

ANSWERS

CHAPTER 1 Stimuli and Responses

Activity 1.1 (p. 7)

Questions

1. Stimulus: Seeing your partner let go of the ruler.
Response: Catching the ruler using your thumb and index finger.
This is a voluntary action because it is a conscious action and is made according to the will of the individual who received the stimulus and is controlled by the brain.
2. The distance moved by the ruler shows the time taken by the student to catch the ruler. The shorter the distance, the faster the reaction time.
3. Different students usually have different reaction time. Besides this, the reaction time of an individual is not constant.
4. In the daily life of humans, reaction time plays an important role to coordinate and control organs and body parts so that they function harmoniously and efficiently.

Activity 1.3 (p. 9)

Questions

1. Stimulus: Intensity of light that enters the eye.
Response: Change in size of the pupil.
This is an involuntary action because this action occurs spontaneously without any conscious control or prior thoughts.
2. The higher the intensity of light, the smaller the size of the pupil.
3. This response can help protect the eye from injury.

Brain Teaser (p. 10)

Muscular system

Formative Practice 1.1 (p. 10)

1. Central nervous system and peripheral nervous system
2. (a) Voluntary actions are conscious actions, carried out according to the wishes of a person and are controlled by the brain.
Examples of controlled actions are reading, writing, speaking, eating, drinking, walking, running, exercising and singing.
(b) Involuntary actions are spontaneous actions that happen without being realised or thought of beforehand.
Examples of uncontrolled actions are heartbeat, breathing, peristalsis, secretion of saliva and sneezing.
3. Injured nerve cells in the human brain are unable to interpret impulses from effectors and cannot send impulses to effectors. Due to this, a person who sustained brain injury is unable to carry out voluntary or involuntary actions involving the brain.
4. The network of nervous system of humans functions to control and coordinate organs and body parts so as to carry out processes in the body and daily activities.

Brain Teaser (p. 15)

Excess mucus is produced when a person suffers from a cold. This excess mucus will obstruct receptors from being stimulated by chemical substances in the air entering the nasal cavity.

Brain Teaser (p. 16)

A blind person uses the sensitivity of the fingertip to read Braille and sensitivity of the hand to detect vibrations of the walking stick when it hits objects to detect any nearby obstructions.

Activity 1.6 (pp. 19, 20)

Questions

1. Tip of index finger. It has the largest number of receptors.
2. Elbow. It has the least number of receptors.
3. Touch receptor.
4. Number of touch receptors and thickness of epidermis.

Activity 1.7 (p. 21)

Questions

1. To ensure no other solutions remain and only the taste of one solution is detected during each attempt.
2. All areas of the tongue can detect all tastes of the solutions.
3. Both sides of the tongue are most sensitive towards taste because they have a large number of taste receptors.
4. The middle part of the tongue is least sensitive to taste because it has a small number of taste receptors.
5. The front part of the tongue is more sensitive to sweet taste, the sides of the tongue are more sensitive to sour and sweet tastes, the back part of the tongue is more sensitive to bitter taste and the middle part of the tongue is more sensitive to umami.

Brain Teaser (p. 22)

No. After the tongue is cleaned, the tongue will become more sensitive.

Activity 1.8 (pp. 22, 23)

Questions

1. Without the nose being pinched.
2. Taste of the cordial drink is more easily detected using a combination of sense of taste and sense of smell.
3. So that your partner does not use sense of sight to determine the taste of the cordial drink based on the colour such as purple for taste of grape, orange for taste of orange, yellow for taste of mango and red for taste of strawberry.
4. In addition to chemical substances in food which dissolve in saliva and stimulate the taste buds, chemical

substances in hot food also evaporate to form vapour which enters the nasal cavity and stimulates the smell sensory cells. The combination of sense of taste and sense of smell causes hot food to taste better.

Formative Practice 1.2 (p. 29)

1. (a) Cornea
(b) Pupil
(c) Retina
(d) Brain
2. Semicircular canals
3. At the upper part of the nasal cavity
4. Sweet, sour, salty, bitter, umami
5. Number of receptors and thickness of skin epidermis
6. (a) Five types of taste, touch, pain, hot objects, cold objects, and pressure.
(b) Five types of taste can be detected by taste receptors in the taste buds of the tongue. The tongue is protected by skin that has touch, pain, heat, cold and pressure receptors. Therefore, it can detect touch, pain, hot objects, cold objects and pressure.

Experiment 1.1 (pp. 30 – 33)

A. Questions (p. 31)

1. Light
2. Shoot of the plant
3. The shoot of the plant shows positive phototropism because shoots of plants grow towards the direction of light.

B. Questions (p. 32)

1. So that light cannot influence the growth of the seedlings.
2. (a) Grow upwards against the direction of gravity.
(b) Grow downwards in the direction of gravity.
3. Roots of plants show positive geotropism because the roots of plants grow towards the direction of gravity. Shoots of plants show negative geotropism because shoots of plants grow against the direction of gravity.

C. Questions (p. 33)

1. Water
2. Roots of the plant
3. Absorbs water and moisture in the air in beaker Y
4. The roots of the plants show positive hydrotropism because they grow towards water.

Formative Practice 1.3 (p. 35)

1. (a) Tropism is a directed response of plants towards stimuli coming from a certain direction.
(b) (i) Thigmotropism
(ii) Geotropism
(iii) Phototropism
2. (a) (i) Shoots
(ii) Roots
(iii) Tendrils or winding shoots
(b) Positive hydrotropism allows roots to obtain water and dissolved mineral salts to survive.
3. Similarity: Tropism and nastic response are responses of plants towards stimuli.
Difference: Tropism is the directed response of plants towards stimuli while nastic response is the response towards stimuli without considering their direction.

Brain Teaser (p. 37)

The blind have a more sensitive sense of hearing. They make use of sound to detect location and estimate distance of nearby objects.

Formative Practice 1.4 (p. 39)

1. Stereoscopic and monocular vision.
2. Location of eyes on the head.
3. Primary consumer has monocular vision. Monocular vision has a wide field of vision and allows it to detect predators coming from various directions.
4. Stereophonic hearing allows us to determine the direction of sound accurately.
5. Azman uses his stereophonic hearing to determine the cat's location. The time and loudness of the sound made by the

cat received by both of Azman's ears are the same. The brain then informs Azman the direction of the cat making the sound.

Summative Practice 1 (pp. 41 – 43)

1. (a) ×
(b) ✓
(c) ×
(d) ✓
2. P: Brain
Q: Spinal cord
R: Peripheral nerve
3. (a) Changes in the size of the pupil of the eye.
(b) Intensity of light which enters the eye.
(c) The lower the intensity of light directed towards the eye, the larger the size of the pupil of the eye.
(d) During a solar eclipse, the bright rays of the sun will enter the eye and damage the cells of the retina.
4. (a) Sound → Earlobe → Ear canal → Eardrum → Ossicles → Oval window → Cochlea → Auditory nerve → Brain
(b) Light → Cornea → Aqueous humour → Pupil → Eye lens → Vitreous humour → Retina → Optic nerve → Brain
5. (a) X: Touch receptor
Y: Pain receptor
(b) Fingertip is more sensitive towards touch stimuli compared to the palm of the hand.
Fingertip has a thinner layer of epidermis and more touch receptors compared to the palm of the hand.
(c) Agree. The tongue is a sensory organ that has receptors known as taste buds on the surface of the tongue which is protected by skin epidermis.
6. (a) The sense of smell helps us to detect danger such as leakage of gas that might occur in the science laboratory. For example, we can detect the presence of dangerous gases such as chlorine and ammonia from their smell.
(b) Dogs have a very sensitive sense of smell because they have more sensory cells for smell than human

and are more efficient to analyse smell than human.

