962

PERCUBAAN STPM 2009

CHEMISTRY (KIMIA)

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MARK SCHEME (SKEMA PEMARKAHAN)

PAPER 1 & 2

SCHEME PAPER 1

1 D
2 B
3 D
4 A
5 C
6 A
7 B
8 B
9 D
10 C
11 A
12 B
13 C
14 C
15 D
16 D
17 B
18 A
19 C
20 D

21 C
22 C
23 D
24 C
25 A
26 D
27 D
28 D
29 C
30 D
31 A
32 D
33 D
34 D
35 D
36 D
37 A
38 A
39 C
40 D

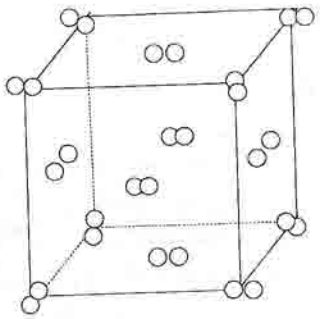
41 D
42 B
43 B
44 C
45 D
46 B
47 B
48 D
49 A
50 D

JADUAL SPEFIKASI ITEM (JSI)
PEPERIKSAAN PERCUBAAN STPM 2009
NEGERI JOHOR

No.	Topic	Question No.			No. of questions
		Easy	Moderate	Difficult	
1	Mattter	1, 46, 43		2	4
2	Electronic structure of Atoms		3, 4, 41		3
3	Chemical bonding	5, 6			2
4	Reaction kinetics		7, 8		2
5	Ionic Equilibria		9, 10, 20, 42		4
6	Chemical Equilibria		11, 12		2
7	Phase Equilibria	14		13	2
8	Electrochemistry	44, 45	15	16	4
9	Thermochemistry	18	17	19	3
10	Period 3 and Group 2		21		1
11	Group 13	22			1
12	Group 14	23			1
13	Group 15		24		1
14	Group 17		25		1
15	d-Block elements		26		1
16	Chemistry of Carbon	27, 29	31, 48		4
17	Hydrocarbon	28, 47	37	49	4
18	Haloalkanes			40	1
19	Alcohols		36	38	2
20	Carbonyl compounds		32, 33	39	3
21	carboxylic acids				
22	Carboxylic acids derivatives		35		1
23	Amines		30		1
24	Amides				
25	nitriles		50		1
26	amino acids				
27	polymerisation		34		1
	Total no. of questions	15	27	8	50

Question 1

(a) (i)

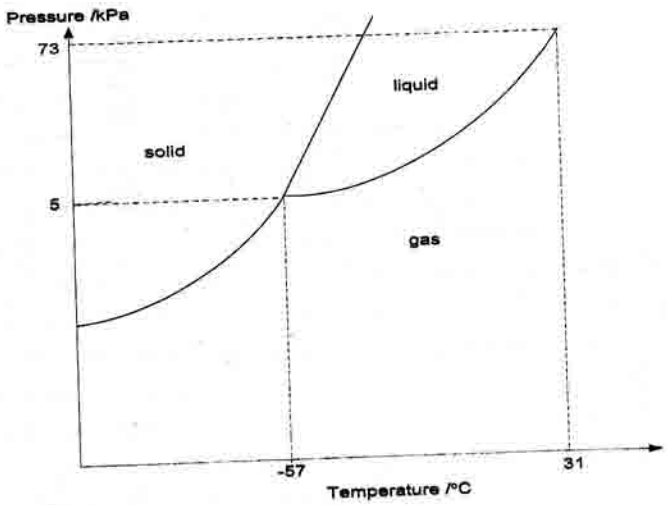


(1)

(ii) (8X2X1/8) + (6X2X1/2) = 8 (1)

(b) (i) A set of temperature and pressure values where solid, liquid and gas exist in equilibrium. (1)

(ii)



General sketch of graph. (1)

The correct axes. (1)

The labellings. (1)

(iii) because its triple point occurs at a pressure above the normal atmospheric pressure. (1)

(iv) $pV = nRT$ @ $pV = \frac{mRT}{M_r}$

p = $\frac{5.50 \times 8.31 \times (24.0+273) \times 10^{-3}}{10.0 \times 10^{-3} \times 44.0}$ kPa (1)

= 30.9 kPa (1)

P_t = 30.9 + 93.7 = 124.6 kPa (1)

Total: 10 marks

Question 2

(a) $Ca^{2+}(g) + 2e^- + 2Cl(g)$ (This is the only answer for the top line) (1)
$Ca^{2+}(g) + 2e^- + Cl_2(g)$ (1)
$Ca^+(g) + e^- + Cl_2(g)$ (1)
$Ca(g) + Cl_2(g)$ (state symbols and electrons essential) (1)
Note: Cl_2 to 2Cl can be in any order but Ca must be in sequence)
Max. 3 marks

