Name:		Index Number:		Class:	

DUNMAN HIGH SCHOOL
Preliminary Examination
Year 6

H2 CHEMISTRY 9647/01

Paper 1 Multiple Choice **27 September 2011**

1 hour

Additional Materials: Optical Mark Sheet
Data Booklet

INSTRUCTIONS TO CANDIDATES

1 Write your **name** and **class** on this question paper.

2 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 Optical Mark Sheet.

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

4 Any rough working should be done in this booklet.

5 You may use a calculator.

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[Turn over

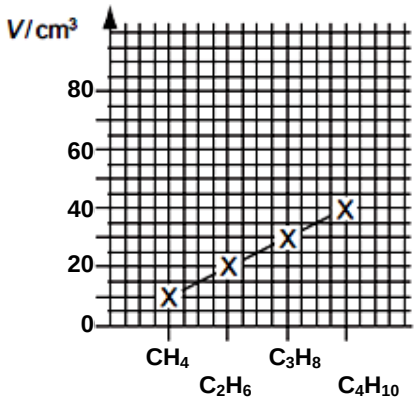
Section A

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

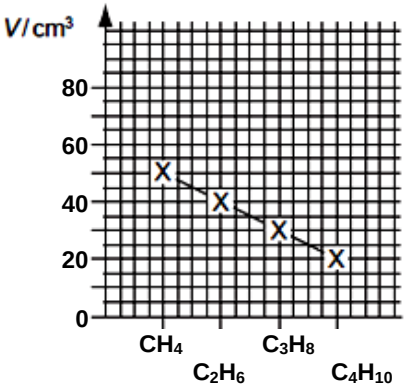
1 Samples of 10 cm^3 of each of the first four members of the alkane series are separately mixed with 70 cm^3 of oxygen. Each is then burned and the total volume, *V*, of the residual gas measured again at room temperature and pressure.

Which graph represents the results that would be obtained?

A



B



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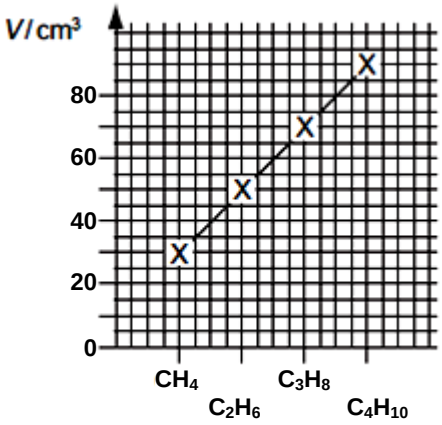

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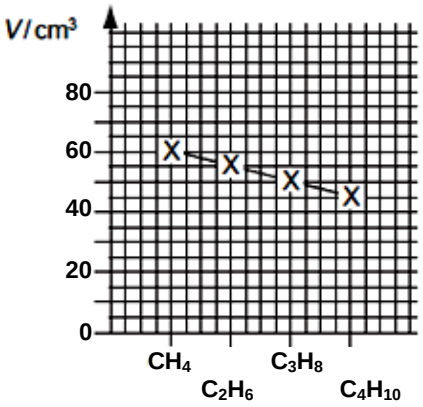


2 In a historically famous experiment Wöhler heated 'inorganic' ammonium cyanate in the absence of air. The only product of the reaction was 'organic' urea, $CO(NH_2)_2$. No other products were formed in the reaction.

What is the formula of the cyanate ion present in ammonium cyanate?

A CNO^-

B CNO^{2-}

C CO^-

D NO^-

3 Which of the following helps to explain the existence of a large number of stable metallic ionic oxides?

A Oxygen is too electronegative to form covalent bonds.

B The enthalpy change of atomisation of oxygen is low.

C Most metals have large ionisation energies.

D The lattice energies of the oxides counterbalance the unfavourable electron affinity of oxygen.

4 Which of the following has the same value as the standard enthalpy change of formation of carbon monoxide?
[ΔH_c^θ and ΔH_f^θ represent the standard enthalpy change of combustion and formation respectively.]