7. (a) – Positive phototropism
– Positive hydrotropism
(b) Positive phototropism ensures shoots and leaves of plants obtain sufficient sunlight to make food through photosynthesis.
Positive hydrotropism allows roots of plants to grow towards water so that they can absorb water to enable plants to carry out photosynthesis.
8. (a) Stereoscopic vision
(b) The eagle is a predatory animal. Stereoscopic vision helps the eagle to hunt its prey by accurately determining the location of its prey.
9. Explanation:
– Fill the transparent plastic bottle with water.
– It functions as a convex lens.
– Place it on top of the newspaper.
– Read the newspaper through it.

CHAPTER 2 Respiration

Experiment 2.1 (pp. 50 – 52)

Question (p. 51)

- The water level in the gas jar containing inhaled air is higher.
- Composition of oxygen in inhaled air is higher than that in exhaled air.
- Burning of candle using the oxygen in the gas jar causes water to enter to fill the space originally filled with oxygen.

Question (p. 52)

- Limewater in the conical flask where exhaled air was passed through turns cloudy.
- Carbon dioxide in the exhaled air reacts with the limewater.

Formative Practice 2.1 (p. 53)

1. (a) Trachea
(b) Bronchus
(c) Bronchiole
2. (a) ✓
(b) ×
(c) ×
(d) ×

3. To provide sufficient oxygen and eliminate carbon dioxide from the air.
4. (a) (i) Rib cage
(ii) Diaphragm
(iii) Trachea and bronchus
(iv) Lungs
(b) – A thin rubber sheet stretches more easily compared to a thick rubber sheet.
– Therefore, a thin rubber sheet is more easily pulled downwards or pushed upwards.
(c) (i) Breathing in or inhaling
(ii) Exhaling
(d) – The structure or volume of the glass jar which represents the rib cage is fixed when the thin rubber sheet is pulled downwards or pushed upwards.
– While the structure and volume of the rib cage changes during the processes of inhaling or exhaling.

Formative Practice 2.2 (p. 56)

1. Difference in concentrations of oxygen gas in the alveolus and blood capillaries.
2. (a) When concentration of oxygen is high, haemoglobin will combine with oxygen chemically to form oxyhaemoglobin which is unstable.
(b) When concentration of oxygen is low, oxyhaemoglobin will decompose to form haemoglobin and oxygen.
3. $\text{Glucose} + \text{oxygen} \rightarrow \text{carbon dioxide} + \text{water} + \text{energy}$
4. Efficiency of exchanging oxygen in the human body decreases at high altitudes. Concentration of oxygen in the air at high altitudes is low. Due to this, the rate of diffusion of oxygen from the alveolus into the blood capillaries is also low.
5. – Thickness of wall of alveolus and blood capillary is one cell thick
– The wall of alveolus is moist
– Alveolus with large surface area
– Dense network of capillaries covering alveolus

Brain Teaser (p. 57)

Forests help to maintain the balance of oxygen and carbon dioxide in the atmosphere.

Brain Teaser (p. 58)

Smoking endangers the health of the smoker and everyone in the vicinity of the smoker.

Brain Teaser (p. 59)

Electric buses do not emit exhaust gases. Therefore, air pollution can be reduced.

Experiment 2.2 (pp. 62, 63)**Questions**

1. Cigarette tar
2. Cigarette smoke is an acidic substance because it changes the purple colour of litmus solution to red.
3. Ammonia, stearic acid, methane, butane, methanol, toluene, cadmium, arsenic, acetone

Formative Practice 2.3 (p. 63)

1. (a) Tar, pollen, haze and dust
(b) Sulphur dioxide, carbon monoxide, nitrogen dioxide
2. Pollen
3. (a) Pain during breathing
(b) Blood in phlegm
(c) Frequent shortness of breath
(d) Wheezing sound when breathing
4. Lung cancer, emphysema, bronchitis, (any two)
5. A person who does not smoke but who breathes in cigarette smoke from smokers nearby.

Formative Practice 2.4 (p. 66)

1. (a) Gills
(b) Trachea
(c) Moist outer skin
2. Thin outer skin of frogs, dense network of blood capillaries under the layer of skin, very permeable to respiratory gases and moist.
3. Body cells of insects have a direct connection with the respiratory surface. Oxygen that enters the tracheole diffuses directly into the cells while carbon dioxide diffuses out.
4. When we exercise, our rate of respiration increases. Higher rate of transport of oxygen to body cells and higher rate of elimination of carbon dioxide from body cells result in healthier body cells. Due

to this, the health of all systems in the body especially the respiratory system is maintained.

5. Not smoking, frequent exercise

Brain Teaser (p. 67)

Organ of gaseous exchange.

Brain Teaser (p. 71)

Air is always moving from one region to another region. Therefore cooperation from the global society is required. Prevention in only one region would not be effective.

Formative Practice 2.5 (p. 72)

1. Leaves, stem, aerial roots
2. P: Guard cell Q: Stomatal pore
3. (a) Stomata open during the day. Water diffuses into guard cells through osmosis causing the guard cells to bend and open the stoma.
(b) Stomata close at night. Water diffuses out of guard cells through osmosis causing the guard cells to straighten up and close the stoma.
(c) Stomata are closed on hot days to prevent excessive loss of water through transpiration.
4. Polluted air will reduce the amount of sunlight reaching the plants and reduce the rate of photosynthesis. Hence, the growth and survival of plants will be jeopardised.

Summative Practice 2 (pp. 74 – 77)

1. (a) Alveolus
(b) Bronchus
(c) Nasal cavity
2. P: Trachea
Q: Bronchus
R: Alveolus
3. (a) ✓
(b) ✓
(d) ✓
4. (a) higher
(b) lower
5. (a) Haemoglobin transports oxygen from the red blood cell to body cells.
(b) Oxyhaemoglobin easily decomposes into haemoglobin and oxygen when

it reaches body cells so that oxygen can diffuse into the cells.

6. (a) Azura may be allergic to pollen. In Spring, more pollen is released from anthers. When Azura inhales air containing pollen, there is a higher risk of her getting an asthma attack.
- (b) Any place that is hazy and dusty. Examples: industrial areas, construction sites and others. Haze and dust also cause asthma attacks in asthma patients.
7. (a) – Thickness of the wall
– Moisture of the wall
– Surface area
– Network of capillaries
- (b) (i) Asthma
Symptom: Shortness of breath
Cause: Excessive release of mucus on the surface of alveolus reduces the surface area and rate of gaseous exchange in the alveolus thereby causing shortness of breath.
- (ii) Bronchitis
Symptom: Shortness of breath
Cause: Inflammation of the bronchus in bronchitis patients caused by tar and irritants in cigarette smoke reduces the rate of movement of air from the nose to the lungs through the bronchus. This causes bronchitis patients to be frequently breathless.
- (iii) Emphysema
Symptom: Shortness of breath
Cause: The alveolus in emphysema patients is damaged by dangerous substances in the air such as irritants in cigarette smoke. Hence, the surface area for

gaseous exchange in the alveolus is reduced causing shortness of breath.

8. – Stop smoking.
To avoid harmful substances found in cigarette smoke from entering the lungs and harming the respiratory system.
- Avoid places with polluted air.
To avoid inhaling air that contains harmful substances such as cigarette tar, carbon monoxide, sulphur dioxide, nitrogen dioxide, haze, dust and pollen which are harmful to the respiratory system.
- Have proper exercise and lead a healthy lifestyle.
To maintain a healthy respiratory system.
9. Users at the waiting areas will become passive smokers if there are other users nearby who smoke. This is harmful to their health.
10. (a) Gaseous exchange is through diffusion into cells.
(b) The respiratory system of insects is more effective than the human respiratory system.
(c) Gaseous exchange through direct diffusion into the cells of insects is easier, quicker and more efficient compared to gaseous exchange through transport of gases by blood in the human body.
11. (a) Carbon monoxide
(b) When the air in a car which contains carbon monoxide is inhaled, the carbon monoxide combines with haemoglobin to form carboxyhaemoglobin. Therefore, a person in the car will not have sufficient oxygen supply which can be fatal.
12. (a) (i) 3.0 dm^3
(ii) 2.5 dm^3
(b) (i) 4.0 dm^3
(ii) 3.0 dm^3
(c) The more active the activity that is performed, the larger the maximum volume of the lungs. From the graphs

in Figures 3(a) and 3(b), the volume of air in the lungs of runners X and Y increases when they are running.

