

External assessment 2021

Multiple choice question book

# Chemistry

## Paper 1

### General instruction

- Work in this book will not be marked.



Queensland  
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## Section 1

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### QUESTION 1

Melting is a

- (A) physical change that is reversible.
- (B) chemical change that is reversible.
- (C) physical change that is irreversible.
- (D) chemical change that is irreversible.

### QUESTION 2

Intra-chain hydrogen bonding between peptide groups occurs in

- (A) primary protein structures.
- (B) secondary protein structures.
- (C) tertiary protein structures.
- (D) quaternary protein structures.

### QUESTION 3

Predict which product is formed at the positive electrode when a 0.1 M aqueous solution of copper(II) sulfate is electrolysed using carbon electrodes.

- (A) Cu(s)
- (B) H<sub>2</sub>(g)
- (C) O<sub>2</sub>(g)
- (D) SO<sub>2</sub>(g)

#### QUESTION 4

The cleaning action of soap is impaired in hard water because the

- (A) hydrophilic end reacts with calcium ions to form insoluble salts.
- (B) hydrophobic end reacts with calcium ions to form insoluble salts.
- (C) hydrophilic end reacts with calcium ions to form insoluble fatty acids.
- (D) hydrophobic end reacts with calcium ions to form insoluble fatty acids.

#### QUESTION 5

A 10.0 M solution of ethanoic acid is best described as a

- (A) dilute solution of a weak acid.
- (B) dilute solution of a strong acid.
- (C) concentrated solution of a weak acid.
- (D) concentrated solution of a strong acid.

#### QUESTION 6

Which type of atoms would be more likely to gain electrons based on its position in the periodic table?

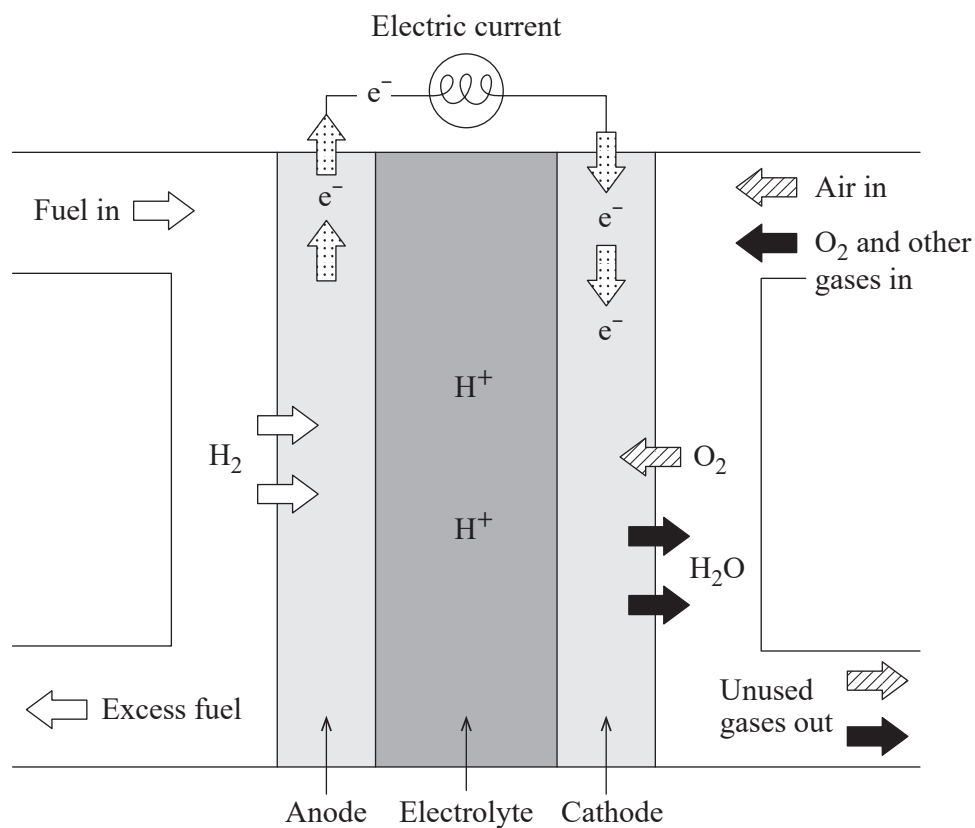
- (A) halogens
- (B) noble gases
- (C) alkali metals
- (D) alkaline earth metals

#### QUESTION 7

Identify which molecule is an amide.