(b) Enthalpy of formation = 178 + 590 + 1145 + (2 × 121) – (2 × 364) – 2237 (1)
= - 810 kJ mol^{-1} (1)

(c) ΔH = -ΔH(lattice formation) + ΣΔH(hydration) (1)
(or cycle with state symbols, numbers or labels)
= 2237 – 1650 – (2 × 364)
= -141 kJ mol^{-1} (1)

(d) Moles of NH_4Cl = 2/53.5 = 0.0374
Heat absorbed = 15 × 0.0374 = 0.561 (1)

$Q = m\,c\,\Delta T$
$\Delta T = Q/mc$ = (0.561×1000)/(50×4.2) = 2.6 (°C) (1)
(allow 2.5 to 2.7; can use 52; ignore units, answer must be at least 2 sig figs)
Final temperature = 20 – 2.6 = 17.4 °C (1)
(Answer is for 20 – previous ans; must be < 20)

Note; may not use moles (loses first 2 marks)
so ΔT = (15×1000)/(50×4.2)
So answers of 71.4 and 68.7 score last 2 out of first 4.
(allow no units for temperature, penalise wrong units)

Total: 10 marks

Question 3

(a) $3s^2\ 3p^1$ (1)

(b) (i) aluminium hydroxide (1)

(ii) $Al(OH)_4^-$ (1)

(c) (i) white precipitate (1)

Effervescence (1)

(ii) $Al(H_2O)_6\ ]^{3+} + H_2O \longrightarrow Al(H_2O)_5(OH)]^{2+} + H_3O^+$ (1)

(d) (i) $AlCl_3 + CH_3Cl \longrightarrow AlCl_4^- + CH_3^+$ (1)

(ii) as lewis acid (1)

In $AlCl_3$,Al has an incomplete octet and accepts a pair of electrons from the Cl atom in CH_3Cl @ $AlCl_3$ is an electron-deficient compound. and acts as an electron-pair acceptor. (1)

(e) light (1)

Total = 10 marks

Question 4

(a) (i) Ag^+/silver (1)

(ii) Carbonyl or C = O (1)

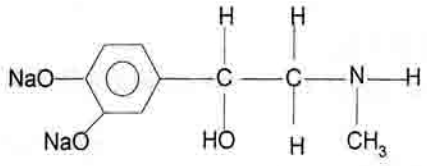
(iii) Helps to speed up the reaction/slow at room temperature/flammable (1)

(iv) Propanal: silver mirror formed (1)

Propanone: no change/solution remains colourless (1)

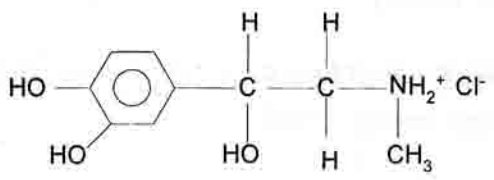
(b) (i) optical isomerism (1)

(ii)(α)



(1)

(β)



(1)

(c) (i) nucleophilic addition (1)

(ii) dry ether, room temperature (1)

Total = 10 marks

Question 5

(a) Lone pair donated / both electrons supplied by one atom (1)

from N (to H^+) [ignore missing charge or hydrogen atom] (1)

dative/dative covalent/coordinate bonding (1)

(b) Van der Waals (or VdW) forces between methane molecules (1)

(or VdW forces in methane)

Hydrogen bonding in ammonia and water (1)

Hydrogen bonds are stronger than van der Waals forces (1)

(or VdW forces are the weakest)

Hydrogen bonds in water more extensive than ammonia because O has two lone pairs (N one) (1)

[or Water forms more H bonds per molecule (than ammonia)]

(or H bonds in water stronger because O more electronegative than N)

(or H bonds in water stronger because O – H bond more polar than N – H)

(c) (i) The change in concentration per unit of time (1)

Both axes must be labelled to gain marks for graph. y axis conc NO_2 and x axis time (1)

Curve starts at origin and levels off. (1)

Note: *If candidates graph does not level off then second mark can be scored for a curve with a continuously decreasing gradient.*

Initial rate can be found by finding the gradient at t = 0 (1)

Note: *Candidates may score this mark if they have shown this on their graph*

(ii) $2SO_2 + O_2 \rightarrow 2SO_3$ (1)

NO is a catalyst (1)

it is regenerated at the end of the reaction (1)

provides an alternative route of lower activation energy (1)

Total = 15 marks

Question 6

(a) (i) A buffer solution has the ability to resist changes in pH when a little acid or base is added . (1)

When a little acid is added, it reacts with NH_3. The acid is used up, pH remains unchanged (1)

