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Unit 4 Chemistry

Practice Exam Question and Answer Booklet

Duration: 15 minutes reading time, 1 and a half hours writing time

Structure of book:

Section	Number of questions	Number of questions to be answered	Number of marks
A	20	20	20
B	7	7	60
		Total	80

- Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers and rulers.
- Students are not permitted to bring into the examination room: blank sheets of paper and/or white out liquid/tape.
- No calculator is allowed in this examination.

Materials supplied:

- This question and answer booklet of 15 pages.

Instructions:

- You must complete all questions of the examination.
- Write all your answers in the spaces provided in this booklet.

Section A – Multiple-choice questions

Instructions

Answer all questions by circling your choice.
Choose the response that is correct or that best answers the question.
A correct answer scores 1, an incorrect answer scores 0.
Marks will not be deducted for incorrect answers.
No marks will be given if more than one answer is completed for any question.

Questions

Question 1

Consider the following equation: $A + 2B \rightleftharpoons 3C + 4D$

The equilibrium constant would be expressed as:

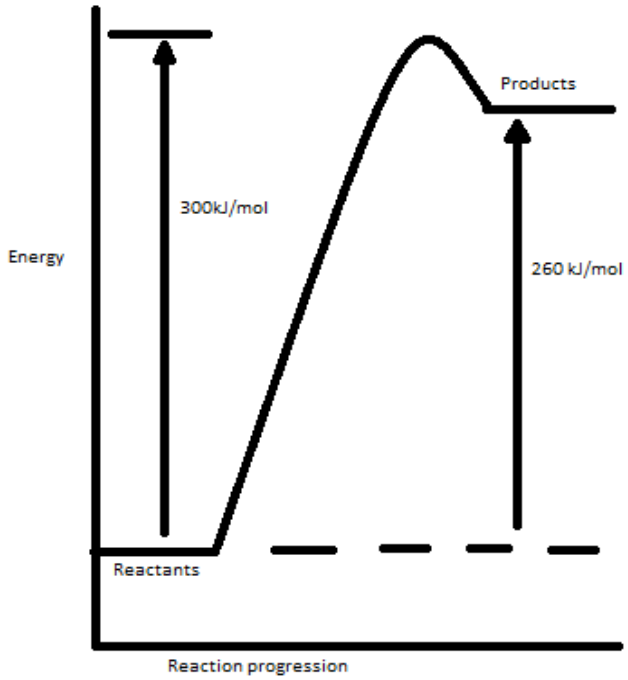
A. $\frac{[D]^3[C]^4}{[A]^2[B]}$
B. $\frac{[D]^4[C]^3}{[A][B]^2}$
C. $\frac{[A]^3[B]^4}{[C]^2[D]}$
D. $\frac{[A][B]^2}{[C]^3[D]^4}$

Question 2

Which of the following decreases the activation energy of a reaction?

A. Increasing the temperature
B. Increasing the kinetic energy of the reactants
C. Addition of a catalyst
D. Increasing the concentration of aqueous reactants

The following energy profile relates to questions 3 and 4:



Question 3

The activation energy of the reverse reaction, in kJ/mol is:

