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Name: …….. ( ) Class: Sec 4A

Queenstown Secondary School

Preliminary Examination 2019
Secondary Four Express
Chemistry
6092/01

4 September 2019 **Time: 1145 – 1245h**
Wednesday **Duration: 1 hour**

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, class and index number on the Answer Sheet in the spaces provided.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
A copy of the Periodic Table is printed on page 18.
The use of an approved scientific calculator is expected, where appropriate.

This document consists of **18** printed pages.

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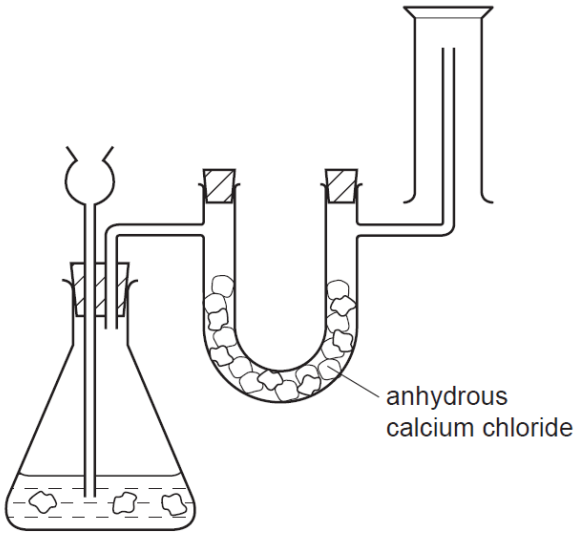
1 The diagram shows a simple laboratory apparatus for the preparation and collection of a dry gas.



What is the gas?

A carbon dioxide
B chlorine
C hydrogen
D hydrogen chloride

2 A student accidentally mixed 50 cm^3 of hexane with 50 cm^3 of sodium chloride solution.
Which methods would allow him to obtain pure samples of hexane and solid sodium chloride respectively?

A filtration followed by crystallisation
B fractional distillation followed by evaporation to dryness
C simple distillation followed by crystallisation
D using a separating funnel followed by evaporation to dryness

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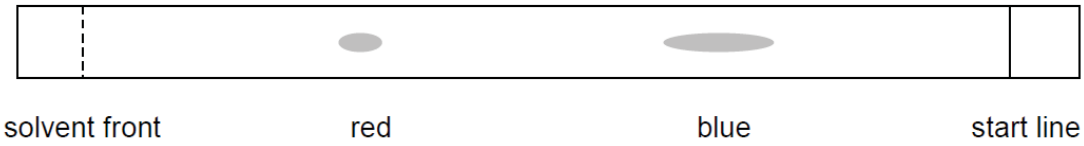
3 The paper chromatogram of a sweet is shown in the diagram.



Which of the following statements can be deduced from the chromatogram?

A The sweet is blue in colour.

B The red dye has a higher solubility than that of the blue dye.

C The molecules of the blue dye are heavier than that of the red dye.

D The R_f value of the blue dye is greater than that of the red dye.

4 Four bottles containing colourless solutions have no labels.

A series of individual tests are carried out on each of the solutions.

Which bottle contains aluminium nitrate solution?

	test 1: add excess aqueous sodium hydroxide	test 2: add excess aqueous ammonia	test 3: add warm aqueous sodium hydroxide with A*l* foil
A	white precipitate formed, soluble in excess	white precipitate formed, insoluble in excess	white precipitate formed; gas produced which turns damp red litmus blue
B	white precipitate formed, soluble in excess	white precipitate formed, soluble in excess	white precipitate formed
C	white precipitate formed, insoluble in excess	white precipitate formed, insoluble in excess	white precipitate formed
D	white precipitate formed, insoluble in excess	white precipitate formed, soluble in excess	white precipitate formed; gas produced which turns damp red litmus blue

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5 The rate of diffusion of methane and butane was compared at 30°C and 70°C.
Which would have the fastest rate of diffusion?

A butane at 30°C
B butane at 70°C
C methane at 30°C
D methane at 70°C

6 An ion, X^{2-}, has a mass number of m and it contains n electrons.
What does the nucleus of an atom of X contain?

	number of protons	number of neutrons
A	n – 2	m – n
B	n – 2	m – n + 2
C	n + 2	m – n + 2
D	n + 2	m – n – 2

7 A new substance was discovered and a series of experiments were conducted on it.
Which observation suggests that the substance **cannot** be an element?

A It has a fixed melting point.
B When heated in air, it forms two oxides.
C It dissolved in water to give a colourless solution.
D Electrolysis of the molten substance gave two products.

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8 In the lattice structure of ionic compounds, the coordination number of each ion is the number of neighbouring ions of opposite charge.

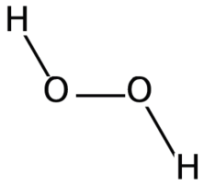
The table below shows the ions present and the coordination number of the ions in some ionic compounds. Taking sodium chloride for instance, each sodium ion is surrounded by 6 chloride ions, while each chloride ion is surrounded by six sodium ions. Hence, the coordination number for both the sodium ions and chloride ions is 6.

ionic compound	ions present		coordination number of		formula
	cation	anion	cation	anion	
sodium chloride	Na^+	Cl^-	6	6	$NaCl$
titanium(IV) oxide	Ti^{4+}	O^{2-}	6	3	TiO_2
P	Q	R	4	8	?

Using information from the table, what is the formula for compound P?
What is the formula of compound P?

A QR_2 **B** Q_2R **C** QR_4 **D** Q_4R

9 The diagram shows the structural formula of hydrogen peroxide.



Which statement is true of the number of electrons in the molecule?

	total number of electrons used in bonding	total number of electrons **not** used in bonding
A	4	4
B	6	6
C	4	8
D	6	12

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10 Fibreglass is used as a reinforcing agent in many polymer products.
It contains a mixture of ionic oxides and giant covalent oxides.

Which substance is **not** a possible constituent of fibreglass?

A CaO **B** Cr_2O_3 **C** P_4O_9 **D** SiO_2

11 The following shows information on bronze, boron nitride and silicon carbide.

- Bronze is an alloy of copper and tin.
- Boron nitride, BN, has a structure similar to graphite.
- Silicon carbide, SiC, has a structure similar to diamond.

