JURONG JUNIOR COLLEGE

JC 2 PRELIMINARY EXAMINATION

Higher 2

CHEMISTRY 9647/01

Paper 1 Multiple Choice **13 September 2012**

1 hour

Additional Materials: Multiple Choice Answer Sheet
Data Booklet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

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

Write your name, class and shade your exam index number on the Answer Sheet in the spaces provided.

There are **forty** 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.

A *Data Booklet* is provided. Do not write anything on the *Data Booklet*.

This document consists of **16** printed pages.

SECTION A

For each question there are four possible answers, **A**, **B**, **C** and **D**. Choose the **one** you consider to be correct.

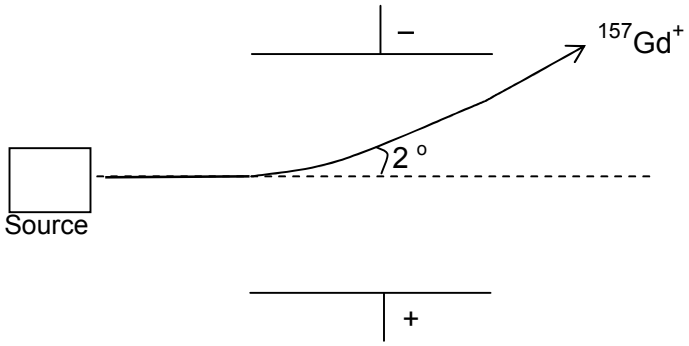
1. *Use of the Data Booklet is relevant to this question.*

When ***x*** mol of cobalt is added to a solution containing ***y*** mol of cobalt(III) ions, cobalt(II) ions are formed in the resultant solution.

In the resultant solution, the number of moles of cobalt(II) ions are three times that of cobalt(III) ions. Hence, which of the following are possible values of ***x*** and ***y***?

	x	***y***
A	1	2
B	1	3
C	1	5
D	2	3

2. In an experiment, a sample of gadolinium element was vaporised, ionised and passed through an electric field. Analysis of the deflection occurring at the electric field region revealed the following data for a beam of $^{157}Gd^{+}$.



What would be the angle of deflection for a sample of doubly charged strontium ions?

A 0.6° **B** 3.6° **C** 7.2° **D** 16.5°

3. In which pair of molecules is the strength of intermolecular forces of **I** greater than that of **II**?

	I	**II**
A	$CH_3CH_2CH_2F$	$CH_3CH_2CHF_2$
B	trans $CH_3CCl=CClCH_3$	cis $CH_3CCl=CClCH_3$
C	CH_4	H_2O
D	CH_3CH_2COOH	$CH_3CH_2CH_2OH$

4. The equation below represents the reaction of gaseous atoms of non-metal Y and of hydrogen to form gaseous Y_2H_6 molecules.

$$2Y(g) + 6H(g) \rightarrow Y_2H_6(g) \qquad \Delta H = -2775 \text{ kJ mol}^{-1}$$

The bond energy of an H–Y bond is 395 kJ mol^{-1}.

What is the bond energy of a Y–Y bond?

A –405.0 kJ mol^{-1}

B –202.5 kJ mol^{-1}

C +202.5 kJ mol^{-1}

D +405.0 kJ mol^{-1}

5. Hydrogen peroxide slowly decomposes into water and oxygen.

$$2H_2O_2(l) \rightarrow 2H_2O(l) + O_2(g)$$

Given that the standard enthalpy change of formation of $H_2O_2(l)$ is –188 kJ mol^{-1} and standard enthalpy change of formation of $H_2O(l)$ is –286 kJ mol^{-1}, calculate the enthalpy change of this decomposition.

A −98 kJ mol^{-1}

B −196 kJ mol^{-1}

C +98 kJ mol^{-1}

D +300 kJ mol^{-1}

6. Nitrosyl chloride, NOC*l*, decomposes on heating according to the equation below:

$$NOCl(g) \rightleftharpoons NO(g) + \tfrac{1}{2}\, Cl_2(g)$$

When 100 cm^3 of nitrosyl chloride was placed in a closed container at constant pressure and heated to a constant temperature, it was found that nitrogen monoxide constitutes 40% of the equilibrium mixture.