A $\frac{1}{2}\Delta H_c^\theta$ (C(graphite))

B $\Delta H_f^\theta (CO_2) - \Delta H_c^\theta$ (C(graphite))

C $\Delta H_f^\theta (CO_2) - \frac{1}{2}\Delta H_c^\theta$ (C(graphite))

D ΔH_c^θ (C(graphite)) – ΔH_c^θ (CO)

5 *The use of the Data Booklet is relevant to this question.*

Spatulas are often made from nickel.

Which aqueous solution should **not** be stirred with a nickel spatula because a reaction could occur?

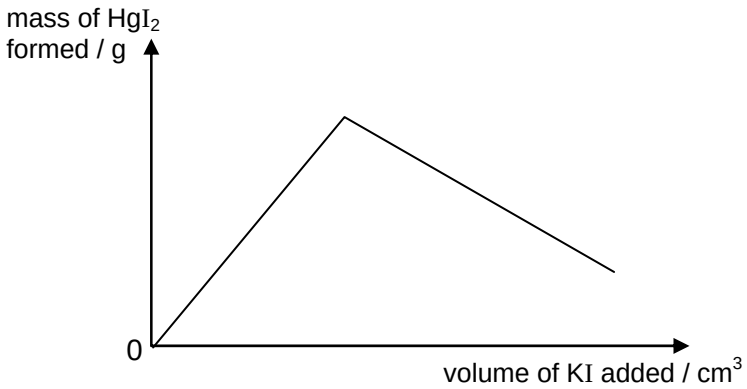
A Co^{2+} (aq) **B** Fe^{3+} (aq) **C** Mn^{2+} (aq) **D** V^{2+} (aq)

6 The reaction between **P** and **Q** in aqueous solution is acid–catalysed, and the reaction is first order with respect to the hydrogen ion. If all other conditions are kept constant, what is the ratio of

$$\frac{\text{rate of reaction at pH 3}}{\text{rate of reaction at pH 1}} ?$$

A 0.01 **B** 0.33 **C** 1 **D** 3

7 When a KI solution is added to a solution of mercury(II) chloride, a precipitate of mercury(II) iodide is formed. A student plotted the mass of the precipitate formed versus the volume of potassium iodide solution added and obtained the following graph.



What can be a possible explanation for the shape of the graph?

A After a certain amount of KI added, no more precipitate is formed and the concentration of HgI_2 decreases with more KI added.

B Mercury(II) iodide is soluble in excess KI because of the common ion effect.

C Mercury(II) iodide reacts with excess KI to form a soluble complex.

D When more KI is added, the ionic product of the solution becomes less than the solubility product and more HgI_2 dissolves.

8 In some fireworks there is a reaction between powdered aluminium and powdered barium nitrate in which heat is evolved and an unreactive gas is produced.

What is the equation for this reaction?

A $2Al + Ba(NO_3)_2 \rightarrow Al_2O_3 + BaO + 2NO$

B $4Al + 4Ba(NO_3)_2 \rightarrow 2Al_2O_3 + 4Ba(NO_2)_2 + O_2$

C $10Al + 3Ba(NO_3)_2 \rightarrow 5Al_2O_3 + 3BaO + 3N_2$

D $10Al + 18Ba(NO_3)_2 \rightarrow 10Al(NO_3)_3 + 18BaO + 3N_2$

9 Which group of particles is in order of increasing size?

A	N	O	F
B	N^{3-}	O^{2-}	F^-
C	Na^+	Mg^{2+}	Al^{3+}
D	Na^+	Ne	F^-

10 Consecutive elements **X**, **Y**, **Z** are in the third period of the Periodic Table. Element **Y** has the highest first ionisation energy and the lowest melting point.

What could be the identities of **X**, **Y** and **Z**?

A aluminium, silicon, phosphorus

B magnesium, aluminium, silicon

C silicon, phosphorus, sulfur

D sodium, magnesium, aluminium

11 Two properties of non–metallic elements and their atoms are as follows.

- property 1 has an oxide that can form a strong acid in water
- property 2 has no paired 3p electrons

Which properties do silicon and sulfur have?

	silicon	sulfur
A	1 and 2	1 only
B	1 and 2	1 and 2
C	2 only	1 only
D	2 only	1 and 2

12 The oxide and chloride of an element **W** are separately mixed with water. The two resulting solutions have the same effect on litmus.

