



2007

Half-yearly Examination

Chemistry

General Instructions

- Reading time – 5 minutes
- Working time – 1.5 hours
- Write using blue or black pen
- Draw diagrams using pencil
- Approved calculators may be used
- Write your student I.D. number on each answer sheet

Total marks

60

Section A

10 multiple choice questions worth 1 mark each

Section B

10 written response questions worth 50 marks in total

The multiple choice answer sheet and the data sheet may be separated from the rest of the paper for convenience.

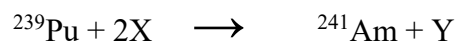
TIC: Mr Geerling

Section A

Allow about 15 minutes for this section.

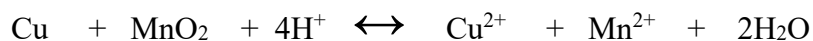
Record your answers to the multiple choice questions by colouring in the appropriate circle on the separate answer sheet.

1. Americium-241 is a radioactive isotope used in domestic smoke detectors. The production of this transuranic element in a nuclear reactor is represented by the equation below.



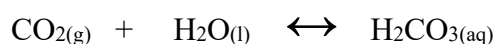
Identify the names of the particles “X” and “Y” respectively.

- (A) Neutron and electron
(B) Electron and proton
(C) Neutron and proton
(D) Proton and electron
2. The molecular formula for 2-pentanol (also known as pentan-2-ol) is:
- (A) $\text{C}_5\text{H}_9\text{OH}$
(B) $\text{C}_5\text{H}_{12}\text{OH}$
(C) C_5H_{10}
(D) $\text{C}_5\text{H}_{12}\text{O}$
3. The term “cracking” of petroleum fractions during the refining process refers to:
- (A) The combining of large molecules to form larger molecules.
(B) The breaking of large molecules to form small molecules.
(C) The use of a catalyst to form molecules.
(D) The use of steam to form molecules.
4. Identify the species which undergoes reduction in the following redox reaction:



- (A) Cu
(B) MnO_2
(C) Cu^{2+}
(D) Mn^{2+}

5. Cellulose is an example of:
- (A) a monomer unit
 - (B) an addition polymer
 - (C) a synthetic polymer
 - (D) a condensation polymer
6. When carbon dioxide is dissolved in water the following equilibrium occurs:



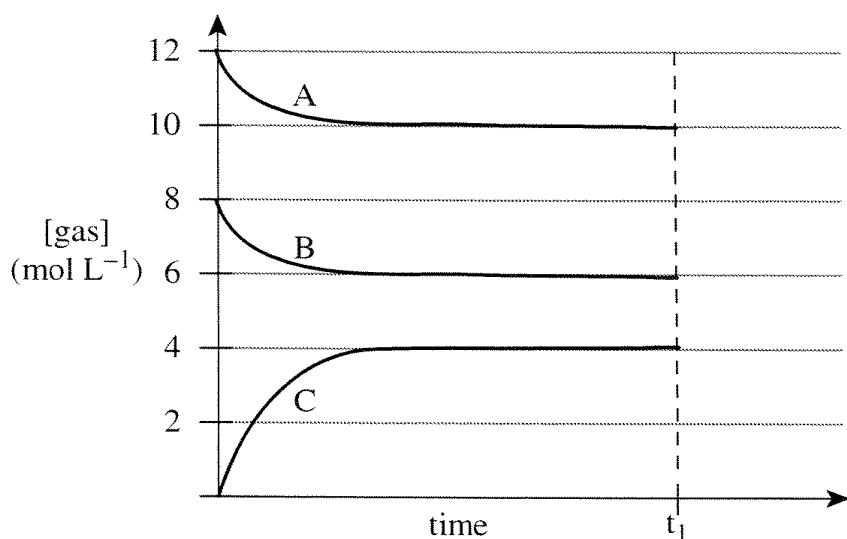
The process is exothermic. What happens to the solubility of carbon dioxide if the solution is heated?