(d) Runner Y.

Cigarette smoke which damages the alveolus will reduce the maximum volume of air in the human lungs. The maximum volume of air in the lungs of runner Y is less, therefore runner Y is a smoker.

(e) Increase in the maximum volume of the lungs increases the rate of respiration because the rate of gaseous exchange in the lungs is increased.

CHAPTER 3 Transportation

Formative Practice 3.1 (p. 82)

1. The function of the transport system is to carry substances needed by cells into organisms and eliminate waste products from organisms to the outside surroundings.
2. Examples of substances needed by cells: Oxygen, nutrients
Examples of waste products eliminated from cells: Carbon dioxide, water, urea
3. Importance of the functions of transport system in organisms are as follows:
 - Transport system provides substances needed by cells such as oxygen and nutrients which are used to produce energy through the process of cellular respiration.
 - Transport system provides substances needed by plant cells such as carbon dioxide and water which are used to carry out photosynthesis.
 - Transport system also eliminates toxic waste products from the cells of organisms to the surroundings.
4. If the transport system of an organism cannot function well,
 - cellular respiration cannot be carried out. Without energy, living process cannot occur in the organism.
 - food cannot be made by green plants through photosynthesis. Without food, plants and animals will die.

- toxic waste products that fail to be eliminated from the body to the outside surroundings will poison and kill the organism.

Activity 3.2 (p. 84)

Fish

- Fish has a single blood circulatory system where blood flows through the heart only once in one complete cycle to the all the other parts of the body.
- Fish's heart has one atrium and one ventricle.
- Deoxygenated blood flows out from the heart to the gills where gaseous exchange occurs in the capillaries of the gills changing deoxygenated blood to oxygenated blood.
- Oxygenated blood flows from the heart to the whole body, changes into deoxygenated blood and flows back into the heart.

Amphibians

- Amphibians have an incomplete double circulatory system where blood flows through the heart twice in one complete cycle to the whole body.
- Amphibian's heart has two atriums and one ventricle.
- Deoxygenated blood flows out from the amphibian's heart to the lungs and skin where gaseous exchange occurs in the blood capillary walls in the lungs or under the skin changing deoxygenated blood to oxygenated blood.
- Oxygenated blood flows from the heart to the brain and a mixture of oxygenated and deoxygenated blood flows to all other parts of the body except the lungs. Oxygenated blood changes into deoxygenated blood and flows back into the heart.

Reptiles

- Reptiles have an incomplete double circulatory system where blood flows through the heart twice in one complete cycle to the whole body.
- Reptile's heart has two atriums and one ventricle with a structure which divides the space in the ventricle into two separate parts.

- Deoxygenated blood flows out from the heart to the lungs where gaseous exchange occurs in the walls of the blood capillaries in the lungs changing deoxygenated blood to oxygenated blood.
- Oxygenated blood flows from the heart to the whole body except the lungs, changes to deoxygenated blood and flows back into the heart.

Mammals and birds

- Mammals and birds have a double circulatory system where blood flows through the heart twice in one complete cycle to the whole body.
- The heart of mammals and birds have two atriums and two ventricles.
- Deoxygenated blood flows out from the heart to the lungs where gaseous exchange occurs in the walls of the blood capillaries in the lungs changing deoxygenated blood to oxygenated blood.
- Oxygenated blood flows from the heart to the whole body except the lungs, changes to deoxygenated blood and flows back into the heart.

Brain Teaser (p. 91)

Systolic pressure is produced when the ventricle pumps blood out from the heart to the whole body. Blood coming out flows with high pressure. Diastolic pressure on the other hand is produced when blood flows into the heart. Blood flows with lower pressure.

Experiment 3.1 (p. 92)

Questions

1. The more active the activity, the higher the pulse rate.
2. The rate of intake of oxygen and release of carbon dioxide by body cells increases while carrying out active activity. This causes the heart to beat more frequently and increases the pulse rate to transport oxygen and carbon dioxide more efficiently.

Formative Practice 3.2 (p. 95)

1. Blood circulatory system is a special transport system in complex organisms which functions to transport nutrients, respiratory gases and waste products.

Artery
Transports oxygenated blood (except the pulmonary artery)
Capillary
Connects arteries to veins and is a place of exchange of substances between cells
Vein
Transports deoxygenated blood (except pulmonary vein)

3. Type of activity, gender, age, health
4. Caring for our heart is important to ensure continuity of our life.

Brain Teaser (p. 99)

An individual who has blood type O can donate blood to all individuals irrespective of their blood type because blood type O does not have any antigens on its red blood cells.

Formative Practice 3.3 (p. 101)

1. Red blood cells, white blood cells, platelets and blood plasma
2. Blood plasma

Blood group of donor	Blood group of recipient			
	A	B	AB	O
A	✓	×	✓	×
B	×	✓	✓	×
AB	×	×	✓	×
O	✓	✓	✓	✓

3.
 - (a) To save lives
 - (b) Leukaemia, haemophilia
4.
 - (a) A person of blood group O can donate blood to any individual because the person has no A antigen and B antigen.
 - (b) A person of blood group AB can receive blood from any individual because his plasma does not contain antibody Anti-A or Anti-B.
 - (c) Blood bank is the place where blood is stored and retrieved.
5.
 - (a) Hospitals, National Blood Centre
 - (b) Road accidents, war
6.
 - (a) Blood group AB
 - (b) Presence of virus and other unwanted substances
 - (c) Prevents clotting of blood

Activity 3.8 (p. 110)

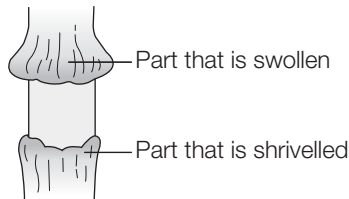
Questions

1. The eosin solution stains to form a specific pattern in the leaves, stem and roots of the plant.
2. Xylem
3. Passage of water in plants is through a transport tissue, namely xylem.

Activity 3.9 (p. 111)

Questions

1.



2. Passage of food in plants is through the phloem.

Formative Practice 3.4 (p. 112)

1. Transpiration is a process of loss of water in the form of water vapour from the surface of plants to the air through evaporation.
2. (a) vapour, liquid
(b) xylem, phloem
3. Light intensity, air humidity, temperature, air movement
4. Passage of water in xylem can be detected with the use of dye because water is colourless.
5. P: Phloem
Q: Xylem
R: Xylem
S: Phloem
T: Xylem
U: Phloem

Formative Practice 3.5 (p. 113)

1. Similarity: – Both are transport systems
– Both transport water, nutrients and dissolved substances
– Both exist in complex organisms
Difference: Pick one of the differences shown in Figure 3.31.
2. Organisms cannot continue to live if they do not have a unique circulatory system according to their respective needs.

