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DUNMAN HIGH SCHOOL
Preliminary Examination 2017
Year 6

H2 CHEMISTRY

9729/01

Paper 1 Multiple Choice

25 September 2017

1 hour

Additional Materials: Data Booklet
 Optical Mark Sheet

INSTRUCTIONS TO CANDIDATES

- 1 Write your **name**, **index number** and **class** on this question paper and the OTAS Mark Sheet.
- 2 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 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 The use of an approved scientific calculator is expected, where appropriate.
- 6 On the OTAS Mark Sheet, please shade the code as "Class/Index number".

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

Which sample of gas contains twice the number of atoms as 4 g of helium gas, He?

- A 22 g of carbon dioxide, CO₂
- B 8 g of methane, CH₄
- C 4 g of hydrogen, H₂
- D 12 g of steam, H₂O

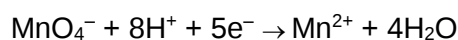
- 2 When 10 cm³ of a gaseous hydrocarbon was sparked with excess oxygen gas and cooled to room temperature, the gaseous mixture contracted by 30 cm³. When the residual gas was passed through aqueous potassium hydroxide, there was a further contraction of 40 cm³.

What is the hydrocarbon?

- A 2-methylpropene
- B propane
- C butadiene
- D butane

- 3 Ethanedioate ions, C₂O₄²⁻, are oxidised by acidified aqueous potassium manganate(VII) to give carbon dioxide. What volume of 0.020 mol dm⁻³ potassium manganate(VII) is required to completely oxidise 2.0 × 10⁻³ mol of the salt NaHC₂O₄·H₂C₂O₄?

The half equation for MnO₄⁻ is given below:



- | | |
|----------------------|-----------------------|
| A 20 cm ³ | B 40 cm ³ |
| C 80 cm ³ | D 100 cm ³ |

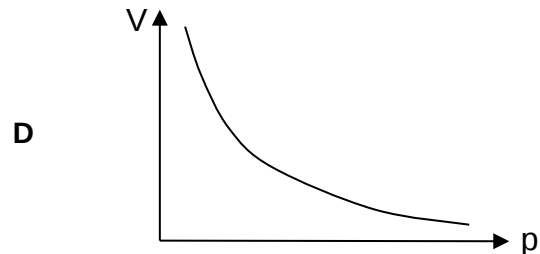
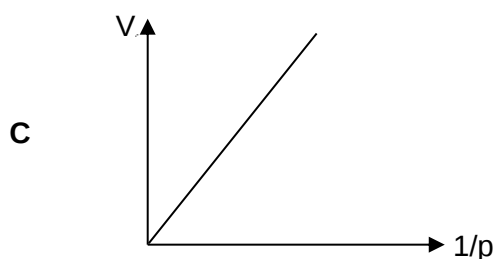
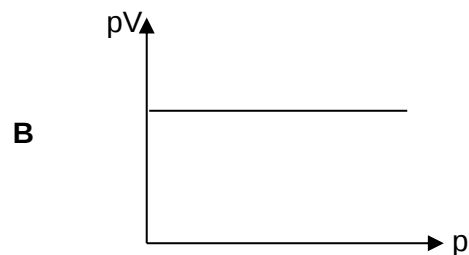
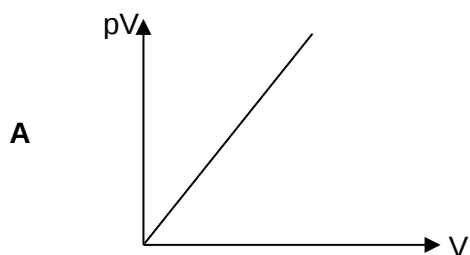
- 4 The successive ionisation energies, in kJ mol^{-1} , of elements **G** and **H** are given below.

G	580	1820	2740	11600	14800	18400	23300
H	940	2050	2970	4140	6590	7880	14900

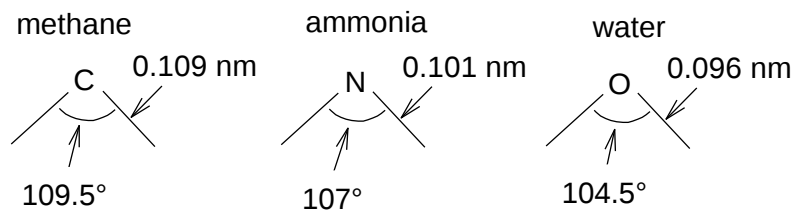
Which statements about elements **G** and **H** are true?

- 1 The first ionisation energy of **G** is lower than that of the element preceding it in the Periodic Table.
 - 2 **G** and **H** forms a compound with the formula G_3H_2 .
 - 3 **H** has an outer electronic configuration $ns^2 np^4$.
 - 4 When oxides of **G** and **H** are added separately to water containing Universal Indicator solution, the solution turns blue and red respectively.
- A 1 and 3 only
 B 3 and 4 only
 C 2, 3 and 4 only
 D 1, 2 and 4 only

- 5 Which graph does **not** describe the relationship between volume and pressure for a fixed mass of an ideal gas under constant temperature?