- (A) Increases
 - (B) Decreases
 - (C) Remains constant, solubility is only affected by pH
 - (D) Increases then decreases slightly
7. Low-density polyethylene is produced using an organic peroxide initiator. Below is a randomly numbered list of the steps involved in its production:
1. Monomer radicals react with doubly bonded carbon atom of another molecule
 2. Free radical organic peroxide initiator reacts with the doubly bonded carbon atom in a monomer
 3. Organic peroxide splits to form free radical
 4. Activated monomer radicals form
 5. Chain growth stops if free radicals combine together
 6. Chain builds and lengthens

Choose the correct sequence from among the choices given below.

- (A) 2 → 3 → 4 → 1 → 5 → 6
 - (B) 3 → 2 → 4 → 1 → 6 → 5
 - (C) 4 → 3 → 1 → 2 → 6 → 5
 - (D) 3 → 1 → 2 → 4 → 5 → 6
8. The molar heat of combustion of ethanol is 1364 kJ mol^{-1} . How much water at 20°C can be heated to 90°C if 20.0 g of ethanol is completely combusted to carbon dioxide and water?
- (A) 2.02 g
 - (B) 2.02 kg
 - (C) 20.2 g
 - (D) 20.2 kg

9. It is known that gases A and B reach equilibrium as they react together to form gas C. The variation in concentration of these gases was monitored and graphed as illustrated below.



By applying Le Chatelier's principle, it can be predicted that at time t_1 the yield of the forward reaction will

- (A) increase if pressure is increased
 - (B) decrease if pressure is increased
 - (C) increase if pressure is decreased
 - (D) not be affected by a change in pressure
10. A group of students produced a red solution by boiling red cabbage leaves in water. When dilute sodium hydroxide was added to the solution, it turned yellowy-green. When dilute hydrochloric acid was added to the red solution, no colour change occurred. The addition of distilled water caused the red solution to turn blue.

Which of these substances, when added, is least likely to cause the red solution to change colour?

- (A) lemon juice
- (B) lime water
- (C) sugar solution
- (D) cleaning solution containing ammonia

Section B

Answer section B questions in the spaces provided.

Allow about 1 hour and 15 minutes for this section.

Show all relevant working in questions that require calculations.

11.

- (a) Draw the structural formula for vinyl chloride. (1 mark)

- (b) The uses of polymers are dependent on their properties.
Explain the uses of polyvinyl chloride in terms of its properties. (3 marks)

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12. A galvanic cell is represented by the following cell diagram (shorthand notation):



- (a) Draw a labelled scientific diagram for this cell showing the components above and also label the
- (i) anode
 - (ii) cathode
 - (iii) direction of electron flow on the diagram.
- (4 marks)

16. (a) Draw a scientific diagram of a dry cell OR a lead-acid cell
On your diagram identify the cathode, the anode and the electrolyte used. (2 marks)

(b) Write equations to represent the chemical reaction occurring at the anode and cathode of the cell you have drawn in (a). (2 marks)

Anode:

Cathode:

(c) Evaluate the dry cell OR the lead-acid cell in comparison to ONE of the following:

- button cell (e.g. silver cell)
- fuel cell
- vanadium redox cell
- lithium cell
- liquid junction photovoltaic device

