ERUVIO MENTORING · EXTERNAL-STYLE EXAMINATION

Chemistry

Units 3 and 4 · Equilibrium, acids and redox reactions; structure, synthesis and design

Paper 1 · Section 1

MULTIPLE CHOICE · 20 MARKS

STUDENT DETAILS

GIVEN NAME(S) _____ FAMILY NAME _____

SCHOOL _____ DATE _____ BOOK OF _____

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Structure of this examination

PAPER	SECTION	QUESTION TYPE	TIME	MARKS
Paper 1	Section 1	Multiple choice, 20 questions	10 min perusal 90 min working	20
	Section 2	Short response, 5 questions		30
Paper 2	Section 1	Short response, 9 questions	10 min perusal 90 min working	50
Total		**34 questions**	**200 minutes**	**100**

Instructions

- **Perusal time: 10 minutes. Working time: 90 minutes.**
- You may use a QCAA-approved scientific or graphics calculator. The QCAA Chemistry formula and data book is provided.
- Write using black or blue pen. Planning paper will not be marked.
- All questions are drawn from Unit 3 (equilibrium, acids and redox reactions) and Unit 4 (structure, synthesis and design).
- **Section 1 contains 20 multiple choice questions.** Choose the best answer for each and record it on the response grid provided.

Answers must be recorded on the response grid on the final page. Marks are not deducted for incorrect answers, so attempt every question.

Section I

Multiple choice · 20 questions · 20 marks

1 For the equilibrium $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$, increasing the total pressure at constant temperature will

A shift the equilibrium towards the products, because there are fewer moles of gas on the product side.

B shift the equilibrium towards the reactants, because there are fewer moles of gas on the reactant side.

C have no effect, because the total number of moles of gas is unchanged.

D increase the value of the equilibrium constant.

2 For the equilibrium $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$, the equilibrium constant expression is

A $K_c = [SO_3] / ([SO_2][O_2])$

B $K_c = [SO_2]^2[O_2] / [SO_3]^2$

C $K_c = [SO_3]^2 / ([SO_2]^2[O_2])$

D $K_c = 2[SO_3] / (2[SO_2] + [O_2])$

3 At a certain temperature the equilibrium $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$ is established. At equilibrium $[H_2] = 0.20$ mol L^{-1}, $[I_2] = 0.20$ mol L^{-1} and $[HI] = 1.60$ mol L^{-1}. The value of K_c is

A 0.016

B 8.0

C 40

D 64

4 Adding a catalyst to a reaction mixture that has reached equilibrium

A has no effect on the position of equilibrium, but equilibrium is reached more quickly.

B shifts the position of equilibrium towards the products.

C increases the value of the equilibrium constant.

D increases the yield of product present at equilibrium.

5 The conjugate base of the dihydrogen phosphate ion, $H_2PO_4^-$, is

A H_3PO_4

B HPO_4^{2-}

C PO_4^{3-}

D H_2O

6 The pH of a 0.0100 mol L^{-1} solution of sodium hydroxide at 25 °C is

A 2.00

B 11.00

C 12.00

D 14.00

7 Ethanoic acid has $K_a = 1.74 \times 10^{-5}$. The pH of a 0.100 mol L^{-1} solution of ethanoic acid is

A 2.88

B 4.76

C 5.76

D 11.12

8 A weak acid is titrated with a strong base and the equivalence point occurs at about pH 8.7. The most suitable indicator is

A methyl orange, range 3.1 to 4.4

B methyl red, range 4.2 to 6.3

C bromothymol blue, range 6.0 to 7.6

D phenolphthalein, range 8.3 to 10.0

9 The oxidation number of chromium in the dichromate ion, $Cr_2O_7^{2-}$, is

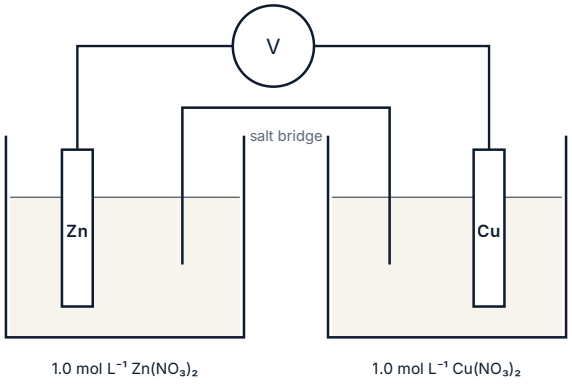
A +3

B +6

C +7

D +12

10 The galvanic cell shown operates under standard conditions. Given $E°(Zn^{2+}/Zn) = -0.76$ V and $E°(Cu^{2+}/Cu) = +0.34$ V, the standard cell potential is



A −1.10 V

B −0.42 V

C +1.10 V

D +2.20 V

11 The IUPAC name of the compound $CH_3CH(CH_3)CH_2CH_2OH$ is

A 3-methylbutan-1-ol

B 2-methylbutan-1-ol

C 3-methylbutan-2-ol

D 2-methylbutan-4-ol

12 Which pair of compounds are structural isomers of each other?

A propane and propene
B butane and butan-1-ol
C ethanol and ethanal
D butan-1-ol and 2-methylpropan-1-ol

13 The functional group present in the compound $CH_3CH_2COOCH_3$ is

A a carboxylic acid
B an ester
C a ketone
D an aldehyde

14 The reaction of ethene with bromine to form 1,2-dibromoethane is an example of

A substitution
B elimination
C addition
D condensation

15 Butan-1-ol boils at 118 °C while butane boils at −1 °C. The main reason is that

A butan-1-ol molecules form hydrogen bonds with one another, which require more energy to overcome.
B butan-1-ol has a much larger molar mass than butane.
C butane is a branched molecule with a smaller surface area.
D the covalent bonds within a butan-1-ol molecule are stronger.

16 A polymer is formed when many molecules of a diol react with many molecules of a dicarboxylic acid, releasing water at each linkage. This polymer is

A an addition polymer
B an addition copolymer
C a condensation polymer
D a cross-linked addition polymer

17 An infrared spectrum shows a strong sharp absorption near 1710 cm^{-1} and a very broad absorption between 2500 and 3300 cm^{-1}. The compound is most likely to be

A an alcohol
B a carboxylic acid
C a ketone
D an alkene

18 The number of different hydrogen environments in propan-1-ol, $CH_3CH_2CH_2OH$, is

A 1
B 2
C 3
D 4

19 Ethanol is heated with propanoic acid in the presence of a few drops of concentrated sulfuric acid. The organic product is

A propyl ethanoate

B ethanoic acid

C ethyl ethanoate

D ethyl propanoate

20 Ethanol can be produced by fermentation: $C_6H_{12}O_6(aq) \rightarrow 2C_2H_5OH(aq) + 2CO_2(g)$. Given $M(C_6H_{12}O_6) = 180.16\ g\ mol^{-1}$ and $M(C_2H_5OH) = 46.07\ g\ mol^{-1}$, the atom economy of this route for making ethanol is

A 25.6%

B 51.1%

C 78.2%

D 100%

Response grid

Shade or cross the box for your chosen answer

Question	A	B	C	D
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END OF SECTION 1