$NH_3 + H^+ \longrightarrow NH_4^+$ (1)

When a little base is added, it reacts with OH^-. The base is used up, pH remains unchanged (1)

$NH_4^+ + OH^- \longrightarrow NH_3 + H_2O$ (1)

(ii) pOH = 14.0 – 9.0 = 5.0 (1)

$$pOH = pK_b + \log \frac{[NH_4^+]}{[NH_3]}$$ (1)

$5.0 = -\log 1.7 \times 10^{-5} + \log [NH_4^+] / 0.10$

$[NH_4^+] = 0.17$ mol dm^{-3} (1)

mass of NH_4Cl in 450 cm^3 = 0.17 x 53.5 x 450 / 1000 = 4.1 g (1)

(b) (i) acid strength increases from no. 1 to no. 3 or
down the table or
as number of Cl increase (1)
due to the electron-withdrawing effect or
electronegativity of chlorine (atoms) (1)
stabilising the anion or weakening the O-H bond (1)
NOT H^+ more available

(ii) chlorine atom is further away (from O-H) in no. 4, so has less influence (1)

(iii) either: pH = pKa – $\log_{10}$ [acid] or $Ka = 10^{-pKa} = 1.259 \times 10^{-3}$
= (4.9 + 2) $[H^+] = \sqrt{(Ka.\ c)} = 3.55 \times 10^{-4}$ (1)
= 3.4 (allow 3.5) pH = 3.4 (1)

Note: [1] for correct expression & values;
[1] for correct working

Total = 15 marks

Question 7

(a) (i) Increase (1)

(ii) Colourless solution turns to a brown solution/ black ppt
(need both colours) (1)
$Cl_2 + 2KI \rightarrow I_2 + 2\ KCl$ (1)
Cl_2 is an oxidising agent (1)

(iii) Add silver nitrate solution (1)
KBr forms creamy ppt (1)
KI forms yellow ppt (1)
$AgNO_3 + KBr \rightarrow AgBr + KNO_3$ or
$AgNO_3 + KI \rightarrow AgI + KNO_3$ (1)
or ionic equations
Then add (dilute or conc) ammonia (1)
AgBr/ cream ppt dissolves in conc NH_3 or
slightly dissolves in dilute NH_3 (1)
AgI is insoluble in dilute or conc NH_3 (1)

(b) $SiCl_4$ reacts/hydrolyses, CCl_4 does not (1)
[This must be clearly stated and not just implied]

(lone) pair of electrons (from the oxygen atom) in a water molecule (1)
cannot form a bond with/be donated to the C atom
Or cannot be accepted by C atom (1)

because C has no available orbital
OR no 3d orbitals in C
OR C is a small atom surrounded by Cl atoms
OR Cl atoms are large and surround C atom (so attack is sterically hindered) (1)
Rejects CCl_4 has no d orbitals

Si has (available) 3d orbitals (1)
Rejects $SiCl_4$ has available 3d orbitals

Question 8

(a) white precipitate formed for barium nitrate (1)

no visible change for magnesium nitrate (1)

$H_2SO_4(aq) + Ba(NO_3)_2 \longrightarrow BaSO_4(s) + 2HNO_3(aq)$ @

$Ba^{2+}(aq) + SO_4^{2-}(aq) \longrightarrow BaSO_4(s)$ (1)

(b) ionic size of $Mg^{2+} < Ba^{2+}$ (1)

magnitude of hydration energy of $Mg^{2+} >> Ba^{2+}$ (1)

ionic size of $SO_4^{2-} >>$ size of cations Mg^{2+} and Ba^{2+} (1)

magnitude of lattice energy for $MgSO_4$ slightly more than $BaSO_4$ (1)

$\Delta H_{solution} = \Delta H_{hydration} - \Delta H_{lattice}$ (1)

For $MgSO_4$, $\Delta H_{solution}$ = exothermic ; For $BaSO_4$, $\Delta H_{solution}$ = endothermic ; (1)

barium sulphate – insoluble in water ; magnesium sulphate – soluble (1)

(c) (i) $(K_{sp} =) [Mg^{2+}][OH^-]^2$ (1)
units are mol^3dm^{-9} (1)