Summative Practice 3 (pp. 116 – 120)

1. (a) PULSE
(b) TRANSPIRATION
(c) CAPILLARY
(d) PHLOEM
(e) HEART
(f) ANTIGEN
2. (a) ✓
(b) ×
(c) ×
(d) ×
3. (a) Valve
(b) Transport oxygenated blood
(c) (i) Blood vessel Q has thick walls to withstand high blood pressure.
(ii) Blood vessel R has walls which are one cell thick to increase the efficiency of exchange of substances between blood and body cells through diffusion.
4. (a) Oxygen, carbon dioxide, water, digested food, waste products
(b) Oxygen, carbon dioxide, water
(c) During the day, plant cells carry out photosynthesis and produce oxygen. Hence, plant cells do not need oxygen supply.
5. (a) (i) dub
(ii) lub
(iii) systolic
(iv) diastolic
(b) Systolic pressure reading is higher than diastolic pressure reading. Systolic pressure reading is reading of blood pressure which is higher when heart ventricle contracts to force blood out of the heart to be distributed to the whole body. Diastolic pressure reading is reading of blood pressure which is lower when heart ventricle slackens to facilitate blood flowing from the whole body back to the heart.
6. (a) (i) Eric, Roy
(ii) Blood will coagulate. The victim may die.
(b) (i) Individual 2.
This is because she fulfils the age condition of 18 years and above but less than 60 years. She also fulfils the body mass

condition of more than 45 kg.

- (ii) Pregnant women are not suitable to donate blood.

7. (a) Transports food
(b) Xylem or Y
(c) (i) The part above the ring will become swollen. Food collected here cannot be transported to the part below the ring because of the absence of X (phloem).
(ii) The plant will dry up and die.

8. Set A = $\frac{54 \text{ g}}{180 \text{ mins}} = 0.3 \text{ g/min}$

Set B = $\frac{36 \text{ g}}{180 \text{ mins}} = 0.2 \text{ g/min}$

9. (a) Badrul. He has the highest pulse rate immediately after activity.
(b) Azizah. Her pulse rate returns to its original rate after a time interval of 15 minutes after activity.

10. (a) Location B.

Location A is not suitable for the growth of herbs. This is because of the absence of light needed by herbs to carry out photosynthesis.

Location C is not suitable for the growth of herbs. High temperature in this location will increase the rate of transpiration of the herbs.

Location B is suitable for the growth of herbs. Temperature in this dim location is able to maintain the rate of transpiration of the herbs. In addition, the presence of sunlight in the bright location enables the herbs to carry out photosynthesis.

- (b) Example of constructed model

Transparent umbrella which can reduce the intensity of light that enters



CHAPTER 4 Reactivity of Metals

Brain Teaser (p. 126)

Mineralogists usually use the name bauxite, civilians such as mine workers use the name aluminium ore and scientists use the name aluminium oxide.

Activity 4.1 (pp. 126, 127)

Questions

- Carbon dioxide
- Flow the gas through limewater. If the limewater turns cloudy, the gas is carbon dioxide. On the other hand, if the limewater does not turn cloudy, the gas is not carbon dioxide.
- (a) Carbon dioxide
(b) Carbon dioxide
- (a) calcium chloride + carbon dioxide + water
(b) calcium oxide + carbon dioxide
- Calcium, carbon, oxygen

Formative Practice 4.1 (p. 128)

- Minerals are naturally occurring solid elements or compounds with definite crystalline structures and chemical compositions.
- (a) Gold, silver, diamond or other mineral elements (Any one)
(b) Bauxite, hematite, galena, cassiterite, quartz or other natural mineral compounds (Any one)
- Calcium oxide that has properties of a base is used to neutralise acidic soil. Silicon dioxide that has a high melting point is used to make glass laboratory apparatus.

Activity 4.3 (pp. 130, 131)

Questions

- (a) Magnesium oxide
(b) Aluminium oxide
(c) Zinc oxide
(d) Iron oxide
(e) Lead oxide
- The more reactive the metal towards oxygen, the more vigorous the reaction.
- Magnesium \rightarrow Aluminium \rightarrow Zinc \rightarrow Iron \rightarrow Lead

Brain Teaser (p. 132)

Carbon + oxygen \rightarrow carbon dioxide

Hydrogen + oxygen \rightarrow water

Activity 4.4 (pp. 132, 133)

Questions

- (a) Zinc + Carbon dioxide
(b) No change
(c) Lead + Carbon dioxide
- Zinc and lead.
Oxides of metals which are less reactive than carbon will turn into the metals when heated with carbon.
- | | | |
|-----------------------|---|-----------|
| Increasing reactivity | ↑ | Aluminium |
| | | Carbon |
| | | Zinc |
| | | Lead |
- Metal extraction. Metals which are less reactive than carbon in the reactivity series of metals can be extracted from their ores through the reduction of the oxide of these metals by carbon.
- (a) more
(b) less

Formative Practice 4.2 (p. 136)

- The reactivity series of metals is an arrangement of metals according to their reactivity towards oxygen.
- (a) Yes. Metal X is reactive towards oxygen because metal X burns with a bright flame.
(b) Metal Y is less reactive than metal X.
(c)

X
↓
Y
↓
Z
- (a) oxygen
(b) potassium
(c) extraction
- (a) Potassium
(b) Gold
- (a) Carbon and hydrogen
(b) Carbon and hydrogen can react with oxygen.

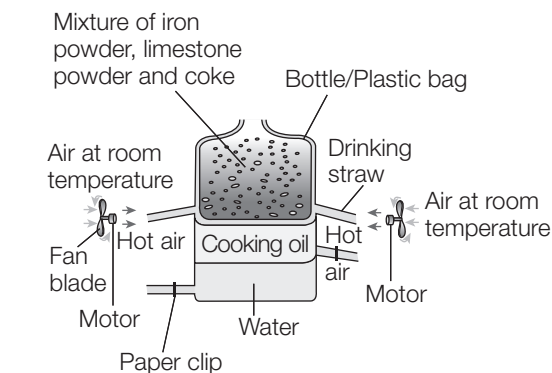
Formative Practice 4.3 (p. 141)

- (a) Electrolysis
(b) Reduction of iron ore with carbon
- (a) Tin
(b) (i) Iron ore, limestone, coke
(ii) Hot air
(c) (i) Slag
(ii) Molten iron
- (a) Soil erosion. Problem of soil erosion can be solved by replanting trees.

- (b) Air pollution. Air pollution can be avoided by filtering the gases produced before releasing them to the atmosphere.

Summative Practice 4 (pp. 143 – 145)

- (a) Elements: Iron, Silver, Potassium, Tin
Compounds: Quartz, Bauxite, Galena, Hematite, Limestone
(b) Bauxite, Aluminium and oxygen
- (a) Tin(IV) oxide
(b) Carbon
(c) Tin + oxygen → Tin(IV) oxide
- (b) ✓
(c) ✓
- (a) Oxygen
(b) Potassium and sodium are very reactive metals. Paraffin prevents potassium and sodium from reacting with oxygen and water vapour in the air.
- (a) Oxygen
(b) To provide oxygen for the reaction.
(c) Heat the powdered metal until it glows before heating potassium manganate(VII) to provide oxygen for the reaction.
(d) To construct a reactivity series of metals.
- For metals which are more reactive than carbon, extraction of the metals is through the electrolysis method. For metals which are less reactive than carbon, extraction of the metals is through reaction of the metal ores with carbon.



Explanation:

Substance	Represent
Bottle	Blast furnace
Cooking oil	Slag
Water	Molten iron
Motor	Heating device
Iron powder	Iron ore
Limestone powder	Limestone

Innovative step: Fan blade is connected in a direction opposite to the normal direction so that sucked air flows through the motor to be heated. Motor is also cooled by this flow of air.

