 30 (a) (ii)

Answers could include:

Bacteria reproduce by binary fission. Chromosomes attach themselves to the cell membrane and make a copy of themselves. The duplicated chromosome also attaches to the cell membrane. As the bacterial cell grows lengthwise, the chromosomes are separated. When the cell wall and cell membrane grow back in between the long cell, one chromosome will be in each new cell.

Question 30 (b)

Sample answer:

| <i>Pharmaceutical products</i> | <i>Percent (%)</i> |
|--------------------------------|--------------------|
| Cough/ cold remedies | 45 |
| Analgesics | 25 |
| Dietary supplements | 20 |
| Other | 10 |

Question 30 (c)

Answers could include:

Aspirin, Panadol, paracetamol, ibuprofen

Question 30 (d) (i)***Answers could include:***

Veins and arteries both carry blood around the body. Veins carry blood to the heart while arteries carry blood away from the heart.

Question 30 (d) (ii)***Sample answer:***

When a drug is injected into the body it enters the circulation and is transported around the body to different sites. Where the blood is injected is not necessarily where it is required, but by being in the circulation which is a closed loop, the drug can be transported to the areas where it will be used.

Question 30 (e) (i)***Sample answer:***

Cephalosporin's source is Cephalosporium acremonium and it affects cell wall synthesis.

Question 30 (e) (ii)***Sample answer:***

Scientists could have set up agar plates with different bacteria swabbed on each plate. After plating the bacteria, an antibiotic disk could be added to each plate. The plates would be incubated at the same temperature for 48 hours then viewed to determine if the bacteria were affected by the antibiotics. Clear areas around the antibiotic disks show the bacteria are sensitive to this antibiotic which has prevented growth of the bacteria.

Question 30 (f)***Answers could include:***

Aspirin has been used as an analgesic for centuries before its mode of action was understood. Inflammation occurs when a cell is injured and starts releasing chemicals such as prostaglandins. Blood vessels dilate to allow more blood into the area and they become more permeable or 'leaky' to allow plasma to pass out of the blood into the affected area. White blood cells are attracted to the area and squeeze out of the vessels into the damaged area.

Their role is to clean up. The increased blood flow to the area increases the temperature and makes the area red. The heat speeds up the metabolic rate of tissue cells. Chemicals are also released that stimulate pain receptors, therefore symptoms of inflammation are heat, redness, swelling and pain. Synapses are the gaps between neurones.

When a cell is damaged, it releases chemicals (prostaglandins) into the synapses around the injury site. Small amounts of the chemicals make the pain receptors more sensitive. Once the impulse reaches the brain we interpret this as 'pain'. Since the prostaglandins magnify the inflammation response which in turn increases our pain, pain killers like aspirin can be used. Aspirin is an analgesic which acts as a prostaglandins inhibitor. By reducing the prostaglandins released, this reduces inflammation and pain into the synapse. This improved understanding of our knowledge of inflammation and synapses has led to improvements in analgesics.

Question 31 (a) (i)***Sample answer:***

Burma's cyclone and China's earthquake are natural disasters because there was a large-scale loss of life/damage from events that were beyond human control.

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

Ash Wednesday Fires in 1983 in Adelaide and parts of Victoria.

Question 31 (b)***Outcomes assessed:******Sample answer:***

| <i>Preservatives in liquid medicines</i> | <i>Percent (%)</i> |
|--|--------------------|
| Drought | 35 |
| Storms | 35 |
| Fires | 20 |
| Other | 10 |

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

Bushfires started by arson in Victoria 2009.

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

If your home or contents suffer loss or damage caused by a violent wind, provided your home was structurally sound or well maintained.

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

Since the window had been left open during the storm, the insurance company will not pay compensation for this damage, since this opening was not created by the storm.

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

Closely-spaced isobars indicate change of air pressure over short distances, which means strong winds will blow.

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

Satellite imaging allows people to monitor the movement of cyclones, which they could not do before 'space age'. This allows more accurate prediction of weather, and people can be evacuated before the storm hits.

Question 31 (g)***Answers could include:***

A central operations centre would receive information about an impending disaster. This centre would send messages to people likely to be affected by the disaster. The message would tell people to prepare themselves, or to evacuate the area. The control centre would have to have access to every person's mobile phone number. Problems might occur if not everyone had their phone switched on, or if the disaster itself damaged the transmission towers or centres. Also, there are dead areas for mobile phone reception which might be a problem. This system could be helpful in saving lives, but it might not reach everyone, and could cause panic.

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

A circadian rhythm is a biological process exhibiting a cyclical variation with a period of approximately 24 hours. The graph shows body temperature changes over a 2-day period.

Question 32 (a) (ii)***Answers could include:***

Shift work. Moving between time zones.

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

| <i>Satellites in orbit</i> | <i>Percent (%)</i> |
|----------------------------|--------------------|
| Low Earth orbit | 45 |
| Geostationary orbits | 35 |
| Medium height orbits | 15 |
| Polar orbits | 5 |

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

The International Space Station or ISS.

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

The tile material has a low thermal conductivity.

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

Low thermal conductivity prevents heat being conducted from outer part of the tile heated by friction to the metal body of the STS Thermal stability (able to withstand high temperatures) is required so that the tiles are not destroyed when they become very hot. High wind velocity/air pressure is encountered during re-entry and therefore must be strong to withstand these extreme conditions.

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

- Dangerous radiation
- Vacuum

Question 32 (f)***Answers could include:***

The statement is not correct because Voyager 2 travelled through space containing both energy (electromagnetic waves) and particles of matter.

Question 32 (g)***Answers could include:***

Since it was first used to look at objects in the solar system, developments in optical telescopes including improved optics and larger diameter lenses/mirrors has enabled them to be used to see finer detail and fainter objects, not only in our solar system, but within and beyond the galaxy. Space-based optical telescopes, such as the Hubble telescope, have further increased the resolution of images obtained.

The VLBA (Very Long Baseline Array) is a network of radio telescopes which has been used to produce radio maps of the universe showing much greater detail than the first single-dish radio telescopes.

Orbiting telescopes such as HALCA (Highly Advanced Laboratory for Communications and Astronomy) provided new information about pulsars and quasars using radio waves received by its 8 metre dish.

The Voyager 1 and 2 satellites travelled through the solar system gathering data about magnetic fields of the gas planets as well as taking photographs of unprecedented quality of these planets. More recently space-based telescopes that produce images in regions of the spectrum including infrared, UV and X-ray have provided even more information about the universe.