- (A)  $\text{CH}_3\text{CH}_2\text{CN}$
- (B)  $\text{CH}_3\text{CH}_2\text{NH}_2$
- (C)  $\text{NH}_4\text{CH}_3\text{COO}$
- (D)  $\text{CH}_3\text{CONHCH}_3$

## QUESTION 8



Identify the operating conditions for the hydrogen fuel cell.

- (A) acidic conditions with hydrogen given off as an unused gas
- (B) alkaline conditions with hydrogen given off as an unused gas
- (C) acidic conditions with hydrogen ions present in the electrolyte
- (D) alkaline conditions with hydrogen ions present in the electrolyte

## QUESTION 9

The boiling points of methane, ethane and propane increase as the lengths of the carbon chains increase because more energy is required to overcome the

- (A) intramolecular hydrogen bonds.
- (B) intermolecular hydrogen bonds.
- (C) intramolecular dispersion forces.
- (D) intermolecular dispersion forces.

### QUESTION 10

Determine which system at equilibrium will shift to the right (products) if the total pressure on the system is increased.

- (A)  $\text{N}_2\text{O}_4(\text{g}) \rightleftharpoons 2\text{NO}_2(\text{g})$
- (B)  $2\text{H}_2\text{O}(\text{g}) \rightleftharpoons 2\text{H}_2(\text{g}) + \text{O}_2(\text{g})$
- (C)  $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{SO}_3(\text{g})$
- (D)  $\text{CO}(\text{g}) + \text{H}_2\text{O}(\text{g}) \rightleftharpoons \text{CO}_2(\text{g}) + \text{H}_2(\text{g})$

### QUESTION 11

Enzymes can act as biological catalysts because they

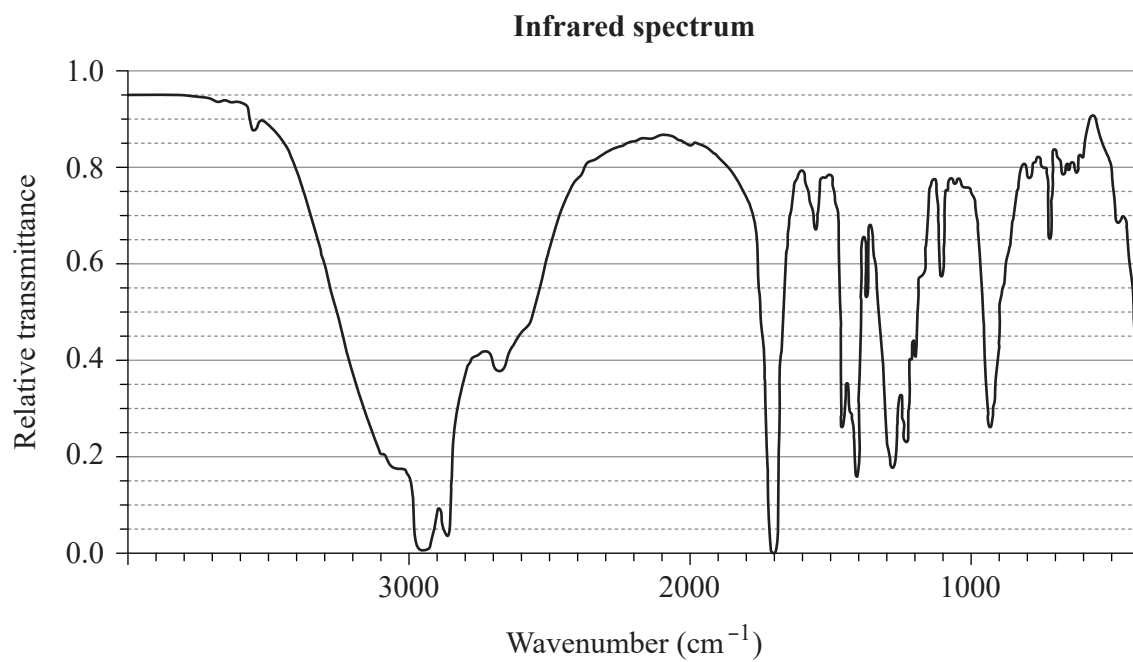
- (A) can be denatured.
- (B) lower the activation energy.
- (C) are sensitive to pH and temperature changes.
- (D) increase the equilibrium constant for the reaction.

