Section A *[15 marks]*

Answer **all** *questions in this section. Choose the* **best** *answer for each of the question. Write your answers in the space provided.*

1. The proton number of ion ***X*** is 15 and its nucleon number is 31. The number of electrons differ from the number of neutrons by 2. What is the charge of ion ***X***?
   A -3 **B** -2 **C** +2 **D** +3

2. In an analysis of a solution containing barium ion, 50.0 cm^3 of the solution gave 0.244 g of $BaSO_4$ (relative molecular mass = 233) upon addition of sufficient sulphuric acid to precipitate the entire barium ion present. What is the concentration of the barium ion in the solution?
   A $\frac{1000}{50.0} \times \frac{0.244}{233}$ mol dm^{-3}
   B $\frac{50.0}{1000} \times \frac{0.244}{233}$ mol dm^{-3}
   C $\frac{1000}{50.0} \times \frac{233}{0.244}$ mol dm^{-3}
   D $\frac{1}{50.0} \times \frac{233}{0.244}$ mol dm^{-3}

3. What is the maximum number of electrons that can be filled into a principal quantum shell of quantum number *n*?
   A $2n$ **B** $2n + 2$ **C** $2n^2$ **D** $4n^2$

4. Coordinate bonds are found in all of the following species **except**
   A Be_2Cl_4 **B** CO **C** $K_3Fe(CN)_6$ **D** ClO_2^-

5. The melting points of iron and aluminium chloride are 1540 ^oC and 192 ^oC respectively. Which of the following best explain the large difference between these two melting points?
   A Covalent bond in iron is generally stronger than ionic bond in aluminium chloride.
   B Metallic bond in iron is generally stronger than ionic bond in aluminium chloride.
   C Metallic bond in iron is generally stronger than covalent bond in aluminium chloride.
   D Metallic bond in iron is generally stronger than van der Waals' forces between aluminium chloride.

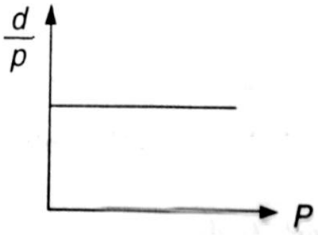
6. A flask contains nitrogen, oxygen and chlorine at pressure of 50 kPa, 100 kPa and 80 kPa respectively. A certain amount of helium is forced into the flask at constant temperature and volume until the total pressure becomes 300 kPa. What is the partial pressure of nitrogen in the new mixture?
   A 50 kPa **B** 70 kPa **C** 130 kPa **D** 230 kPa

7. Which of the following factors accounts for the deviation of gases in Contact process from ideal gas behaviour?
   A the presence of catalyst
   B The temperature of 500 ^oC
   C Pressure at 1000 atm
   D The double bond in the SO_2 molecule

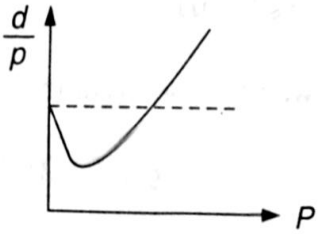
8. Uranium-238 undergoes radioactive decay spontaneously to produce lead. It is a first order reaction with a half-life of 4.50×10^9 years. A piece of rock fossil was found to have the ratio of uranium to lead as 1:3. Estimate the age of the rock.
   A 13.5×10^9 years
   B 9.00×10^9 years
   C 6.80×10^9 years
   D 4.90×10^9 years

9. The $\frac{d}{p}$ for ammonia gas is plotted against p at constant temperature. Which of the following graphs is most likely to be correct? [d = density of ammonia; p = pressure]

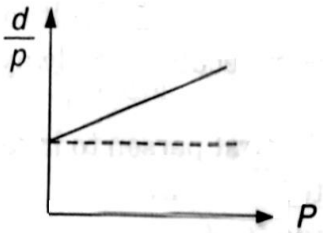
A



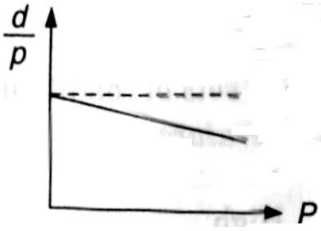
B



C



D



10. Which of the following must be correct regarding a reaction that is second order with respect to a reactant ***X***?
A The reaction involves only two molecules of ***X***.
B The reaction occurs in two steps.
C The step with the highest activation energy involves only two molecules of ***X***.
D The rate of reaction is independent to the concentration of ***X***.

