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ST BENEDICT'S

SUBJECT	Physical Sciences Paper 2: Chemistry	DATE	14 July 2017
GRADE	12	MARKS	200
EXAMINER	Mrs Esterhuizen	MODERATOR	Mrs U Visentin Mr S Graham (Reddam)
NAME	MEMORANDUM	DURATION	180 min
CLASS			

LOW
ORDER

55%

HIGH ORDER

45%

INSTRUCTIONS

Question	1	2	3	4	5	6	7	8	Total
Marks	20	22	21	19	26	28	16	48	200

QUESTION 1 – MULTIPLE CHOICE

20 MARKS

- 1.1 B
 - 1.2 A
 - 1.3 C
 - 1.4 C
 - 1.5 A
 - 1.6 B
 - 1.7 B
 - 1.8 D
 - 1.9 D
 - 1.10 A
-

QUESTION 2 – START ON THE TOP OF A NEW PAGE

22 MARKS

2.1

2.1.1 HF✓

2.1.2 PH₃✓

2.1.3 HF✓

2.1.4 CO₂✓

2.1.5 NaCl✓

2.1.6 C✓

(6)

2.2

2.2.1 (A bond) occurring between atoms within molecules.✓✓ (2)

2.2.2 The electronegativity difference (between the atoms)✓ is 0✓

OR

The atoms are identical/the same element✓ and so they pull the electron pair equally✓ (2)

2.2.3 The H₂ molecule is non-polar✓

Experiences weak London forces OR forms temporary or induced dipoles✓

There is a small electron cloud so very few dipoles are set up OR few London forces exist ✓

Very little energy is needed to overcome these London forces/induced dipole attractions✓ (4)

2.2.4

(a) (A bond) between a positive kernel and a sea of delocalised electrons✓✓ (2)

(b) In copper (the kernels) particle 2 consists of the nucleus and core electrons OR consists of Cu²⁺ ions✓

In hydrogen (the kernel) is made up of just a proton✓ (2)

(c) In metallic hydrogen, the kernels (2) are very small ✓ compared to those in copper (the kernels are far bigger)✓ so the chance of the (delocalised) electrons colliding with the kernels in copper✓ is greater✓ (or converse for hydrogen)

OR

In metallic hydrogen, there are no electrons in the kernel while in copper there are many✓

There will be repulsion between the valence electrons and the core electrons in copper✓, resisting the flow of charge✓ but not in hydrogen✓ (4)

QUESTION 3 – START ON THE TOP OF A NEW PAGE 26 MARKS

3.1 How finely divided it (the marble) is✓

The mass (of the marble chips)✓ (2)

3.2 a gas/ $\text{CO}_2(\text{g})$ is given off✓ do not accept CO_2 is given off (1)

3.3 Reason B: the loss of mass was greater than 1,0 g (no mark)

Do not mark further if an incorrect reason is given

It would take longer time✓ to release a mass of gas greater than 1,0 g✓ (2)

3.4 For CO_2 : $n = m/M = 1/44✓ = 0,023 \text{ mol}✓$ Ratio $\text{CO}_2:\text{HCl}$ is 1:2 (✓ award if this is given but rest of calculation is wrong)So $2 \times 0,023 = 0,046 \text{ mol HCl}✓$ is neededFor HCl : $C = n/V = 0,046/0,250✓ = 0,182 \text{ mol.dm}^{-3}✓$ Min conc = $0,182/0,2 = 0,909 \text{ mol.dm}^{-3}✓$ (- 1 no final unit) (6)

3.5

3.5.1 the change in concentration per unit time of either a reactant or product✓✓ (2)

