



CHEMISTRY

9729/01

Paper 1 Multiple Choice

15th September 2018
1 hour

Additional materials: Multiple Choice Answer Sheet
Data Booklet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid.

1. Enter your NAME (as in NRIC). _____
2. Enter the SUBJECT TITLE. _____
3. Enter the TEST NAME. _____
4. Enter the CLASS. _____

Write your **name**
and **Civics Group**

Write and shade
your index number

WRITE		SHADE APPROPRIATE BOXES									
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A	B	C	D	E	F	G	H	I			
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	

There are **thirty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A, B, C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

The use of an approved scientific calculator is expected, where appropriate.

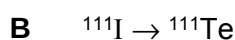
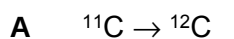
This document consists of **13** printed pages.

Section A

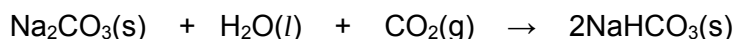
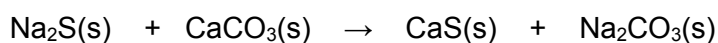
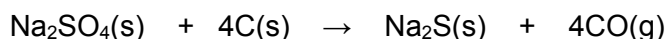
For each question there are four possible answers, **A**, **B**, **C** and **D**. Choose the **one** you consider correct and record your choice in soft pencil on the separate Answer Sheet (OMS).

- 1** Some isotopes are unstable and undergo nuclear (radioactive) reactions. In one type of reaction, an unstable nucleus assimilates an electron from an inner orbital of its electron cloud. The net effect is the conversion of a proton and an electron into a neutron.

Which of the following describes this type of reaction?



- 2** Sodium hydrogencarbonate can be prepared from sodium sulfate by a three-step process:



What is the mass of sodium hydrogencarbonate that could be formed from 100 kg of the sodium sulfate, assuming a 90% yield in each step?

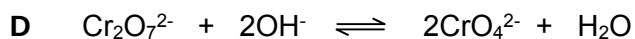
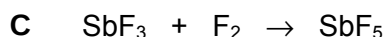
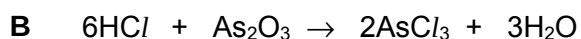
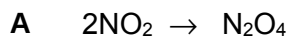
A 106 kg

B 96 kg

C 86 kg

D 43 kg

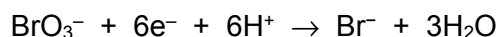
- 3** Which of the following reactions is a redox reaction?



- 4 When 2.6 g of a metal X are added to copper(II) sulfate solution 4.8 g of copper are obtained. The relative atomic mass of X is 52. Which one of the following cations of X is produced?

A X^{4+} B X^{3+} C X^{2+} D X^{+}

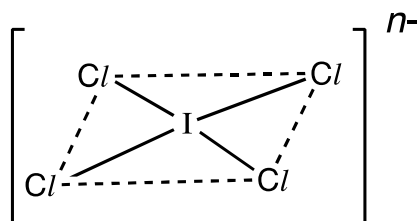
- 5 20.0 cm³ of 0.02 mol dm⁻³ bromate(V), BrO₃⁻, was found to react completely with 80.0 cm³ of 0.01 mol dm⁻³ hydroxylamine, NH₂OH. BrO₃⁻ ions are reduced as follows:



Which of the following could be the half-equation for the oxidation of hydroxylamine?

- A $\text{NH}_2\text{OH} \rightarrow \frac{1}{2} \text{N}_2\text{O} + 2\text{H}^+ + \frac{1}{2} \text{H}_2\text{O} + 2\text{e}^-$
 B $\text{NH}_2\text{OH} + \text{H}_2\text{O} \rightarrow \text{NO}_2^- + 5\text{H}^+ + 4\text{e}^-$
 C $\text{NH}_2\text{OH} \rightarrow \text{NO} + 3\text{H}^+ + 3\text{e}^-$
 D $\text{NH}_2\text{OH} + 2\text{H}_2\text{O} \rightarrow \text{NO}_3^- + 7\text{H}^+ + 6\text{e}^-$

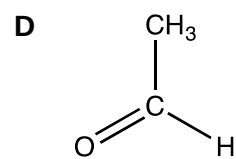
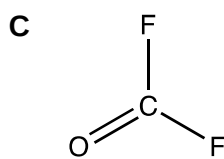
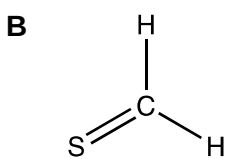
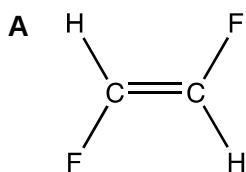
- 6 An ion ICl_4^{n-} has a square planar structure as shown below.