Which of the statements about their physical properties are correct?

1 All atoms are bonded covalently.
2 All have high melting and boiling point.
3 All except bronze are soluble in organic solvent.
4 All except silicon carbide conduct electricity when solid.

A 1 and 2 **B** 2 and 3 **C** 2 and 4 **D** 3 and 4

12 In leaded petrol, an additive is added.
This additive is a compound made up of lead, carbon and hydrogen only.
An analysis of this compound shows that it contains 29.7% carbon and 6.19% hydrogen by mass.

What is the value of x in the empirical formula, PbC_8H_x?

A 5 **B** 10 **C** 15 **D** 20

13 Upon strong heating, a metal nitrate compound undergoes decomposition according to the following equation:

$$2XNO_3\ (s) \rightarrow 2X\ (s) + 2NO_2\ (g) + O_2\ (g)$$

Complete decomposition of 3.40 g of the nitrate gives 240 cm^3 of oxygen, measured at room temperature and pressure. What is the relative atomic mass of X?

A 85 **B** 108 **C** 133 **D** 170

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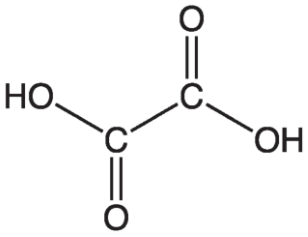
14 The structure of oxalic acid is shown.

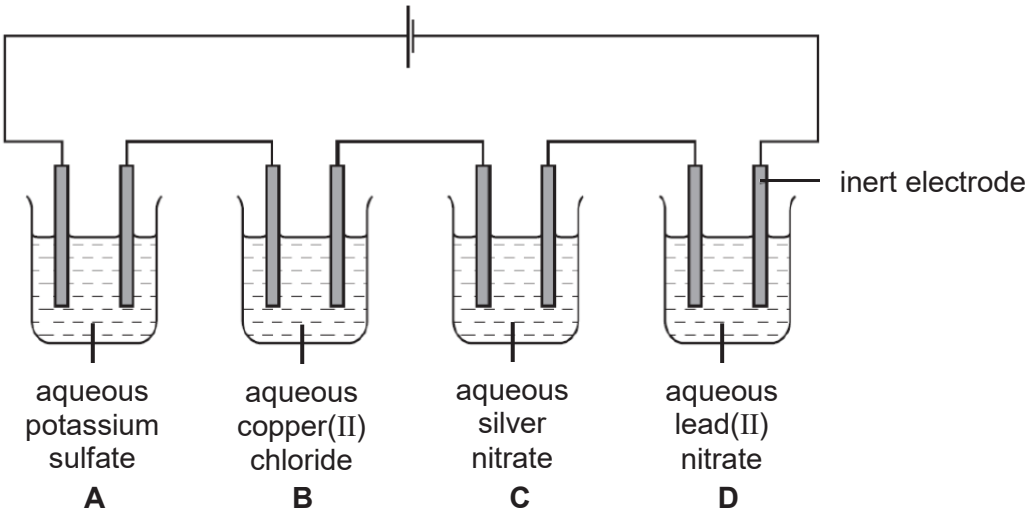


A 25.0 cm^3 solution of oxalic acid reacts completely with 15.0 cm^3 of 2.50 mol/dm^3 aqueous sodium hydroxide. What is the concentration of the oxalic acid?

A 0.750 mol/dm^3 **B** 2.08 mol/dm^3 **C** 1.50 mol/dm^3 **D** 4.17 mol/dm^3

15 When electrolysed using inert electrodes, which dilute salt solution would produce the greatest increase in mass of the cathode?

[A_r: K, 39; Cu, 64; Ag, 108; Pb, 207]



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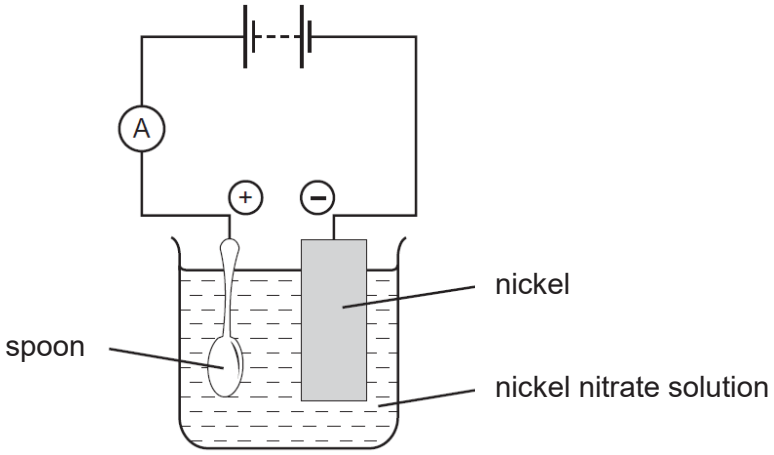
16 The apparatus shown below was set up to electroplate the metal spoon with nickel.



The experiment did **not** work. What was the mistake in the apparatus?

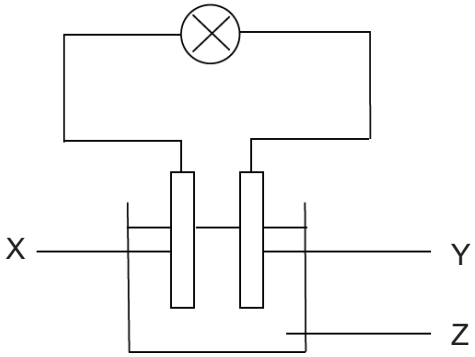
A A variable resistor should be included in the electrical circuit.

B Dilute nitric acid should be used as the electrolyte.

C The nickel electrode should be fully immersed in the solution.

D The spoon should be the negative electrode.

17 A simple cell was set up to light up a bulb, as shown in the diagram.



What should X, Y and Z be for the bulb to light up the brightest?