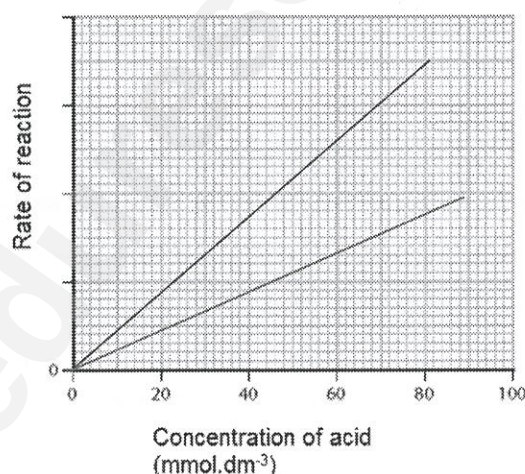
3.5.2 $\text{g.s}^{-1}✓$ ~~accept any mass.time⁻¹ unit.~~ or mass.time⁻¹ (1)

3.5.3 Higher concentration has more reactive particles per unit volume✓

There is a greater chance of collisions with sufficient energy and correct orientation (successful collisions)✓

Every second✓ (3)

3.5.4



(2)

Straight line from origin below original
✓✓

3.6

Rate $\propto [\text{Q}(\text{aq})] \times [\text{J}(\text{aq})]✓✓$ (2)

QUESTION 4 – START ON THE TOP OF A NEW PAGE 16 MARKS4.1 A system where the particles are conserved. *Or words to that effect* ✓✓ (2)

4.2

$$4.2.1 \quad K_c = \frac{[ICl]^2}{[I_2][Cl_2]} \quad \checkmark \text{num} \quad \checkmark \text{denom} \quad (2)$$

$$4.2.2 \quad K_c = \frac{x^2}{x \cdot x} \quad \checkmark \text{num} \quad \checkmark \text{denom} = 1 \checkmark \quad (3)$$

4.3

4.3.1

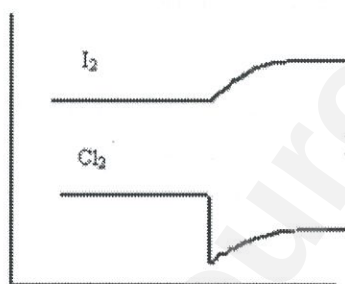
(a) Iodine was added into the system ✓✓ (2)

(b) temperature was decreased ✓✓ (2)

4.3.2 The pressure of the system was increased ✓ the equilibrium position shifted to favour the reaction with fewer gas moles ✓

The forward and reverse reactions both produce 2 moles of gas, ✓
 hence neither reaction is favoured OR after the stress no further changes occur/the equilibrium position does not change ✓. (4)

4.3.3



4.4 graph 2. ✓✓

(2)

QUESTION 5 – START ON THE TOP OF A NEW PAGE

26 MARKS

5.1

5.1.1 A solution of known concentration.✓✓ (2)

5.1.2 Volumetric flask✓ (only) (1)

5.1.3 $\text{H}_2\text{A} + 2\text{H}_2\text{O} \rightleftharpoons 2\text{H}_3\text{O}^+ + \text{A}^{2-}$ bal✓ - 1 if not reversible (3)5.1.4 poor electrolyte✓ *electrical conductor*.A low K_a means that there are few ions in solution at equilibrium
OR the acid is weak OR the equilibrium lies to the left✓✓ (3)

5.1.5 The mass in grams of one mole of that substance✓✓ (2)

5.1.6 $23,3 \text{ cm}^3$ ✓ only (1)5.1.7 NaOH : $n = c \times V = 0,1 \times 0,0233 = 2,33 \times 10^{-3} \text{ mol}$ ✓Ratio $\text{NaOH} : \text{H}_2\text{A}$ is 2:1✓Therefor $1,165 \times 10^{-3} \text{ mol}$ H_2A in 25 cm^3 (4)5.1.8 In 250 cm^3 there will be $1,165 \times 10^{-2} \text{ mol}$ H_2A ✓.So $M = m/n = 1,05/1,165 \times 10^{-2} = 90,13 \text{ g.mol}^{-1}$ (2)

5.2

5.2.1 a reaction with water where water itself is decomposed✓✓ (2)

5.2.2 the equivalence point OR the steepest part of the curve✓ is not at
pH 7 (accept a stipulated correct value)✓ (2)

5.2.3 (aqueous) potassium hydroxide✓ (1)