A. 560
B. 40
C. -40
D. -260

Question 4

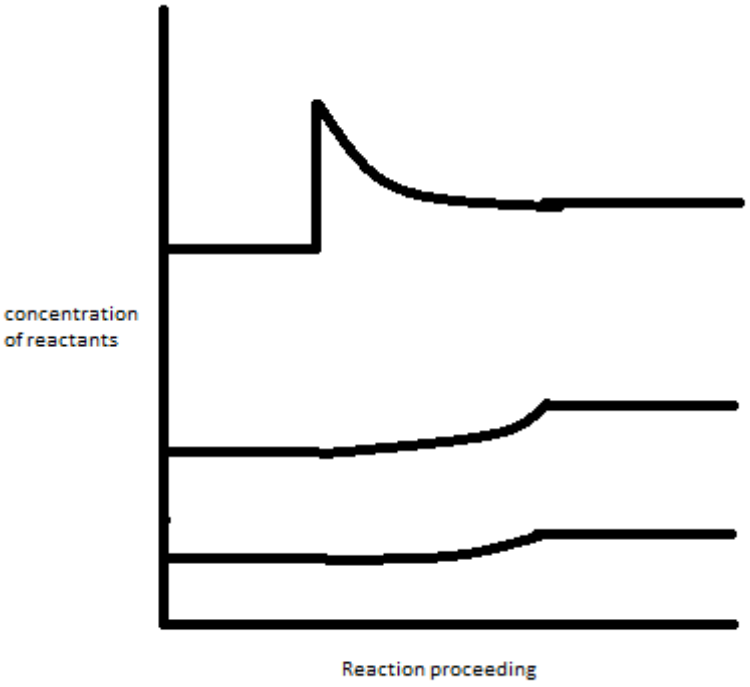
The ΔH for the reverse reaction, in kJ/mol is:

A. -260
B. +260
C. -300
D. +300

Question 5

Consider the following diagram depicting the changes in concentrations of reactants of the following equilibrium system. Each line represents one of the reactants.

$W(aq) + X(aq) \rightleftharpoons Y(aq)$



What change has occurred to the system?

A. Reactant Y has been added
B. Reactant X has been added
C. The solution has been diluted
D. The solution has been heated up

Question 6

Which of the following best describes the features of a cathode in an electrolytic cell?

	Polarity	Electrode Reaction
A.	Positive	Reduction
B.	Negative	Reduction
C.	Positive	Oxidation
D.	Negative	Oxidation

Question 7

A 1.64×10^{-2} mol sample of methane gas was burnt in a bomb calorimeter, and its temperature rose by 2.00°C. The equation for the combustion reaction that took place is:

$CH_{4(g)} + 2O_{2(g)} \rightarrow 2H_2O_{(g)} + CO_{2(g)} \quad \Delta H = -889kJ/mol$

What is the calibration factor of the calorimeter?

A. 7.29J/°C
B. 7.29kJ/°C
C. 29.15J/°C
D. 29.15kJ/°C

Question 8

A 20mL, 0.5M solution of HCl is diluted to 100mL. The concentrations of H^+ and OH^- respectively would:

A. Increase, increase
B. Increase, decrease
C. Decrease, decrease
D. Decrease, increase

Question 9

The pH of a 0.07 M solution of Lithium Hydroxide (LiOH) at 25°C is:

A. 11.32
B. 1.15
C. 2.34
D. 12.85

Question 10

Identify both the strongest oxidant and reductant of the following species.

$Pb^{2+} + 2e^- \rightarrow Pb$

$Ag^+ + e^- \rightarrow Ag$

	Strongest Oxidant	Strongest reductant
A.	Pb^{2+}	Pb
B.	Pb^{2+}	Ag
C.	Ag^+	Ag
D.	Ag^+	Pb

Question 11

When the temperature of a gaseous equilibrium system is increased:

A. The kinetic energy of each reactant and product is increased by a certain amount
B. The average kinetic energy of the system is increased by a certain amount
C. If the reaction is exothermic, products are favoured
D. If the reaction is endothermic, reactants are favoured

Question 12

Which of the following is the largest source of energy generation in Australia?

A. Coal
B. Hydroelectric
C. Geothermal
D. Solar

Question 13

Which of the following gives the correct order from oldest to youngest:

A. Brown coal, black coal, peat
B. Black coal, brown coal, peat
C. Peat, brown coal, black coal
D. Peat, black coal, brown coal

Question 14

What is the raw material for the energy produced in large quantities in the Latrobe valley, Victoria?

A. Brown coal
B. Water
C. Black coal
D. Crude oils

Question 15

Which of the following is NOT a disadvantage of fuel cells?

