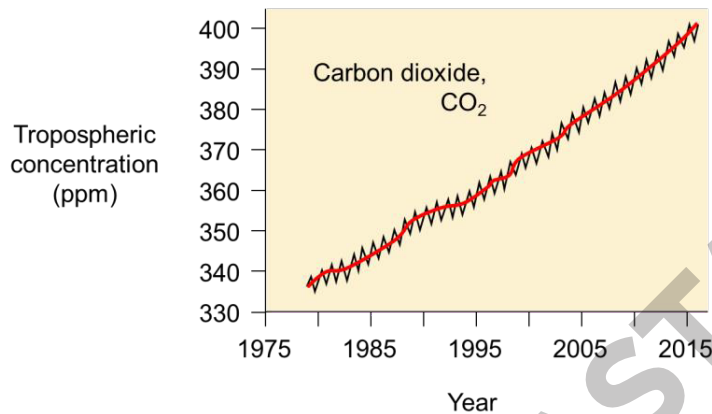


## Review Test 1

## Question 1

The graph below shows changes in the tropospheric concentration of carbon dioxide between 1979 and 2015.



(a) Carbon dioxide is emitted into the troposphere from both natural and anthropogenic sources.

(1) State one natural source of carbon dioxide emissions.

\_\_\_\_\_ (1 mark) KA1

(2) Electrical power stations are a major source of the emissions of carbon dioxide.

State one other anthropogenic source of carbon dioxide.

\_\_\_\_\_ (1 mark) KA1

(b) Carbon dioxide is a greenhouse gas.

(1) Explain the term greenhouse gas using carbon dioxide as an example.

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_ (2 marks) KA1

(2) Describe one consequence of the increasing trend shown in the graph above.

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_ (2 marks) IAE3

## Review Test 2

## Question 1

Ammonia is a basic chemical that is used to produce a wide range of materials including fertilisers, explosives, pharmaceuticals and nitric acid.

Ammonia is produced in the reaction of nitrogen ( $\text{N}_2$ ) and hydrogen ( $\text{H}_2$ ) in the Haber process.



- (a) Write the expression for the equilibrium constant ( $K_c$ ) in this reaction.

(2 marks) KA4

- (b) Nitrogen was reacted with hydrogen in a sealed vessel at  $180^\circ\text{C}$

	$\text{N}_2$	$\text{H}_2$	$\text{NH}_3$
Initial concentration ( $\text{mol} \cdot \text{L}^{-1}$ )			0
Change in concentration ( $\text{mol} \cdot \text{L}^{-1}$ )			
Equilibrium concentration ( $\text{mol} \cdot \text{L}^{-1}$ )	0.10	0.30	0.60

- (1) Complete the ICE table above.

(3 marks) KA4

- (2) Determine the value of the equilibrium constant at  $180^\circ\text{C}$ .

(2 marks) KA4

- (c) The reaction is carried out at a temperature of  $450^\circ\text{C}$  in ammonia manufacturing plants.

- (1) State one advantage of carrying out the reaction at a greater temperature.

\_\_\_\_\_

\_\_\_\_\_

(1 mark) KA2

- (2) State one disadvantage of carrying out the reaction at a greater temperature.

\_\_\_\_\_

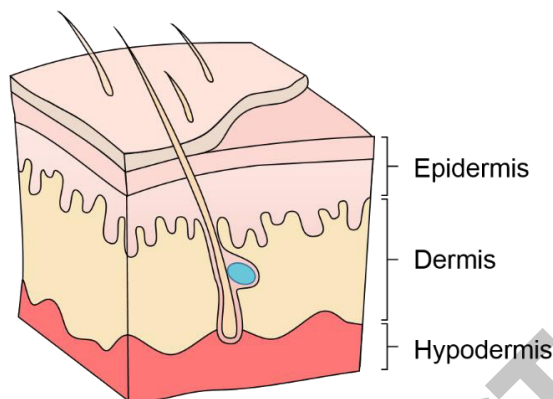
\_\_\_\_\_

(1 mark) KA2

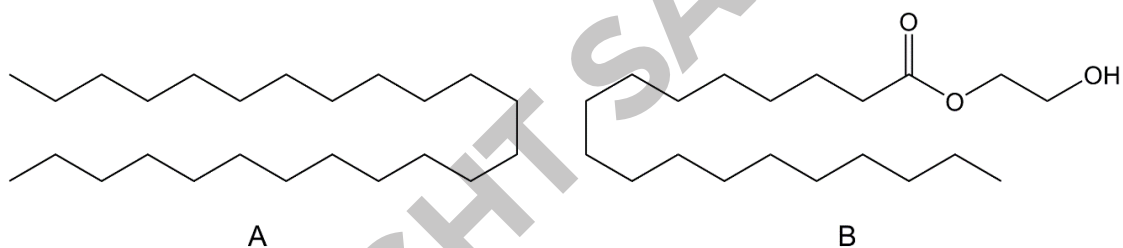
## Review Test 3

## Question 1

Moisturiser is a hygiene product used to prevent water loss through the epidermis of the skin.



