Pasir Ris Secondary School

Name	Class	Register Number

SECONDARY 4 EXPRESS
PRELIMINARY EXAMINATION 2023

CHEMISTRY **6092/01**

Paper 1 Multiple Choice **25 Aug 2023**

Friday 1105 – 1205 **1 hour**

Additional Material: 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 register 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**.

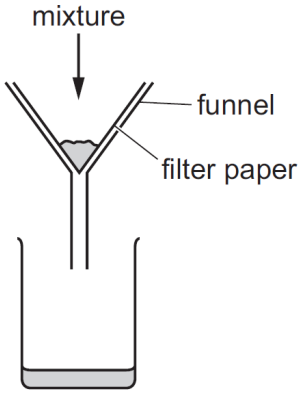
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

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 14.
The use of an approved scientific calculator is expected, where appropriate.

Setter: Ms Chua Wei Tian **[Turn over**

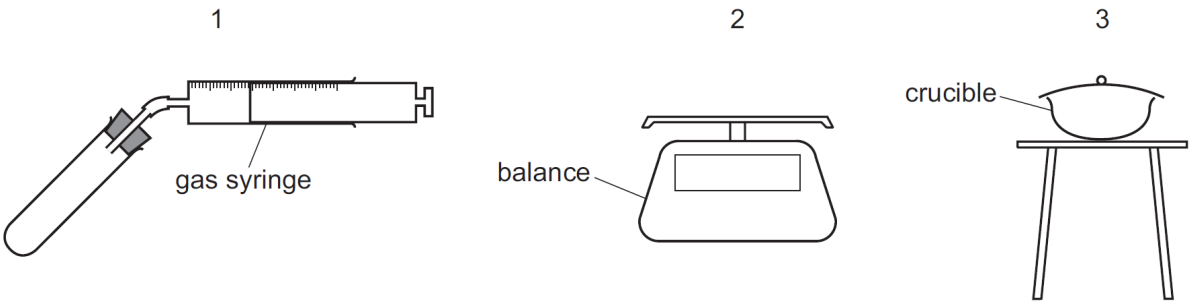
1 A mixture is separated using the apparatus shown.



What is the likely identity of the mixture?

A aqueous copper(II) sulfate and aqueous sodium chloride
B aqueous copper(II) sulfate and calcium carbonate
C copper and sulfur
D ethanol and ethanoic acid

2 The formula of zinc oxide can be investigated by using the fact that when zinc is heated, it reacts with oxygen to form zinc oxide. Which apparatus is used for this investigation?



A 1 and 2 only
B 1 and 3 only
C 2 and 3 only
D 1, 2 and 3

3 Which statement about states of matter is correct?

A When a gas cools, the particles cannot vibrate about its fixed positions.
B When a liquid freezes, it becomes a solid and energy is released to the surroundings.
C When a solid is heated, the size of particles increases.
D When a solid melts, the particles get further apart and have less energy.

4 The melting points and boiling points of some gases in air are shown.

gas	melting point / °C	boiling point / °C
argon	–190	–187
nitrogen	–210	–197
oxygen	–220	–183

At which temperature will oxygen be the **only** liquid present?

A –180°C
B –185°C
C –188°C
D –200°C

5 Deuterium, D, is an isotope of hydrogen with a nucleon number of 2. Heavy water, D_2O, is water in which both the hydrogen atoms have been replaced with deuterium. It is commonly used in nuclear reactors. Some properties of ordinary water and heavy water are as shown.

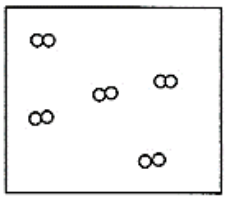
	ordinary water, H_2O	heavy water, D_2O
relative molecular mass	18	20
melting point / ºC	0	3.8
boiling point / ºC	100.0	101.4
density / g/cm^3	0.997	1.104

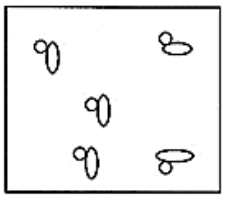
Which process can be used to recover heavy water from ordinary water?