A. In most cases they work best using expensive platinum electrodes
B. They run flat and cannot be recharged
C. They are difficult to transport
D. A constant supply of reactants is needed, as well as a way to remove products

Question 16
A dilute solution of HNO_3 is electrolysed. The nitrate ions are:

A. Oxidised at the positive electrode.
B. Reduced at the positive electrode.
C. Neither reduced nor oxidised at the positive electrode.
D. Not attracted to either electrode.

Question 17
The mass of one atom of $^{4}_{2}He$ is:
A. The mass of the four neutrons and two protons
B. Slightly more than the mass of the four protons and two protons
C. The mass of the two neutrons and two protons
D. Slightly more than the mass of the two neutrons and two protons

The following information relates to questions 18, 19 and 20

Question 18
The overall reaction for the nickel cadmium cell (used in batteries for appliances such as drills, torches and video cameras)

$$Cd(s) + 2NiO(OH)(s) + 2H2O(l) \rightarrow Cd(OH)2(s) + 2Ni(OH)2(s)$$

When the cell is recharging, the product formed at the negative electrode is:
A. Cd(s)
B. $Cd^{2+}(s)$
C. $Ni^{2+}(s)$
D. $Ni^{3+}(s)$

Question 19
When the cell is discharging, the product formed at the negative electrode is:
A. Cd(s)
B. $Cd^{2+}(s)$
C. $Ni^{2+}(s)$
D. $Ni^{3+}(s)$

Question 20
When the cell is recharging, the product formed at the positive electrode is:
A. Cd(s)
B. $Cd^{2+}(s)$
C. $Ni^{2+}(s)$
D. $Ni^{3+}(s)$

Section B – Short-answer questions

Instructions

Answer all questions in the spaces provided.
In all questions where a numerical answer is required an exact value must be given unless otherwise specified.
In questions where more than one mark is available, appropriate working must be shown.
Unless otherwise indicated, the diagrams in this book are not drawn to scale.

Questions

Question 1

Give brief explanations for the following observations:

a. On a hot day, you can hardly touch the car door because it is so hot, yet when you get to the beach, the water feels too cold to get in.

2 marks

b. Petrol, which is made up of a large variety of hydrocarbons, differs in its composition of these hydrocarbon chains in winter and summer.

2 marks

c. Cryolite is commonly added to alumina in the Hall – Herault process

2 marks

Total: 6 marks

Question 2

Consider the photosynthesis reaction:

$6O_2 + C_6H_{12}O_6$ (+ sunlight) → $6H_2O + 6CO_2$

a. Is this reaction exothermic or endothermic? Draw its energy profile.

2 marks

b. Enzymes are used as biological catalysts in this reaction. What is the role of a catalyst?

1 mark

c. Suppose that photosynthesis has an activation energy of 469 kJ/mol and the heat of reaction is +128 kJ/mol (hypothetical values). What is the activation energy for the reverse reaction, cellular respiration?

1 mark

Total: 4 marks

Question 3

In VCE Unit 4 Chemistry you were required to study the industrial production of one of the following chemicals: ammonia, sulphuric acid, ethene or nitric acid
Name your chemical:

a. Name and describe one use of your selected chemical

1 mark

b. Write the chemical equation for the step in the industrial process where your chemical is the final product

1 mark

c. Write the chemical equation for the step in the production of your product with most relevance to Le Chatelier's principle

1 mark

d. In reference to the reaction you have described above, explain, using Le Chatelier's principle, the effect of:
   i. Increasing the temperature
   ii. Decreasing the pressure

4 marks

e. Explain two safety precautions used in the production of your chosen chemical

4 marks

f. What are the actual conditions used in the production of this chemical? Consider reaction rate, yield and cost in your explanation.

3 marks

Total: 14 marks

Question 4

a. Ethanoic acid is the principle acidic constituent of vinegar. The K_a of ethanoic acid 1.75×10^{-5}M. A particular brand of vinegar was found to have a pH of 3.65. Calculate the concentration of ethanoic acid in the vinegar.

2 marks

b. Calculate the pOH of a 0.40M solution of ethanoic acid at 25°C.