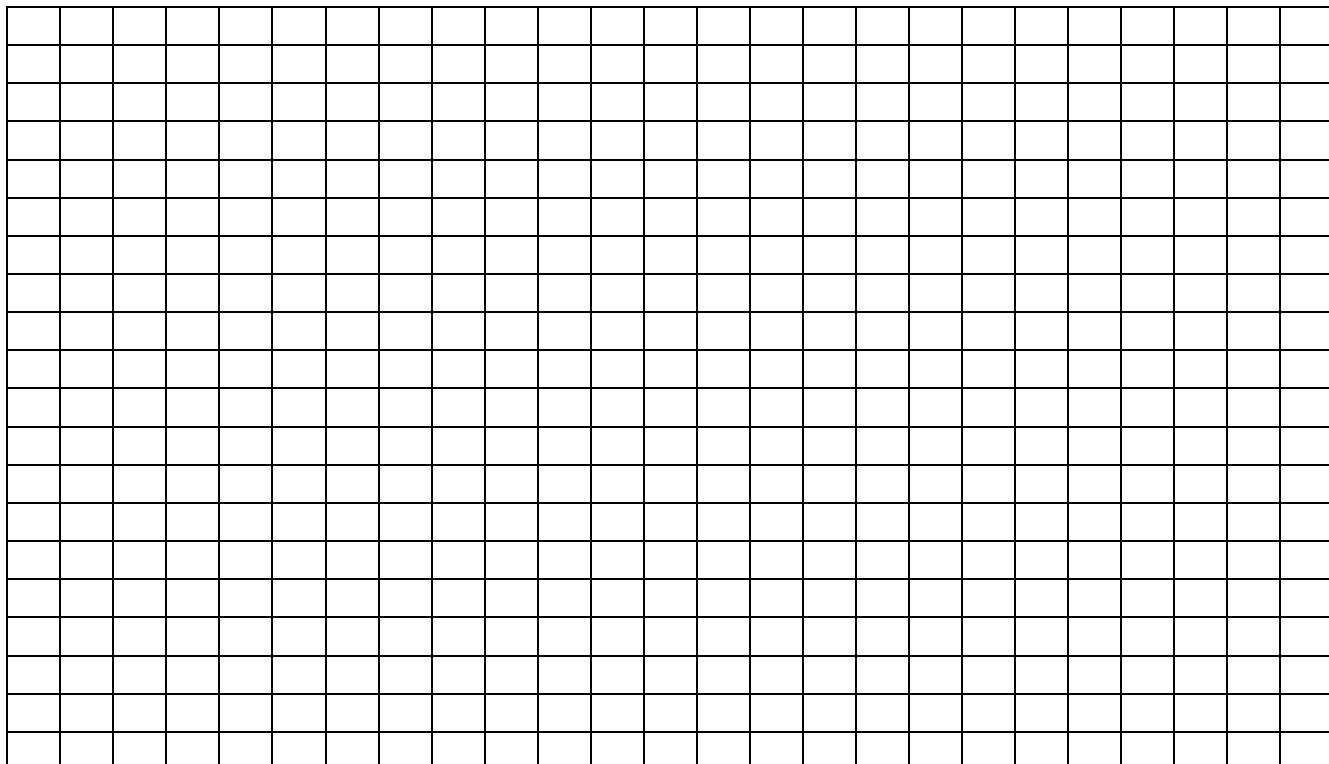
in terms of environmental impact. (3 marks)

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17. A student carried out a first-hand investigation to monitor the mass changes involved when a soft drink is de-carbonated. The student weighed a sealed can of soft drink and found its mass to be 400 g. The can was then placed on a set of scales which was connected to a data logger. The can was then opened and the mass of the can and its contents was recorded every two hours over a 24 hour period. The following results were obtained.

Time elapsed after opening can (hours)	Mass of can and contents (g)
0	400
2	396
4	393
6	390
8	388
10	387
12	386
14	385
16	385
18	385
20	385
22	385
24	385

- (a) Assuming that all the mass loss was due to the release of carbon dioxide, graph the mass of carbon dioxide released against the time that has elapsed. (4 marks)



- (b) Calculate the total volume of carbon dioxide released at 25°C and 100 kPa. Show full working. (2 marks)

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- (c) The volume of the liquid in the can is measured before and after its degassing and it is found to have NOT changed appreciably.

Using your knowledge of the kinetic theory of matter, propose an explanation to account for this observation. (2 marks)

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18. Outline the relationship between the position of elements in the Periodic Table and the acid-base behaviour of their oxides. (2 marks)

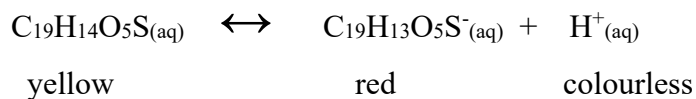
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19. Phenol red, $C_{19}H_{14}O_5S$, is an acid-base indicator. When phenol red is dissolved in water, the following equilibrium occurs.



In aqueous solution, the molecule $C_{19}H_{14}O_5S$ is yellow, the ion $C_{19}H_{13}O_5S^{-}$ is red, and the ion H^{+} is colourless.