11. The Arrhenius equation is given as $k = Ae^{-\frac{E_a}{RT}}$. A reaction happens 27 times faster at 52 ℃ than at 22 ℃. Calculate the activation energy, in kJ mol^{-1}, for this reaction.
[Gas constant R = 8.31 J K^{-1} mol^{-1}]
A 1.04 **B** 10.5 **C** 38.1 **D** 87.5

12. The equilibrium constant, K_p, for reaction (i) is y. What is the equilibrium constant, K_p', for reaction (ii)?

$$SO_2(g) + ½O_2(g) \rightleftharpoons SO_3(g) \text{ …….(i)}$$
$$2SO_3(g) \rightleftharpoons 2SO_2(g) + O_2(g) \text{ …….(ii)}$$

A y^{-2} **B** y^2 **C** $2y$ **D** $2y^{-1}$

13. Which of the following statements is correct about a reaction for which the equilibrium constant is independent of temperature?
A The activation energies for both forward and reverse reaction is zero.
B The enthalpy change is zero.
C Its rate constants do not vary with temperature.
D The forward and reverse reactions are of the same order.

14. What is the pH of 0.100 mol dm^{-3} ammonium hydrogensulphite, NH_4HSO_3?
[K_a of HSO_3^- = 6.20 x 10^{-8} mol dm^{-3}; K_b of NH_3 = 1.80 x 10^{-5} mol dm^{-3}]
A 0.0 **B** < 7.0 **C** 7.0 **D** > 7.0

15. The pH of a 0.550 mol dm^{-3} acid, HA is 4.48 at 298 K. What is the acid dissociation constant K_a of the acid in mol dm^{-3}?
A 4.48 x 10^{-7} **B** 9.52 x 10^{-7} **C** 2.00 x 10^{-9} **D** 3.00 x 10^{-4}

Section A [15 marks]

1.	2.	3.	4.	5.
6.	7.	8.	9.	10.
11.	12.	13.	14.	15.

Section B ***[15 marks]***

Answer **all** *questions in this section. Write your answers in the space provided.*

16. Under the conditions prevailing in the centre of a star like sun, where the temperature is about 1.6×10^7 K, hydrogen, ^1_1H, undergoes nuclear changes according to the following sequence of reactions.

$$^1_1H + {}^1_1H \rightarrow \boldsymbol{X} + {}^0_{+1}e + \nu$$

a positron (or positive electron); a neutrino (which has no mass)

$$^2_1H + \boldsymbol{Y} \rightarrow {}^3_2He + \gamma$$

gamma rays

$$^3_2He + \boldsymbol{Z} \rightarrow {}^4_2He + {}^1_1H + {}^1_1H$$

the positrons are annihilated by meeting electrons, with the consequent production of gamma rays.

$$^0_{+1}e + {}^0_{-1}e \rightarrow \gamma$$

gamma rays

(a) Identify the nuclei ***X***, ***Y*** and ***Z***, giving their atomic symbols, nucleon numbers and proton numbers.

X: ……. ***Y:*** ……. ***Z:*** …….

[3 marks]

(b) The energy associated with radiation of frequency, f, is given by the equation E = hf, where h is Planck constant.

(i) Calculate the energy in joules associated with one quantum of gamma radiation of wavelength 50.0 pm.