What is the total volume of gases in the equilibrium mixture at the temperature of the reaction?

A 100 cm^3 **B** 125 cm^3 **C** 150 cm^3 **D** 167 cm^3

7. The equilibrium constant for the reaction represented by the following equation is smaller than 1.0. Which of the following gives the correct relative strengths of the acids and bases in the reaction?

$$HPO_4^{2-}(aq) + H_2BO_3^{-}(aq) \rightleftharpoons H_2PO_4^{-}(aq) + HBO_3^{2-}(aq)$$

	Acids		Bases
A	$H_2PO_4^{-} > H_2BO_3^{-}$	and	$HBO_3^{2-} > HPO_4^{2-}$
B	$H_2BO_3^{-} > H_2PO_4^{-}$	and	$HBO_3^{2-} > HPO_4^{2-}$
C	$H_2PO_4^{-} > HPO_4^{2-}$	and	$HBO_3^{2-} > H_2BO_3^{-}$
D	$H_2BO_3^{-} > HPO_4^{2-}$	and	$H_2PO_4^{-} > HBO_3^{2-}$

8. A sparingly soluble barium salt dissociates in solution according to the equation:

$$BaL_2(s) \rightleftharpoons Ba^{2+}(aq) + 2L^{-}(aq)$$

If the solubility product of BaL_2 is q mol^3 dm^{-9}, what is the concentration of L^- at equilibrium in a saturated solution of BaL_2?

A $\frac{q}{3}$ **B** $\left(\frac{q}{4}\right)^{\frac{1}{3}}$ **C** $q^{\frac{1}{3}}$ **D** $(2q)^{\frac{1}{3}}$

9. A commercial pharmaceutical drug **X** has a constant half–life of 2.0 hours. The drug will lose its effectiveness in the human body once its mass falls below 40 mg.

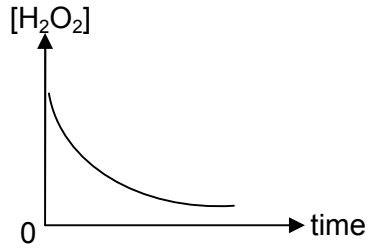
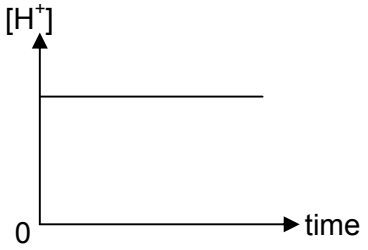
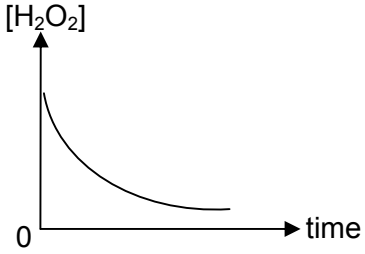
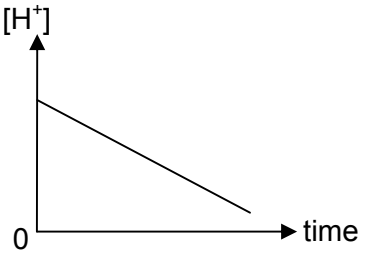
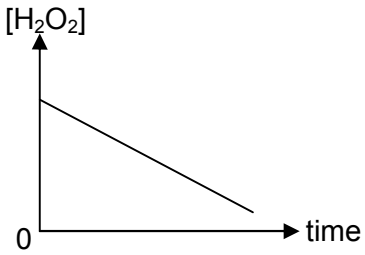
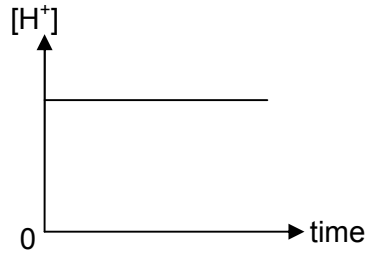
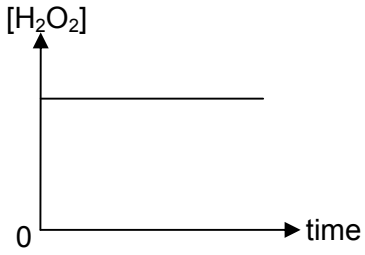
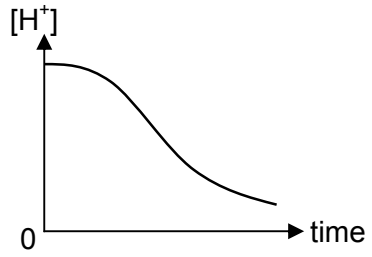
Given that a patient was prescribed with 320 mg tablet form of drug **X**, how often should he take his prescription in order to maintain the effectiveness of drug in his body?