CHAPTER 5 Thermochemistry

Experiment 5.1 (pp. 149 – 151)

Questions (p. 151)

- (a) Release of heat is shown by the rise in thermometer reading.
(b) Absorption of heat is shown by the drop in thermometer reading.
- (a) Thermal equilibrium
(b) When the net rate of heat transfer between the products of reaction and thermometer is zero, products of reaction and thermometer is in thermal equilibrium. Hence, the temperature reading on the thermometer is fixed at maximum value or minimum value.
- (a) The temperature during reaction is higher than the temperature before reaction occurred.
(b) The temperature during reaction is lower than the temperature before reaction occurred.
- Sodium hydroxide dissolving in water
– Reaction between sodium hydroxide and hydrochloric acid (Neutralisation)
- Ammonium chloride salt dissolving in water

– Reaction between sodium hydrogen carbonate and hydrochloric acid

- (a) Wrapping the polystyrene cup with cotton wool or felt cloth, using a lid for the cup.
(b) Heat insulators such as cotton wool and felt cloth and lid for cup reduces the transfer of heat to the surroundings.

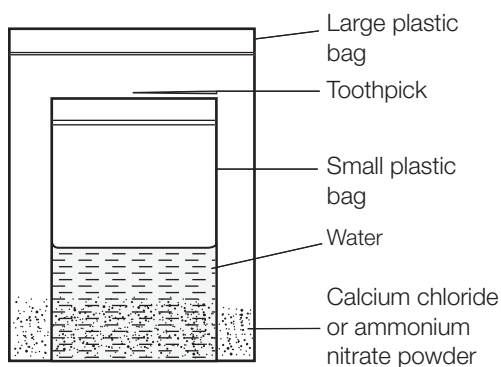
Formative Practice 5.1 (p. 154)

- (a) An endothermic reaction is a chemical reaction that absorbs heat from the surroundings.
(b) An exothermic reaction is a chemical reaction that releases heat into the surroundings.
- Thermochemistry is the study of heat changes when chemical reactions occur.
- The rate of respiration increases when performing vigorous physical activities, because respiration is an exothermic reaction. Heat produced by the exothermic reaction is absorbed into the body. Hence, the body temperature increases.
- (a) Global warming
(b) Reduce burning of fossil fuels.
- (a) Exothermic reaction.
(b) Exothermic reactions release heat into the surroundings and increase the temperature. High temperatures can relieve muscle cramp.

Summative Practice 5 (pp. 155 – 158)

- (a) Exothermic reaction
(b) Endothermic reaction
(c) Exothermic reaction
(d) Endothermic reaction
(e) Exothermic reaction
(f) Exothermic reaction
- (a) released
(b) increases
(c) hot
(d) absorbed
- (a) THERMOCHEMISTRY
(b) PHOTOSYNTHESIS
(c) RESPIRATION
(d) THERMOMETER
(e) ENDOTHERMIC
(f) EXOTHERMIC

4. Heating of calcium carbonate is an endothermic reaction. Heat is absorbed by the chemical reaction that occurs during the decomposition of calcium carbonate.
5. The reaction between hydrochloric acid and sodium carbonate is an exothermic reaction whereas the reaction between hydrochloric acid and sodium hydrogen carbonate is an endothermic reaction.
6. Replanting of trees will increase the rate of photosynthesis. As photosynthesis is an endothermic reaction, more heat will be absorbed from the surroundings into the plants to carry out photosynthesis. Hence, the surrounding temperatures will drop.
7. (a) Thermite reaction is an exothermic reaction because heat is released into the surroundings.
(b) In a thermite reaction, heating of iron(II) oxide, aluminium and magnesium tape produces iron and carbon dioxide through an exothermic reaction. The heat released in this reaction increases the temperature of the iron and carbon dioxide until the iron melts. This molten iron is used to repair and reconnect the broken iron railway rails.
- 8.



Instant hot pack:

- Use toothpick to prick a hole in the small plastic bag so that water flows out from the plastic bag and mixes with the calcium chloride powder in the large plastic bag.
- Dissolving of calcium chloride in water is an exothermic reaction which heats up the large plastic bag.

- Hence, the large plastic bag functions as an instant hot pack.

Instant cold pack:

- Use toothpick to prick a hole in the small plastic bag so that water flows out from the plastic bag and mixes with the ammonium nitrate powder in the large plastic bag.
- Dissolving of ammonium nitrate in water is an endothermic reaction which cools down the large plastic bag.
- Hence, the large plastic bag functions as an instant cold pack.

CHAPTER 6 Electricity and Magnetism

Activity 6.1 (p. 165)

Questions

1. Electric current
2. Cutting of magnetic field lines (by copper wire or coil of wire)
3. Induced current

Activity 6.2 (p. 166)

Questions

1. (b) ✓
(c) ✓
2. Induced current is detected based on the lighting up of the LED. Induced current is produced and flows through the LED. Therefore the LED lights up.
3. Current is induced when magnetic field lines are cut.
4. Sound energy, heat energy, light energy
5. – LED lasts longer and does not burn out easily
– LED will light up when electric current flows through as compared to filament bulb which only lights up when its filament is hot enough.

Activity 6.4 (pp. 172 – 175)

Questions

1. To show the shape of graph, direction of current and voltage change for direct current and alternating current.
2. Similarity: Magnitude of the displacement of the light spot from the zero position

in steps 6 and 8 is fixed and the same. This shows that the voltage of the battery is fixed and of the same value.

Difference: Displacement of the light spot from the zero position in step 6 is positive while displacement of the light spot from the zero position in step 8 is negative. This shows that the current in step 6 flows from positive to negative whereas in step 8 the flow of current in the C.R.O. has been reversed.

3. (a) First inference:
The different position of the straight line on the display screen in steps 7 and 9 shows that direct current is the electric current which flows in the opposite direction.
- (b) Second inference:
The position of the straight line from the zero position in steps 7 and 9 which are different shows that direct current in steps 7 and 9 flow in the opposite directions.
4. Voltage produced by the power supply keeps changing. Hence, the light spot on the screen moves up and down to produce a vertical trace on the screen irrespective of the type of terminal connection to the C.R.O.
5. (a) First inference:
The shape of graph on the display screen produced by the vertical and horizontal trace made by a light spot shows continuous change in the direction of current flow and the voltage of the alternating current.
- (b) Second inference:
The shape of graph on the display screen in steps 13 and 15 is the same. This shows continuous change in the direction of the current flow and the voltage of the alternating current irrespective of the type of terminal connection to the C.R.O..
6. (a) Direct current
(b) Alternating current and direct current

Formative Practice 6.1 (p. 176)

1. Renewable energy sources are energy sources that can be replaced continually and will not deplete while non-renewable energy sources are energy sources that cannot be replaced and will deplete.
2. (a) LED lights up in arrangements P and Q. In arrangements P and Q, magnetic field lines are cut by the coil of wire to produce induced current. This induced current flows through the LED causing the LED to light up.
(b) LED does not light up in arrangement R. In arrangement R, there is no cutting of magnetic field lines and no induced current flows through the LED.
3. To show the shape of graph, direction of current and voltage change for direct current and alternating current.

Experiment 6.1 (pp. 178 – 180)

Questions

1. (a) Bulb P is brighter compared to bulb S.
(b) $V_p > V_s$
(c) Step-down transformer
2. (a) Bulb S is brighter compared to bulb P.
(b) $V_p < V_s$
(c) Step-up transformer
3. If the difference between the number of turns in the primary coil and the number of turns in the secondary coil in a transformer is increased, the difference between the primary voltage and secondary voltage becomes bigger.
4. A transformer can only change the voltage of an alternating current if the number of turns of the primary coil and secondary coil is different. On the contrary, if the number of turns in the primary and secondary coil in a transformer is the same, then there is no change in the primary voltage and secondary voltage.