- (a) Predict the colour a solution of phenol red would be if a few drops were added to a 1 mol/L solution of hydrochloric acid. (1 mark)

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- (b) Explain your prediction in part (a) with reference to Le Chatelier's principle. (3 marks)

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20. Ethanol is used as a solvent for both polar and non-polar substances. Account for this property of ethanol. (3 marks)

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Chemistry Half Yearly Exam, 2007 - Marking Criteria

Question	Correct answer	% students with correct answer
1.	A	59
2.	D	75
3.	B	96
4.	B	33
5.	D	89
6.	B	79
7.	B	85
8.	B	39
9.	D	15
10.	A	79

Question 11 a.

Criteria	Mark
Correct identification of systematic name	1

Question 11 b.

Criteria	Mark
Explaining the uses of polyvinyl chloride in terms of its properties (at least 2 uses).	3
Describing 2 or more uses of polyvinyl chloride in terms of properties.	2
Identifying and/or describing one use of polyvinyl chloride in terms of its properties.	1

Question 12.

Criteria	Mark
Correctly labelled, neat diagram showing anode, cathode, direction of electron flow	4
Correctly labelled, neat diagram showing the above with one missing/incorrect.	3
Correctly labelled, neat diagram showing the above with two missing/incorrect.	2
Neat diagram without labels.	1

Question 12 b.

Criteria	Mark
Correct oxidation and reduction half-equations and calculation of E^{\ominus}	2
Correct redox half-equations or correct calculation of E^{\ominus} .	2

Question 13.

Criteria	Mark
An appropriate discussion and evaluation (judgement value) of the use of biomass for fuel and chemical production in industry. Must include 2 balanced equations showing conversion of biomass to ethanol and ethene.	6 - 7
A discussion and evaluation (with judgement value) of the use of biomass as a source of fuel and chemicals ie ethanol and ethene.	4 - 5
A description of biomass as a source of fuel (ethanol) and/or chemicals (ethene).	2 - 3

Identifying biomass as a source of fuel and chemicals (includes correct definition).	1
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Question 14.

Criteria	Mark
Names a commercial radioisotope AND a transuranic radioisotope AND Describes the production of each one (ie. gives the main features of each) AND Uses the correct text type (ie. Answer written as a comparison, using key words such as 'both' or 'whereas', 'a similarity ...').	3
Names a commercial radioisotope AND a transuranic radioisotope AND Describes the production of each one (ie. gives the main features of each)	2
Describes the production of ONE named transuranic OR commercial radioisotope OR Names a commercial radioisotope AND a transuranic radioisotope	1

Question 15.

Criteria	Mark
<u>6 marks were allocated as follows –</u> Procedure – Maximum of 3 marks. 3 = Method is described thoroughly and could be followed to produce results that are both valid and reliable. (Method includes as a minimum - reagents, exact quantities used, equipment used, controlled variables, how many repetitions were done, as well as a logical and informative description) 2 = Method is described well (but lacking one or more exact details (eg. quantities used or controlled variables) and could be followed to produce results that are either valid or reliable 1 = a method is outlined that has the potential, if more detail was provided, to produce results that are valid and reliable Justifying validity of procedure – max of 2 marks Two reasons are given as to why the method describes will produce valid results Justifying reliability of procedure – max of 1 mark One reason is given as to why the method describes will produce reliable results (ie. The method was repeated 10 times)	6
Less than full marks were allocated for less complete answers	1-5

NOTE- the questions required you to JUSTIFY (ie. give reasons for) the procedure described rather than ASSESS the appropriateness of the procedure

High scoring answers were well set out with the answer clearly divided into three sub-sections – method, justifying validity, justifying reliability

Question 16 a.

Criteria	Mark
Draws a scientific diagram of the identified cell, following the correct conventions for scientific diagram construction – pencil, straight lines ruled, labels, to scale, etc AND Identifies the anode, the cathode and the electrolyte used	2
Draws a scientific diagram of the identified cell, following the correct conventions for scientific diagram construction – pencil, straight lines ruled, labels, to scale, etc OR Identifies the anode, the cathode and the electrolyte used	1

Question 16 b.