[Planck constant, h = 6.63×10^{-34} J s; velocity of light, c = 3.00×10^8 ms^{-1} ; 1 pm = 10^{-12} m]

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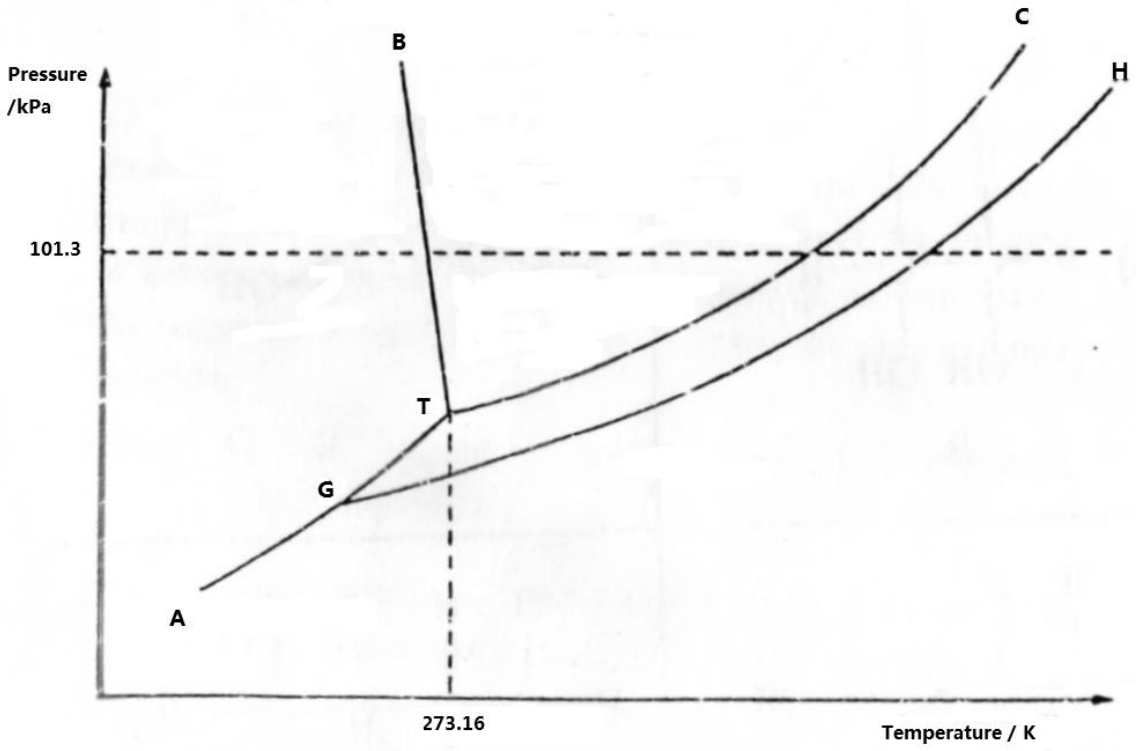
[2 marks]

(ii) How much energy will be associated with the formation of L quanta of gamma radiation? L is Avogadro constant with the value of 6.022×10^{23} mol^{-1}.

.....

[1 mark]

17. (a) In the phase diagram below, the line **TA**, **TB** and **TC** refer to pure water and the curve **GH** refers to a dilute solution of a non-volatile solute.



(i) Comment on any anomalous features of water according to the phase diagram above.

.....

.....

.....

.....

[2 marks]

(ii) Add to the diagram above a further curve labeled **VW** for a solution of the same non-volatile solute but less concentrated than that corresponding to **GH**.

[1 mark]

(iii) By reference to the phase diagram, explain the effect of a non-volatile solute on the freezing point and the boiling point of water.

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.....

[2 marks]

(b) A container of fixed volume 40.0 dm^3 contains 1.20 mol of oxygen gas, O_2, 1.40 mol nitrogen monoxide, NO and ***x*** mol argon gas. Assume the pressure of 1 mol of gas in the container is 100 kPa at room conditions.

(i) If the total pressure of gases in the container is 300 kPa, find the value of ***x***.

.....

[1 mark]

(ii) The gaseous mixture is ignited and then cooled to room temperature. What is the total pressure of the gaseous mixture after the reaction?

.....

[2 marks]

(iii) Calculate the partial pressure of argon in the mixture after the reaction.

.....