	X	Y	Z
A	lead	zinc	dilute salt solution
B	lead	iron	dilute sugar solution
C	silver	zinc	dilute salt solution
D	silver	iron	dilute sugar solution

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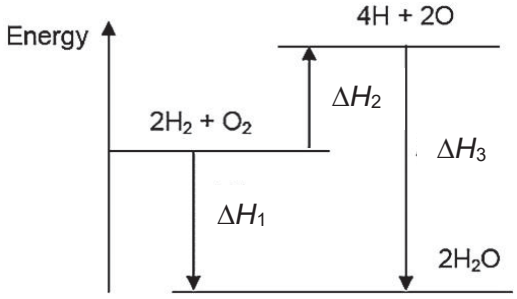
18 Hydrogen and oxygen react to form steam, as shown in the equation below.

$$2H_2\,(g) + O_2\,(g) \rightarrow 2H_2O\,(g)$$

The energy level diagram below represents this reaction.



Which symbols represent the energy involved in bond breaking and formation?

	energy involved in bond breaking only / kJ	energy involved in bond formation only / kJ
A	ΔH_1	ΔH_2
B	ΔH_1	ΔH_3
C	ΔH_2	ΔH_1
D	ΔH_2	ΔH_3

19 Phosphorus pentachloride, PCl_5, is a dangerous substance as it reacts violently with water. It is also corrosive when in contact with skin and can be fatal when inhaled.

Gaseous phosphorus pentachloride can be decomposed into gaseous phosphorus trichloride and chlorine by heating.

$$PCl_5\,(g) \rightarrow PCl_3\,(g) + Cl_2\,(g)$$

The table below gives the bond energies.

bond	bond energy / kJ mol^{-1}
P – Cl	330
Cl – Cl	240

What is the enthalpy change of the decomposition of phosphorus pentachloride?

A +90 kJ **B** -90 kJ **C** +420 kJ **D** -420 kJ

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20 Hydrogen peroxide can be used for the sterilisation of surgical tools.
It decomposes according to the equation:

$$2H_2O_2\ (aq) \rightarrow 2H_2O\ (l) + O_2\ (g)$$

What would be the effect on the initial rate of reaction and the volume of oxygen gas produced, if an equal volume of water was added to the hydrogen peroxide solution at the start of the reaction?

	initial rate of reaction	volume of oxygen gas produced
A	decreased	decreased
B	decreased	increased
C	increased	decreased
D	unchanged	unchanged

21 In which reaction is pressure **least** likely to affect the rate of reaction?

A $N_2\ (g) + 3H_2\ (g) \rightarrow 2NH_3\ (g)$
B $HCl\ (g) + NH_3\ (g) \rightarrow NH_4Cl\ (s)$
C $CO_2\ (g) + Ca(OH)_2\ (aq) \rightarrow CaCO_3\ (s) + H_2O\ (l)$
D $NaOH\ (aq) + HCl\ (aq) \rightarrow NaCl\ (aq) + H_2O\ (l)$

22 Chromium and manganese are two transition elements.
In which of the following pairs is the oxidation number of chromium more than that of manganese?

A $K_2\underline{Cr}O_4$ and $K\underline{Mn}O_4$
B $\underline{Cr}Cl_3$ and $\underline{Mn}O_2$
C $\underline{Cr}_2(SO_4)_3$ and $\underline{Mn}SO_4$
D $K_2\underline{Cr}_2O_7$ and $\underline{Mn}O_4^-$

23 Which of the following illustrates a correct result of adding an oxidising agent?

A It turns aqueous potassium iodide brown.
B It turns aqueous iron(III) nitrate pale green.
C It turns aqueous copper(II) sulfate colourless.
D It turns acidified aqueous potassium manganate(VII) colourless.

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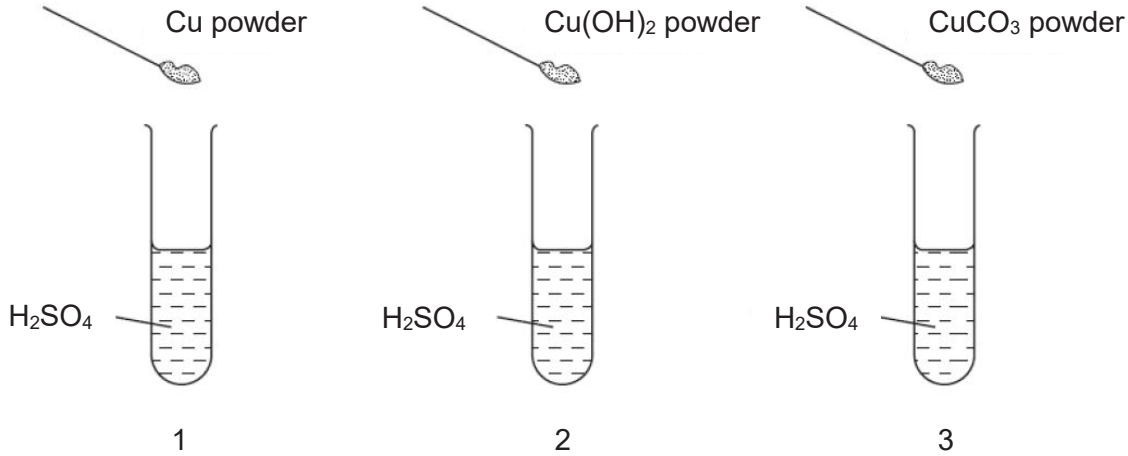
24 The diagrams show three experiments using sulfuric acid.

Three different powders are added to the acid. The mixtures are stirred.



Which test-tubes will contain aqueous Cu^{2+} ions?

A 1 and 2 only
B 1 and 3 only
C 2 and 3 only
D All of the above

25 A solution of a salt X gives an insoluble hydroxide Y on reacting with aqueous sodium hydroxide. Y dissolves in excess aqueous sodium hydroxide to give solution Z. On adding dilute hydrochloric acid to Z, the precipitate Y reappears but dissolves in excess dilute hydrochloric acid.

What is the nature of hydroxide Y?