5.2.4 $\text{CH}_3\text{COOH} + \text{KOH} \rightarrow \text{CH}_3\text{COOK} + \text{H}_2\text{O}$ ✓

OR ca from 5.3.3

 $\text{CH}_3\text{COOH} + \text{NH}_4\text{OH} \rightarrow \text{CH}_3\text{COONH}_4 + \text{H}_2\text{O}$ ✓

Accept location of cation before or after anion (3)

QUESTION 6 – START ON THE TOP OF A NEW PAGE**29 MARKS**

6.1

6.1.1 a substance that donates electrons.✓✓ (2)

6.1.2 $\text{Pb}(\text{NO}_3)_2$ ✓✓ (2)

6.1.3

(a) there is not enough information to place Cobalt and Magnesium in order✓ or there has been no comparison between cobalt and magnesium. (1)

(b) Place cobalt into magnesium nitrate solution✓✓ OR place magnesium into a cobalt nitrate solution. (2)

(c) Result must correspond with (b) suggestion.

Cobalt would not react with magnesium nitrate✓

OR

A shiny grey solid deposits on the magnesium✓

As magnesium is a stronger reducing agent than cobalt✓ (or converse) (2)

6.1.4 $\text{Pb} + 2\text{Ag}^+ \rightarrow 2\text{Ag} + \text{Pb}^{2+}$ $\text{Ag}^+ \rightarrow \text{Ag}$ ✓ $\text{Pb} \rightarrow \text{Pb}^{2+}$ ✓ bal✓ (- 1 if double arrow given) (3)

6.2

6.2.1 Chemical to electrical✓✓ (2)

6.2.2 $E^\circ = -0,76 - (-1,66)$ ✓ = 0,9 V✓ (2)6.2.3 $\text{Al}(\text{s})/\text{Al}^{3+}(\text{aq})//\text{Zn}^{2+}(\text{aq})/\text{Zn}(\text{s})$ each half cell ✓✓ states✓

Do not award marks for half cells if written cathode first

States can be awarded despite rest of cell being incorrect if all are given (3)

6.2.4 As the reaction progresses:

(a) Aluminium electrode will corrode/dissolve/ get eaten away✓ (1)

(b) to the right✓ (1)

(c) the solution around the copper electrode will become negatively charged✓

as positively charged/ Zn^{2+} ions are reduced✓ (accept $\frac{1}{2}$ rxn ✓)

The potassium ions are positively charged✓

So will be attracted into the negative solution✓ (4)

(d) FROM A TO B✓ (1)

6.2.5 GREATER THAN✓✓ (2)

QUESTION 7 – START ON THE TOP OF A NEW PAGE 16 MARKS

7.1 A solution that conducts electricity✓ due to the presence of free ions✓
owtte. (2)

7.2 copper sulphate OR copper nitrate.✓ Do not accept copper chloride. (1)

7.3 idea that teapot is connected to the incorrect electrical pole OR idea that
in the picture the teapot would in fact be the anode✓

The teapot needs to be negative✓

To attract the copper ions to it OR for the copper ions to reduce there✓ (3)

7.4 $m = n \times M = 0,01 \times 63,5 = 0,635 \text{ g}$ ✓ (2)

7.5 ratio Cu : e⁻ is 1:2 so 0,02 mol electrons must be transferred✓.

$Q = nF = 0,02 \times 96500 = 1930 \text{ C}$ ✓transferred

$t = Q/I = 1930/0,5 = 3860 \text{ s}$ ✓s (5)

7.6 less time to plate with ^{0,01}~~0,02~~ mol of silver✓

Each mole of silver ions requires only 1 mole of electrons while each mole
of copper ions requires 2 mole of electrons✓ accept a meaningful ratio *equ.*
here e.g. Cu:Ag 1:2

As the current is the same✓ this would take a shorter time. (3)

$$I = \frac{Q}{t}$$

QUESTION 8 – START ON THE TOP OF A NEW PAGE

41 MARKS

8.1

8.1.1 Contain the same functional group✓

Differ from each other by $-\text{CH}_2$ ✓.