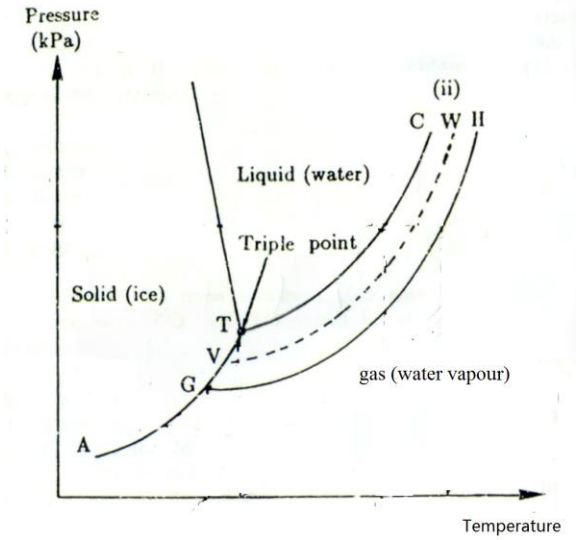
[1 mark]

STPM TRIAL EXAMINATION 2015 (PAPER 1)
CHEMISTRY ANSWER
(LOWER SIX)

Section A [15 marks]

1.	**A**	2.	**A**	3.	**C**	4.	**D**	5.	**D**
6.	**A**	7.	**C**	8.	**B**	9.	**C**	10.	**C**
11.	**D**	12.	**A**	13.	**B**	14.	**D**	15.	**C**

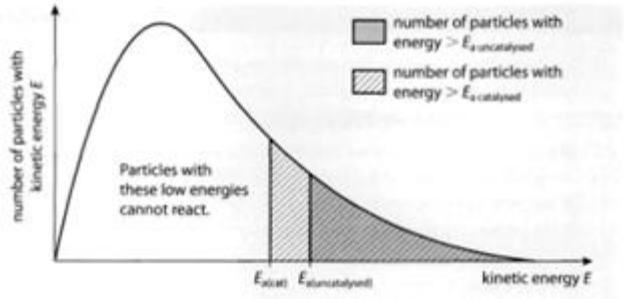
Section B – Structured Questions [15 marks]

16 (a)	***X*** is $^{2}_{1}H$; ***Y*** is $^{1}_{1}H$ and ***Z*** is $^{3}_{2}He$.	3
(b)(i)	$E = \frac{hc}{\lambda} = \frac{(6.63 \times 10^{-34})(3.00 \times 10^{8})}{50.0 \times 10^{-12}}$ = **3.98×10^{-15} J**	2
(ii)	The associated energy with the formation of *L* quanta of gamma radiation: $E = 6.022 \times 10^{23} \times 3.98 \times 10^{-15}$ = **2.39×10^{9} J mol^{-1}**	1
	Total	**6**
17 (a)(i)	The melting curve of water has a negative gradient. This indicates that the **melting point of water decreases as pressure increases.** When pressure increases, it tends to form water as **water has smaller volume than ice**. Heat is absorbed and thus temperature decreases.	1 1
(ii)		1
(iii)	The presence of foreign molecules **makes the orderly arrangement more difficult to achieve.** Hence, the temperature has to be lower for freezing to occur. Thus, **freezing point of water decreases.** The presence of non-volatile solute particles **lowering the vapour pressure of the solvent.** Therefore, a higher temperature is needed to raise the solution's vapour pressure to equal the external pressure. Thus, **boiling point of water increases.**	1 1

(b) (i)	Total no. of mol of gas = 300/100 = 3.00 mol No. of mol Argon gas = 3.00 – 1.20 – 1.40 = **0.40 mol**	 1
(ii)	$2NO(g) + O_2(g) \rightarrow 2NO_2(g)$ Initial (mol): 1.40 1.20 0 After (mol): 0 1.20 – 0.70 = 0.50 mol 1.40 No. of moles of gas after reaction = 0.50 + 1.40 + 0.40 = 2.30 mol Total pressure = 2.30 x 100 kPa = **230 kPa**	1 1
(iii)	P_{Ar} = 0.40/2.30 x 230 = **40 kPa**	1
	Total	**9**

Section C – Essay Questions [30 marks]