A acidic
B amphoteric
C basic
D neutral

26 Which of the following method could **not** be used to prepare a dry sample of lead salt?

	name of salt	method
A	lead(II) carbonate	add aqueous sodium carbonate to aqueous lead(II) nitrate
B	lead(II) chloride	add hydrochloric acid to aqueous lead(II) nitrate
C	lead(II) iodide	add nitric acid to lead(II) carbonate, then add aqueous potassium iodide
D	lead(II) sulfate	add sulfuric acid to lead(II) carbonate

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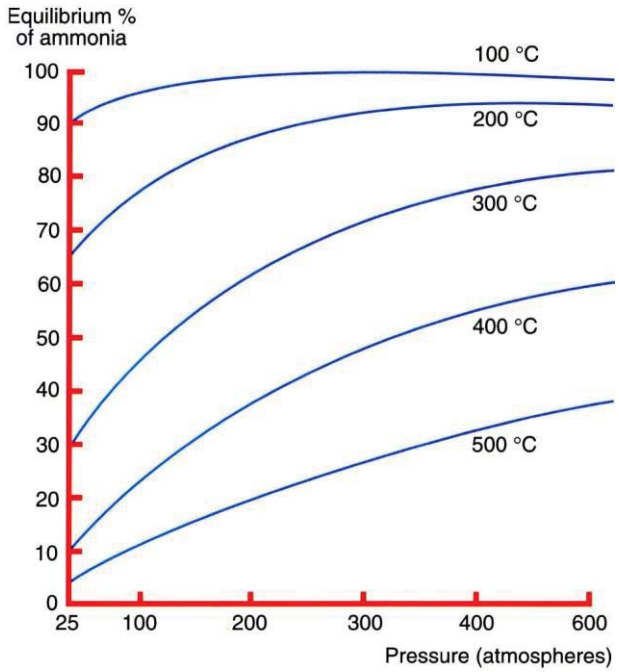
27 Ammonia is produced from Haber Process using a suitable catalyst.

$$N_2\,(g) + 3H_2\,(g) \rightleftharpoons 2NH_3\,(g)$$

The following graph shows the different yields of ammonia at different temperature and pressure.



Which of the following is **not** true?

A A higher percentage yield of ammonia can be obtained at higher pressure.

B A higher percentage yield of ammonia can be obtained at lower temperature.

C Some of the ammonia formed will decompose to form hydrogen and nitrogen.

D At the right conditions of temperature and pressure, all of the hydrogen and nitrogen can be converted into ammonia.

28 Germanium, Ge, is in the same group as carbon and silicon in the Periodic Table. Which is the correct formula for its chloride, hydride and oxide?

	chloride	hydride	oxide
A	$GeCl$	GeH	GeO
B	$GeCl$	GeH_4	GeO_2
C	$GeCl_4$	GeH	GeO
D	$GeCl_4$	GeH_4	GeO_2

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29 Excess bromine is shaken with a mixture of sodium chloride and sodium iodide solutions. Which substances will the final mixture contain?

A bromine, iodine, sodium bromide
B bromine, iodine, sodium bromide, sodium chloride
C bromine, iodine, sodium bromide, sodium iodide
D iodine, sodium bromide, sodium chloride

30 In an experiment to determine the order of reactivity, metals Q, R and S were placed into four separate solutions containing aqueous metal ions.

metal	aqueous metal ion			
	P^{2+}	Q^{2+}	R^{2+}	S^{2+}
Q	✓	×	✓	✓
R	×	×	×	×
S	×	×	✓	×

What is the order of reactivity of the metals?

	most reactive → least reactive			
A	Q	P	R	S
B	Q	P	S	R
C	Q	S	P	R
D	R	S	P	Q

31 Approximately 40% of all iron and steel are produced by recycling.
The following statements are possible reasons for recycling iron.

1 Recycling reduces the need to collect scrap iron and steel.
2 Recycling reduces the amount of waste taken to landfill sites.
3 Recycling reduces the amount of pollution at the site of the ore extraction.
4 Scrap steel contains a higher percentage of iron than iron ore.

Which of the statements are correct?

A 1 and 2 only
B 1, 2 and 3 only
C 1, 2 and 4 only
D All of the above

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32 An iron nail takes three days to rust completely when exposed to water and air. Two different metals, X and Y, are attached separately to the same type of iron nail. The time taken for the iron nail to rust completely is measured and shown in the following table.

metal attached to iron nail	time taken for iron nail to rust / days
X	2
Y	5

Using the data above, arrange iron, metal X and metal Y, in ascending order of their reducing power.

A iron, X, Y
B X, iron, Y
C Y, X, iron
D Y, iron, X

33 Biodiesel, an alternative fuel made from vegetable oil, can be used as a fuel for vehicles. Although carbon dioxide is released during the combustion of biodiesel, scientists still claim that it is a carbon neutral fuel.

Which is the basis for this claim?

A Biodiesel is not a carbon compound.
B Biodiesel produces less carbon dioxide when it burns.
C Plants release carbon dioxide during respiration.
D Plants absorb carbon dioxide during photosynthesis.

34 Petrol and diesel are two common fuels used by cars and buses respectively. The combustion of these fuels produces air pollutants.
The following table shows the mass of pollutants found in the exhaust fume when 1 kg of each fuel is burnt.

pollutant	mass of pollutant in petrol engine / g	mass of pollutant in diesel engine / g
carbon monoxide	14	10
oxides of nitrogen	30	60
sulfur dioxide	1	4
unburnt hydrocarbons	15	20

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Which of the following statements can be inferred using the data in the table?

A Petrol contributes more towards the formation of acid rain.

B The temperature in petrol engine is lower than that in diesel engine.

C The amount of oxygen in petrol engine is higher than that in diesel engine.

D All the pollutants listed in the table can be removed by installing a catalytic converter.

35 Petrol and diesel are fractions obtained from the fractional distillation of petroleum. Which row explains why petrol is collected above diesel?

	relative molecular mass of petrol	boiling point of petrol	flammability of petrol
A	lower than diesel	higher than diesel	lower than diesel
B	higher than diesel	higher than diesel	higher than diesel
C	lower than diesel	lower than diesel	higher than diesel
D	higher than diesel	lower than diesel	lower than diesel

36 The table shows the properties of four hydrocarbons.

hydrocarbon	1	2	3	4
state at room temperature	gas	gas	liquid	liquid
reaction with aqueous bromine	decolourises bromine	no reaction	decolourises bromine	no reaction

Which of the following statements is true of the hydrocarbons?