Formative Practice 6.2 (p. 183)

1. A transformer is a device that changes the voltage of an alternating current.

2. (a) alternating
 (b) more
 (c) step-up
 (d) step-down
3. (a) Microwave oven, washing machine, refrigerator, television
 (b) Mobile phone charger, laptop/tablet charger
4. (a) $\frac{V_p}{V_s} = \frac{N_p}{N_s}$
 $\frac{240}{5} = \frac{N_p}{10}$
 $N_p = 10 \times \frac{240}{5}$
 $= 480$
 Number of turns in primary coil,
 $N_p = 480$
- (b) The transformer in the mobile phone charger is a step-down transformer because:
- the output voltage is lower than the input voltage.
 - the number of turns in the secondary coils, N_s , is less than the number of turns in the primary coils, N_p ($N_s < N_p$).

Brain Teaser (p. 187)

In one cycle, single-phase wiring has two peaks whereas three-phase wiring has six peaks. Because of this, the current supply of three-phase wiring is more stable.

Brain Teaser (p. 192)

Because most electric kettles sold in the market use 10 – 12 A current.

Formative Practice 6.3 (p. 194)

- (a) Step-up transformer station
 (b) Switch zone
 (c) Step-down transformer
- (a) increased
 (b) National Grid Network
 (c) Switch zone
- (a) Fuse, earth wire, circuit breaker, lightning conductor (any three)
 (b) Fuse functions as a safety component that melts and cuts off electric current supply when excessive current flows through it.

- (a) Damaged wire insulator. Exposed live wire touches the exposed neutral wire.
 (b) (i) Excessive load
 (ii) Fire. Large flow of current causes wires, plugs and sockets to become so hot that they burn.

Brain Teaser (p. 199)

Can be used in Thailand but the time taken to boil water is longer.

Brain Teaser (p. 201)

No. A green building uses the concept of savings on energy, water and material consumption.

Formative Practice 6.4 (p. 202)

- Energy efficiency is the percentage of energy input converted into useful energy output.

- (a) Using the formula:

$$P = \frac{E}{t}$$

$$P = \frac{180 \text{ kJ}}{2 \text{ minutes}}$$

$$= \frac{180\,000 \text{ J}}{120 \text{ s}}$$

$$= 1\,500 \text{ W}$$

- (b) Power of air conditioner,

$$P = 1\,500 \text{ W}$$

$$= \frac{1\,500}{1\,000} \text{ kW}$$

$$= 1.5 \text{ kW}$$

-

$$P = VI$$

$$1\,200 \text{ W} = 240 \text{ V} \times I$$

$$\text{Electric current, } I = \frac{1\,200 \text{ W}}{240 \text{ V}}$$

$$= 5 \text{ A}$$

- (a) $E = Pt$

$$= \frac{800}{1\,000} \text{ kW} \times \frac{30}{60} \text{ h}$$

$$= 0.4 \text{ kWh}$$

- (b) Cost of energy used by rice cooker
 = Electrical energy used in kWh \times
 cost of energy for each kWh
 = 0.4 kWh \times 30 sen/kWh
 = 12 sen

5. (a) Star rating labelling on an electrical appliance shows the energy efficiency of the electrical appliance.
 (b) At least 3 stars. The more stars on a star rating label means more energy savings.

Summative Practice 6 (pp. 204 – 207)

1. (a) True
 (b) False
 (c) True
2. (a) Non-renewable energy source
 (b) Renewable energy source
 (c) Renewable energy source
 (d) Renewable energy source
3. (a) Magnetic field lines are cut
 (b) Induced current
 (c) LED lights up. Induced current flows through the LED. The flow of current through the LED causes the LED to light up.
 (d) Generator
4. (a) Cathode ray oscilloscope
 (b) Shape of graph, direction of current and voltage changes for direct current and alternating current.
 (c) (i) Alternating current
 (ii) Direct current
5. (a) Step-down transformer
 (b) Number of turns in the primary coil is more than the number of turns in the secondary coil.
 (c) To reduce eddy current and increase the efficiency of the transformer
- (d) Using the formula, $\frac{V_p}{V_s} = \frac{N_p}{N_s}$
- $$\frac{10}{V_s} = \frac{100}{20}$$
- Secondary voltage, $V_s = 10 \times \frac{20}{100}$
 $= 2 \text{ V}$
6. (a) Main fuse
 (b) (i) Fuse and MCB function as safety devices that protect appliance from any excessive current flow.
 (ii) When the current flowing through a fuse exceeds the value of the fuse, the fuse will melt and cannot be reused without

replacing the burnt fuse wire with a new fuse wire.

An MCB is an electromagnetic switch connected to the live wire. An MCB cuts the circuit by turning off its switch when the current flowing through it exceeds its limit. The MCB can be reused by turning on the switch again without having to do any replacement.

- (c) Using the formula:

$$P = VI$$

$$700 \text{ W} = 240 \text{ V} \times I$$

$$\text{Electric current, } I = \frac{700 \text{ W}}{240 \text{ V}}$$

$$= 2.9 \text{ A}$$

Fuse chosen is a 3 A fuse because the value of the fuse is slightly higher than the value of the electric current flowing through the hair dryer.

7. (a) Using the formula:

$$\text{Power (W)} = \text{Voltage (V)} \times \text{Electric current (A)}$$

$$= 230 \text{ V} \times 10 \text{ A}$$

$$= 2300 \text{ W}$$

$$= \frac{2300}{1000} \text{ kW}$$

$$= 2.3 \text{ kW}$$

- (b) 13 A fuse.

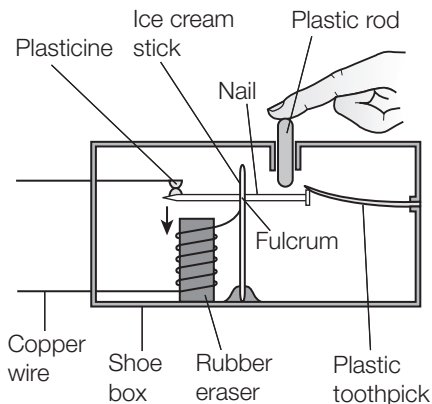
13 A fuse is the most suitable because a 13 A fuse allows a 10 A current to flow through it but does not allow a current exceeding 13 A to flow through the electric heater. A current that is too high will damage the electric heater.

- (c) A 10 A current that flows through 1A, 2A, 3A and 5A fuses will melt the fuse wires. Hence, the electric heater will not be able to function.

15 A and 30 A fuses allow current which is much greater than 10 A to flow through the electric heater. This will damage the electric heater.

10 A fuse is also not suitable because most 10 A fuses normally allow maximum current of less than 10 A to flow through it. Hence, the

- 10 A fuse will blow if installed in the electric heater.
8. (a) An MCB is a small electromagnetic switch connected to the live wire.
 (b) An MCB functions as an electric safety device. An MCB cuts off the circuit when the current flowing through it is too high or exceeds its limit value.
 (c)



Contact – plasticine
 Iron – nail
 Fulcrum – an ice cream stick
 Reset button – plastic rod
 Spring – plastic toothpick
 Iron core – Rubber eraser
 Electric wire – copper wire

Scenario: When the electric current that flows through the MCB exceeds its limit value, the solenoid becomes a strong electromagnet.

MCB	Model of MCB
Electric wire that is mounted to the contact and iron is pulled downwards as shown in Figure 4.	Copper wire that is mounted to the plasticine and iron nail is pulled downwards as shown in the above diagram.

MCB	Model of MCB
The iron rotates in an anti-clockwise direction at the fulcrum.	The iron nail rotates in an anti-clockwise direction at the fulcrum on the ice cream stick.
The rotating iron pushes the spring upwards. Finally, the spring is released and it is below the iron.	The rotating iron nail pushes the toothpick upwards. Finally, the toothpick is released and it is below the iron nail.
Reset button when pushed downwards will push the iron downwards until the iron nail is below the spring again.	When the plastic rod is pushed downwards, it will push the iron nail downwards until the iron nail is below the toothpick again.

