Section A [15 MARKS]
Answer **all** questions in this section.

1. The following data were obtained from the mass spectrum of a sample of copper.

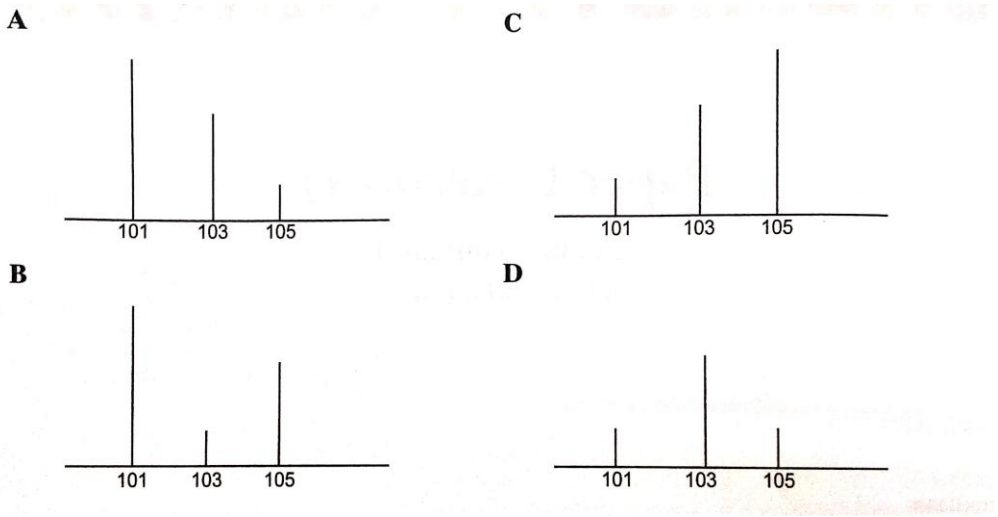
Relative mass	Percentage abundance
63	69
65	71

What is the relative atomic mass of copper?

A $\frac{(63 + 65)}{2}$ C $\frac{63(69) + 65(71)}{69 + 71}$

B $\frac{(63 + 65)}{(69 + 71)}$ D $\frac{63(71) + 65(69)}{69 + 71}$

2. Chlorine consists of two isotopes; ^{35}Cl and ^{37}Cl in the ratio 3:1. Phosphorous is monoisotopic, ^{31}P. A sample of phosphorous trichloride, PCl_3, is analysed in the mass spectrometer. Part of the mass spectrum consists of three lines with *m/e* of 101, 103 and 105. Which of the following diagram best represent the relative abundance of the three lines?



3. Which of the following species will be deflected most in a mass spectrometer?

A $^{36}Y^{+}$ B $^{36}Y^{2+}$ C $^{38}Y^{+}$ D $^{38}Y^{2+}$

4. In polluted air, the white paint pigment in older paint pigment in order oil paintings forms lead(II) sulphide, PbS that is black. To restore the white colour solution of hydrogen peroxide H_2O_2, is used.

$PbS\ (s) + 4\ H_2O_2\ (aq) \rightarrow PbSO_4\ (s) + 4\ H_2O\ (l)$

What mass of hydrogen peroxide is required to react with 0.239 g of lead(II) sulphide?

A 0.034 g C 0.136 g
B 0.060 g D 0.956 g

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5. Which of the ions below has the same number of electrons and neutrons?

A $^{28}Si^{4-}$ C $^{32}S^{2-}$
B $^{31}P^{3-}$ D $^{35}Cl^{-}$

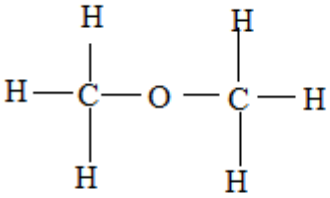
6. An atom of element X has only 7 electrons in the *d*-orbitals. What is the valence electronic configuration of X^{2+} ion?
A. $3d^5\ 4s^2$
B. $3d^5$
C. $3d^7\ 4s^2$
D. $3d^7$

7. Compound Q and R have the following properties

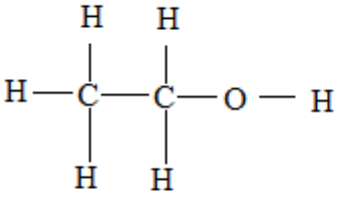
- Both are polar molecules
- Both have the same type of intermolecular forces
- Boiling point of Q is higher than R.