A every 2.0 hours
B every 4.0 hours
C every 6.0 hours
D every 8.0 hours

10. The reaction of hydrogen peroxide with iodide ions in an acidic solution is first order with respect to hydrogen peroxide as well as iodide ions, and zero order with respect to hydrogen ions.

$$H_2O_2(aq) + 2H^+(aq) + 2I^-(aq) \rightarrow 2H_2O(l) + I_2(aq)$$

Two experiments were carried out. Which pair of diagrams represents the variation of $[H_2O_2]$ and $[H^+]$ with time?

	Experiment 1: In the presence of excess I^-	**Experiment 2: In the presence of excess I^- and H_2O_2**
A		
B		
C		
D		

11. The standard electrode potentials of $Ag^+|Ag$, $Zn^{2+}|Zn$ and $Cu^{2+}|Cu$ are +0.80 V, −0.76 V and +0.34 V respectively. Which of the following conclusions can be drawn from these data?

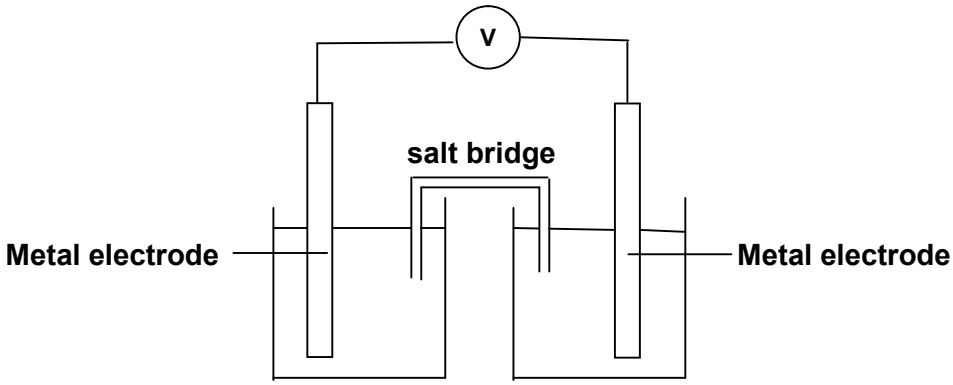
A Silver is less electropositive than copper.

B Silver displaces zinc from a solution containing zinc ions.

C Zinc ion has a greater tendency to be reduced than copper ion.

D Zinc has a lower tendency than silver to form positively charged ions.

12. Four metals Pb, *x*, *y* and *z*, were connected in pairs as shown in the diagram below and the voltage was recorded.



The results obtained are recorded in the table below.

Negative terminal	Positive terminal	Voltage (V)
Pb	*x*	0.35
y	Pb	1.10
z	Pb	2.60

Which set shows an increase in the reducing power of the metals?

	weakest ⟶ strongest			
A	*z*	*y*	Pb	*x*
B	*x*	*y*	Pb	*z*
C	Pb	*x*	*y*	*z*
D	*x*	Pb	*y*	*z*

13. Which property of Group II elements (beryllium to barium) decreases with increasing atomic number?

A reactivity with water

B solubility of hydroxides

C second ionisation energy

D thermal stability of the carbonates

14. The element astatine lies below iodine in Group VII of the Periodic Table.

Which one of the following properties is correct for astatine?