Two chemical compounds present in moisturiser are shown below.



(a) Write the molecular formula of compound A.

\_\_\_\_\_ (2 marks) KA4

(b) Name two functional groups in molecule B.

\_\_\_\_\_ (2 marks) KA4

(c) Skin becomes dry when water from the dermis and epidermis enter the atmosphere.

Compounds A and B are applied directly to the epidermis of human skin.

Explain how compounds A and B prevent water loss through the epidermis of the skin.

\_\_\_\_\_  
 \_\_\_\_\_  
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 \_\_\_\_\_

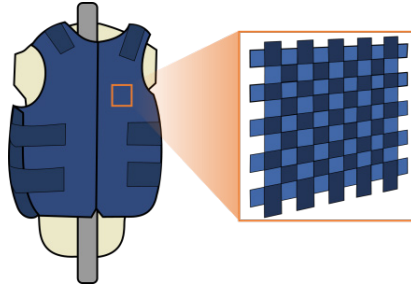
(2 marks) KA2

## Review Test 4

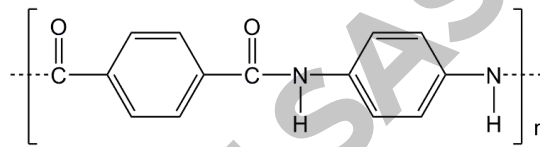
## Question 1

Bulletproof vests are made from an Aramid reinforced polymer composite (ARPCs).

Kevlar fibres (matrix) are embedded in a thermoset polymer resin (reinforcement).



(a) The repeating unit of Kevlar is given below.



(1) Draw the structural formula of the monomers that react and form Kevlar.

(4 marks) KA4

(2) State the type of polymerisation reaction that forms Kevlar.

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(1 mark) KA1

(3) Kevlar molecules are joined by hydrogen bonds in ARPCs.

State whether Kevlar is a thermoset or thermoplastic polymer.

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(1 mark) KA2

(b) State one advantage of using composite materials such as ARPCs.

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(1 mark) KA1

(c) Bulletproof vests are shredded and repurposed after 5 years of use.

State why bulletproof vests must be recycled in this way.

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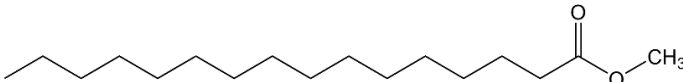
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(1 mark) KA1

Solutions: Chapter 1			
Question	Part	Suggested response	Marks
1	(a)	Surface	1
	(b)	$163 + 23 = 186 \text{ W.m}^2$	1
	(c)	Outgoing radiation	1
	(d)	Greenhouse gases absorb infrared radiation that is emitted (radiated) by atoms and molecules on the surface of a planet.	1
		Greenhouse gases reradiate this energy (as infrared radiation) to the surface which warms the Earth (Greenhouse Effect).	1
	(e)	Increase	1
(f)	More outgoing infrared radiation is absorbed by greenhouse gases in the troposphere; Increase in energy reradiated to the surface by greenhouse gases which causes an increase in the average surface and atmospheric temperature (Global Warming).	1 1	
2	(a)	<b>Any two:</b> Ocean-atmosphere exchange; Plant and animal respiration; Respiration of soil microbes and aerobic decay of organic matter in soils; Volcanic eruptions.	1+1
		Electrical energy production; Transportation.	1 1
		Natural	1
		(1) $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$	2
			(2) Combustion of the fuel used as an energy source to heat the limestone to a high temperature.
	(e)	More carbon dioxide accumulates in the troposphere as less is absorbed by the remaining trees. More infrared radiation is reradiated to the surface by carbon dioxide which causes an enhanced Greenhouse Effect.	1 1
3	(a)	$\text{CO}_2$	1
	(b)	$\text{H}_2$	1
	(c)	Increasing population uses more materials (meat, milk, wool) from livestock; Humans raise more livestock to meet the global demand which increases the number of sources of methane emissions.	1 1
		<b>Any one:</b> Reduce human reliance on fossil fuels by using alternative or renewable fuel sources (solar, wind) for electrical energy production; Introduce methane emission standards for fossil fuel companies.	1
	(e)	<b>Any one:</b> Landfill and waste; Anaerobic decay of rice paddies in waterlogged soils; Combustion of biomass and biofuels.	1
	4	(a)	The solubility of carbon dioxide decreases as the water temperature increases.
(b)		The ocean surface (water) temperature increased between 1982 and 2009.	1
(c)		Emissions of carbon dioxide from the oceans will increase.	1
		Carbon dioxide becomes less soluble in oceans as the water temperature increases; More carbon dioxide will move out of the water (as gas) and into the atmosphere.	1 1
(d)		Enhanced Greenhouse Effect will occur.	1