	Q	R
A	HF	NH_3
B	HBr	HI
C	PCl_3	BCl_3
D	H_2O	H_2S

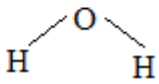
8. Dimethyl ether, ethanol and water are compounds with an oxygen in its molecule.



Ether



Ethanol



Water

What is the correct sequence of these compounds according to descending order of their boiling point?
A. dimethyl ether, ethanol,water
B. water, ethanol, dimethyl ether
C. ethanol, water, dimethyl ether
D. dimethyl ether, water, ethanol

9. Which of the following species has a bond angle of 109.5°?
A. NH_4^+
B. SF_4
C. XeF_4
D. ICl_4^-

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10. A sample of nitrogen occupies100cm^3 at 25°C and 101 kPa. At what temperature will the same sample occupy 200cm^3 at 101 kPa?
    A. 50°C
    B. 248°C
    C. 298°C
    D. 323°C

11. A mixture of 5.00 moles of neon and 3.00 moles of nitrogen occupy a volume of 36.0 litres in a vessel where the total pressure is 6.00 atm. The partial pressure of the neon in the container is
    A. 0.375 atm
    B. 0.625 atm
    C. 2.25 atm
    D. 3.75 atm

12. Under which condition does Dalton's law of partial pressure can be applied?
    A. At s.t.p
    B. At constant temperature and pressure
    C. When the gases show ideal behaviour
    D. At room conditions

13. The triple point of substance W is at 4.2 atm and 278K. If the temperature of solid W increases 200K to room temperature at a constant pressure of 3.0 atm, which of the following will **not** occur?
    A. The solid gradually melts to form a liquid
    B. The molecules will occupy a bigger volume.
    C. The average kinetic energy of the molecules increases.
    D. The attractive forces between the molecules decreases.

14. The kinetic data for reaction $P + Q \longrightarrow R + S$ is shown below

Experiment	[*P*] / mol dm^{-3}	[*Q*] / mol dm^{-3}	*Initial rate* / mol dm^{-3} s^{-1}
1	0.5	0.4	1.2 x 10^{-3}
2	1.0	0.8	4.8 x 10^{-3}
3	1.0	1.6	1.92 x 10^{-2}

What is the rate law for the reaction?

A Rate = $k\,[P]^2$ **B** Rate = $k\,[Q]^2$ **C** Rate = $k\,[P][Q]^2$ **D** Rate = $k\,[P]^2[Q]$

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(ii) Write the rate equation for the reaction [1 mark]

_____

(iii) A kinetic study of the above reaction yields the following results. Complete the table 1.

Initial rate (mol dm^{-3} s^{-1})	Initial concentration (mol dm^{-3})		
	H_2O_2	H^+	I^-
1.0 x 10^{-4}	0.10	0.10	0.10
2.0 x 10^{-4}		0.10	0.10
1.0 x 10^{-4}	0.10	0.20	
4.0 x 10^{-4}	0.20	0.10	0.20

Table 1

[2 marks]

(b) From a graph concentration against time for the hydrolysis of sucrose at 30^0C, the half – life corresponding to the initial concentration is shown in the table 2 below.

[Sucrose] (mol dm^{-3})	1.0	0.8	0.5	0.4
Half – life (min^{-1})	198	198	198	198

Table 2

(i) What is the order of reaction? [1 mark]

_____

(ii)Determine the rate constant for the hydrolysis. [1 mark]

(iii) If the hydrolysis is carried out at higher temperatures, how would the half – life be affected? [1 mark]

_____

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Section C [30 MARKS]
Answer **two** questions in this section.

18. (a) The activation energy, E_A, of a reaction can be calculated from the Arrhenius equation

$$k = Ae^{-\frac{Ea}{RT}}$$

where k = rate constant
R = gas constant ($8.31\ J\ K^{-1}\ mol^{-1}$)
T = temperature
A = frequency factor

In an investigation, the rate constant for the gas phase decomposition of nitrogen monoxide, NO into its elements are measured at five different temperatures. The result are shows in the table below :

T (K)	298	308	318	328	338
k ($mol^{-1}\ dm^3\ s^{-1}$)	1.74×10^{-5}	6.61×10^{-5}	2.51×10^{-4}	7.59×10^{-4}	2.40×10^{-3}

Determine graphically the activation energy of the decomposition of nitrogen monoxide. Write an equation for the reaction involve and state the order of this reaction.