What is element **W**?

A sodium

B magnesium

C aluminium

D phosphorus

13 Aluminium chloride catalyses certain reactions by forming carbocations (carbonium ions) with chloroalkanes as shown.

$$RCl + AlCl_3 \rightarrow R^+ + AlCl_4^-$$

Which property makes this reaction possible?

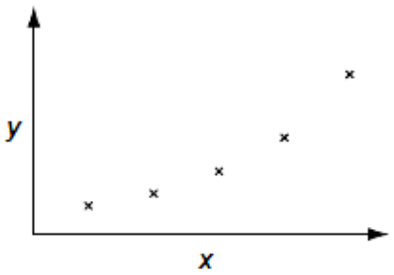
A Aluminium atom in $AlCl_3$ has an incomplete octet of electrons.

B Chlorine atom in RCl has a vacant p orbital.

C $AlCl_3$ exists as the dimer Al_2Cl_6 in the vapour.

D $AlCl_3$ is a covalent molecule.

14 Use of the *Data Booklet* is relevant to this question.
The sketch graph shows the variation of one physical or chemical property with another for the Period 3 elements.



What are the correct labels for the axes?

	x–axis	*y*–axis
A	atomic number	mass number
B	atomic number	melting point
C	first ionisation energy	atomic number
D	first ionisation energy	atomic radius

15 Due to their similar ionic radii, the reactions of lithium and magnesium and their corresponding compounds are very similar.

Which statement concerning the reactions of lithium and its compounds is correct?

A Lithium carbonate decomposes on heating at a relatively low temperature, forming lithium oxide and carbon dioxide.

B Lithium nitrate decomposes on heating, forming lithium nitrite and oxygen.

C Lithium burns only slowly in oxygen.

D Lithium reacts violently with cold water, liberating hydrogen.

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

A reactivity with water

B second ionisation energy

C solubility of hydroxides

D stability of the carbonates

17 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

18 Mohr's salt is a pale green crystalline solid which is soluble in water. It is a 'double sulfate' which contains two cations, one of which is Fe^{2+}. The identity of the second cation is determined by heating solid Mohr's salt with solid sodium hydroxide and a colourless gas is evolved. The gas readily dissolves in water giving an alkaline solution. A grey–green solid residue was also formed which was insoluble in water.

What are the identities of the gas and the solid residue?

	gas	residue
A	H_2	$FeSO_4$
B	NH_3	$Fe(OH)_2$
C	NH_3	Na_2SO_4
D	SO_2	$Fe(OH)_2$

19 A compound **U** has all of the properties below.

- It is a liquid at 25 °C.
- It mixes completely with water.
- It reacts with aqueous sodium hydroxide.

What could **U** be?

A ethanoic acid

B ethanol

C ethanal

D ethyl ethanoate

20 In which class of compound, in its general formula, is the ratio of hydrogen atoms to carbon atoms the highest?

A alcohols

B aldehydes

C carboxylic acids

D halogenoalkanes

21 Which property does benzene have as a consequence of the delocalised electrons present in its molecule?

A Addition reactions of benzene take place more easily than substitution.

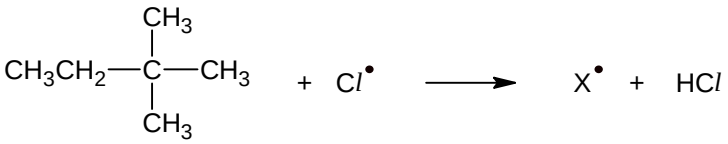
B Benzene is a good conductor of electricity.

C Substitution in benzene takes place at one particular carbon atom.

D The carbon–carbon bond lengths are between those of C–C bonds and C=C bonds.