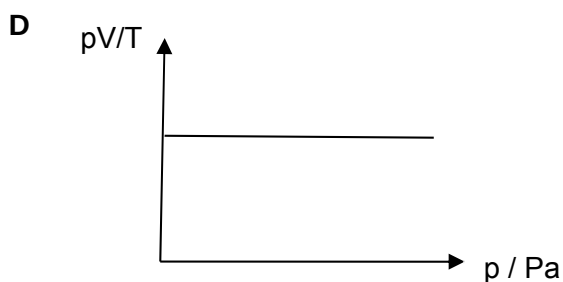
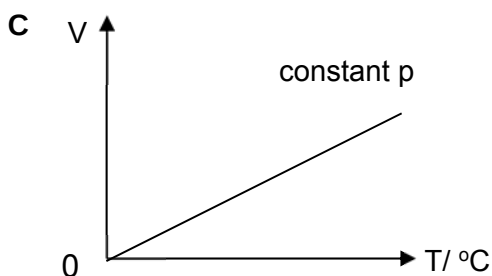
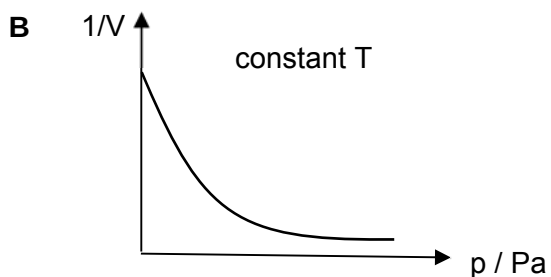
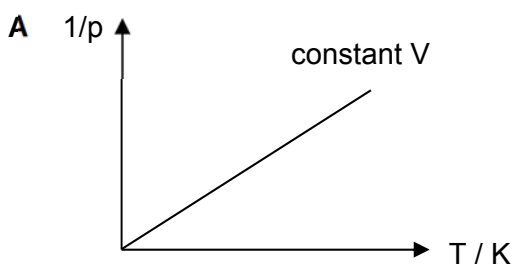
What is the value of n ?

- A 1
 B 2
 C 3
 D 4

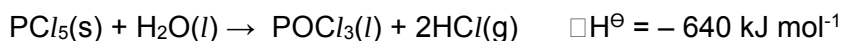
7 Which molecule has the largest dipole?



8 Which of the following graphs correctly describes the behaviour of a fixed mass of ideal gas?



9 Phosphorus pentachloride reacts with limited amount of water to give a liquid and white fumes as shown in the equation below.



The following enthalpy changes are given:

$$\Delta H_f^\ominus \text{PCl}_5(\text{s}) = -444 \text{ kJ mol}^{-1}$$

$$\Delta H_f^\ominus \text{HCl}(\text{g}) = -92 \text{ kJ mol}^{-1}$$

$$\Delta H_c^\ominus \text{H}_2(\text{g}) = -286 \text{ kJ mol}^{-1}$$

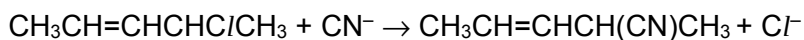
What is the standard enthalpy change of formation of $\text{POCl}_3(\text{l})$?

- A** $-1278 \text{ kJ mol}^{-1}$ **B** $-1186 \text{ kJ mol}^{-1}$ **C** $+94 \text{ kJ mol}^{-1}$ **D** $+274 \text{ kJ mol}^{-1}$

10 Which quantity is not required in the calculation of the lattice energy of calcium hydride, CaH_2 , using the Born-Haber cycle?

