SAMPEL PERCUMA

Pra-Pentaksiran STPM 2017 Kimia Semester 1 SMK Yong Peng

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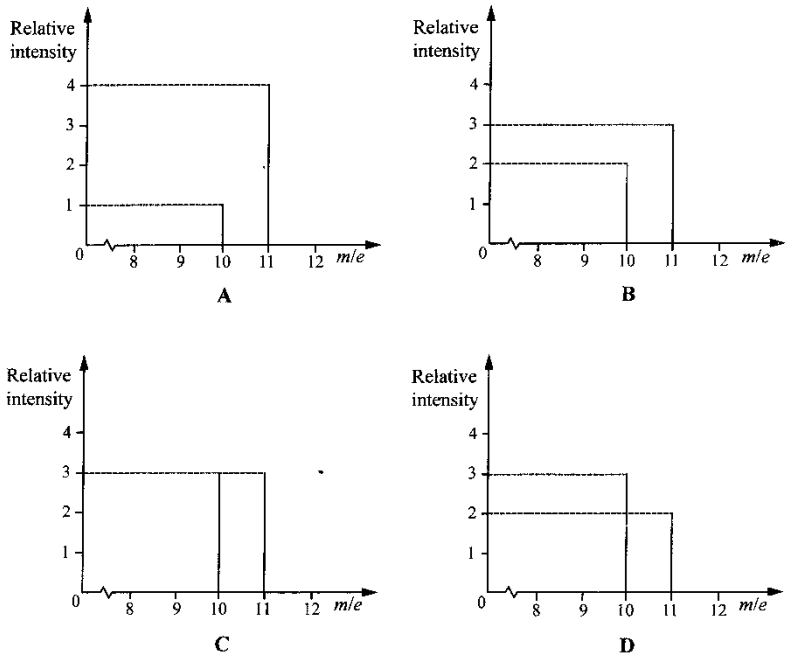
SECTION A
(15 MARKS)

Answer all questions in this section.

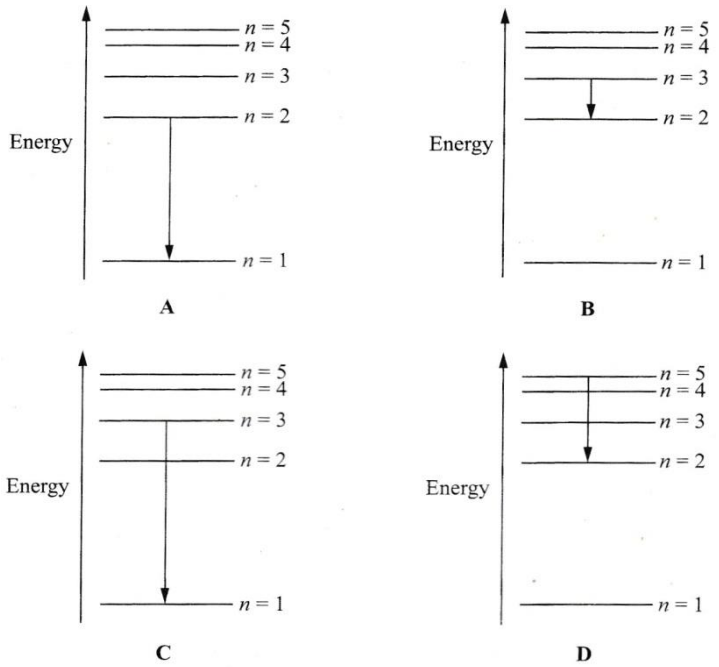
1. The proton number of ion Y is 16, its nucleon number is 33 and it has the same number of electrons and neurons. What is the charge of ion Y?

A. +1 B. -1 C. +2 D. -2

2. Boron has two isotopes with relative isotopic masses of 10 and 11. When 1.00 g of boron reacts completely with hydrogen, 1.278 g of boron hydride, B_2H_6 is produced. Which graph shows the mass spectrum of boron?