[*8 marks*]

(b) Hydrogen sulphide is a pollutant that exists in the water of industrial waste products. By using chlorine, hydrogen sulphide can be eliminated from the water of industrial waste by the following equation :

$$H_2S\ (aq) + Cl_2(aq) \rightarrow S(s) + 2HCl\ (aq)$$

The rate of above reaction is first order with respect to each of the reactant.

(i) Determine the overall order of the reaction [*1 mark*]

(ii) Determine the rate of disappearance of hydrogen sulphide at temperature of 28 ^oC if the value of rate constant is $3.5 \times 10^{-2}\ mol^{-1}\ dm^3\ s^{-1}$ and the concentration of H_2S and Cl_2 are 1.6×10^{-4} and 0.07 mol dm^{-3} respectively. [*3 marks*]

(iii) Calculate the rate formation of concentrated hydrochloric acid under the above reaction condition. [*3 marks*]

19. The Haber process is an industrial process for the manufacture of ammonia.

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

(a) Using the concept of hybridisation and overlapping of orbitals, describe the bonding in ammonia, NH_3 molecule. [*6 marks*]

(b) The value of equilibrium constant K_p for the above equilibrium at 550°C is 1.5×10^{-5} atm^{-2}. What pressure must be applied to a mixture of nitrogen and hydrogen in molar ratio of 1:3 at 550°C so as to convert 50% of the mixture into ammonia at equilibrium? [*4 marks*]

(c) When 6.20g of iron is burned in 3.74g oxygen, iron (III) oxide is formed.

i) Write a balanced equation for the action of heating iron in oxygen. [1 mark]

ii) What mass of Fe_2O_3 will be produced? [2marks]

iii) What mass of oxygen will be left over at the end of the reaction [2 mark]

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SMK PUSAT BANDAR PUCHONG (1)
PEPERIKSAAN PERCUBAAN
PENGGAL 1 (KOHORT 2018)
CHEMISTRY (KIMIA)

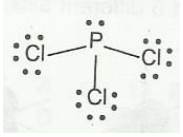
Section A [15 MARKS]

1	C
2	A
3	B
4	C
4	D

6	D
7	A
8	B
9	A
10	D

11	D
12	C
13	A
14	B
15	C

Section B [15 MARKS]

Number	Rubric	Marks
16 (a) (i)	$H_2O_2 + 2H^+ + 2I^- \rightarrow 2H_2O + I_2$	1
(ii)	Rate = k $[H_2O_2][I^-]$	1
(iii)	$[H_2O_2] = 0.2$ mol dm^{-3} $[I^-] = 0.1$ mol dm^{-3}	1 1
(b)(i)	First order	1
(ii)	$K = \frac{\ln 2}{195} = 3.55 \times 10^{-2}$ min^{-1}	1
(iii)	$T_{\frac{1}{2}}$ will decrease (because the rate increase)	1
17.(a) (i)	 polar	1 1
(ii)	Trigonal pyramidal	1
(b) (i)	$3s^1\ 3p^3\ 3d^1$	1
(ii)	Nitrogen is from Period 2/ have 2 shell Does not have empty d-orbital.	2
(c)	<table><tr><td>Ion</td><td>CO_3^{2-}</td><td>CH_3F</td><td>CO_2</td></tr><tr><td>Type of hybridisation of carbon atom</td><td>sp^2</td><td>sp^3</td><td>Sp</td></tr></table> 1- Any 2 correct 2- All correct	2

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Section C [30 MARKS]

<table>
<tr><th>Number</th><th>Rubric</th><th>Marks</th></tr>
<tr><td>18.(a)</td><td>
Refer graph paper
Correct x-axis , y-axis and label
Correct graph line
All point label

<table>
<tr><td>$\frac{1}{T}$ (K^{-1})
($\times 10^{-4}$)</td><td>33.6</td><td>32.5</td><td>31.4</td><td>30.5</td><td>29.6</td></tr>
<tr><td>ln K ($\times 10^{-1}$)</td><td>-109.6</td><td>-96.2</td><td>-82.9</td><td>-71.8</td><td>-60.3</td></tr>
</table>
$\ln k = \ln A - \frac{E_a}{R}\frac{1}{T}$