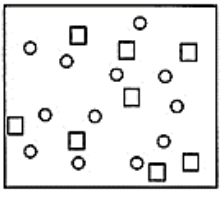
A cracking
B fractional distillation
C separating funnel
D simple distillation

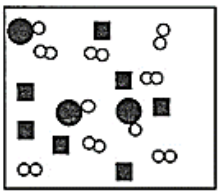
6 The diagrams below can be used to illustrate the following.

1 pure element
2 a mixture of elements
3 pure compound
4 a mixture of elements and a compound


W


X


Y


Z

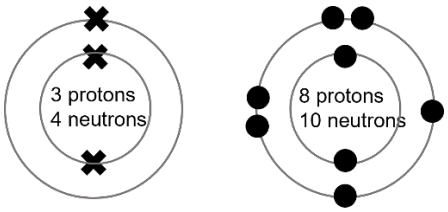
What is the correct order of the diagrams?

	1	2	3	4
A	**W**	**X**	**Y**	**Z**
B	**Z**	**W**	**X**	**Y**
C	**W**	**Y**	**X**	**Z**
D	**X**	**Z**	**W**	**Y**

7 An element, **M**, has p protons and n neutrons in its nucleus. Which row gives the correct number of protons, neutrons and electrons in a positive ion of an isotope of **M**?

	protons	neutrons	electrons
A	p	n	p + 1
B	p	n – 1	p – 1
C	p + 1	n	p + 1
D	p + 1	n + 1	p – 1

8 The atomic structures of two elements, **Q** and **R**, are shown.



atom **Q** atom **R**

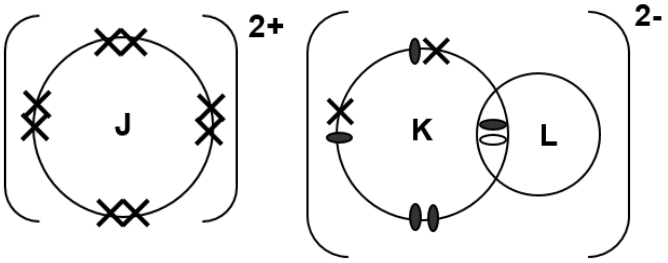
What is the mass of one mole of the compound formed between **Q** and **R**?

A 18 g **B** 25 g
C 32 g **D** 43 g

9 In which molecule are all the valence electrons of the atoms involved in bonding?

A CH_4 **B** HF
C H_2O **D** NH_3

10 **J**, **K** and **L** are three different elements in the Periodic Table. The electronic structure of the compound formed between **J**, **K** and **L**, with only the valence electrons, is shown.



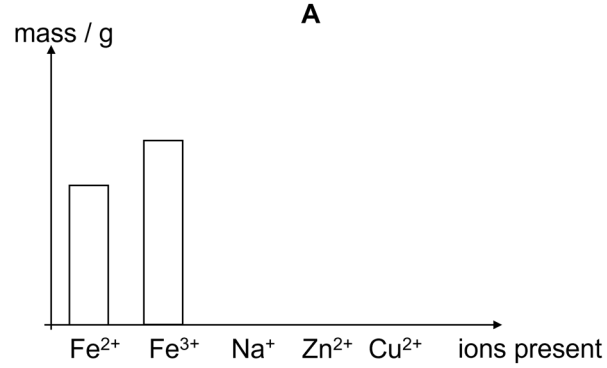
Which statement is **incorrect**?

A Element **J** belongs to Group II of the Periodic Table.
B Element **K** could be nitrogen.
C Element **K** and element **L** are bonded together by a covalent bond.
D Element **L** is a metal.