- A first electron affinity of hydrogen
- B second electron affinity of hydrogen
- C first ionisation energy of calcium
- D second ionisation energy of calcium

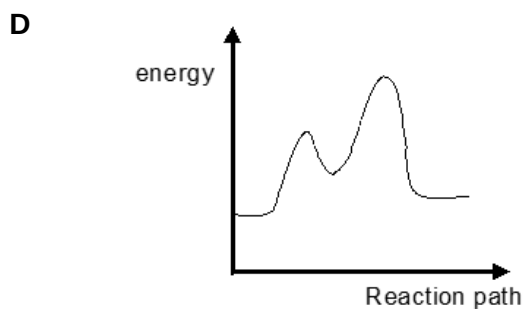
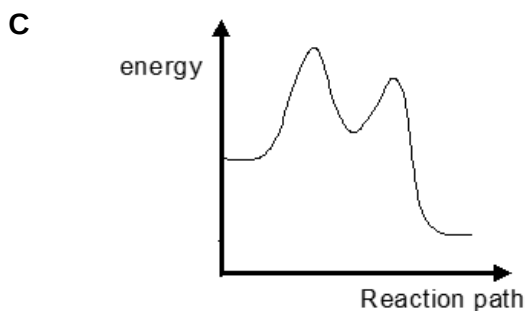
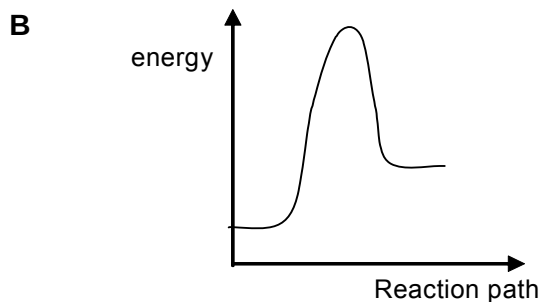
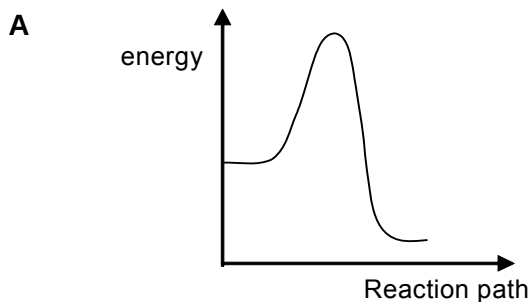
11 Compound **M**, $\text{CH}_3\text{CH}=\text{CHCHC}/\text{CH}_3$, reacts readily with alcoholic KCN according to the following equation:



The following kinetics data were collected:

Experiment	[M] / mol dm^{-3}	[CN^-] / mol dm^{-3}	Relative Rate
1	0.1	0.1	1
2	0.2	0.1	2
3	0.3	0.3	3

Which diagram represents the reaction profile for this reaction?



- 12** The radioactive decay of isotopes **P** and **Q** follow first-order kinetics.

Isotope **P** decreases from 1800 counts per minute to 450 counts per minute in six months.
Isotope **Q** decreases from 5400 counts per minute to 1350 counts per minute in four months.

In a separate experiment, a sample containing a mixture of the two isotopes was left to decay, and the molar ratio of **P** : **Q** was found to be 1 : 1 after six months.

What is the molar ratio of **P** : **Q** at the beginning?

- | | | | |
|----------|-------|----------|-------|
| A | 1 : 2 | B | 1 : 4 |
| C | 2 : 1 | D | 4 : 1 |

- 13** **X**, **Y** and **Z** are elements in Period 3 of the Periodic Table. The following statements were made about the properties of **X**, **Y** and **Z**, and their compounds.

- 1 The oxide of **Z** does not dissolve in excess dilute NaOH(aq).
- 2 When a sample containing equimolar quantities of each oxide is mixed with water, the solution obtained is highly acidic.
- 3 Only the chlorides of **Y** and **Z** give an acidic solution with water.

Based on the statements above, identify elements **X**, **Y** and **Z**.

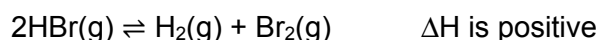
	X	Y	Z
A	Na	S	Mg
B	Mg	P	Si
C	Al	S	Mg
D	Na	P	Si

- 14** Which of the following statements are true?

- 1 The lattice energy of magnesium oxide is more negative than the lattice energy of barium oxide.
- 2 The solubility product of magnesium hydroxide is smaller than that of calcium hydroxide.
- 3 The reducing power of strontium is weaker than that of barium.
- 4 Barium nitrate decompose more readily than magnesium nitrate.