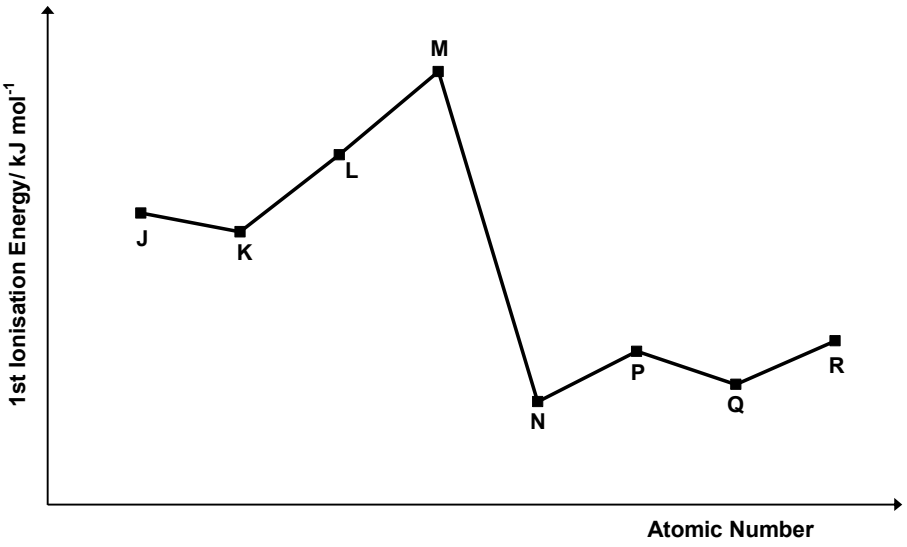
A It forms diatomic molecules which dissociate less readily than chlorine molecules.

B It reacts explosively with hydrogen.

C It can oxidise iodide to iodine.

D It exists as a crystalline solid.

15. The following graph shows the first ionisation energies of eight consecutive elements **J** to **R**, which have atomic numbers between 3 to 20 in the Periodic Table.



Which one of the following statements about the elements is **false**?

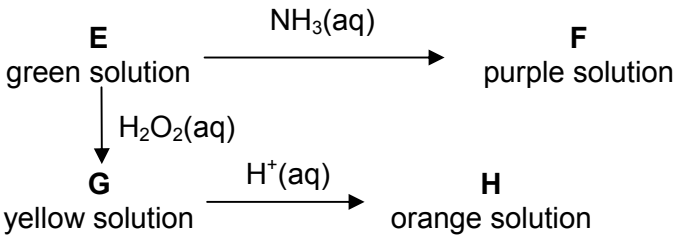
A **R** has the highest melting point.

B The ionic radius of **J** is larger than the ionic radius of **K**.

C **Q** forms a insoluble hydroxide which dissolves in excess dilute NaOH(aq).

D Oxide of **P** gives a higher pH than oxide of **N** when reacted with water.

16. A chromium compound dissolves in water to give a green solution **E** which undergoes the following reactions.



Which of the following statements is **incorrect**?

A The reaction of **E** to form **F** is a ligand displacement reaction.

B The complex ion in **F** is more stable than that in **E**.

C The yellow solution **G** contains $Cr_2O_7^{2-}$ ions.

D The reaction of **G** to **H** is an acid-base reaction.

17. *Use of the Data Booklet is relevant to this question.*

Which of the following is true about the first row transition metals or its compounds?

A $Fe(CN)_6^{3-}$ can oxidise Br^- to Br_2.

B $CrCl_2(aq)$ is chemically unstable when left to stand in the atmosphere.

C On addition of $H_2O_2(aq)$ to acidified $KMnO_4(aq)$, the purple solution remains.