	(2)	$  \begin{array}{ccccccc}  \text{H} & \text{H} & \text{O} & \text{H} & \text{H} & \text{H} & \text{H} \\    &   &    &   &   &   &   \\  \text{H}-\text{C}-\text{C}-\text{C}-\text{C}-\text{C}-\text{C}-\text{H} \\    &   & &   & \text{CH}_3 &   &   \\  \text{H} & \text{H} & & \text{H} & \text{H} & \text{H} & \text{H}  \end{array}  $	2	
	(3)		2	
	(4)		2	
80	(a)	(1)	methanal	2
		(2)	hexanal	2
		(3)	2-methylpropanal	2
		(4)	3-ethylpentanal	2
		(5)	3,4-dimethylhexanal	2
		(6)	2-ethyl-7-methyloctanal	2
	(b)	(1)	$  \begin{array}{ccccccc}  \text{H} & \text{H} & \text{H} & \text{H} & \text{O} \\    &   &   &   & // \\  \text{H}-\text{C}-\text{C}-\text{C}-\text{C}-\text{C} \\    &   &   &   & \backslash \\  \text{H} & \text{H} & \text{H} & \text{H} & \text{H}  \end{array}  $	2
		(2)	$  \begin{array}{cccccccc}  \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{O} \\    &   &   &   &   &   &   & // \\  \text{H}-\text{C}-\text{C}-\text{C}-\text{C}-\text{C}-\text{C}-\text{C}-\text{C} \\    &   &   &   &   &   &   & \backslash \\  \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H}  \end{array}  $	2
		(3)	$  \begin{array}{ccccccc}  \text{H} & \text{CH}_3 & \text{H} & \text{H} & \text{H} & \text{O} \\    &   &   &   &   & // \\  \text{H}-\text{C}-\text{C}-\text{C}-\text{C}-\text{C}-\text{C} \\    &   &   &   &   & \backslash \\  \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H}  \end{array}  $	2
		(4)	$  \begin{array}{ccccccc}  \text{H} & \text{H} & \text{CH}_3 & \text{O} \\    &   &   & // \\  \text{H}-\text{C}-\text{C}-\text{C}-\text{C} \\    &   &   & \backslash \\  \text{H} & \text{H} & \text{CH}_3 & \text{H}  \end{array}  $	2
		(5)	$  \begin{array}{ccccccc}  \text{H} & \text{H} & \text{C}_2\text{H}_5 & \text{H} & \text{O} \\    &   &   &   & // \\  \text{H}-\text{C}-\text{C}-\text{C}-\text{C}-\text{C} \\    &   &   &   & \backslash \\  \text{H} & \text{H} & \text{C}_2\text{H}_5 & \text{H} & \text{H}  \end{array}  $	2
		(6)	$  \begin{array}{ccccccc}  \text{H} & \text{CH}_3 & \text{H} & \text{H} & \text{O} \\    &   &   &   & // \\  \text{H}-\text{C}-\text{C}-\text{C}-\text{C}-\text{C} \\    &   &   &   & \backslash \\  \text{H} & \text{H} & \text{H} & \text{C}_2\text{H}_5 & \text{H}  \end{array}  $	2
	81	(a)	(1)	heptanedial
(2)			propanedial	2