18 (a)(i)	Boron trichloride has **3 bonding pairs of electron without any lone pair of electron** while nitrogen trichloride has **3 bonding pairs of electron with one lone pair of electron.** According to VSEPR, the **lone pair and bonding pair electron repulsion** in NCl_3 is **larger than the bonding pair and bonding pair electron repulsion** in PCl_3.	1 1
(ii)	Bromine atom is a very **large atom** compare to fluorine atom. The **steric hindrance effect** causes the compound of SBr_6 to be **too bulky** and thus the **S-Br bond is very weak** and unstable.	1 1
(iii)	Sodium hydride is a solid at room condition because it exists as **giant ionic structure** with **strong electrostatic forces / ionic bond** between Na^+ ion and H^- ions. A lot of energy is required to break the strong ionic bond. Hydrogen sulphide is a gas at room condition because it exists **as simple molecular structure** which only bonded by a very **weak intermolecular of van der Waal's forces**.	1 1
(iv)	Hydrogen chloride in aqueous solution **ionises completely in water to release H^+ ions** that turns dry blue litmus paper red. $HCl(aq) \rightarrow H^+(aq) + Cl^-(aq)$ Hydrogen chloride in methylbenzene exists as **simple covalent molecule** with strong H-Cl covalent bond. **The absence of H^+ ion** cause hydrogen chloride has no effect on dry blue litmus paper.	1 1
(b)	$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ ΔH = -92 kJ or ΔH = negative The production of ammonia in Haber process is an **exothermic process** and accompanied by a **decrease in the number of gas particles**. According to Le Chatelier's principle, **an increase in pressure and a decrease in temperature** will **increase the yield of ammonia** in the equilibrium mixture.	1 1 1

	However, at high pressure, the reactant gas of $N_2(g)$ and $H_2(g)$ may be **liquefied** and the **cost to maintain the high pressure is expensive**. At low temperature, **the rate of attainment equilibrium will become low**. Thus, **iron is added as catalyst to increase the rate of reaction** and the compromised temperature and pressure for optimum reaction are **500 ^{o}C and 250 atm.**	1 1 1 1
	Total	**15**
19 (a)(i)	Let rate = $k[A]^p[B]^q$ $\frac{\text{Experiment 2}}{\text{Experiment 1}} : \frac{1.26 \times 10^{-2}}{8.21 \times 10^{-3}} = \frac{k(0.0713)^p(0.0216)^q}{k(0.0575)^p(0.0216)^q}$ $1.5347 = 1.24^p$ $\log_{10} 1.5347 = p \log_{10} 1.24$ $p = 1.99 \approx 2$ $\frac{\text{Experiment 3}}{\text{Experiment 1}} : \frac{1.26 \times 10^{-2}}{8.21 \times 10^{-3}} = \frac{k(0.575)^p(0.0333)^q}{k(0.0575)^p(0.0216)^q}$ $1.5347 = 1.5417^q$ $\log_{10} 1.5347 = q \log_{10} 1.5417$ $q = 0.989 \approx 1$ Thus, the reaction is **second order with respect to A** and **first order with respect to B.** **The overall order of reaction is 3.** Rate = $k[A]^2[B]$ From Experiment 1, $8.21 \times 10^{-3} = k(0.0575)^2 (0.0216)$ **$k = \underline{115\ mol^{-2}\ dm^6\ s^{-1}}$**	1 1 1
(ii)	When the reaction is second order with respect to concentration A, **the rate of reaction is proportional to the square of the concentration of reactant A.** *OR* **Doubling the concentration of A increases the rate of reaction by quadrate.** When the reaction is first order with respect to concentration B, **the rate of reaction is directly proportional to the concentration of reactant B.** *Or* **Doubling the concentration of B doubles the rate of reaction.**	1 1
(iii)	The stoichiometric chemical equation might be only an overall equation that **representing a series of elementary steps of reaction** that **including the slowest step which will responsible to determine the rate equation.**	1
(b)	 A catalyst increases the rate of reaction by **providing an alternative reaction pathway with lower activation energy** compare to uncatalysed reaction. Thus **more reactant particles** can **overcome the energy barrier** and hence increasing the effective collision.	2 1 1

Suka sampel ini?

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- 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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