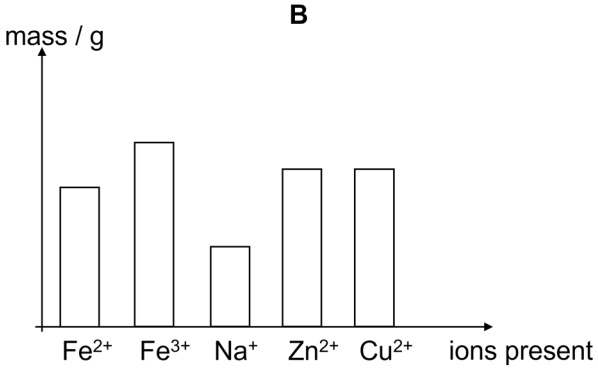
11 Five solutions were prepared so that each solution contained 1 mol/dm^3 of one of the following ions: Fe^{2+}, Fe^{3+}, Na^+, Zn^{2+} and Cu^{2+}. To each solution, excess aqueous ammonia was added and the precipitate, if any, was filtered and weighed. The masses were obtained and plotted on a bar graph.

Which of the following shows the correct graph?

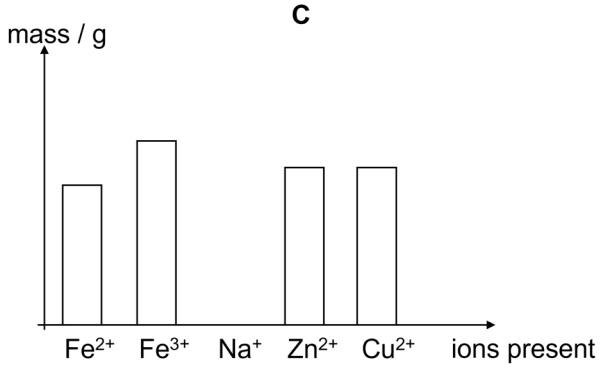
A



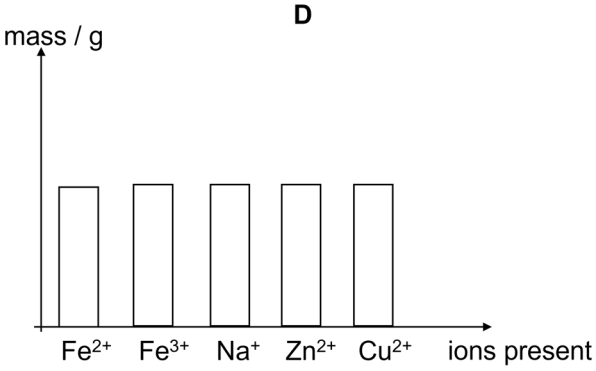
B



C



D



12 A **concentrated** aqueous solution of a strong acid, HX, contains molecules of water and the ions H^+ and X^-. Which statement is correct?

A The pH value of the acid is above 7.
B The solution also contains a high concentration of water molecules.
C The solution also contains OH^- ions.
D The solution contains less H^+ ions than water molecules.

13 Two reagent bottles contain solutions of ammonium nitrate and ammonium carbonate respectively. The labels have fallen off the bottles. Which substance could be added to each bottle to identify the reagents correctly?

A aqueous ammonia
B aqueous nitric acid
C aqueous potassium nitrate
D aqueous sodium hydroxide

14 **Z** is a solid which conducts electricity and has a high melting point. On warming, **Z** partly dissolves in excess dilute nitric acid, leaving behind a residue. What is the likely identity of **Z**?

A brass
B graphite
C sodium chloride
D zinc

15 Which three salts are all prepared by precipitation?

A barium sulfate, calcium nitrate, lead(II) sulfate
B barium sulfate, calcium nitrate, silver chloride
C calcium carbonate, barium sulfate, lead(II) chloride
D calcium chloride, barium sulfate, silver sulfate

16 In an experiment, 2.0 cm^3 of 1.0 mol/dm^3 aqueous copper(II) nitrate and 4.0 cm^3 of 1.0 mol/dm^3 aqueous potassium carbonate are mixed. What does the reaction vessel contain once the reaction is complete?