22 When heated with chlorine, the hydrocarbon 2,2–dimethylbutane undergoes free radical substitution.

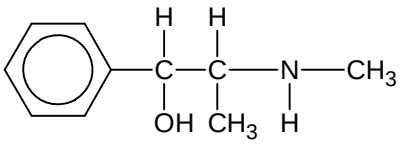
In a propagation step, the free radical $X^{\bullet}$ is formed.



How many different forms of $X^{\bullet}$ are possible?

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

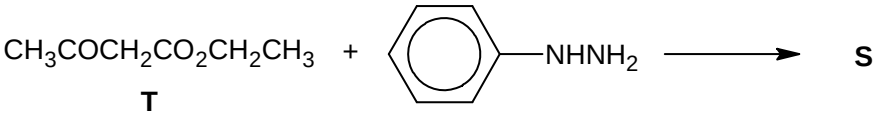
23 Ephedrine is a drug that is widely used in cold and allergy medications.



Which of the following pairs of reagents consists of one which reacts with ephedrine and one which does not react with ephedrine?

A	CH_3COOH	CH_3COCl
B	CH_3Br	NaOH (aq)
C	HCl(aq)	PCl_5
D	$[Ag(NH_3)_2]^+$	Br_2

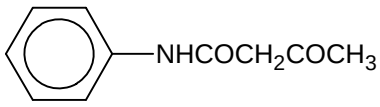
24 The first stage in the synthesis of antipyrine, a drug used in reducing fever, is the reaction between compound **T** and phenylhydrazine.



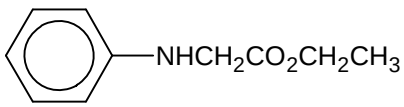
T

What will be the product **S**?

A



B



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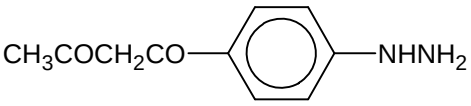
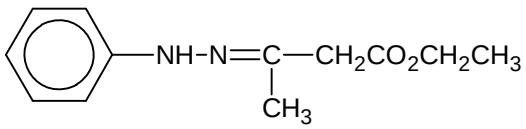
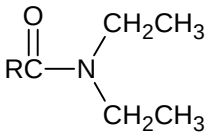


D



25 A hallucinogen has the following structure.



Which one of the following is ***least*** likely formed when the hallucinogen is boiled with excess potassium hydroxide solution?

A $CH_3CH_2NH_2$ **B** $(CH_3CH_2)_2NH_2^+$

C $(CH_3CH_2)_2NH$ **D** $RCOO^-K^+$

26 **P**, **Q** and **R** are three different 3–carbon compounds. **P** and **Q** react together to form an ester. **R** reacts with **P** to give the same ester but much ***less*** readily when compared to **Q**.

Compound **Q** could be

A propanoic acid **B** propanone

C propan–2–ol **D** propanoyl bromide

27 The mechanism for a certain reaction is given below.

$$(CH_3)_3COH + HCl \xrightarrow{fast} (CH_3)_3\overset{+}{C}OH_2 + Cl^-$$

$$(CH_3)_3\overset{+}{C}OH_2 \xrightarrow{slow} (CH_3)_3\overset{+}{C} + H_2O$$

$$(CH_3)_3\overset{+}{C} + Cl^- \xrightarrow{fast} (CH_3)_3CCl$$

Which of the following statement is **not** true?

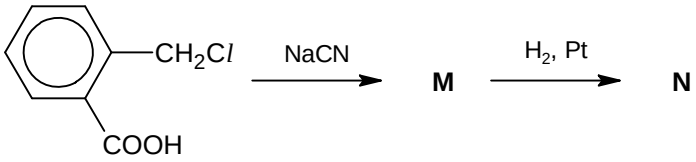
A $(CH_3)_3\overset{+}{C}OH_2$ and $(CH_3)_3COH$ are conjugate acid–base pair.

B The nucleophile in the reaction is HCl.