- A** 1, 2 and 3 only **B** 1, 3 and 4 only **C** 1, 2 and 4 only **D** 2, 3 and 4 only

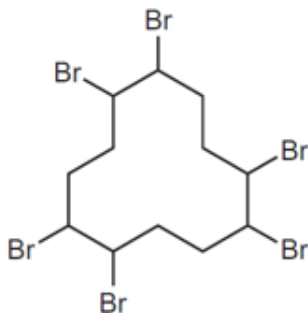
- 15 Astatine (At) is an element in Group 17. Which of the following statements is correct?
- A Silver astatide reacts with aqueous ammonia to form a soluble complex.
 - B HAt(aq) is a weaker acid than HCl(aq) .
 - C Astatine reacts with aqueous iron(II) sulfate to form iron(III) ions and astatide.
 - D The enthalpy change of formation of hydrogen astatide is less exothermic than that of hydrogen chloride.
- 16 A sample of 0.300 mol of HBr gas was decomposed in a sealed container at temperature T . The resulting equilibrium mixture was found to contain 0.015 mol of Br_2 .



Which of the following statements are true for the reaction?

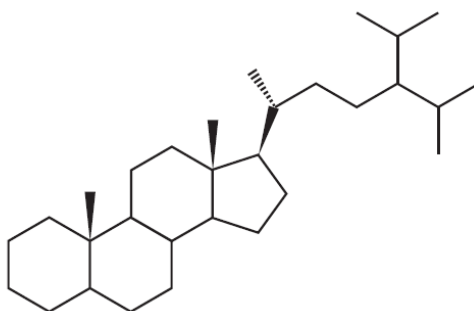
- 1 The mole fraction of HBr(g) is 0.27 at equilibrium
 - 2 The equilibrium constant $K_c = 3.09 \times 10^{-3}$
 - 3 The K_c will increase if reaction is carried out at higher temperature.
- A 1, 2 and 3
 - B 1 and 2 only
 - C 2 and 3 only
 - D 1 only
- 17 Which statement(s) about indicators is always correct?
- 1 The pH working range is greater for indicators with higher pK_a values.
 - 2 The pK_a value of an indicator is within its pH working range.
 - 3 The mid-point of an indicator's colour change is at $\text{pH} = 7$.
 - 4 The colour red indicates an acidic solution.
- A 1 and 2 only
 - B 2 only
 - C 1 and 3 only
 - D 3 and 4 only

- 18 The compound shown is used as flame retardant.



Which statement about this molecule is **not** correct?

- A The carbon atom ring is planar.
 B It is immiscible in water.
 C Its empirical formula is C_2H_3Br .
 D The compound reacts with ethanolic sodium hydroxide to form $C_{12}H_{12}$.
- 19 The molecule 24-isopropylcholestane, which has been isolated from a class of sponge, can serve as a biomarker and has determined the first evolutionary appearances of some species.

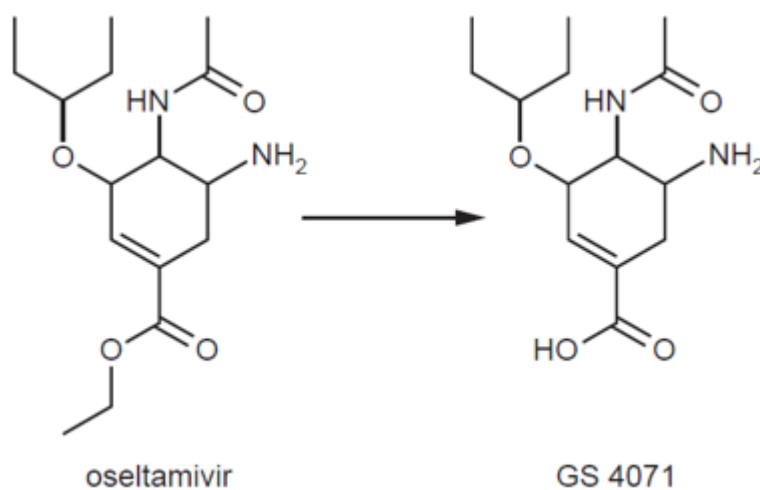


Carbon atoms in a molecule are classified as primary, secondary, tertiary or quaternary, depending on whether they are directly bonded to one, two, three or four other carbon atoms.

How many tertiary carbons and how many chiral carbons are there in this molecule?

	Tertiary carbons	Chiral carbons
A	9	4
B	9	8
C	11	4
D	11	8

- 20 Which forms of isomerism will be shown by the molecule 2,4-dimethylhex-2-ene?
- A Enantiomerism only
- B Cis-trans isomerism only
- C Both enantiomerism and cis-trans isomerism.
- D Neither enantiomerism nor cis-trans isomerism.
- 21 Oseltamivir is an anti-viral drug that is converted to its active form, GS 4071, in the body after being administered. Assume that R-O-R is an inert functional group.