A Hydrocarbons 1 and 2 are in the same homologous series.

B Hydrocarbon 1 is less viscous than hydrocarbon 3.

C Hydrocarbons 2 and 4 are unsaturated.

D Hydrocarbon 3 could be ethene.

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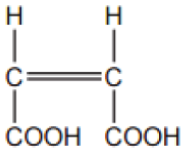
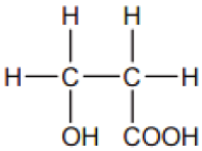
37 The structures of compounds W, X, Y and Z are shown below.

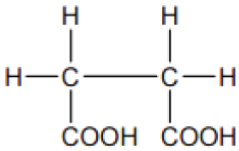
W



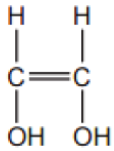
X



Y



Z



What reactions do compounds W, X, Y and Z undergo?

	decolourises aqueous bromine	decolourises acidified aqueous potassium manganate(VII)	effervescence with aqueous sodium carbonate
A	X and Y	X and Z	W and Y
B	X and Y	W, X and Y	W and Y
C	W and Z	X and Z	W, X and Y
D	W and Z	W, X and Y	W, X and Y

38 Two esters have the same molecular formula, $C_3H_6O_2$.
What are the names of these two esters?

1 methyl ethanoate
2 ethyl methanoate
3 ethyl propanoate
4 propyl methanoate

A 1 and 2 **B** 1 and 3 **C** 2 and 4 **D** 3 and 4

39 Engine oil is used to lubricate the car engine. Certain polymers are added to improve the viscosity of engine oil. A portion of the chain of one such polymer is shown below.

$$–CH_2–CH(CH_2CH_2CH_3)–CH_2–CH(CH_2CH_2CH_3)–CH_2–CH(CH_2CH_2CH_3)–$$

A molecule of this polymer contains 40 carbon atoms. How many molecules of monomer are required to form one molecule of this polymer?

A 4 **B** 5 **C** 8 **D** 10

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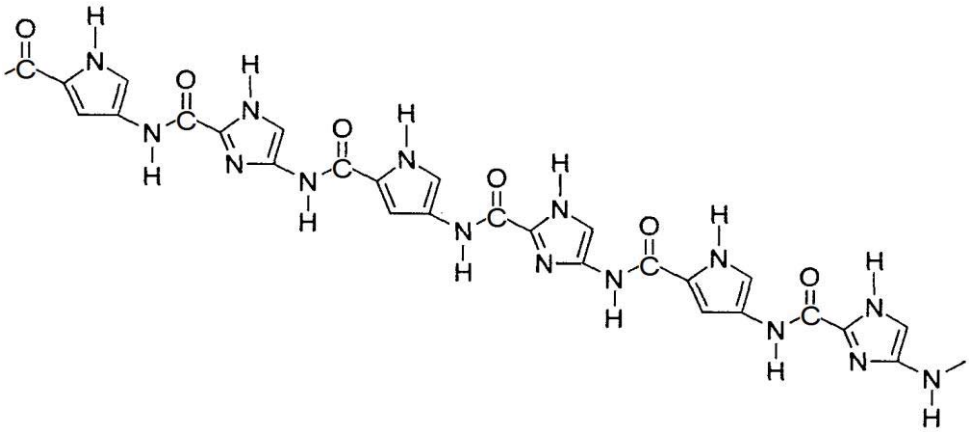
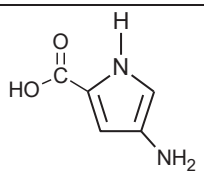
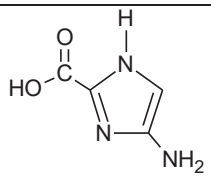
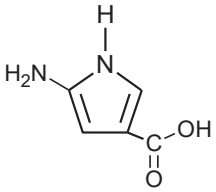
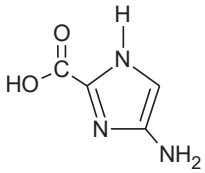
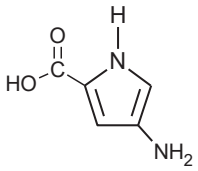
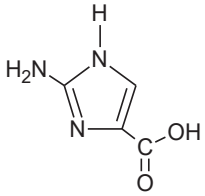
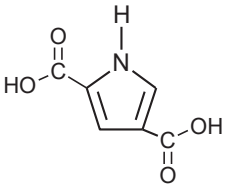
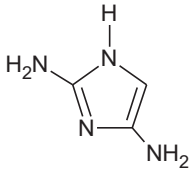
40 The structure below shows part of a polymer.



Which one of the following options show the correct monomers?

A		
B		
C		
D		

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[insert Periodic Table here]

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Name: …….. ( ) Class: Sec 4A

Queenstown Secondary School

Preliminary Examination 2019
Secondary Four Express
Chemistry
6092/02

27 August 2019
Tuesday

Time: 1100 – 1245h
Duration: 1 hour 45 minutes

Additional Materials: Candidates answer on the Question Paper.
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Section A
Answer **all** questions in the spaces provided.

Section B
Answer all **three** questions, the last question is in the form either/or.
Answer **all** questions in the spaces provided.

At the end of the examination, fasten all your work securely together
The number of marks is given in brackets [ ] at the end of each question or part question.
A copy of the Periodic Table is printed on page 21.

The use of an approved scientific calculator is expected, where appropriate.

Examiner's Use	
Section A	/50
Section B	/30
B1	
B2	
B3	
TOTAL	/80

This document consists of **21** printed pages.

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Section A

Answer **all** questions in this section in the spaces provided.

The total mark for this section is 50.

A1 Choose from the following substances to answer the questions.

ammonium sulfate	**calcium sulfate**	**carbon tetrachloride**
copper(II) chloride	**hydrogen chloride**	**magnesium nitrate**
	zinc iodide	

Each substance can be used once, more than once or not at all.