$m = -\frac{E_a}{R} = \frac{(100\text{-}65)\times 10^{-1}}{(32.8\text{-}30.0)\times 10^{-4}}$ (from graph)
$\frac{E_a}{R} = -1.25 \times 10^{-4}\ K$
$E_a = 103.9 \times 10^3\ Jmol^{-1}$
$E_a = 103.9\ kJmol^{-1}$

$2NO \rightarrow N_2 + O_2$
Second order (unit of k = $mol^{-1}\ dm^3\ s^{-1}$)
</td><td>

1
1
1

1

1

1
1
</td></tr>
<tr><td>(b)(i)</td><td>Second order</td><td>1</td></tr>
<tr><td>(ii)</td><td>
$-\frac{d[H_2S]}{dt} = k[H_2S][Cl_2]$
$= -3.5 \times 10^{-2}\ mol^{-1}\ dm^3\ s^{-1} \times 1.6 \times 10^{-4}\ mol\ dm^{-3} \times 0.07\ mol\ dm^{-3}$
$= -3.92 \times 10^{-7}\ mol\ dm^3\ s^{-1}$
</td><td>1
1
1</td></tr>
<tr><td>(iii)</td><td>
$-\frac{d[H_2S]}{dt} = \frac{d[HCl]}{2\ dt}$

$-2\ \frac{d[H_2S]}{dt} = \frac{d[HCl]}{dt}$

$\frac{d[HCl]}{dt} = -2\ (-3.92 \times 10^{-7}\ mol\ dm^3\ s^{-1})$

$= 7.84 \times 10^{-7}\ mol\ dm^3\ s^{-1}$
</td><td>1

1

1</td></tr>
</table>

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Number	Rubric	Marks
19.(a)	Nitrogen atom undergoes sp^3 hybridisation Electronic configuration of nitrogen atom is $1s^2\ 2s^2\ 2p^3$ One 2s orbital hybridized with three 2p orbital to form four sp^3 orbitals With 3 unpaired electron and 1 lone pair Nitrogen atom forms 3σ bond with hydrogen bond by head on overlapping Leaving the paired electron as lone pair	1 1 1 1 1 1
(b)	$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ I (mol): 1 ; 3 ; 0 C: - 0.5 ; -3(0.5) ; + 2 (0.5) E (mol): 1-0.5 =0.5 ; 3-1.5 =1.5 ; 2.0 $n_T = 0.5 + 1.5 + 1.0 = 3.0$ $P_{N2} = \frac{0.5}{3} P \quad P_{H2} = \frac{1}{2} P \quad P_{NH3} = \frac{1}{3} P$ $= \frac{1}{6} P$ $K_P = \frac{(P_{NH3})^2}{(P_{N2})(P_{H2})^3}$ $1.5 \times 10^{-5}\ atm^{-2} = \frac{(\frac{1}{6} P)^2}{(\frac{0.5}{3} P)(\frac{1}{2} P)^3}$ $1.5 \times 10^{-5}\ atm^{-2} = \frac{16}{3P^2}$ $P = 596.3\ atm$	1 1 1 1 1 **Max 4**
(c) (i)	$4\ Fe + 3\ O_2 \rightarrow 2\ Fe_2O_3$	1
(ii)	Mol of Fe = 6.20 / 55.8 Mol= 0.111mol Since 4 Fe ; 2 Fe_2O_3 = 0.05556 Mass of Fe_2O_3 = 0.05556 x 159.6 = 8.87 g	1 1 1 **Max 2**
(iii)	Since mol of Fe ; O_2 is 4:3 Mol of O_2 = 0.0833mol Mass of O_2 used = 0.0833 x 32 = 2.67 g Unused = 3.74 g – 2.67 g =1.07 g	 1 1 1 **Max 2**

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Suka sampel ini?

Kertas Percubaan STPM

Sem 1 · Kimia

- Semester 1: kertas percubaan (trial) negeri, subjek yang dipilih + skema
- Blueprint 30 hari Semester 1 (setiap subjek)
- Semester 3: percubaan 2024, 10 subjek, banyak negeri, soalan + skema dalam satu fail

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