### QUESTION 12

Green chemistry principles include the design of chemical synthesis processes that

- (A) use renewable raw materials and minimise unwanted products.
- (B) use renewable raw materials and minimise unwanted reactants.
- (C) use non-renewable raw materials and minimise unwanted products.
- (D) use non-renewable raw materials and minimise unwanted reactants.

### QUESTION 13



Determine the functional group present in the infrared spectrum.

- (A) ester
- (B) ketone
- (C) alcohol
- (D) carboxylic acid

## QUESTION 14

Acid	$K_a$ value
Nitrous acid	$K_a = 4.00 \times 10^{-4}$
Ethanoic acid	$K_a = 1.76 \times 10^{-5}$
Hydrofluoric acid	$K_a = 7.20 \times 10^{-4}$
Chloroethanoic acid	$K_a = 1.40 \times 10^{-3}$

Analyse the data to determine the relative strengths of acids from strongest to weakest.

- (A) chloroethanoic, ethanoic, nitrous, hydrofluoric
- (B) chloroethanoic, hydrofluoric, nitrous, ethanoic
- (C) ethanoic, nitrous, hydrofluoric, chloroethanoic
- (D) ethanoic, hydrofluoric, nitrous, chloroethanoic

## QUESTION 15

Which organic compound has the highest boiling point?

- (A)  $\text{CH}_3(\text{CH}_2)_3\text{CH}_3$
- (B)  $\text{CH}_3(\text{CH}_2)_3\text{CHO}$
- (C)  $\text{CH}_2\text{CH}(\text{CH}_2)_2\text{CH}_3$
- (D)  $\text{CH}_3(\text{CH}_2)_3\text{CH}_2\text{OH}$

## QUESTION 16

Calculate the percentage yield of magnesium ethanoate when 8.0 moles of ethanoic acid reacts with 6.0 moles of magnesium carbonate, producing 3.5 moles of magnesium ethanoate as shown in the equation.



- (A) 44%
- (B) 58%
- (C) 88%
- (D) 100%



### QUESTION 17

Determine the concentration of hydrogen ions ( $\text{H}^+$ ) in an aqueous solution containing  $1.2 \times 10^{-3}$  M hydroxide ions ( $\text{OH}^-$ ).

- (A)  $1.2 \times 10^{11}$
- (B)  $8.3 \times 10^{-12}$
- (C)  $8.3 \times 10^{-17}$
- (D)  $1.2 \times 10^{-17}$

### QUESTION 18

Identify the major product when 2-methylbut-2-ene reacts with water under acidic conditions.