Name the substance which

(a) produces a gas that turns damp red litmus paper blue only when reacted with warm aqueous sodium hydroxide and aluminium foil,

…….. [1]

(b) reacts with water to form a solution that turns the Universal Indicator red,

…….. [1]

(c) is produced from a substitution reaction,

…….. [1]

(d) when dissolved in water leads to a decrease in the temperature of water,

…….. [1]

(e) contains both ionic and covalent bonding,

…….. [1]

(f) is prepared by reacting aqueous solutions followed by filtration,

…….. [1]

(g) is prepared by the use of a pipette and burette.

…….. [1]

[Total: 7]

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A2 There are four bottles of solutions, silver nitrate, copper(II) nitrate, potassium carbonate and hydrochloric acid.

Julian mixed the pairs of the solutions together and obtained the following results.

reactants	observation
solution **P** and solution **Q**	no visible reaction
solution **R** and solution **Q**	green precipitate
solution **S** and solution **R**	effervescence formed
solution **P** and solution **R**	white precipitate
solution **P** and solution **S**	white precipitate

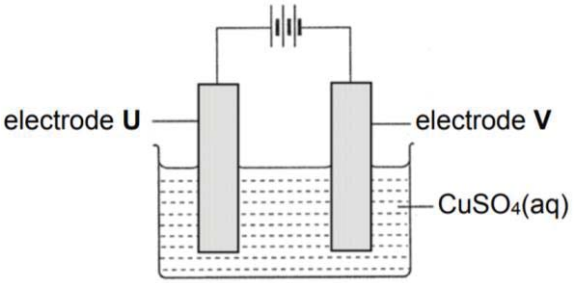
Use information in the table to identify the four solutions.

reactants	identity
solution **P**	
solution **Q**	
solution **R**	
solution **S**	

[4]

[Total: 4]

A3 In an experiment, a cell was set up to obtain pure copper from 150 g of a copper-silver alloy as shown below.



When a current of 40.0 A flows through the electrolyte for 26.8 minutes, the mass of the anode left was 136.5 g, while the cathode increases by 12.6 g.

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(a) **(i)** Identify which electrode should be pure copper and which should be the copper-silver alloy.

electrode **U**: …….. electrode **V**: …….. [2]

(ii) Hence, write the half equations for the reactions occurring at both electrodes.

electrode **U**: ……..

electrode **V**: …….. [2]

(b) Calculate the percentage of silver present in the alloy.

percentage of silver …….. [1]

(c) The experiment was repeated with the change of electrolyte to $CuCO_3$.

Explain why the setup will be unable to obtain pure copper.

…….

……. [1]

[Total: 6]

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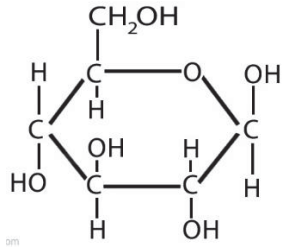
A4 Respiration is a reaction that occurs in all living things so as to produce energy. It is a process which produces energy and carbon dioxide from the intake of food and oxygen. The reaction is catalysed by enzymes.

The overall reaction is as shown below.

$$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O \qquad \Delta H = -2803 \text{ kJ/mol}$$

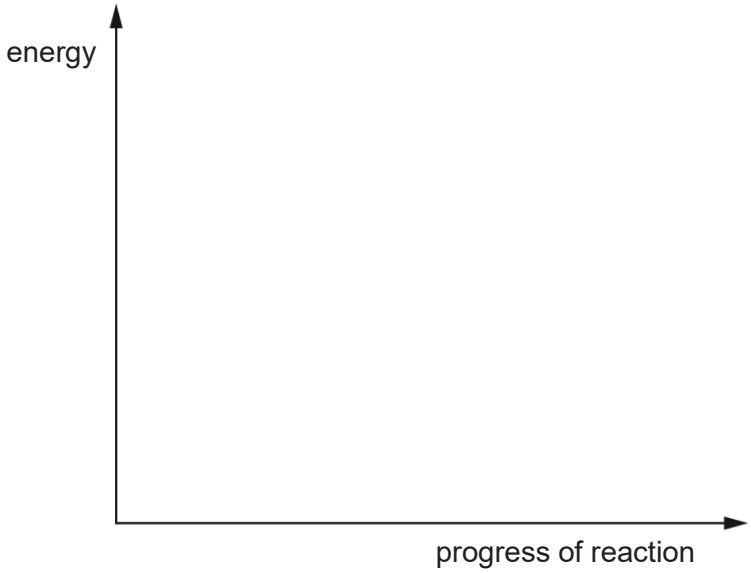
The structural formula of glucose, $C_6H_{12}O_6$, is as shown below.



(a) Draw an energy profile diagram for respiration using the axes shown.

Your diagram should include

- the reaction pathway for the reaction, and
- labels to show the enthalpy change of reaction and the activation energy.



[3]

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(b) **(i)** Using ideas about activation energy, explain how the enzyme catalyst affects the rate of respiration.

……

……

…….. [2]

(ii) In the school laboratory, this reaction is warmed to 40°C.

Using ideas about collisions between particles, explain how an increase in temperature increases the rate of respiration.

……

…… [1]

(c) Using ideas about bond breaking and bond making, explain why this reaction is exothermic.

……

……

……. [3]

(d) Using the chemical equation and the bond energies below, calculate the bond energy of the O–H bond.

bond	C–H	O=O	O–O	C–C	C–O	C=O
bond energy / kJ mol^{-1}	413	495	146	347	358	799

bond energy of the O–H bond …….. [3]

[Total: 12]

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A5 Helium, neon, argon, krypton and xenon are five noble gases.
They are monatomic elements.

(a) State the meaning of the term *monatomic*.

…… [1]

(b) Explain, using the electronic structures of helium and neon, why they are chemically similar.

……

……

…… [2]

(c) Scientists have managed to form compounds using xenon.
The compound is very unstable and hydrolyses to produce dangerous substances.