A a colourless solution only
B a green precipitate and a blue solution
C a green precipitate and a colourless solution
D a white precipitate and a colourless solution

17 Ammonia is used to make nitric acid, HNO_3 by the Ostwald Process. Three reactions occur in the following stages.

1 $4NH_3(g) + 5O_2(g) \longrightarrow 4NO(g) + 6H_2O(g)$
2 $2NO(g) + O_2(g) \longrightarrow 2NO_2(g)$
3 $3NO_2(g) + H_2O(l) \longrightarrow 2HNO_3(aq) + NO(g)$

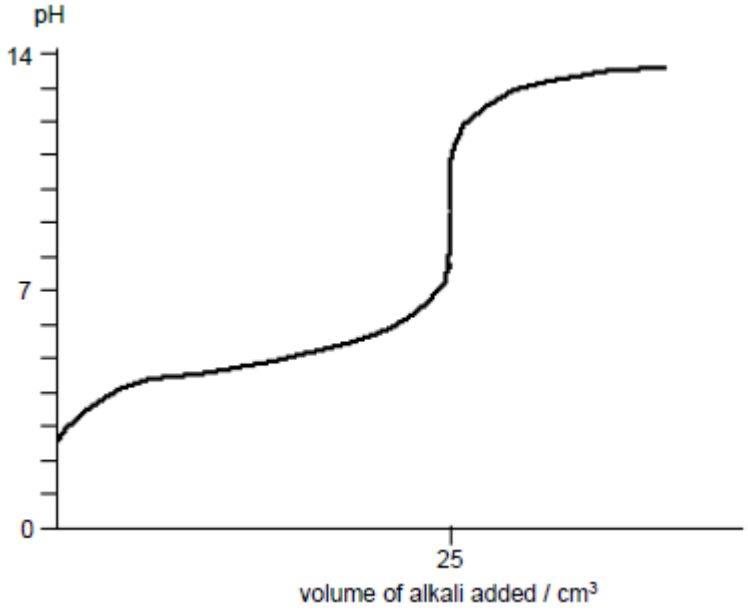
What is the number of moles of nitric acid produced from the reaction between 50.0 dm^3 of oxygen gas and excess ammonia gas in stage 1?

A 1.11
B 1.25
C 1.39
D 1.74

18 Hydrazine, N_2H_4, is a powerful reducing agent. When reacted with an aqueous solution containing silver ions, nitrogen is one of the products formed. Which ionic equation best represents this reaction?

A $N_2H_4 + 2Ag^+ \longrightarrow N_2 + 2AgH_2$
B $N_2H_4 + Ag^+ \longrightarrow N_2 + 2H_2 + Ag$
C $N_2H_4 + Ag^+ \longrightarrow N_2 + 4H^+ + Ag$
D $N_2H_4 + 4Ag^+ \longrightarrow N_2 + 4H^+ + 4Ag$

19 Dilute ethanoic acid was titrated with aqueous sodium hydroxide. The pH changes were recorded using a pH meter. The graph of pH against volume of alkali added was plotted as shown.



The diagram shows the pH ranges of three indicators.

pH	1	2	3	4	5	6	7	8	9
methyl orange	red				yellow				
phenolphthalein	colourless								pink
bromothymol blue	yellow						blue		

Which indicator(s) can be used to determine the end-point of the titration?

A methyl orange only
B phenolphthalein only
C bromothymol blue and phenolphthalein only
D bromothymol blue, methyl orange and phenolpthalein

20 Some properties of metal **H** are listed.

- **H** does not react with cold water.
- **H** reacts with dilute hydrochloric acid.
- No reaction occurs when the oxide of **H** is heated with carbon.

What is a possible identity of metal **H**?

A copper
B iron
C magnesium
D potassium

21 10 cm^3 of propane is burned in 70 cm^3 of oxygen in a closed container.

$$C_3H_8(g) + 5O_2(g) \longrightarrow 3CO_2(g) + 4H_2O(l)$$

What is the total volume of gas present after the reaction at room temperature and pressure?

A 30 cm^3 **B** 50 cm^3
C 70 cm^3 **D** 90 cm^3

22 When a mixture of sodium chloride and sodium hydrogencarbonate is heated, the following reaction takes place.

$$2NaHCO_3(s) \longrightarrow Na_2CO_3(s) + CO_2(g) + H_2O(g)$$

Sodium chloride is unchanged on heating. When 6.0 g of the mixture is heated, the loss in mass is 1.5 g. What is the percentage by mass of sodium hydrogencarbonate in the mixture?