- (A)  $(\text{CH}_3)_2\text{CHCOCH}_3$
- (B)  $(\text{CH}_3)_2\text{C}(\text{OH})\text{CH}_2\text{CH}_3$
- (C)  $(\text{CH}_3)_2\text{CHCH}(\text{OH})\text{CH}_3$
- (D)  $(\text{CH}_3)_2\text{C}(\text{OH})\text{CH}(\text{OH})\text{CH}_3$

### QUESTION 19

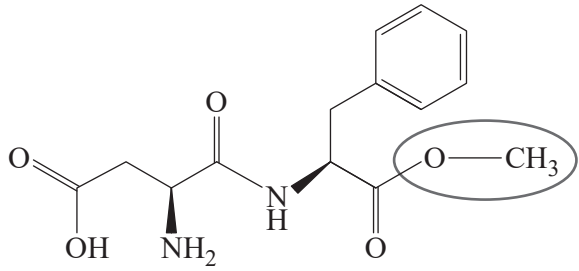
To form ethanol biofuel in the fermentation of glucose, a catalyst is used because

- (A) less energy is required and the rate of reaction is increased.
- (B) less energy is required and the rate of reaction is decreased.
- (C) more energy is required and the rate of reaction is increased.
- (D) more energy is required and the rate of reaction is decreased.

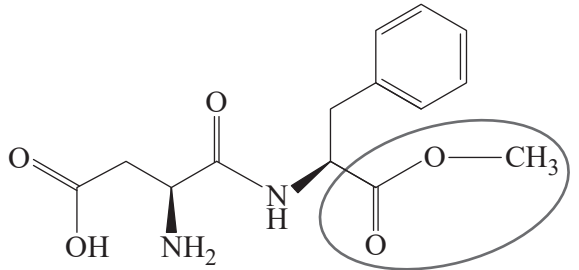
## QUESTION 20

Identify the ester linkage in aspartame.

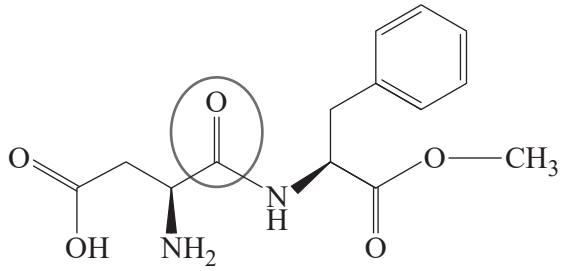
(A)



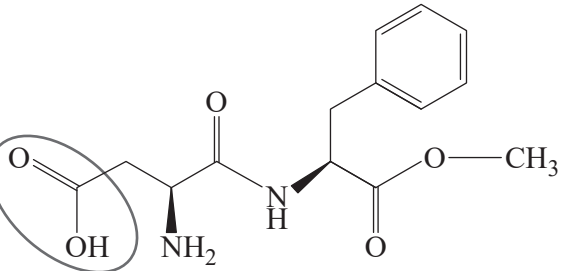
(B)



(C)



(D)



The image shows four panels (A, B, C, D) of the chemical structure of aspartame. Each panel highlights a different part of the molecule with a circle:

- (A) The methyl ester group ( $\text{O}-\text{CH}_3$ ) is circled.
- (B) The methyl ester group ( $\text{O}-\text{CH}_3$ ) is circled.
- (C) The amide carbonyl group ( $\text{C}=\text{O}$ ) is circled.
- (D) The carboxylic acid group ( $\text{C}=\text{O}$  and  $\text{OH}$ ) is circled.

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## References

### Question 8

Adapted from Dervisoglu, R 2012, 'Solid oxide fuel cell protonic', *Wikimedia Commons*,  
[https://commons.wikimedia.org/wiki/File:Solid\\_oxide\\_fuel\\_cell\\_protonic.svg](https://commons.wikimedia.org/wiki/File:Solid_oxide_fuel_cell_protonic.svg).

### Question 13

Adapted from National Institute of Standards and Technology 2018, *Octanoic acid: Infrared spectrum* in  
'Octanoic acid', *NIST Chemistry WebBook*, US Department of Commerce,  
<https://webbook.nist.gov/cgi/cbook.cgi?ID=C124072&Type=IR-SPEC&Index=2>.



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