D A mixture of excess NaOH(aq) and $FeCl_3(aq)$ produces a gas that relights a glowing splint.

18. In black and white photographic film, light converts silver chloride into metallic silver. After the film has been developed, the unreacted silver chloride is removed by reaction with sodium thiosulfate to produce a 'fixed' negative.

$$AgCl + 2Na_2S_2O_3 \rightarrow 4Na^+ + Cl^- + [Ag(S_2O_3)_2]^{3-}$$

What is the function of the thiosulfate ion?

A to make the silver ions soluble

B to oxidise the silver ions

C to oxidise the silver metal

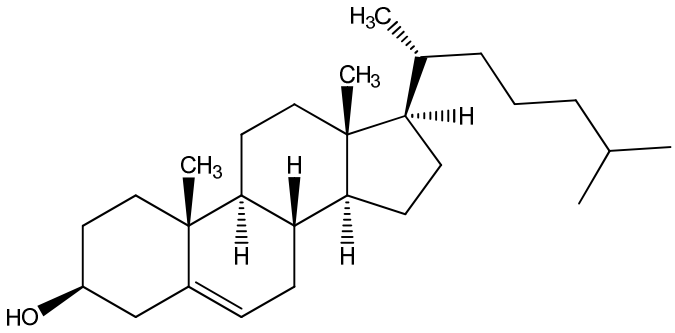
D to reduce the silver ions

19. Species with the molecular formula CH_3 can act as an electrophile, a free radical or a nucleophile depending on the number of outer shell electrons on the central carbon atom.

How many outer shell electrons must be present on carbon atom of CH_3 to act as an electrophile, a free radical or a nucleophile?

	CH_3 as an electrophile	CH_3 as a free radical	CH_3 as a nucleophile
A	6	7	8
B	6	8	7
C	7	6	8
D	8	7	6

20. The diagram shows the structure of the naturally-occurring molecule cholesterol.



Cholesterol is separately treated with

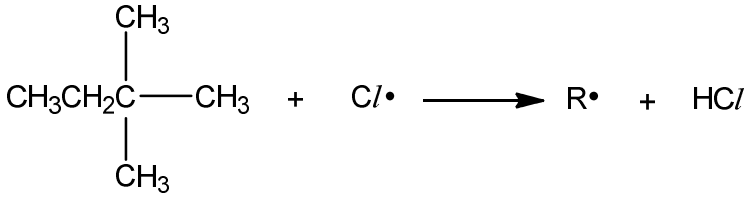
- cold, dilute acidified $KMnO_4$,
- hot, concentrated acidified $KMnO_4$.

What is the change in the number of chiral carbon atoms in the molecule during each reaction?

	cold, dilute acidified $KMnO_4$	hot, concentrated acidified $KMnO_4$
A	+1	0
B	+1	–1
C	+2	0
D	+2	–1

21. When heated with chlorine, 2,2-dimethylbutane undergoes free radical substitution.

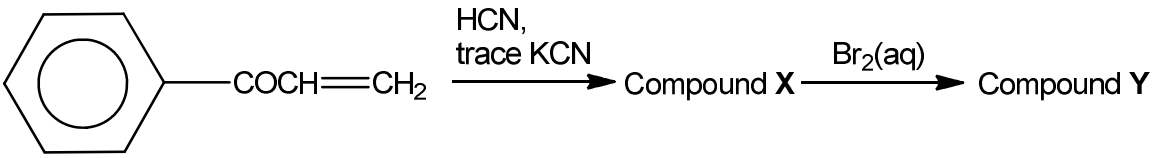
The alkyl free radical R• is formed in the propagation step as shown.



How many different forms of R• are possible?

A 2 **B** 3 **C** 4 **D** 5

22. Compound **W** was used in the following synthesis route.



Compound **W**

How many sp, sp^2 and sp^3 hybridised carbon atoms are there in compound **Y**?

	sp	sp^2	sp^3
A	0	6	4
B	0	6	3
C	1	6	3
D	1	6	2

23. In which reaction does the underlined carbon in the reactant have a bond angle that is larger than its corresponding carbon in the product?