(i) A 1.0 g sample of this xenon compound contains 0.549 g of xenon, 0.134 g of oxygen and the rest of the compound is made up of fluorine.
Calculate the empirical formula of this compound.

empirical formula …….. [2]

(ii) State **one** piece of information you need to deduce the chemical formula of this compound.

…… [1]

[Total: 6]

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A6 Tungsten, also known as wolfram, is an element with a proton number of 74. It was first isolated as a metal in 1781 from tungsten(VI) oxide, WO_3.

In the natural state, tungsten can be found as four different particles, namely tungsten-182, tungsten-183, tungsten-184 and tungsten-186.

In January 2019, the Straits Times published an article on the poor air quality of Bangkok. It contained harmful levels of cadmium, tungsten, arsenic and polycyclic aromatic hydrocarbons (PAH).

Traffic, factories and crematoriums are found to be the major sources of air pollution in Bangkok. In the transport sector, the incomplete burning of fuel in the vehicles emits a large amount of PAH, which is cancer causing. Also, the city's traffic congestion causes an increase in the level of tungsten in the air as the drivers apply their car brakes, in which tungsten carbide is used as a brake lining. Hence, tungsten particles are released into the air.

Source is extracted from https://www.straitstimes.com/asia/se-asia/bangkok-air-full-of-toxic-heavy-metals-studies-show

(a) Which of the following statements is/are true for tungsten?

Put a tick (✓) in **one** box in each row.

	true	false
It has a low melting point.		
It forms coloured compounds.		
It can form oxides with these formulae WO_2, WO_3, W_2O_3.		
It contains positive ions in a sea of delocalised negative ions.		

[2]

(b) **(i)** What is the term used to describe the four particles of tungsten?

……... [1]

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(ii) Compare and contrast the number of sub-atomic particles in the four particles of tungsten.

……...

……... [2]

(c) Tungsten is obtained from heating its ore, tungsten(VI) oxide, with hydrogen.

(i) Write a balanced chemical equation to show the reaction between tungsten(VI) oxide, WO_3, and hydrogen.

……... [1]

(ii) Use oxidation states to explain why this is a redox reaction.

……...

……...

……... [2]

(iii) Predict the position of tungsten in the reactivity series with reference to hydrogen.

……... [1]

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(d) Besides air pollution caused by PAH, heavy metals and so on, there are other air pollutants that contribute to the poor air quality in Bangkok from traffic, factories and crematoriums.

Name **two other** air pollutants that contribute to the poor air quality.
What are the harmful effects of these air pollutants.

air pollutant …….

harmful effect …….

……..

air pollutant …….

harmful effect …….

…….. [3]

[Total: 12]

A7 Tetradecane, $C_{14}H_{30}$, can be cracked to produce octane, C_8H_{18}, and one other hydrocarbon, **T**.

(a) Give the conditions for cracking to occur.

…….

……. [1]

(b) Draw the full structural formulae of two isomers of **T**.

isomer 1	isomer 2

[2]

[Total: 3]

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Section B

Answer all **three** questions in this section.

The last question is in the form of an either/or and only one of the alternatives should be attempted.

B8 Many carbonates thermally decompose to form an oxide and carbon dioxide.

Six 2.00 g samples of metal carbonates are heated strongly until there is no further change in mass. The table shows the mass of solid remaining at the end of the heating process.

carbonate	mass before heating / g	mass after heating / g
metal carbonate **1**	2.00	1.12
metal carbonate **2**	2.00	1.29
metal carbonate **3**	2.00	1.24
metal carbonate **4**	2.00	0.95
metal carbonate **5**	2.00	2.00
metal carbonate **6**	2.00	1.30

(a) **(i)** Using information from the table, arrange the metal carbonates in order of decreasing thermal stability. Explain your answer.

order …… [1]

explanation ……

……

……

…….. [1]

(ii) Suggest a possible name for any **two** of the metal carbonates.

metal carbonate (**1**, **2**, **3**, **4**, **5** or **6**)	name of metal carbonate

[2]

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(b) Cement can be produced when clay is heated with powdered calcium carbonate. As the temperature is high, calcium carbonate decomposes to form calcium oxide and carbon dioxide.

$$CaCO_3\,(s) \rightarrow CaO\,(s) + CO_2\,(g)$$

(i) Draw the "dot and cross" diagrams for calcium oxide and carbon dioxide, showing only the outer shell electrons.

calcium oxide	carbon dioxide

[2]

(ii) If the percentage yield of the reaction is 90%, calculate the mass of calcium oxide formed when 200 kg of calcium carbonate is used.

mass of calcium oxide …….….. [2]

(iii) Describe a chemical test to show that carbon dioxide is formed.

chemical test ……

result …….

……. [1]

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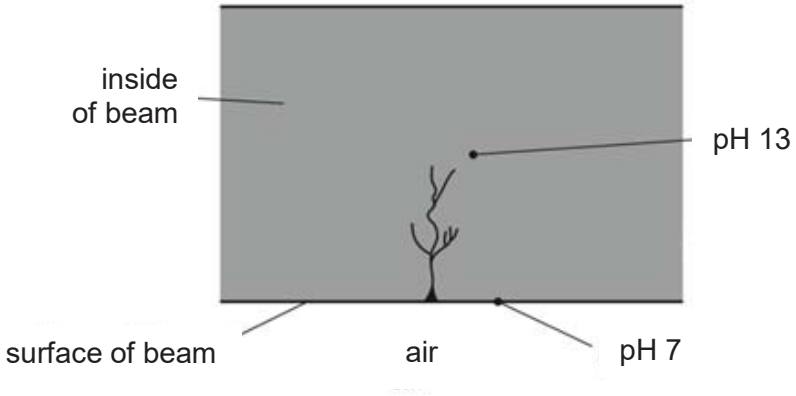
(iv) Concrete is made from cement, sand and water and it is slightly porous. When rain water soaks through concrete, some of the calcium oxide dissolves in rain water to form calcium hydroxide.

The aqueous calcium hydroxide in wet concrete reacts with carbon dioxide in the air to form a white solid and water.

The diagram shows the pH at various points inside a cracked concrete beam.



Explain why the surface of the beam has a lower pH than the centre of the beam.