- 6 The bond lengths and bond angles in the molecules of methane, ammonia and water may be represented as follow:



What causes this trend in the bond angles shown?

- 1 Increasing repulsion between hydrogen atoms as the bond length decreases.
 - 2 Number of non-bonding electron pairs of the central atom in the molecule.
 - 3 Non-bonding electron pair-bonding electron pair repulsion is greater than bonding electron pair-bonding electron pair repulsion.
- A 3 only
 B 1 and 2 only
 C 2 and 3 only
 D 1, 2 and 3
- 7 Equimolar samples of gaseous NH_3 and HBr were injected into an evacuated flask maintained at a fixed temperature. Some white crystals of NH_4Br were observed in the flask.
- Which is the only piece of information you would need to calculate the value of K_p ?
- A initial amount of HBr used
 B mass of NH_4Br formed at equilibrium
 C base dissociation constant, K_b , of NH_3
 D total pressure of the system at equilibrium
- 8 *Use of the Data Booklet is relevant to this question.*

Nickel tetracarbonyl, $\text{Ni}(\text{CO})_4$, is an intermediate in the Mond process. It has a melting point of -17.2°C and a boiling point of 43°C .

A 40.3 g sample of nickel tetracarbonyl is placed in a 10 dm^3 vessel under an atmosphere of neon gas at 20°C and a pressure of 1.0 atm. When the vessel is warmed to 60°C and the contents are allowed to reach equilibrium, 10% of the nickel tetracarbonyl has dissociated into nickel metal and carbon monoxide.

What is the total pressure of the gases in the vessel at 60°C ?

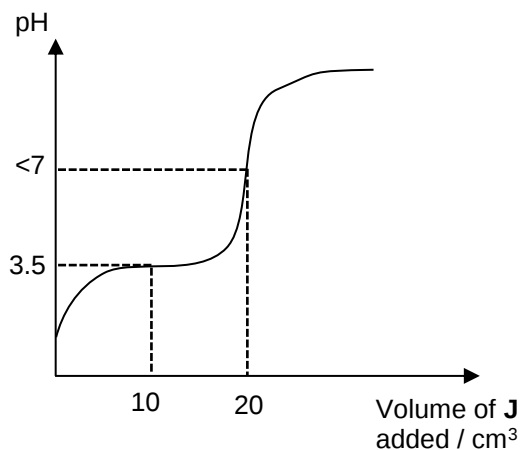
[M_r of $\text{Ni}(\text{CO})_4 = 170.7$]

- A 2.04 atm B 1.97 atm C 1.37 atm D 0.837 atm

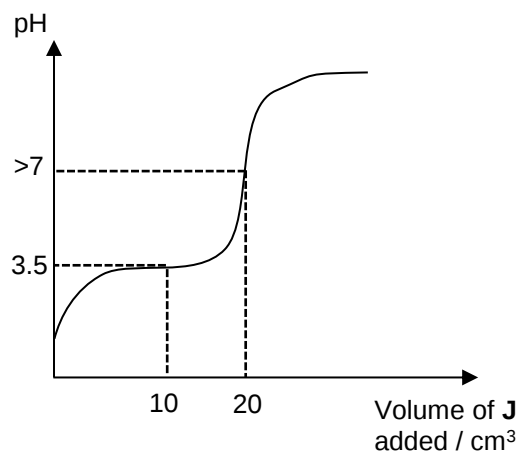
- 9 **J** is a monoacidic weak base with a pK_b of 3.5.

A total of 50 cm^3 of 0.1 mol dm^{-3} of **J** was added dropwise to 20 cm^3 of 0.1 mol dm^{-3} HNO_3 . Which pH curve correctly describes the changes in the pH of the resultant solution as **J** was added to HNO_3 ?