A reducing $CH_3\underline{C}O_2H$ with LiA/H_4

B heating $CH_3\underline{C}HO$ with acidified $K_2Cr_2O_7$

C complete combustion of $\underline{C}H_2=CH_2$ in air

D heating $CH_3\underline{C}H_2Br$ under reflux with alcoholic KOH

24. Under identical conditions, even though it proceeds by the same mechanism, reaction 1 is faster than reaction 2.

reaction 1: $CH_3CHBrCH_3 + NaCN \rightarrow CH_3CH(CN)CH_3 + NaBr$

reaction 2: $CH_3CHBrCH_3 + NaI \rightarrow CH_3CHICH_3 + NaBr$

What factor will explain this result?

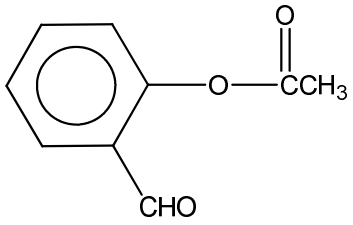
A The C–I bond is a stronger bond than the C–Br bond.

B The C–N bond is a stronger bond than the C–I bond.

C The cyanide ion is a stronger nucleophile than the iodide ion.

D The bromide ion is a stronger nucleophile than the iodide ion.

25. The following compound is a flavoring agent in food.



Which of the following reagents will give a positive chemical test with the above compound?

A phosphorus pentachloride

B aqueous alkaline iodine

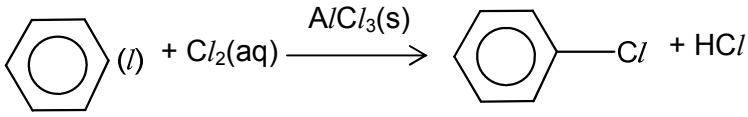
C acidified potassium dichromate(VI)

D Fehling's solution

26. The reaction conditions for four different reactions are given. Which reaction has the correct conditions?

[(alc) indicates an alcoholic solution.]

A $CH_3CH_3(g) + Cl_2(aq) \xrightarrow{\text{uv light}} CH_3CH_2Cl + HCl$

B  $\xrightarrow{AlCl_3(s)}$ $+ HCl$

C $CH_2{=}CH_2(g) + HBr(g) \longrightarrow CH_3CH_2Br$

D $CH_3CH_2I(l) + NaOH(alc) \xrightarrow{\text{heat}} CH_3CH_2OH + NaI$

27. Which halogenoalkane will undergo an S_N1 reaction and produce a yellow precipitate when $AgNO_3(aq)$ is added to it?

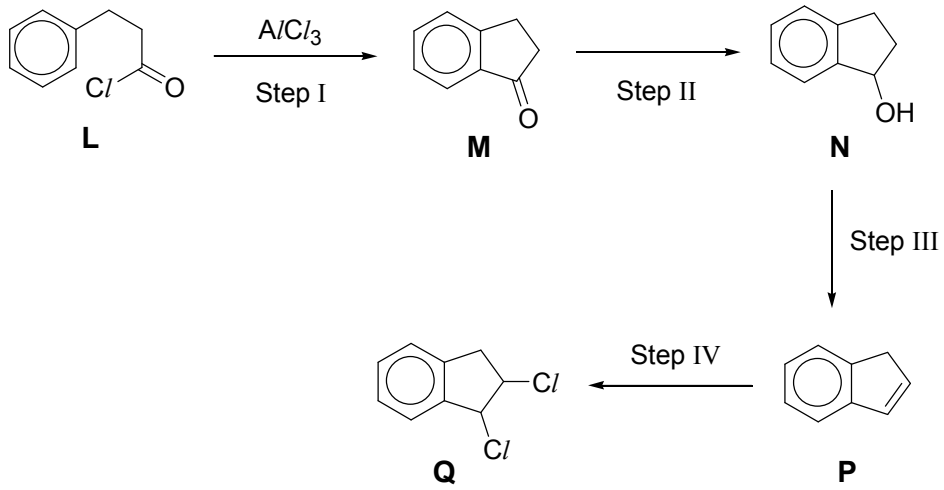
A 1-chlorobutane

B 1-iodobutane

C 2-chloro-2-methylpropane

D 2-iodo-2-methylpropane

28. Consider the following reaction scheme.



Which of the type of reactions is **incorrect**?