CHAPTER 7 Energy and Power

Brain Teaser (p. 210)

- (a) 1 000 (or 10^3) J
 (b) 1 000 000 (or 10^6) J

Brain Teaser (p. 212)

No

Activity 7.1 (pp. 214, 215)

Questions

- (a) Frictional force
 (b) Gravitational force
- Student's answer
- Force, displacement in the direction of the force, time
- Student's answer
- (a) Aeroplane that is taking off, moving ERL train.
 (b) Sleep, sit

Formative Practice 7.1 (p. 215)

- (a) Work is defined as the product of force and displacement in the direction of the force.
(b) Joule
- Energy is the ability to do work.
- (a) Power is defined as the rate of doing work.
(b) Watt
- (a) $W = Fs$
 $= 2\,500\text{ N} \times 4\text{ m}$
 $= 10\,000\text{ J}$
(b) Energy used = work done
 $= 10\,000\text{ J}$
(c) Power of crane, $P = \frac{W}{t}$
 $= \frac{10\,000\text{ J}}{1.2\text{ minutes}}$
 $= \frac{10\,000\text{ J}}{72\text{ s}}$
 $= 138.89\text{ W}$

Formative Practice 7.2 (p. 221)

- (a) Gravitational potential energy is the work done to lift an object to a height, h , from the surface of the Earth.
(b) Elastic potential energy is the work done to compress or stretch an elastic material over a displacement, x from the position of equilibrium.
- (a) $W = Fs$
 $= 40\text{ N} \times 0.5\text{ m}$
 $= 20\text{ J}$
(b) Gravitational potential energy
(c) Gravitational potential energy of possessed by the chair = work done on it
 $= 20\text{ J}$
- Distance of compression of spring
 $=$ original length $-$ length of
of spring $-$ compressed spring
 $= 50\text{ cm} - 30\text{ cm}$
 $= 20\text{ cm}$
 $= 0.2\text{ m}$
Elastic potential energy
 $= \frac{1}{2}Fx$
 $= \frac{1}{2}(20\text{ N})(0.2\text{ m})$
 $= 2\text{ J}$

4. (a) Kinetic energy $= \frac{1}{2}mv^2$

where m is mass
 v is velocity

Even though the value of the velocity, v of a heavy vehicle is small, the value of its mass, m is big. Hence, the large mass of these heavy vehicles causes more kinetic energy.

- (i) Bullet fired from a pistol.
(ii) Aeroplane taking off from runway at airport.

Formative Practice 7.3 (p. 226)

- The Principle of Conservation of Energy states that energy cannot be created or destroyed but can only be converted from one form to another.
- (a) P, R
(b) Q
- (a) Gravitational potential energy
 $= mgh$
 $= 2\text{ kg} \times 10\text{ m s}^{-2} \times 2.5\text{ m}$
 $= 50\text{ J}$
(b) According to the Principle of Conservation of Energy,
Kinetic energy = Gravitational potential energy
 $\frac{1}{2}mv^2 = 50\text{ J}$
 $\frac{1}{2} \times 2\text{ kg} \times v^2 = 50\text{ J}$
 $v^2 = 50\text{ m}^2\text{s}^{-2}$
 $v = \sqrt{50\text{ m}^2\text{s}^{-2}}$
 $= 7.07\text{ m s}^{-1}$

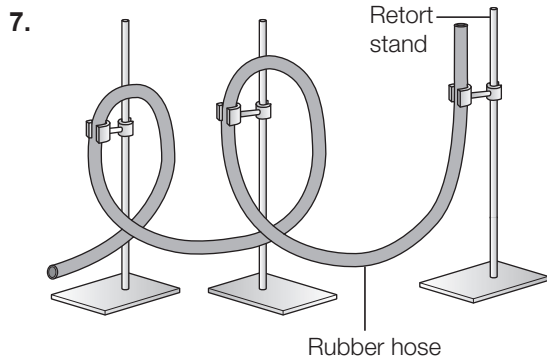
Summative Practice 7 (pp. 228, 229)

- (a) Energy possessed by an object is due to its position or condition.
(b) Energy possessed by a moving object.
- (a) N m
(b) Work
(c) stationary
(d) can
(e) acceleration
- (a) $W = Fs$

$$= 5 \text{ kg} \times 10 \text{ m s}^{-2} \times 2 \text{ m}$$

$$= 100 \text{ J}$$

- (b) Energy used by motor = work done
= 100 J
4. (a) Gravitational potential energy = mgh
where m is the object mass
 g is the gravitational acceleration
 h is the height
- (b) Elastic potential energy = $\frac{1}{2}Fx$,
where F is the compression or stretching force
 x is the displacement from equilibrium position
- (c) Kinetic energy = $\frac{1}{2}mv^2$,
where m is the mass,
 v is the velocity
5. (a) Work = force \times displacement
= $200 \text{ N} \times 0.4 \text{ m}$
= 80 J
- (b) Elastic potential energy
= $\frac{1}{2}Fx$
= $\frac{1}{2} \times 200 \text{ N} \times 0.4 \text{ m}$
= 40 J
- (c) Because part of the work done is used to bend the bow.
6. (a) Principle of Conservation of Energy
(b) Vertical displacement of 2.5 cm from position Y.
(c) Potential energy at X = mgh
= $\frac{40}{1000} \text{ kg} \times 10 \text{ m s}^{-2} \times \frac{5}{100} \text{ m}$
= 0.02 J
Potential energy at Y = 0 J, so
difference in potential energy
= $(0.02 - 0) \text{ J}$
= 0.02 J



Explanation: This model of a roller coaster has vertical, winding and turning loops.

CHAPTER 8 Radioactivity

Brain Teaser (p. 235)

- (a) $1 \text{ Ci} = 3.7 \times 10^{10} \text{ Bq}$
(b) $1 \text{ Bq} = 2.70 \times 10^{-11} \text{ Ci}$

Formative Practice 8.1 (p. 237)

- (a) Wilhelm Roentgen
(b) Henri Becquerel
(c) Marie and Pierre Curie
- Radioactivity is the spontaneous decay process of an unstable nucleus by emitting radioactive radiation.
- (a) curie (Ci), becquerel (Bq)
(b) The decay rate of an unstable nucleus.
- Carbon-14 (C-14), Radon-222 (Rn-222), Thorium-232 (Th-232), Uranium-238 (U-238)
- Half-life, $T_{\frac{1}{2}}$, is the time taken for the number of undecayed nuclei to be reduced to half of its original value.

Formative Practice 8.2 (p. 239)

- According to Dalton's Atomic Theory, an atom is the smallest particle and cannot be further divided.
- (a) When an atom loses electrons.
(b) When an atom gains electrons.
- (a) Q and S. In Q and S, the number of protons is more than the number of electrons.
(b) R and T. In R and T, the number of electrons is more than the number of protons.
(c) P. In P, the number of protons is the same as the number of electrons.
- (a) One electron is gained.
(b) The number of electrons in the ion increases by one.
(c) Bromide ion, Br^-

Brain Teaser (p. 243)

$1 \mu\text{Sv/h}$ is equivalent to 10^{-6} J of ionising radiation energy absorbed by 1 kilogram of living tissue in a time interval of 1 hour.