[relative molecular mass, M_r: $NaHCO_3$, 84; Na_2CO_3, 106; CO_2, 44; H_2O, 18]

A 34% **B** 48%
C 68% **D** 95%

23 These statements refer to hydrogen and its use as a fuel.

1 Both water and hydrocarbons can be used as a source of hydrogen.
2 In a fuel cell, hydrogen reacts with oxygen to generate electricity.
3 The reaction taking place in a fuel cell is a redox reaction.

Which statements are correct?

A 1 and 2 only **B** 1 and 3 only
C 2 and 3 only **D** 1, 2 and 3

24 Metals **P**, **Q**, **R** and **S** are found to have the following properties.

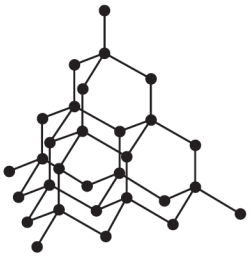
1 Only oxides of **P** and **R** can be reduced by heating with hydrogen.
2 **P** and **Q** react with acid but not with cold water.
3 **R** does not react with both acid and water.
4 Carbonate of **S** does not decompose under heat.

What is the order of reactivity of the metals?

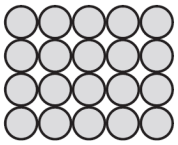
	most reactive ⟶ least reactive			
A	**Q**	**S**	**P**	**R**
B	**R**	**P**	**Q**	**S**
C	**S**	**Q**	**P**	**R**
D	**S**	**R**	**Q**	**P**

25 Which diagram shows the structure of an alloy?

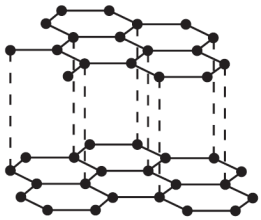
A



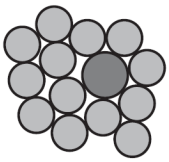
B



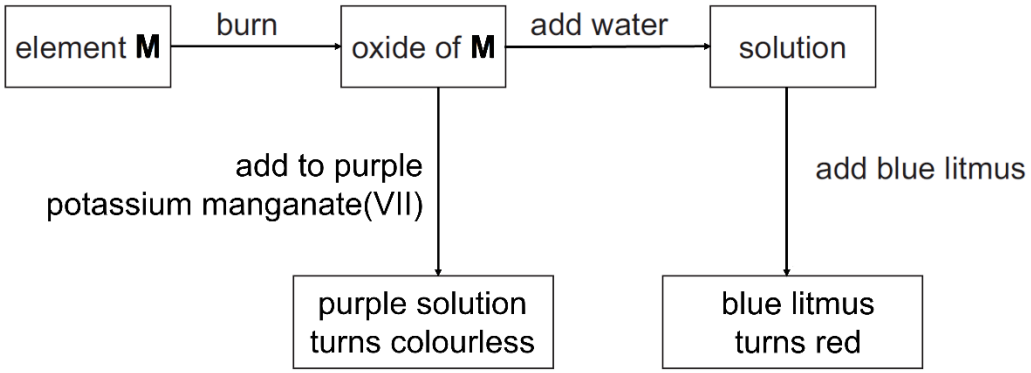
C



D



26 Some reactions of element **M** are shown.



What is the likely identity of element **M**?

A carbon
B iron
C magnesium
D sulfur

27 Disproportionation is a reaction in which the same element is oxidised and reduced simultaneously. Which reaction is an example of disproportionation?

A $3Cu + 8HNO_3 \longrightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O$