	Step	Type of reaction
A	I	Condensation
B	II	Reduction
C	III	Elimination
D	IV	Electrophilic addition

29. Which mixtures, on heating, will **not** produce a basic product containing deuterium, D?

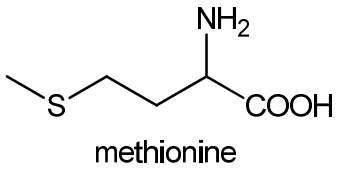
A $C_6H_5CH_2CN$ in D_2 with Ni catalyst

B $(ND_2H_2)_2SO_4$ and NaOD in D_2O

C $CH_3CH{=}CH_2$ with $D_2O(g)$ in the presence of H_3PO_4 catalyst

D $CH_3CH_2CONH_2$ and NaOD in D_2O

30. Which of the following statements about the amino acid, methionine, is true?



methionine

A It migrates towards the cathode under an applied electric current in a solution of $Na_2CO_3(aq)$.

B It exists predominantly as a zwitterion in a solution of pH 1.

C It exists as a crystalline solid with high melting point.

D It forms covalent disulfide linkage with another methionine molecule.

SECTION B

For each of the questions in this section, one or more of the three numbered statements **1** to **3** may be correct.

Decide whether each of the statements is or is not correct.

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, **2** and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

No other combination of statements is used as a correct response.

31. Gaseous particle **Y** has a proton number of n+1 and a charge of +2. Gaseous particle **X** has proton number n and is isoelectronic with **Y**.

Which of the following statements are true?

1 **X** has a larger radius than **Y**.

2 **X** requires less energy than **Y** when an electron is removed from each particle.

3 **X** releases less energy than **Y** when an electron is added to each particle.

32. Which of the following have a negative entropy change?

1 $Pb(NO_3)_2(aq) + CaSO_4(aq) \longrightarrow PbSO_4(s) + Ca(NO_3)_2(aq)$

2 Changing the temperature of nitrogen gas from $-50\,^{o}C$ to $-20\,^{o}C$

3 $2Na(s) + 2H_2O(l) \longrightarrow 2NaOH(aq) + H_2(g)$

33. Finely divided iron is used in the Haber process.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

What effect does iron have on this equilibrium?

1 It lowers the value of activation energy for the forward reaction.

2 It increases the rate of the reverse reaction.

3 It increases the average kinetic energy of the reacting particles.

A	B	C	D
1, **2** and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

34. The numerical values of the solubility product of strontium carbonate and strontium fluoride are 8.7×10^{-9} and 4.0×10^{-11} respectively at 25 ^{o}C.

Which of the following statements are true?

1 Addition of potassium fluoride to a solution containing strontium fluoride does not affect the solubility product of strontium fluoride.

2 Addition of potassium fluoride to a saturated solution of strontium fluoride decreases the solubility of strontium fluoride.

3 Strontium fluoride has a higher solubility than strontium carbonate.

35. Which of the following statements are correct for the sequence hydrogen chloride, hydrogen bromide and hydrogen iodide?

1 The thermal stability of hydrogen halides decreases.

2 The polarity of the hydrogen halide molecule decreases.

3 The enthalpy change of formation becomes more exothermic.

36. When the yellow liquid NCl_3 is stirred into aqueous sodium hydroxide, the reaction that occurs can be represented by the following equation.

$$2NCl_3(l) + 6NaOH(aq) \rightarrow N_2(g) + 3NaCl(aq) + 3NaOCl(aq) + 3H_2O(l)$$

Which of the following statements are true for this reaction?