Formative Practice 8.3 (p. 246)

- (a) Ionising radiation is radiation that produces positive and negative ions while passing through the air.
Examples of ionising radiation: alpha radiation, beta radiation, gamma ray and X-ray (any one)
(b) Non-ionising is radiation that does not produce ions while passing through the air.
Examples of non-ionising radiation: light (visible), infrared, radio waves
- (a) lower, higher
(b) higher, lower
- (a) Cosmic rays, background radiation
(b) Nuclear accidents, nuclear tests, use of radioisotopes in medical field
- (a) microSievert/hour ($\mu\text{Sv/h}$)
(b) 1 Sv is 1 Joule of ionising radiation energy absorbed by 1 kilogram of living tissue.
(c) Radiation dose less than $0.2 \mu\text{Sv/h}$
- The higher an individual is from the surface of Earth, the stronger the cosmic rays received. Hence, an individual who is in an aeroplane at a high altitude will absorb more cosmic rays causing his ionising radiation dose to exceed the safety level.
- Ionising radiation dose received by the student = $0.01 \text{ mSv/h} \times 2 \text{ h} \times 5$
= 0.1 mSv

Formative Practice 8.4 (p. 250)

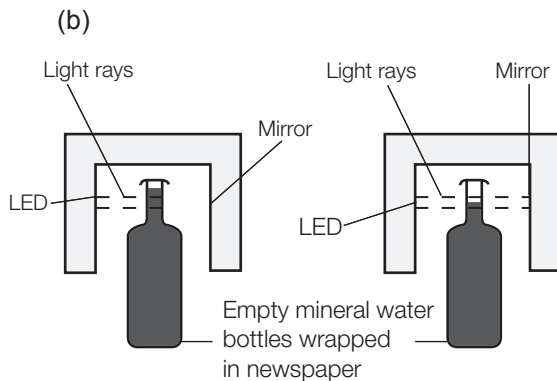
- (a) Carbon-14 dating to determine the age of an ancient object.
(b) Cobalt-60 to treat cancer by killing cancer cells.
(c) Phosphorus-32 to determine the absorption rate of phosphate fertilisers in plants.
(d) Uranium-235 to build weapons such as atomic bombs.
(e) β -radiation to monitor the thickness of metal sheets.
- (a) Gamma rays
(b) Gamma rays preserve food by killing the bacteria in the preserved food.
- Boxes with thick lead walls can prevent all types of radioactive radiation emitted by radioactive sources or radioactive waste from escaping.

- (a) Presence of radioactive substance or radioactive radiation.
(b) Hospitals, atomic research centres, X-ray rooms.
(c) Alpha radiation. It has the lowest penetration power.
- (a) Lead (or aluminium)
(b) For lead:
Advantage – Lead is an appropriate shield from all types of radioactive radiation including gamma rays which have high penetration power.
Disadvantage – The high density of lead makes the clothing too heavy.
For aluminium:
Advantage – The lower density of aluminium makes the clothing less heavy.
Disadvantage – Aluminium is a less efficient shield from gamma rays which have high penetration power.

Summative Practice 8 (pp. 252 – 254)

- (a) ✓
(b) ×
(c) ✓
- Radioactive decay is a spontaneous process by which an unstable nucleus emits radioactive radiation until the nucleus becomes more stable.
- sodium-24 (Na-24)
- | | | | | | |
|-----------------|---|-------------------|---|-------------------|--|
| 0 hours
32 g | → | 5.2 hours
16 g | → | 10.4 hours
8 g | |
| | | | | | |
| | → | 15.6 hours
4 g | → | 20.8 hours
2 g | |
- Therefore the remaining mass of Pa-234 after 20.8 hours is 2 g.
- (a) Ion formed is a positive ion because Mg atom loses two electrons to form Mg^{2+} ion.
(b) Ion formed is a negative ion because F atom gains one electron to form F^- ion.
- (a) X-ray and gamma ray:
 - are ionising radiation
 - have high penetration power in air
 - are electromagnetic waves(b) (i) Sample Y. This is because the strawberry in sample Y is still in good condition.

- (ii) Gamma rays
 - (iii) Gamma rays kill bacteria in food.
 - (iv) Yes. This is because the radioactive radiation dose in preserved food is within the normal level or safe level.
7. (a) • Wear appropriate protective clothing.
- Detect radioactive radiation dose found on clothing with detectors such as Geiger Müller tube which gives a warning sound if the dose detected exceeds the normal level.



Explanation:

Component in the model	Representing component in the system
LED	Beta radiation source
Light rays	Beta radiation
Mineral water bottles wrapped in newspaper	Bottles filled with drinking water
Mirror	Beta radiation detector

CHAPTER 9 Space Weather

Formative Practice 9.1 (p. 263)

1. Photosphere, chromosphere, corona
2. Prominence, solar flare, coronal mass ejection
3. Earth's magnetosphere is defined as a

region in space surrounding Earth. It is a combination of the Earth's magnetic field (as the main magnetic field) and the magnetic field in the region in space.

4. Solar wind
5. Comet

Formative Practice 9.2 (p. 265)

1. Phenomena that occur on the surface of the Sun and in outer space.
2. Formation of aurora, disturbances to telecommunication, navigation system and electric power lines
3. When the number of sunspots increases, coronal mass ejections will increase.

Summative Practice 9 (pp. 266 – 267)

1. A: Convection zone
B: Chromosphere
C: Photosphere
D: Radiation zone
E: Core
F: Corona
2. 11 years
3. Sunspots
4. – Smartphone (mobile)
– Internet
– TV broadcast
– Global positioning system (GPS)
5. All living things would die. Ionising radiation in solar winds would reach Earth and be absorbed by living things at levels exceeding the safety level. Hence, the risks to the health of living things would increase and this would be fatal.
6. Sketch of model: Student's answer
Explanation:
 - Green plastic bag represents 'Bow Shock'
 - White thread represents magnetic field lines from other planets
 - Red thread represents Earth's magnetic field
 - Polystyrene cup represents a protective layer, the magnetosphere
 - Convex cover represents the part of the magnetosphere that is directed towards the Sun
 - Plasticine represents Earth

CHAPTER 10 Space Exploration

Formative Practice 10.1 (p. 272)

- Geocentric model
 - Heliocentric model
 - Modified heliocentric model according to Kepler's Law
- Similarity: In the Solar System models built by Ptolemy and Copernicus, Earth or the Sun revolve in orbits.
 - Difference: In the Solar System model built by Ptolemy, Earth is at the centre of the orbit whereas in the Solar System model built by Copernicus, the Sun is at the centre of Earth's orbit.
- Similarity: The Solar System models built by Copernicus and Kepler are heliocentric models.
 - Difference: In the Solar System model built by Copernicus, Earth and the planets revolve in circular orbits whereas in the Solar System model built by Kepler, Earth and the planets revolve in elliptical orbits.

Formative Practice 10.2 (p. 276)

- Telescope
- Discovery is a space shuttle.
 - Hape is a rocket which sent Discovery to space.
- Remote sensing technology
 - To identify the locations hit by flood and determine the places to transfer flood victims
- MACRES is responsible for all remote sensing projects in Malaysia.

Summative Practice 10 (pp. 278 – 280)

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- Ptolemy
 - Kepler
- Through human effort to obtain rational explanation about objects and phenomena in space based on their intellectual abilities.
- Because space probes are not built to return to Earth.
- To gather information about Saturn to be sent back to Earth.
 - Solar wind
 - Solar energy
- Oversee conditions and usage of land
– Predict yield of crops
 - Explore regions to search for oil and mineral sources
– Map Earth's surface
 - Oversee natural disasters such as floods
– Oversee forest fires, oil spills in the oceans and landslides
 - Detect enemy invasions from air, land and sea
– Detect nuclear tests
- A rocket is an aircraft that obtains its thrust using a rocket engine.
 - To send astronauts, spaceships, satellites, remote sensing instruments and space probes to space.
 - Functions as a weapon by carrying guided missiles.
- Sketch of model: Student's answer
Explanation:

Material	Function
Aluminium foil	Shield against ionising radiations from space
Cylindrical cardboard	As a rocket
Black plastic sheet	Solar battery/ Source of energy for spaceship
Cardboard in the form of a spaceship	As a spaceship