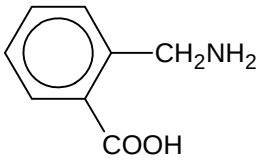
C The overall reaction is $(CH_3)_3COH + HCl \rightarrow (CH_3)_3CCl + H_2O$

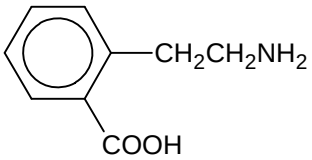
D The above mechanism is a nucleophilic substitution reaction.

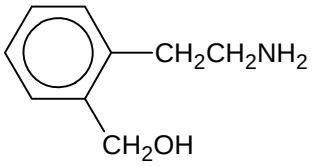
28 A reaction sequence is shown below.



What will be the product **N**?

A


B


C


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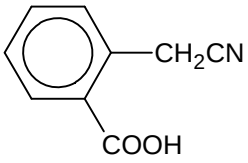


29 Isopentyl acetate, $CH_3CO_2CH_2CH_2CH(CH_3)_2$ is prepared by reacting an excess of ethanoic acid with isopentyl alcohol in the presence of sulfuric acid.

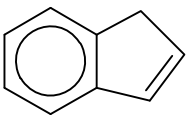
$$(CH_3)_2CHCH_2CH_2OH + CH_3COOH \rightleftharpoons CH_3CO_2CH_2CH_2CH(CH_3)_2 + H_2O$$

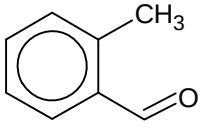
The method to obtain the product, isopentyl acetate, would involve

I: adding anhydrous sodium sulfate
II: distillation
III: separation of liquids using a separating funnel
IV: shaking the mixture with $NaHCO_3$

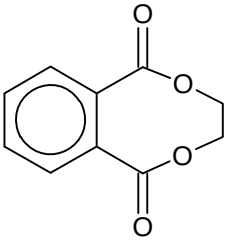
A I, II, III
B II, III, IV
C I, II, IV
D I, II, III, IV

30 Which of the following organic compound will ***not*** produce 1,2–benzene–dicarboxylic acid when subjected to the reagents and conditions as specified?

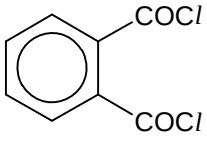
A

, $KMnO_4/H^+$, heat

B


, $K_2Cr_2O_7/H^+$, heat

C


, H^+ (aq), heat

D


, H^+ (aq)

Section B

For each question, 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 (you may find it helpful to put a tick against the statements which you consider to be 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 Chlorine exists naturally as a mixture of the isotopes ^{35}Cl and ^{37}Cl. Which of the following physical properties would be different for the gases $^{35}Cl_2$ and $^{37}Cl_2$?

1 average molecular kinetic energy at the same temperature and pressure.

2 boiling point at atmospheric pressure.

3 relative molecular mass.

32 In microwave ovens, the wave energy is absorbed by certain polar molecules.

Which of the following would absorb microwave energy?

1 CH_3CO_2H **2** $NaCl$ **3** SiO_2

33 0.10 mol dm^{-3} solutions of potassium carbonate, sodium ethanoate and ammonium sulfate are prepared. Which of the solutions would have pH greater than 7?

1 ammonium sulfate

2 potassium carbonate

3 sodium ethanoate

34 Which process is more exothermic for gaseous magnesium ions than for gaseous calcium ions?

1 The conversion of gaseous ions into gaseous atoms.

2 The hydration of gaseous ions.

3 The formation of an ionic oxide lattice.

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.

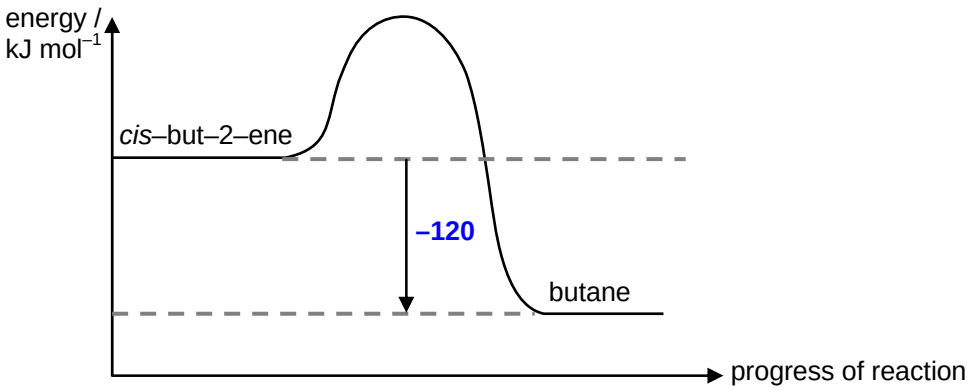
35 Which of the following would yield either hydrogen, oxygen or both gases upon electrolysis?