3. Transition of electrons between energy levels in an atom will cause an absorption or emission of light. Which energy level diagram shows the transition of electrons that emits light with the shortest wavelength?



4. An atom of element Z has nucleon number 55 and thirty fundamental uncharged particles in its nucleus. What is the electronic configuration of a Z^{2+}?

A. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5$
B. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^4 4s^1$
C. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^3 4s^2$
D. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2$

5. Polyatomic molecules and ions have varied geometries. Which species and geometry correspond correctly?

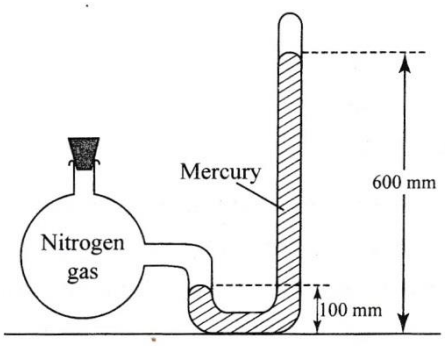
	Species	Geometry
A	NH_2^-	Linear
B	H_3O^+	Trigonal planar
C	$SiCl_4$	Square planar
D	ICl_3	T-shaped

6. Which ionic compound has the highest covalent characteristic?
A. MgO B. Al_2O_3 C. MgF_2 D. AlF_3

7. The boiling points of CH_3OH and CH_3SH are 64.5 °C and 5.8 °C respectively. What is the cause of the difference in the boiling points?

A. The O-H bond is stronger than the S-H bond
B. Hydrogen bonds exist between CH_3OH molecules
C. CH_3SH molecule is bigger than CH_3OH molecule
D. The electronegativity of oxygen is higher than that of sulphur.

8. A manometer is a device for measuring gas pressures. A sample of nitrogen gas is placed in a close-end manometer at 25°C until there is an increase of 0.100 g in its mass. The diagram below shows the heights of mercury in the manometer.



What is the volume of the nitrogen gas in the manometer?
[Relative atomic mass: N = 14.0; molar gas constant = 8.31 JK^{-1} mol^{-1} ; 760 mm Hg = 101 kPa]
A. 95 cm^3 B. 111 cm^3 C. 133 cm^3 D. 266 cm^3

9. Fullerene , C_{60} is one of carbon allotropes which is used as the base study of carbon nanotube and its technology. Which statement about fullerene is not true?
A. Its density is higher than diamond
B. It contain delocalised electrons
C. The bonding angle of fullerene is 120°C
D. All of its carbon atoms are sp^2 hybridised

10. The initial rate of reaction between P and Q at different concentration is given in the table below.

[P] / mol dm^{-3}	[Q] / mol dm^{-3}	Initial rate of reaction / mol dm^{-3} s^{-1}
x	y	r
4x	y	2r
16x	2y	8r

What is the initial rate of reaction in terms of r if the concentration of Pand Q is 4x and 3y respectively?

A. 2r B. 6r C. 12r D. 48r

11. A mixture of 0.60 mol of carboxylic acid X, 0.5 mol of alcohol Y, 0.60 mol of ester Z and 0.40 mol of water of total volume V dm^3 is refluxed in the presence of hydrochloric acid. At equilibrium, only 0.40 mol of X remains. What is the numerical value of K_C for the reaction

X (aq) + Y (aq) Z (aq) + H_2O (l) ?