B $2KOH + H_2SO_4 \longrightarrow K_2SO_4 + 2H_2O$

C $2NO_2 + H_2O \longrightarrow HNO_3 + HNO_2$

D $2Pb(NO_3)_2 \longrightarrow 2PbO + 4NO_2 + O_2$

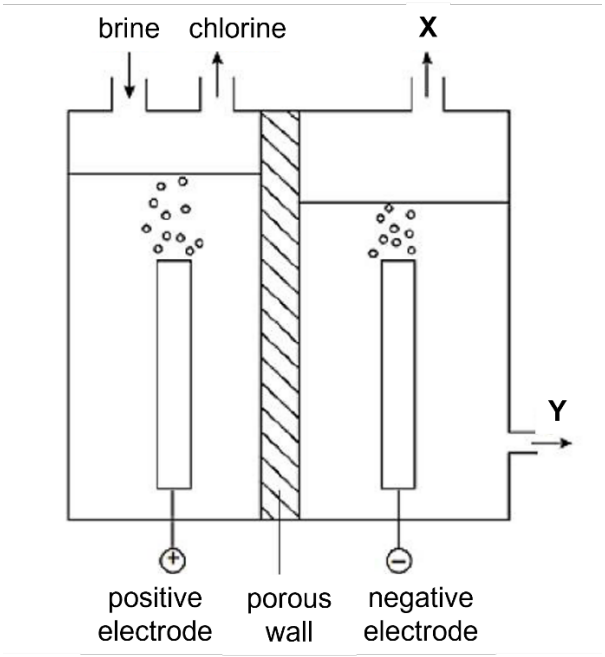
28 A student wrote four statements about the following reaction.

$$TiCl_4(l) + O_2(g) \longrightarrow TiO_2(s) + 2Cl_2(g) \qquad \Delta H = \text{negative}$$

Which statement is **incorrect**?

A Complete combustion is involved in this process.
B Energy is absorbed when the bonds are broken in titanium(IV) chloride and oxygen gas.
C The reaction releases energy and is an exothermic reaction.
D The volume of gas produced after reaction is twice the original volume.

29 The electrolysis of brine, concentrated sodium chloride solution, is shown in the diagram.



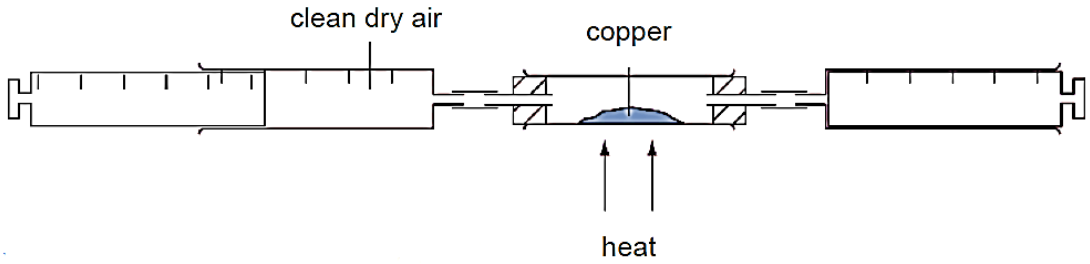
What are products **X** and **Y**?

	X	Y
A	hydrogen	dilute hydrochloric acid
B	hydrogen	dilute sodium hydroxide
C	oxygen	dilute hydrochloric acid
D	oxygen	dilute sodium hydroxide

30 In an electrolysis experiment, the same amount of charge deposited 38.4 g of copper and 14.4 g of titanium. The charge on the copper ion is 2+ and titanium has a relative atomic mass of 48. What was the charge on the titanium ion?

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

31 A sample of clean, dry air is passed over hot copper until all the oxygen in the air reacts with the copper. The volume of air decreases by 31.5 cm^3.



What was the starting volume of the sample of air?

A 63 cm^3 **B** 105 cm^3
C 150 cm^3 **D** 315 cm^3

32 Which statement about gases in the atmosphere is correct?

A Carbon monoxide is a pollutant which causes acid rain.
B Catalytic converters reduce carbon monoxide to carbon dioxide.
C Methane in the atmosphere depletes the ozone layer.
D Photosynthesis adds oxygen to the atmosphere.