1 $CuSO_4(aq)$ using Cu electrodes

2 $MgBr_2(aq)$ using C electrodes

3 $Na_2SO_4(aq)$ using Pt electrodes

36 The enthalpy change of hydrogenation, $\Delta H_{hydrogenation}^{\theta}$ of *cis*–but–2–ene is found to be –120 kJ mol^{-1}. When a mixture of *cis*– and *trans*–but–2–ene is allowed to undergo hydrogenation to form butane, the overall $\Delta H_{hydrogenation}^{\theta}$ is found to be –117 kJ mol^{-1}. It is known that *cis*–but–2–ene is less stable than the *trans*–isomer by 4 kJ mol^{-1}.



Which of the following statement is correct?

1 $\Delta H_{hydrogenation}^{\theta}$ of *trans*–but–2–ene is –120 kJ mol^{-1}.

2 $\Delta H_{hydrogenation}^{\theta}$ value can be used to determine stability of cis–trans isomers.

3 The fraction of *cis* but–2–ene in the mixture is 0.25.

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.

37 Given the following bond energies:

bond	*bond energy / kJ mol^{-1}*
C–C	350
C=C	610

What can be deduced from the data?

1 The π bond is stronger than the σ bond.

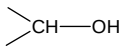
2 The π bond energy can be determined from the data.

3 The C≡C bond energy is estimated to be 870 kJ mol^{-1}.

38 In the presence of concentrated acids, alcohols can act as a base. Which of the following ions can be found in a mixture of ethanol and excess concentrated sulfuric acid?

1 $CH_3CH_2O^-$ **2** $CH_3CH_2OH_2^+$ **3** HSO_4^-

39 2–methylpropan–2–ol, $(CH_3)_3COH$, is more difficult to oxidise than propan–2–ol, $(CH_3)_2CHOH$. This is because 2–methylpropan–2–ol

1 does not contain the  grouping.

2 has more methyl groups, which are much larger than hydrogen atoms, hence posing steric hindrance to the attacking oxidising agent.

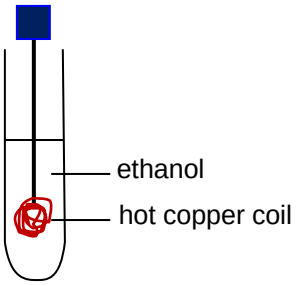
3 has a higher boiling point.

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.

40 A piece of hot copper coil is repeatedly plunged into ethanol as shown in the diagram below. To the resulting colourless solution **L**, ammonical silver nitrate is added and a silver mirror is observed. Which of the statement is correct?



1 Both ethanol and solution **L** when reacted with alkaline aqueous iodine will give a yellow solid.

2 Ethanol is oxidised on the surface of the copper coil.

3 The copper is reduced in the above reaction.

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DHS H2 CHEMISTRY YEAR 6 PRELIMINARY EXAMINATION 2011

Paper 1 MCQ – Answers

1	2	3	4	5	6	7	8	9	10
D	**A**	**D**	**D**	**B**	**A**	**C**	**C**	**D**	**C**

11	12	13	14	15	16	17	18	19	20
C	**D**	**A**	**A**	**A**	**B**	**A**	**B**	**A**	**A**

21	22	23	24	25	26	27	28	29	30
D	**C**	**B**	**D**	**B**	**D**	**B**	**B**	**D**	**B**

31	32	33	34	35	36	37	38	39	40
C	**D**	**C**	**A**	**C**	**C**	**C**	**C**	**D**	**B**