A. 0.25 B. 4.0 C. 6.7 D. 40.0

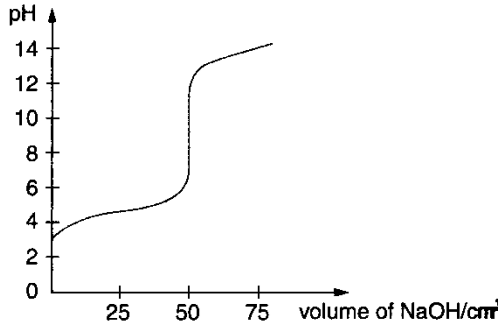
12. An equilibrium system is subjected to the following changes separately:

(i) Decreasing pressure at a constant temperature
(ii) Increasing temperature at a constant pressure

The equilibrium system whose reaction product will increase in quantity when subjected to the above changes is

A. $2SO_2$ (g) + O_2 (g) $2SO_3$ (g) ΔH = negative
B. N_2 (g) + $3H_2$(g) $2NH_3$ (g) ΔH = negative
C. H_2 (g) + I_2 (g) 2HI (g) ΔH = positive
D. $CaCO_3$ (s) CaO (s) + CO_2 (g) ΔH = positive

13. The graph below shows the variation in pH against the volume of sodium hydroxide added when a sample of acid, HA is titrated with sodium hydroxide.



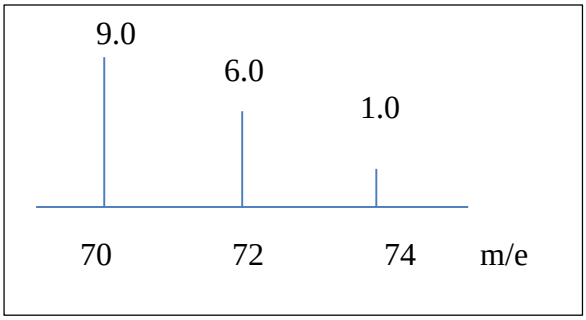
Which of the following statements is not true?

A. HA is a weak acid
B. The pKa for HA is around 4.5
C. The concentration of NaOH used is 0.050 mol dm^{-3}
D. Phenolphthalein will be a suitable indicator for this titration

SECTION B
(15 MARKS)

Answer all questions in this section

16. (a) Element R consists of two isotopes ^{35}R and ^{37}R. Part of the mass spectrum of R is shown below.



(i) Define isotopes [1 mark]

……

(ii) Calculate the relative abundance of ^{35}R : ^{37}R [4 marks]

(b) Relative molecular mass of S is 28.0. Calculate the density of gas S in g dm^{-3} at 107°C and 200.0 kPa. [2 marks]

17. benzoic acid C_6H_5COOH and citric acid $C_5H_7O_4COOH$ with K_a 6.3 x10^{-5} mol dm^{-3} and 7.0 x 10^{-4} mol dm^{-3}.
(a) Write the expression of K_a for each acids. [2 marks]

(b) Using given K_a value, compare the acidity of two acid. Explain your answer. [2 marks]

……..

……..

(c)Calculate the pH of a 0.25 mol dm^{-3} citric acid solution [2 marks]

(d) Calculate the pH of an aqueous solution containing 0.25 mol dm^{-3} of citric acid and 0.3 mol dm^{-3} of sodium citrate. [2 marks]

SECTION C
(30 MARKS)

Answer any two questions in this section.

18. Period 3 elements can form different fluoride based compound for example MgF_2, AlF_3 and PF_3.
(a) Melting point of MgF_2, AlF_3 and PF_3 are described in the table below.

Compound	Melting point / °C
Magnesium fluoride	1264
Aluminium fluoride	1040
Nitrogen trifluoride	-22

Explain melting point of these fluorides [4 marks]
(b) Sulphur can also react with fluorine to form sulphur fluoride at different oxidation states, namely sulphur difluoride (SF_2), sulphur tetrafluoride (SF_4) and sulphur hexafluoride (SF_6)

(i) Explain what is meant by valence-shell electron-pair repulsion theory. [2 marks]

(ii) Draw the Lewis structures of SF_2, SF_4 and SF_6. Using valence-shell electron-pair repulsion theory, deduce the shape of these molecules. [6 marks]

(c) Sulphur trioxide formed is very hygroscopic , where SO_3 has a high ability of a substance to attract and hold water molecules from the surrounding environment. Using suitable bonding concept, explain this phenomenon. [3 marks]

19. Variation of the rate constant with temperature for the reaction

$$A \longrightarrow 2B + C$$

is given in the table below.