94	(a)	Methanoic acid	2
	(b)	(1) $\text{HCOOH} + \text{NaHCO}_3 \rightarrow \text{NaHCOO} + \text{CO}_2 + \text{H}_2\text{O}$	2
		(2) As the baking soda remains on the surface of the skin whereas the formic acid is injected under the skin.	1
95	(a)	ethanoic acid	2
	(b)	$\text{CH}_3\text{COOH} + \text{H}_2\text{O} \rightleftharpoons \text{CH}_3\text{COO}^- + \text{H}_3\text{O}^+$	2
	(c)	$2\text{CH}_3\text{COOH} + \text{CaCO}_3 \rightarrow \text{Ca}(\text{CH}_3\text{COO})_2 + \text{CO}_2 + \text{H}_2\text{O}$	2
		Acetic acid reacts with and dissolves calcium carbonate forming a water-soluble salt (calcium acetate) that is washed away when water is added.	1
	(d)	$n_{\text{CaCO}_3} = \frac{m}{M}$	1
		$n_{\text{CaCO}_3} = \frac{0.65}{100.09}$	
		$n_{\text{CaCO}_3} = 6.5 \times 10^{-3} \text{ mol}$	
		$n_{\text{CH}_3\text{COOH}} = 2n_{\text{CaCO}_3}$ (stoichiometric ratio is 2:1)	
		$n_{\text{CH}_3\text{COOH}} = 2 \times 6.5 \times 10^{-3}$	
		$n_{\text{CH}_3\text{COOH}} = 1.3 \times 10^{-2} \text{ mol}$	
		$c_{\text{CH}_3\text{COOH}} = 5.0 \times 10$	
		$c_{\text{CH}_3\text{COOH}} = 50 \text{ g.L}^{-1}$	
		$c_{\text{CH}_3\text{COOH}} = 50 \div M_{\text{CH}_3\text{COOH}}$	
$c_{\text{CH}_3\text{COOH}} = 50 \div 60.052$			
$c_{\text{CH}_3\text{COOH}} = 0.83 \text{ mol.L}^{-1}$			
$V_{\text{CH}_3\text{COOH}} = \frac{n_{\text{CH}_3\text{COOH}}}{c_{\text{CH}_3\text{COOH}}}$	1		
$V_{\text{CH}_3\text{COOH}} = \frac{1.3 \times 10^{-2}}{0.83}$			
$V_{\text{CH}_3\text{COOH}} = 0.016 \text{ L (16 mL)}$	1		
96	(a)	$\text{CH}_3\text{COOH} + \text{NaHCO}_3 \rightarrow \text{NaCH}_3\text{COO} + \text{CO}_2 + \text{H}_2\text{O}$	2
	(b)	$\text{HCOOH} + \text{KOH} \rightarrow \text{KHCOO} + \text{H}_2\text{O}$	2
	(c)	$2\text{CH}_3(\text{CH}_2)_6\text{COOH} + \text{Na}_2\text{CO}_3 \rightarrow 2\text{NaCH}_3(\text{CH}_2)_6\text{COO} + \text{CO}_2 + \text{H}_2\text{O}$	2
	(d)	$\text{C}_6\text{H}_5\text{COOH} + \text{KOH} \rightarrow \text{KC}_6\text{H}_5\text{COO} + \text{H}_2\text{O}$	2
97	(a)	$\text{C}_6\text{H}_5\text{COOH} + \text{NaOH} \rightarrow \text{NaC}_6\text{H}_5\text{COO} + \text{H}_2\text{O}$	2
	(b)	Sodium benzoate is much more soluble in water and mixtures containing water such as soft drink. Compounds with higher solubility are dispersed homogeneously throughout the volume of soft drink (liquid) offering greater protection against bacteria.	1 1
98	(a)	$\text{C}_{13}\text{H}_{18}\text{O}_2$	2
	(b)	Ibuprofen molecules have large electron clouds;	1
		Intermolecular/secondary forces (hydrogen bonds and dispersion forces) between molecules are stronger;	1
		Water cannot overcome the extensive network of intermolecular forces between molecules.	1
(c)	(1) Ibuprofen react with lysine forming a lysine carboxylate salt; Ion-dipole forces are formed between water and the carboxylate salt of ibuprofen; Ion-dipole forces help to facilitate the mixing of ibuprofen with water.	1 1 1	

