Chemistry CAT 1: Written examination

GENERAL COMMENTS

The assessment criterion as published in the *VCE Bulletin* are as follows:

The extent to which the response demonstrates:

1. knowledge of the key ideas
2. understanding of the key ideas and chemical principles
3. application of chemical concepts to explain observations
4. interpretation of experimental data
5. knowledge and understanding of experimental procedures and techniques
6. understanding of experimental procedures and techniques
7. competence in performing calculations

SPECIFIC INFORMATION

Question-by-question details

Section A

Multiple choice

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

Q13 *Very many good students did not perceive that the concentrations of H^+ and OH^- must be identical in pure water. They preferred to believe that K_w was 10^{-14} whatever the temperature! This conclusion was supported by the surprisingly high percentage of students (28%) who opted for 10^{-14} as the value of K_w at 60°.*

Section B

Each asterisk indicates a mark.

1 (10 marks)

1a 3 rise*; reaction goes backwards due to addition of CO*; reaction will be exothermic in reverse direction*

1b 2 decrease*; reaction goes in direction needed to minimise number of mole (molecules)*

1c 2 remain constant*; no change in concentrations/partial pressures of components*

1d 1 3 x 0.0083 = 0.025 M* (0.03, 0.0249 acceptable)

1e 2 $$K = \frac{[H_2]^3[CO]}{[CH_4][H_2O]}* = \frac{(0.0249)^3 \times 0.0083}{(0.012)^2}$$

$$= 8.9\text{E-}4 \text{ (9E-4, 8.89E-4 acceptable)}*$$

1a and 1c were generally badly done. Indeed, 1c was almost invariably wrong as students failed to realise that the concentrations or partial pressures of the reactants and products were not varied by the addition of inert gas.

2 (8 marks)

2a 3 %O = 100 – (52.2 + 13) = 100 – 65.2 = 34.8%*

$$C : H : O = \left\{\frac{52.2}{12} : \frac{13}{1} : \frac{34.8}{16}\right\}* = (2 : 6 : 1)*$$

2b 3 $$n = \frac{pV}{RT} = \frac{\left(\frac{750}{760} \times 101325\right) \times 265\text{E}-6}{8.314 \times (120 + 273)}$$

$$= 0.00811 \text{ mole}*$$

$$M = \frac{m}{n}* = \frac{0.373\text{g}}{0.00811\text{mol}} = 46 \text{ g mol}^{-1}*$$

2c 2 ethanol*; $C_2H_4(g) + H_2O(g) = C_2H_6O(g)$*

Most students made some sort of realistic attempt here.

3 (7 marks)

3 7 Three equations are required. One mark is available for all three and all three *must be correct* in order to gain the mark:
$C(s) + O_2(g) = CO_2(g)$; $CaCO_3(s) = CaO(s) + CO_2(g)$;
$3CO(g) + Fe_2O_3(s) = 3CO_2(g) + 2Fe(l)$*

Note that states should be *substantially* correct – no states, no mark.

• Two marks can be awarded for each explanation:
$C(s) + O_2(g) = CO_2(g)$; burning of coke provides heat/ energy for the blast furnace** Accept also 'the generation of CO_2 for the subsequent formation of CO via $C(s) + CO_2 = 2CO(g)$.' for 1 mark if this alone is given.
$CaCO_3(s) = CaO(s) + CO_2(g)$; reaction produces CaO which reacts with SiO_2 to produce slag.**
$3CO(g) + Fe_2O_3(s) = 3CO_2(g) + 2Fe(l)$; the reduction reaction in which iron (pig iron) is produced.**

Only one mark was possible for the simple recall of three equations – and the states had to be correct.

4 (12 marks)

4a 2 $\frac{23.15}{1000}$* ×0.200 = 0.00463 mol* (accept 0.46 mol; 0.004630 mol)

4b 1 2 × 0.00463 = 0.00926 mol*

4c 1 $0.00926 \times \frac{1000}{10} = = 0.926$ M*

4d 1 0.926× 10 = 9.26M*

4e 2 ** for any two of: safety glasses; lab. coat; protective gloves.....

4f 3

	distilled water cleaner solution	dilute concrete carbonate solution	standard sodium
pipette		*	
burette			*
conical flask	*		

4g 2 distilled water: concrete cleaner in pipette will be at slightly lower concentration that in volumetric flask – hence concentration as determined would be too low*
sodium carbonate: some concrete cleaner in pipette will react with small amount of sodium carbonate solution – hence concentration as determined would be too low*

This question was well answered by many students.

5 (12 marks)

5a 2 oil in water diagram* water in oil diagram*

5bi 1 separates into two phases*

5bii 2 must have hydrophilic* & hydrophobic* parts in a single molecule (give credit if this is clearly implied)

5c 4 electrical conductivity* correct results* (moderate for o/w, v low for w/o)
feel on skin* correct results* (cool for o/w, greasy for w/o)
{alternative possibilities:
water soluble dye* correct results* (colour for o/w, no colour for w/o)
oil soluble dye* correct results* (no colour for o/w, colour for w/o)}

5di 1 $CH_3(CH_2)_{14}COOH + KOH(aq) = CH_3(CH_2)_{14}COO^-(aq) + K^+(aq)$*
{or
$CH_3(CH_2)_{14}COOH + KOH(aq) = CH_3(CH_2)_{14}COOK(aq)$*}

5dii 2 The hydrophilic part of the anion/soap/product is much more hydrophilic* than the -COOH group, because of the charged/strongly polar* $-COO^-$ group.

***5di** and **5dii** were poorly answered, particularly **5dii**. Very few students seemed to be able to perceive that a charged grouping would be more hydrophilic than an otherwise similar uncharged grouping.*