(2)

8.1.2 Hydrocarbons OR only hydrogen and carbon✓

Carbons bonded by single (covalent) bonds✓ / saturated

(2)

Set, H/C's

8.1.3 Physical✓

(1)

8.1.4 Propane C_3H_8 is an alkane used as a fuel.

(a) the net change of chemical potential energy of the system✓✓

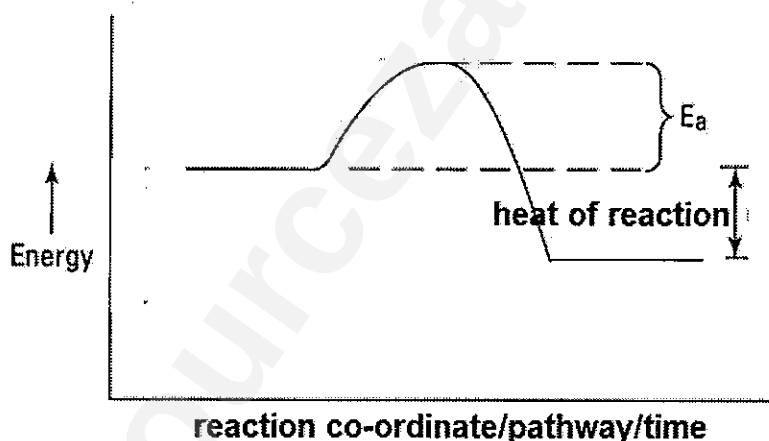
(2)

(b) $\text{C}_3\text{H}_8 + 5\text{O}_2 \rightarrow 3\text{CO}_2 + 4\text{H}_2\text{O}$ ✓ bal✓

(3)

(c)

exothermic✓✓
 x/y axis labels ✓
 E_a ✓
 Heat of reaction✓



(5)

8.1.5

(a) Chain✓ functional✓ positional✓

(2)

(b) dimethylpropane✓✓ accept 2,2-dimethylpropane

(3)

(c) $\text{CH}_3(\text{CH}_3)\text{CH}_2\text{CH}_2\text{CH}_3$ ✓✓ or $\text{CH}_3(\text{CH}_3)(\text{CH}_2)_2\text{CH}_3$

(2)

8.1.6

(a) (intramolecular) bonds are broken✓

New substances are formed✓

(2)

(b) hydrogen (gas)✓✓

(2)

(c) red bromine water will decolourise✓ instantly in ethene✓ but slowly in ethane✓ as long as there is light present✓

(4)

(d) ethanol✓✓

(2)

8.2 Two liquid organic compounds, X and Y, both with the molecular formula $C_4H_8O_2$, are placed in separate test tubes.

8.2.1 turns blue litmus red✓ (1)

8.2.2 Boiling point: X has a higher boiling point than Y✓

The acid experiences hydrogen bond forces✓

which are stronger than the dipole dipole attractions in an ester✓

more energy is required to overcome the IMFs and boil the acid✓

OR

Solubility: X is more soluble than Y✓

The acid experiences hydrogen bond IMFs✓

Which are of similar strength to the IMFs between water molecules✓

X has weaker dipole-dipole attractions which are not similar in strength to the IMFs between water molecules✓ (4)

8.2.3

(a) butanoic acid✓✓ (2)

(b) ethyl ethanoate OR methyl propanoate OR propyl methanoate✓✓ (2)

8.3.1

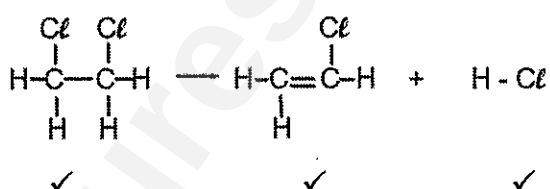
(a) addition✓ or halogenation (1)

(b) substitution✓ (1)

8.3.2 reaction 1✓

The reaction requires less energy than reaction 2.✓ (2)

8.3.3



(3)

END OF EXAMINATION ☺