……

…… [1]

[Total: 10]

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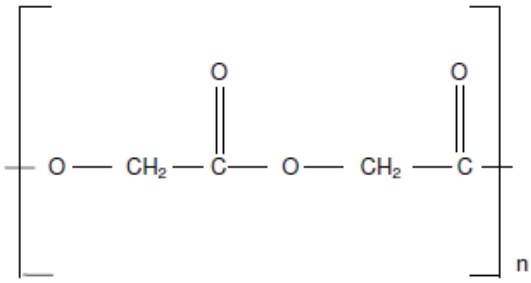
B9 The table below shows some information of the different types of plastics that are commonly used.

plastics	tensile strength / MPa	density / g cm^{-3}	number of years to break down plastic
biopolymers	36	1.24	0.5
poly (propene)	40	0.92	20-30
kevlar	3620	1.44	-

Extracted from http://www.matweb.com/reference/tensilestrength.aspx

Note: Tensile strength measures the resistance of a material to breaking under tension.

Biopolymers are renewable plastic materials manufactured from biomass such as corn, wheat, sugar cane and potatoes. An example of the structure of a type of biopolymer, polylactic acid (PLA), is as shown.



(a) **(i)** With reference to the structural formula of PLA, state the type of polymerisation for its formation.

…… [1]

(ii) This biopolymer can be broken down easily to its monomer.

Draw the full structural formula of this monomer when the biopolymer is being broken down.

[1]

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(iii) Based on the given information, discuss **one** advantage and **one** disadvantage of using biopolymers to make plastic products.

advantage ……

…… [1]

disadvantage ……

…… [1]

(b) Poly (propene) is used in piping systems due to its high strength and rigidity.

(i) Draw the structure of poly (propene) showing three repeating units.

[1]

(ii) Describe a chemical test to differentiate between poly (propene) and its monomer.

chemical test ……

result with poly (propene) ……..

…….

result with monomer ……

……. [2]

(iii) Poly (propene) is non-biodegradable.

Describe **one** environmental issue when poly (propene) is burnt.

……

……..... [1]

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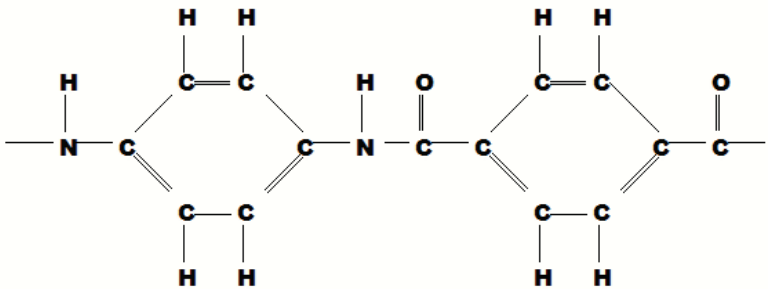
(c) Kevlar is a polyamide. Its structure is as shown below.



Kevlar is a heat-resistant and strong synthetic fiber, which when spun into fibers or fabric sheets. It is a plastic that is five times stronger than steel, and can stop bullets from penetrating it.

Deduce the structural formula of the **two** monomers that react to form the polyamide above.

monomer 1	monomer 2

[2]

[Total: 10]

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EITHER

B10 Alkynes are a homologous series of unsaturated hydrocarbons, with at least one carbon-carbon triple bond. The table shows information about some alkynes.

alkyne	molecular formula	melting point / °C	boiling point / °C
ethyne	C_2H_2	-81.5	-84
propyne	C_3H_4	-102.7	-23.2
pentyne	C_5H_8	-90	39.3

(a) Use the information in the table to give **two** pieces of evidence that suggest that the alkynes are a homologous series.

……

……

…… [2]

(b) Butyne is an alkyne.

Deduce the formula and predict the boiling point of butyne.

formula …….. predicted boiling point …….. [2]

(c) At room temperature, propyne diffuses at a slower rate than ethyne.

Explain why.

……

…… [2]

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(d) Ethyne, C_2H_2, reacts with basic sodamide, $NaNH_2$, to form a sodium salt and ammonia gas.

(i) Describe a chemical test to check if the reaction is occurring.

chemical test ……

result …….. [1]

(ii) Write a balanced chemical equation for the reaction mentioned above.

……. [1]

(iii) Ammonia can also be produced from Haber process.

Describe how is ammonia produced in the industry.

Include a balanced chemical equation in your answer.

…….

……

……. [2]

[Total: 10]

OR

B10 Deepwater Horizon was an ultra-deepwater, offshore drilling rig, built in South Korea in 2001 by Hyundai Heavy Industries. The concrete foundation of the rig usually includes massive steel legs. The rig drilled the deepest oil well in history at a vertical depth of about 10 683 m. The rig exploded in 2010, when a surge of natural gas blasted through the concrete core, which killed 11 crewman, and the fire was inextinguishable.

Extracted from https://en.wikipedia.org/wiki/Deepwater_Horizon

(a) Steel can be obtained by mixing 70% iron with 30% carbon.

(i) Explain why steel is used instead of pure iron, which has a lower cost.

……

…… [2]

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(ii) Draw a labelled diagram to show the arrangement of the particles in steel containing 70% iron with 30% carbon.

[1]

(iii) Iron is produced in a blast furnace by heating a mixture of iron(III) oxide, coke and limestone with air.

With the help of relevant equations, describe how iron is produced.

……

……

……

……

…… [3]

(b) What is the main component found in natural gas?

…… [1]

(c) Describe how petrol can be obtained from the oil from oil rigs.

……

……

……

…… [2]

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(d) A protocol called the Convention for the Protection of the Marine Environment of the North East Atlantic, which came into force in 1998, stated that offshores platforms cannot be disposed of at sea or simply be left to rust and corrode if they weigh less than 10 000 tonnes. The scrap metals are then sent to a shore-based recycling centre.

Obtained from http://www.bbc.com/future/story/20160804-what-it-takes-to-dismantle-an-oil-rig

Apart from the potential issues that affect the marine life, explain why the scrap metals from the rigs need to be recycled.

…… [1]

[Total: 10]

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[insert Periodic Table]

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