3 marks

c. Explain why triprotic acids generally have a higher acidity constant than their diprotic counterparts, which in turn have a higher acidity constant than their monoprotic counterparts.

2 marks

Total: 7 marks

Question 5

A bomb calorimeter measures the energy content of different types of food.

a. Why should a calorimeter be well insulated?

1 mark

b. Why should a calorimeter be calibrated?

1 mark

c. A current of 1.20A at a potential difference of 5.84V raised the temperature of a bomb calorimeter by 1.30°C in 1 minute. What is the calibration factor for this calorimeter?

2 marks

d. The combustion of a 3.00 g piece of chocolate in this bomb calorimeter results in an observed temperature rise of 2.4°C. What is the heat of combustion of the chocolate?

2 marks

e. Why do we measure the heat of combustion of materials such as chocolate, wood, crude oils and coconut per gram, not per mol?

2 marks

Total: 8 marks

Question 6

a. What is a fuel cell? Explain how fuel cells differ from regular batteries and their main drawbacks that stop them from being used as widely as batteries.

3 marks

b. Explain the difference between a primary cell and a secondary cell. Give an example of a primary cell (cell reactions are not required)

2 marks

c. Both dry cells and alkaline cells use graphite mixed with a manganese dioxide oxidant. Suggest what the role of graphite may be in these cells.

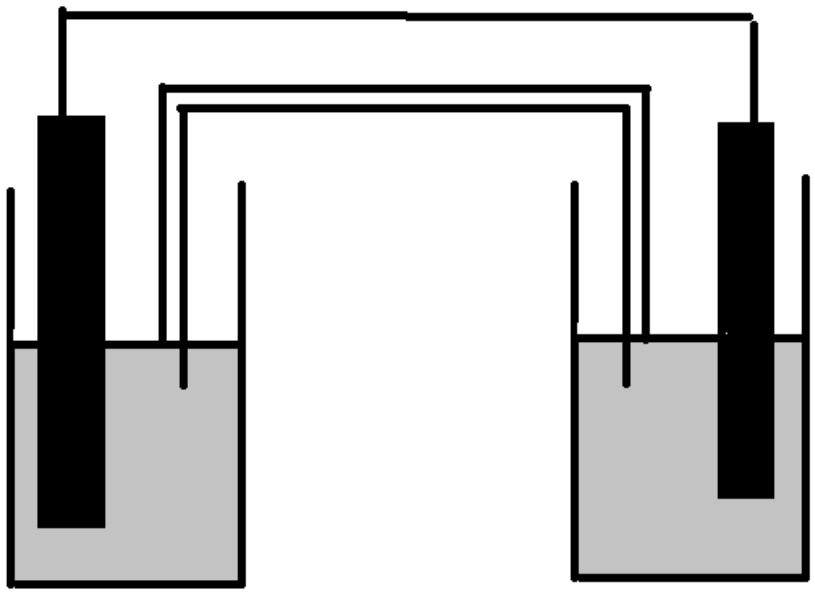
1 mark

d. A galvanic cell is set up using the two half cells, $Fe^{2+}(aq)/Fe(s)$ and $Fe^{3+}(aq)/Fe^{2+}(aq)$

i. What materials would be suitable for use as the anode and cathode in this cell?

2 mark

ii. Mark the following on the diagram below:
Anode, cathode, salt bridge, direction of electron flow



3 marks

iii. The overall voltage of this cell should theoretically be 1.21 volts. However, in practise, the cell only produces 1.13 volts. Why is this?

1 mark

Total: 12 marks

Question 7

a. Explain what the purpose of electrolytic cells is and briefly outline how they work.

4 marks

b. The following two half equations refer to an electrolytic cell

$Fe^{2+}(aq) + 2e^- \rightarrow Fe(s)$
$Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$

Give the equations for the reaction occurring at the anode and cathode

2 marks

c. During the electrolysis, 78,000 electrons were pumped into the cathode. Determine the mass of the product deposited.

3 marks

Total: 9 marks

End of Booklet