33 Which noble gas has the highest concentration in dry air?

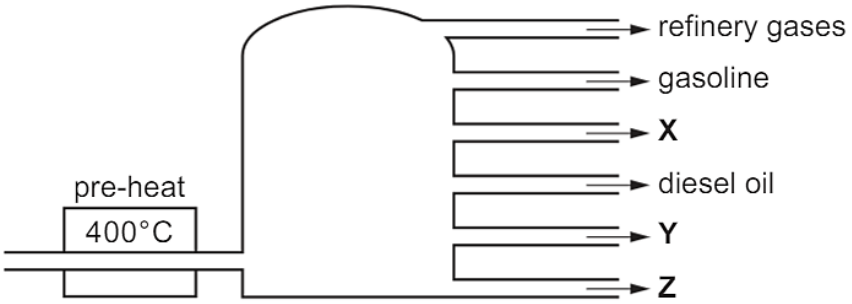
A argon **B** helium
C krypton **D** neon

34 How many of the following statements correctly describe(s) the petroleum gas fraction obtained after fractional distillation of crude oil?

1 Its molecules are hydrocarbons.
2 Its molecules have one to four carbon atoms.
3 The fraction has a fixed boiling point.
4 The fraction is the same as natural gas.

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

35 In an oil refinery, petroleum is separated into useful fractions. The diagram shows some of these fractions.



What are fractions **X**, **Y** and **Z**?

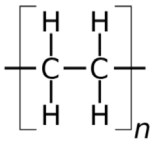
	X	Y	Z
A	kerosene	bitumen	lubricating oil
B	kerosene	lubricating oil	bitumen
C	lubricating oil	bitumen	kerosene
D	lubricating oil	kerosene	bitumen

36 Which statements are true about alkanes?

1 Their general formula is C_nH_{2n}.
2 They are flammable.
3 They can undergo combustion reaction.
4 They react with chlorine only.

A 1 and 2 only
B 1, 2 and 3
C 2 and 3 only
D 2, 3 and 4

37 The diagram shows a sample of poly(ethene).



Poly(ethene) contains molecules with an average relative molecular mass of 2800. How many carbon atoms are there in an average molecule of the polymer?

A 100
B 150
C 200
D 250

38 Two compounds, **Q** and **R**, react together to form a polymer.

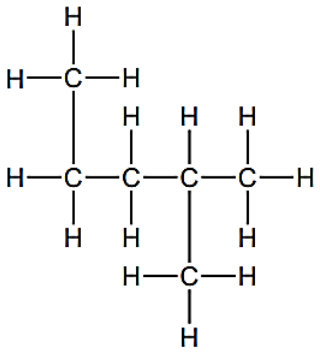
Q	**R**
$H_2N–(CH_2)_{10}–NH_2$	$HOOC–(CH_2)_6–COOH$

What is the formula of the repeating unit within the polymer?

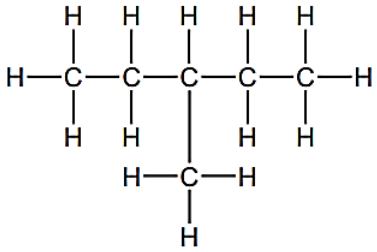
A $C_{16}H_{34}N_2O_2$ **B** $C_{18}H_{34}N_2O_2$
C $C_{18}H_{36}N_2O_3$ **D** $C_{20}H_{38}N_2O_3$

39 Alkanes are saturated compounds containing carbon and hydrogen only. Structures 1, 2, 3 and 4 are saturated hydrocarbons.

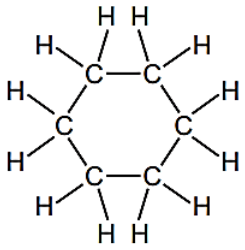
1



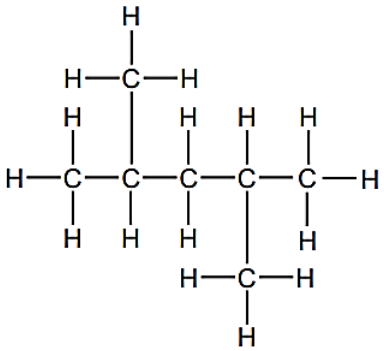
2



3



4



Which pair of structures are isomers?

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

40 A polyunsaturated compound has a molecular mass of 400. 100 g of the polyunsaturated compound reacts with 127 g of iodine.

How many double bonds are there in each molecule of the fat?

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

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		Key proton (atomic) number atomic symbol name relative atomic mass									5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).