Which of the following statements are correct?

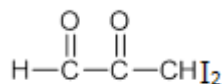
- 1 The reaction shown above is an elimination reaction.
 - 2 There are three single C-C σ bonds formed by sp^2 - sp^2 overlap in oseltamir and GS 4071.
 - 3 GS 4071 gives an orange precipitate with 2,4-dinitrophenylhydrazine.
 - 4 When oseltamir is hydrolysed by aqueous HCl, 3 products are obtained
- A 1 and 3 only
- B 2 and 4 only
- C 1, 2 and 3 only
- D 4 only

22 Compound X has the following properties.

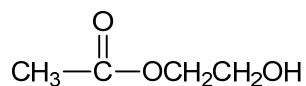
- It causes decolourisation of purple acidified potassium manganate (VII).
- It gives yellow precipitate with alkaline aqueous iodine.

Which compound could be X?

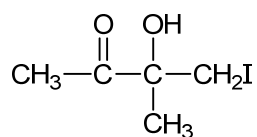
A



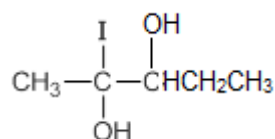
B



C



D



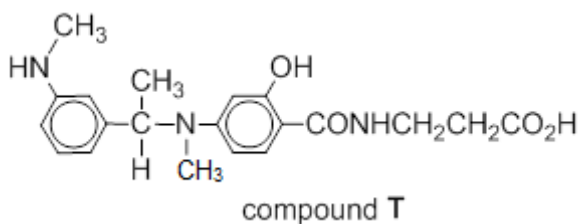
23 Consider the following four compounds, which are structural isomers of one another.

- 1 $\text{CH}_2\text{ClCHClCOOH}$
- 2 $\text{CHCl}_2\text{CH}_2\text{COOH}$
- 3 $\text{CH}_2\text{OHCHClCOCl}$
- 4 $\text{ClCH}_2\text{OCOCH}_2\text{Cl}$

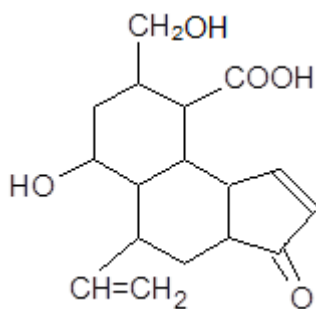
Which sequence arranges the aqueous solution of the compounds of the same concentration in order of increasing pH?

- A 4 2 1 3
- B 1 2 3 4
- C 3 1 2 4
- D 3 2 1 4

- 24 Which of the following statements regarding compound **T** is correct?



- A 1 mol of compound **T** reacts with 4 mol of ethanoyl chloride.
- B 1 mol of compound **T** reacts with 3 mol of cold dilute hydrochloric acid.
- C 1 mol compound **T** reacts with 4 mol of hot dilute NaOH.
- D Compound **T** reacts with excess aqueous bromine to give a product with five bromine atoms.
- 25 What is the correct number of hydrogen atoms incorporated per molecule of compound **Y** when it is reacted with each of the following reducing agents?

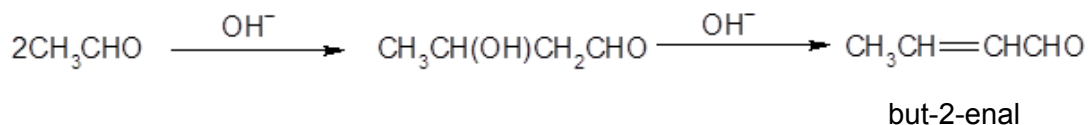


Compound **Y**

	Reducing agent	Number of hydrogen atoms incorporated per molecule of Y
1	H ₂ / Ni	6
2	LiAlH ₄ in dry ether	8
3	NaBH ₄ in ethanol	2