Temperature /K	Rate constants / s^{-1}
298	1.74×10^{-5}
308	6.61×10^{-5}
318	2.51×10^{-4}
328	7.59×10^{-4}
338	2.40×10^{-3}

(a) (i) What is meant by rate constant [1 mark]

(ii) What is the order of this reaction? Justify your answer [2 marks]

(b) (i) By plotting a graph of ln k against 1/T, determine the activation energy for the reaction above. [8 marks]

(ii) Based on the graph which you have plotted, calculate the half-life of the above reaction at 300 K. [4 marks]

20. (a) Pure Bromic acid, HBrO is a colourless liquid which forms an azeotropic mixture with water, aqueous bromic acid shows deviation from Raoult's law.

(i) Explain the type of deviation in aqueous bromic acid. [2 marks]

(ii) Sketch a boiling-composition diagram for aqueous hydrochloric acid given that pure bromic acid boils at 48.0°C and an azeotrope mixture containing 49.2% of bromic acid by mass boils at 122°C and 101KPa. [4 marks]

(iii) State the charges which occur in the composition of the residual liquid and the distillate when a solution containing 80.0% of bromic acid is continuously distilled [3 marks]

(b) (i) A mixture containing hydrogen and nitrogen in the ratio of 3:1 (by volume) is allowed to come to equilibrium at 20 atm pressure and *T* °C. Under these conditions the equilibrium mixture contains 40% by volume of ammonia.

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

Calculate K_p for the reaction. [3 marks]

(ii) Calculate the equibrium constant K_c at 100°C for the system below

$$N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g) \qquad \Delta H: -92.2 \text{ kJ}$$

[$K_c = 6 \times 10^5$ dm^6 mol^{-2} at 25°C] [3 marks]

Answer

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

16. (a) (i) same proton number but different number of neutron / nucleon number. [1 mark]

(ii) M_r of R_2 = $\frac{(70x9) + (72x6) + (74x1)}{9 + 6 + 1}$ [1 mark]

= 71.0 [1 mark]

A_r of R = ½ x 71.0

= 35.5

$35\alpha + 37(1 - \alpha) = 35.5$ [1 mark]

$\alpha = 0.75$

$^{35}R : {}^{37}R = 0.75: 025$

= 3: 1 [1 mark]

(b). PV=nRT

$m/V = PM_r / RT$

$= \frac{200 \times 28.0}{8.31 \times (273 + 107)}$ [1 mark]

= 1.77 g dm^{-3} [1 mark]

17. (a) $K_a = \frac{[H^+][C_6H_5COO^-]}{[C_5H_6COOH]}$ $K_a = \frac{[C_5H_7O_4COO^-][H^+]}{[C_5H_7O_4COOH]}$ [2 marks]

(b) - citric acid are more acidic than than benzoic acid [1 mark]

- pKa lower more acidic [1 mark]

(c) $[H^+] = \sqrt{K_a \times c}$

$= (7.0 \times 10^{-4})(0.25)$

= 0.0132 [1 mark]

$-\log [H^+] = -\log (0.0132)$

pH = 1.88 [1 mark]

(d) $pH = pKa - \log \frac{[C_5H_7O_4COOH]}{[C_5H_7O_4COONa]}$

$= -\log (7.0 \times 10^{-4}) - \log \frac{[0.25]}{[0.30]}$ [1 mark]

pH = 3.24 [1 mark]

18.(a) - MgF_2 and AlF_3 are hold by ionic crystal lattice [1 mark]

- NF_3 is simple covalent molecule hold by weak van Der Waals forces [1 mark]

- Al^{3+} in AlF_3 has higher charge than Mg^{2+} in MgF_2 [1 mark]

- Al^{3+} has higher polarising power/covalency [1 mark]

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