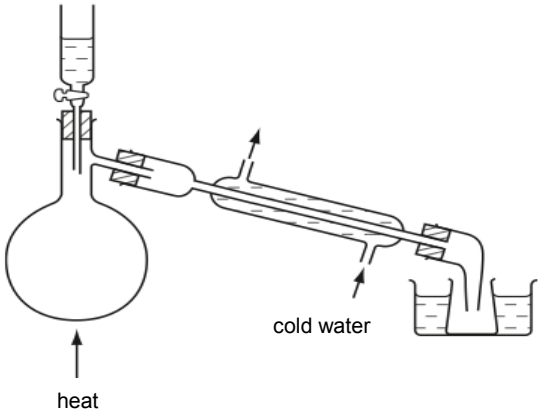
1 The oxidation state of nitrogen atom changes from -3 to 0.

2 A bleaching solution is produced after the reaction.

3 The final solution gives a precipitate with acidified silver nitrate.

A	B	C	D
1, **2** and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

37. The diagram shows some laboratory apparatus.



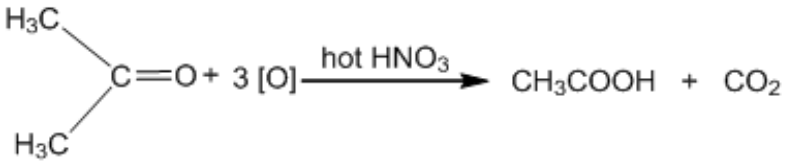
Which preparations could this apparatus be used for?

1 bromoethane, from ethanol, sodium bromide and concentrated sulfuric acid

2 ethanal, from ethanol, sodium dichromate(VI) and sulfuric acid

3 1,2–dibromoethane, from bromine and ethene

38. With vigorous oxidation using hot concentrated nitric acid, ketones can be oxidised to acids. The chemical equation showing the oxidation of propanone is as follows.



What are the products formed when butanone undergoes the same type of oxidation?

1 CO_2

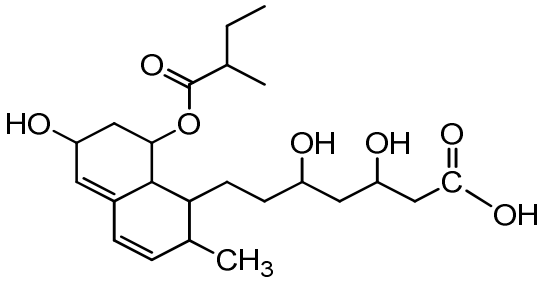
2 CH_3CO_2H

3 $CH_3CH_2CO_2H$

A	B	C	D
1, **2** and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

39. The cholesterol-lowering agents called *statins*, such as Pravastatin, are among the most

widely prescribed drugs in the world.



Pravastatin

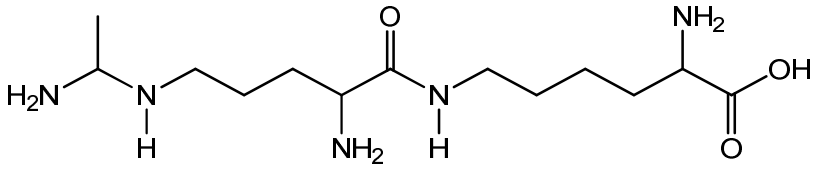
Which of the following statements about Pravastatin are correct?

1 1 mole of Pravastatin reacts with 2 moles of hot NaOH(aq).

2 When 1 mole of Pravastatin is treated with an excess of Na, 2 moles of H_2 are produced.

3 In the presence of a suitable catalyst, 1 mole of Pravastatin reacts with 4 moles of HC*l*(g).

40. Which of the following statements about compound **Z** are correct?



compound **Z**

1 **Z** can be hydrolysed to produce amino acids.

2 **Z** gives an orange precipitate with Brady's reagent.

3 **Z** forms amide and ester functional groups with ethanoyl chloride.