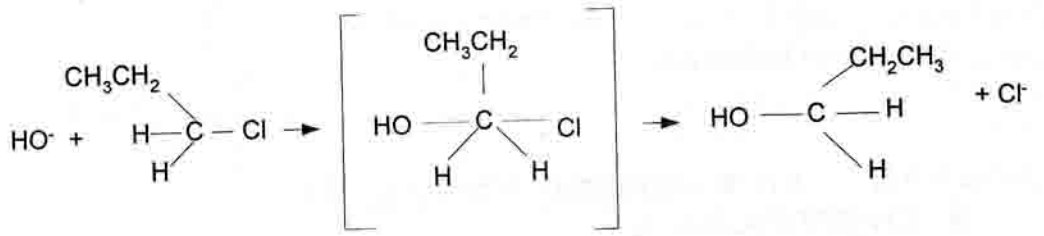
(ii) Let $[Mg(OH)_2(aq)] = [Mg^{2+}] = x$
$Ksp = 2 \times 10^{-11} = 4x^3$ (1)
$x = 1.71 \times 10^{-4}$ mol dm^{-3} (1)

(iii) less soluble because of the common ion effect
or the equilibrium $Mg(OH)_2(s) \rightarrow Mg^{2+}(aq) + 2OH^-(aq)$ is moved to the left (1)

Total = 15 marks

Question 9

(a) (i)



(1) (1)

bimolecular nucleophilic substitution (1)

(ii) rate increases. (1)
atomic size of Br>Cl . (1)
Hence the C-Br bond is weaker and is easier to break than C-Cl bond (1)

(iii)

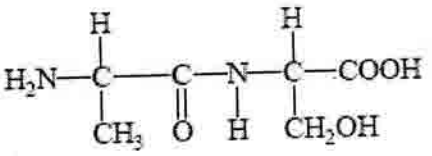
$$CH_3CH_2CH_2Cl + NaOH(aq) \xrightarrow{\text{reflux (1)}} CH_3CH_2CH_2OH + NaCl \quad (1)$$

$$CH_3CH_2CH_2OH \xrightarrow[180^oC]{\text{conc. } H_2SO_4 \ (1)} CH_3CH{=}CH_2 \quad (1)$$

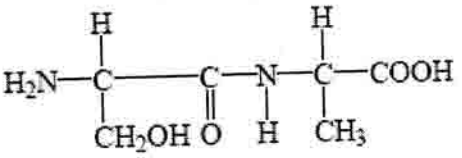
$$CH_3CH{=}CH_2 + HCl \longrightarrow CH_3CHClCH_3 \quad (1)$$

(b)

(i)



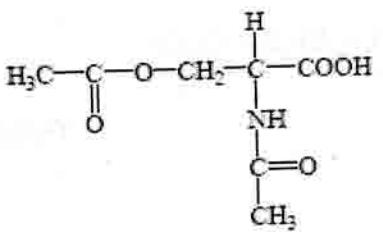
penalise –COONH- again (1)



penalise polymer both times (1)

(ii) serylalanine or alanylserine (1)

(iii)



(1)

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Total = 15 marks

Question 10

They don't react with Fehling's solution – they are ketones (1)

A and B gives positive iodoform test – they have the structure
$CH_3C(=O)$– or methylketone (1)

Boiling point of A > B - A is less branched compared to B (1)

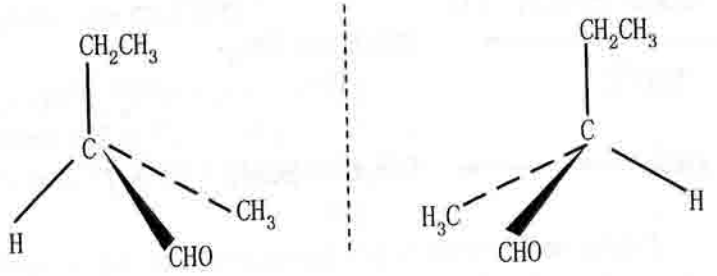
A is $CH_3COCH_2CH_2CH_3$ (1)

B is $CH_3COCH(CH_3)_2$ (1)

C is $CH_3CH_2COCH_2CH_3$ (1)

D and E gives a positive test with Fehling's solution - they are aldehydes (1)

D is optically active. Hence isomers of D are



(2)

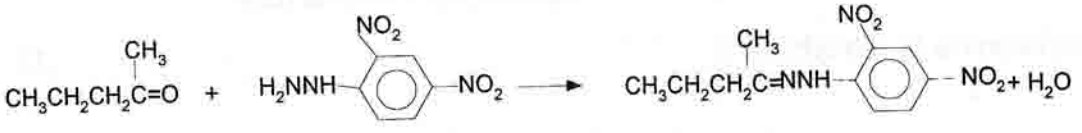
Reduction of E gives a long chain compound, F

E is $CH_3CH_2CH_2CH_2CHO$ (1)

F is $CH_3CH_2CH_2CH_2CH_2OH$ (1)

P is copper(I) oxide (reject Cu_2O) (1)

Examples of equations: (3)



$$CH_3CH_2CH_2COCH_3 + I_2 + NaOH \xrightarrow[\triangle]{} CHI_3 + CH_3CH_2CH_2COO^-$$

Total = 15 marks