Criteria	Mark
Writes TWO correct equations	2
Writes ONE correct equation	1

Question 16 c.

Criteria	Mark
An evaluation (judgement statement matching the information on the cells described) on the two cells plus correct description of the impact of two cells on the environment.	3
Correct description of the impact of two cells on the environment (must include chemistry).	2
Correct description of the impact of ONE cell on the environment (must include chemistry).	1

Question 17 a.

Criteria	Mark
The correct data (ie. mass of CO ₂ released over a 24hour period) is plotted AND the graph shows the following features 1. has a meaningful title 2. independent variable is on horizontal axis 3. dependent variable is on the vertical axis 4. axes are fully labelled, including units 5. graph covers > 2/3 of the grid 6. points are accurately plotted 7. points are neatly plotted 8. the line of best fit is a smooth curve for t = 0 – 14 hr and a straight line for t = 14 – 24 hr. 9. graph is drawn using a pencil	4
The correct data is plotted however 1, 2 or 3 of the points outlined above are missing, inaccurate or incomplete	3
The correct data is plotted however more than 3 of the points outlined above are missing, inaccurate or incomplete. OR The incorrect data is plotted (ie. mass of can contents over time) but the graphing conventions have been appropriately applied	2
The incorrect data is plotted and 1, 2 or 3 graphing conventions are missing, inaccurate or incomplete.	1

Question 17 b.

Criteria	Mark
Correctly calculates the moles of CO ₂ as 0.034083 mol and the volume of CO ₂ as 8.45 L AND Shows full working	2
Correctly calculates the volume of CO ₂ as 8.45 L BUT doesn't show full working OR Correctly calculates ONE step of the calculations with full working.	1

Question 17 c.

Criteria	Mark
Outlines the kinetic theory of matter as it specifically relates to liquids (ie. liquids are made up of small particles that are close together, that cannot move freely but can roll over one another and are held together by relatively weak intermolecular forces) AND	2

Proposes either – 1. the molecules of H ₂ CO ₃ must be the same size as the molecules of H ₂ O so that their packing density (and hence volume) is the same OR 2. the molecules of CO ₂ "fit" into the spaces between the water molecules so that the packing density of the water molecules is unaffected	
Outlines the kinetic theory of matter as it specifically relates to liquids	1

Question 18.

Criteria	Mark
The relationship between position of the element on the PT and the acid/base behaviour of their oxides is outlined (ie. basic oxides are found on the LHS of the PT whereas acidic oxides are found on the RHS of the PT. The trend across a period is basic → amphoteric → acidic	2
The relationship between acid/base behaviour of the oxides and their classification as either metal oxides or non-metal oxides is outlined OR The location of either acidic oxides or basic oxides in relation to the PT is identified	1

Question 19 a.

Criteria	Mark
Identifies that the indicator will turn yellow in colour	1

Question 19 b.

Criteria	Mark
* States Le Chatelier's Principle * Identifies that adding HCl will increase the [H ⁺] * Explains that the system will minimise the disturbance by favouring the reverse reaction which uses up some of the added H ⁺ (and also uses up some of the red C ₁₉ H ₁₃ O ₅ S ⁻ at the same time) and produces more of the yellow C ₁₉ H ₁₄ O ₅ S.	3
* States Le Chatelier's Principle * Identifies that adding HCl will increase the [H ⁺]	2
States Le Chatelier's Principle OR Identifies that adding HCl will increase the [H ⁺]	1

Question 20.

Criteria	Mark
Identifies that ethanol has a non-polar alkyl segment and a polar hydroxyl segment. AND Describes that the polar hydroxyl group is able to form dipole-dipole interactions (or H-bonding) with polar solutes causing them to dissolve AND Describes that the non-polar alkyl group is able to form dispersion forces with non-polar solutes causing them to dissolve	3
Identifies that ethanol has a non-polar alkyl segment and a polar hydroxyl segment. AND Outlines that the polar hydroxyl end dissolves polar solutes while the non-polar alkyl group dissolves non-polar solutes	2
Identifies that ethanol has a non-polar alkyl segment and a polar hydroxyl segment.	1