Solutions: Chapter 4					
Question	Part	Suggested response	Marks		
124	(a)	$6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$	2		
	(b)	More incident solar radiation is absorbed by the soil as there is less shelter from trees.	1		
	(c)	$\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O}$	2		
	(d)	Increased soil temperature will increase the rate of aerobic respiration reactions occurring in soil microbes. More carbon dioxide enters the atmosphere from aerobic respiration in soil microbes; Enhanced Greenhouse effect will occur which will cause Global Warming.	1 1 1		
125	(a)	$\text{C}_6\text{H}_{12}\text{O}_6 \rightarrow 2\text{C}_2\text{H}_5\text{OH} + 2\text{CO}_2$	2		
	(b)	(1) Sugarcane	1		
		(2) Brazil or France	1		
	(c)	(1)	<b>Any one:</b> Increased emissions of greenhouse gases from combustion of fossil fuels to provide energy for the manufacture of fertilisers. Increased emissions of nitrous oxide from soil microbes as a result of increase in nitrogen fertiliser use. Increase in waste products from the manufacture of fertilisers.	1	
			(2)	Unlikely to be sustainable as the global water supply is affected by Global Warming. If Global Warming continues, water shortages will reduce the amount water available for the growth of food crops for the manufacture of bioethanol.	1
			(3)	The fuel energy balance is much greater in Brazil when compared to the USA, meaning that less energy is required to produce bioethanol in Brazil which makes it a more economic fuel source.	1
		(4)	Bioethanol is manufactured using important food crops; Demand for these food crops will increase in the future with the growing human population and through increased use of bioethanol as a fuel; Price of food crops will increase with demand.	1 1 1	
			<b>Alternate response:</b> Available land for growth of food crops will increase; More food crops would need to be imported; Import taxes on food crops increases the price of food	As above	
			(1)	$(\text{C}_6\text{H}_{10}\text{O}_5)_n + n\text{H}_2\text{O} \rightarrow n\text{C}_6\text{H}_{12}\text{O}_6$	2
		(d)	(2)	<b>Any one:</b> Reduces amount of plant waste; Converts a waste product into a by-product; Using plant waste material does not impact on the availability of land for the growth of food crops.	1
	(e)		(1)	$\text{C}_2\text{H}_5\text{OH}_{(l)} + 3\text{O}_2_{(g)} \rightarrow 2\text{CO}_2_{(g)} + 3\text{H}_2\text{O}_{(l)}$	2
		(2)	Increased emissions of carbon dioxide will increase greenhouse warming; Rate of evaporation of water from soils (and transpiration from plants) will increase;	1 1	
				Reduces availability of water for photosynthesis in food crops which reduces the availability of food crops for the manufacture of biofuels.	1
126	(a)	(1) 	2		



Solutions: Review Test 1			
Question	Part	Suggested response	Marks
1	(a)	(1) <b>Any one:</b> Ocean-atmosphere exchange; Plant and animal respiration; Respiration of soil microbes and aerobic decay of organic matter in soils; Volcanic eruptions.	1
		(2) <b>Any one:</b> Combustion of fossil fuels for transportation; Cement production and industry; Deforestation.	1
	(b)	(1) Carbon dioxide is a gas in the troposphere that absorbs infrared radiation emitted from the surface of the Earth. Carbon dioxide molecules then reradiate the energy in all directions including the surface of the Earth.	1 1
		(2) Increase in the tropospheric concentration of carbon dioxide will cause an enhanced greenhouse effect. Enhanced greenhouse effect could cause global warming which will lead to climate change and significant environmental issues for life on Earth.	1 1
	(c)	(1) Reduce emissions of carbon dioxide into the atmosphere.	1
		(2) pH decreases due to the formation of hydronium ions.	1
		$\text{CO}_2 + 2\text{H}_2\text{O} \rightleftharpoons \text{HCO}_3^- + \text{H}_3\text{O}^+$	2
		(3) <b>Any one:</b> Danger of large mass of greenhouse gases being released if equipment (pipes/pumps) is damaged; Danger of greenhouse gases leaking from transport vehicles on route to the carbon sequestration facility from other sites; Power plants connected to artificial carbon sequestration technologies use <u>more energy</u> than conventional power plants (to pump gases underground) ∴ release more greenhouse gases and form more NO <sub>x</sub> and other pollutants due to increased energy use. Power plants connected to artificial carbon sequestration technologies require more fossil fuels for energy production. The extraction, processing and purification of fossil fuels release greenhouse gases into the atmosphere.	1
	(4) <b>Any one:</b> Large initial capital cost to install the carbon sequestration technology at a power plant; Ongoing costs associated with maintenance of the technology.	1	
	2	(a)	$n_{\text{NaCl}} = \frac{m_{\text{NaCl}}}{M_{\text{NaCl}}}$
$n_{\text{NaCl}} = \frac{1000}{(22.99 + 35.45)}$			1
$n_{\text{NaCl}} = 17.1 \text{ mol}$			1
$n_{\text{NaHCO}_3} : n_{\text{NaCl}} \text{ is } 1:1$			
$n_{\text{NaHCO}_3} = 17.1 \text{ mol}$			1
$n_{\text{Na}_2\text{CO}_3} : n_{\text{NaHCO}_3} \text{ is } 1:2$			
$n_{\text{Na}_2\text{CO}_3} = \frac{n_{\text{NaHCO}_3}}{2}$			
$n_{\text{Na}_2\text{CO}_3} = \frac{17.1}{2}$			