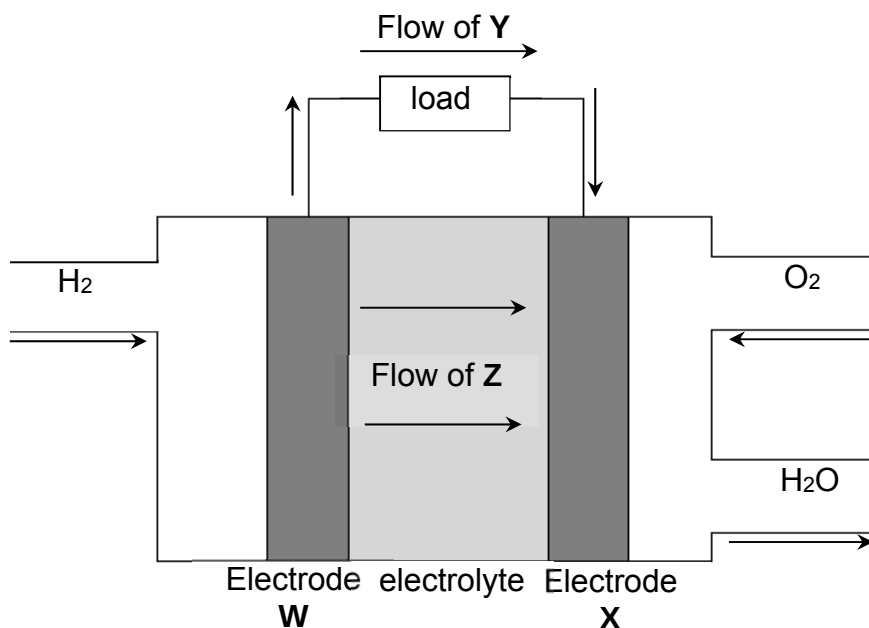
- A 1 only
- B 1 and 2 only
- C 1 and 3 only
- D 2 and 3 only

- 26 In the presence of dilute alkali, some carbonyl compounds undergo Aldol condensation to form a conjugated enone compound. For example, ethanal forms but-2-enal according to the reaction scheme below.



Which of the following gives the structure of the product formed when propanone undergoes the same reaction?

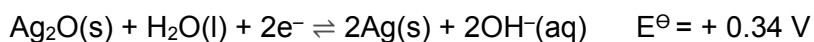
- A $\text{CH}_3\text{CH}_2\text{CH}=\text{C}(\text{CH}_3)\text{CHO}$
 B $(\text{CH}_3)_2\text{C}=\text{C}(\text{CH}_3)\text{CHO}$
 C $\text{CH}_3\text{CH}_2\text{CH}=\text{CHCOCH}_3$
 D $(\text{CH}_3)_2\text{C}=\text{CHCOCH}_3$
- 27 A diagram of a hydrogen/ oxygen fuel cell is shown below.



Which of the following shows the correct identities of W, X, Y and Z?

	W	X	Y	Z
A	anode	cathode	electron	H^+
B	anode	cathode	electron	OH^-
C	cathode	anode	electron	H^+
D	cathode	anode	OH^-	electron

- 28 The zinc/silver oxide cell is used for button cells in watch batteries and is based on the following half-cells:

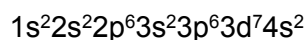


Which of the following statements are true for the zinc/ silver oxide cell?

- 1 Zinc is the positive electrode.
- 2 The $\Delta G^{\ominus}$ of the reaction is $-212.3 \text{ kJ mol}^{-1}$.
- 3 E_{cell} becomes more positive when small amount of $\text{NaOH}(\text{s})$ is added to the Zn^{2+}/Zn half-cell.

- A 1 only
 B 1 and 2 only
 C 2 and 3 only
 D 1, 2 and 3

- 29 The ground state electronic configuration of a transition element is shown.



What oxidation states for this element are able to occur in its compounds?

- 1 +2
- 2 +3
- 3 +6

- A 1, 2 and 3 B 1 and 2 only C 1 and 3 only D 2 and 3 only

- 30 When copper(II) chloride is dissolved in water it gives a blue solution. When this solution is treated with an excess of concentrated hydrochloric acid it turns yellow.

What are the formulae of the copper species in the blue and yellow solutions?

	Blue	Yellow
A	CuCl_2	$[\text{CuCl}_4]^{2-}$
B	$\text{CuCl}_2(\text{H}_2\text{O})_4$	$[\text{CuCl}_6]^{4-}$
C	$\text{Cu}(\text{OH})_2$	$\text{CuCl}_2(\text{H}_2\text{O})_4$
D	$[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$	$[\text{CuCl}_4]^{2-}$