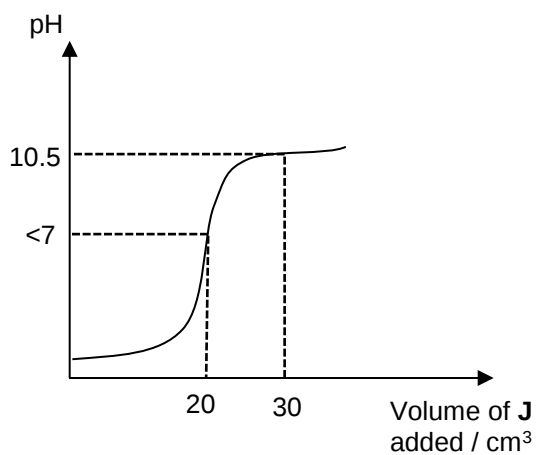
A



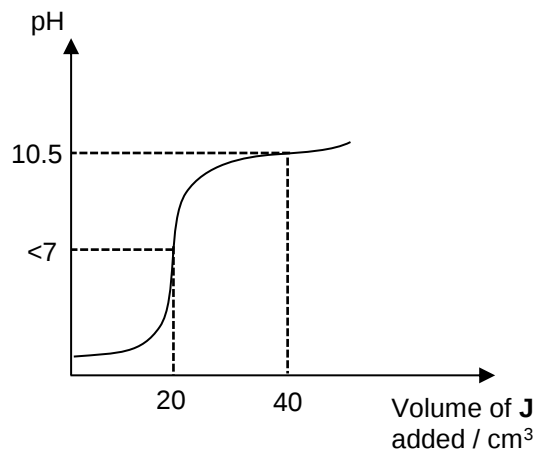
B



C



D



- 10 Consider the following solutions at 298K:

solutions	concentration / mol dm ⁻³
NH ₃ ($K_b = 1.8 \times 10^{-5}$ mol dm ⁻³)	0.010
CH ₃ COOH ($K_a = 1.8 \times 10^{-5}$ mol dm ⁻³)	0.010
NH ₄ Cl	0.10
CH ₃ COO ⁻ Na ⁺	0.10

Which sequence correctly ranks these solutions in increasing pH?

- A NH₄Cl < CH₃COO⁻Na⁺ < CH₃COOH < NH₃
 B NH₄Cl < CH₃COOH < NH₃ < CH₃COO⁻Na⁺
 C CH₃COOH < NH₄Cl < CH₃COO⁻Na⁺ < NH₃
 D CH₃COOH < NH₄Cl = CH₃COO⁻Na⁺ < NH₃

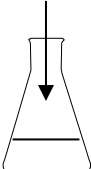
- 11 The table below lists the K_{sp} values of some lead containing salts.

salts	K_{sp} value
PbCrO ₄	2.8×10^{-13}
PbCO ₃	7.4×10^{-14}
Pb(OH) ₂	1.2×10^{-15}
Pb ₃ (AsO ₄) ₂	4.0×10^{-36}

A student prepared four solutions containing x mol dm⁻³ of Pb²⁺ ions. She then added solutions containing an anion drop-wise to one of these Pb²⁺ containing solutions, as shown below.

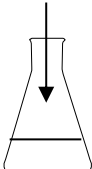
Which set-up will allow for the greatest volume of anion-containing solution to be added before a precipitate is formed?

CrO₄²⁻ (aq)
 y mol dm⁻³



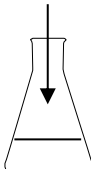
A

CO₃²⁻ (aq)
 y mol dm⁻³



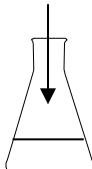
B

OH⁻ (aq)
 y mol dm⁻³



C

AsO₄³⁻ (aq)
 y mol dm⁻³



D

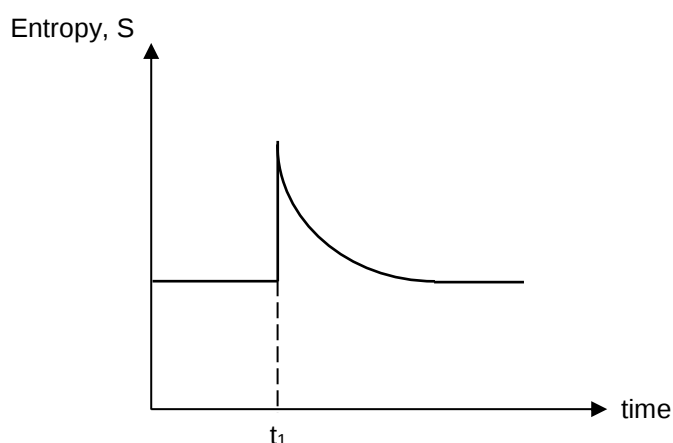
12 *Use of the Data Booklet is relevant to this question.*

Hexamine has an enthalpy change of combustion of $-4288 \text{ kJ mol}^{-1}$.

12.4 g of hexamine tablets were burnt to heat up 850 g of water. Given that the process was 75% efficient and temperature of the water increased from 10°C to 90°C, what is the molar mass of hexamine?

- | | | | |
|----------|---------------------------|----------|---------------------------|
| A | 124.7 g mol ⁻¹ | B | 140.3 g mol ⁻¹ |
| C | 187.1 g mol ⁻¹ | D | 249.4 g mol ⁻¹ |

13 1 mol of unknown organic compound **W** was placed in a closed vessel. This closed system was kept at room temperature and pressure. The absolute entropy, S , of the system was measured over a period of time as shown in the graph below:

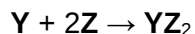


At time t_1 , 1 mol of unknown compound **X** was added into the closed vessel and the vessel was sealed again.

What could be compounds **W** and **X**?

	W	X
A	ethanol	sodium metal
B	pent-2-ene	liquid bromine
C	propanoic acid	sodium carbonate
D	propanoic acid	sodium borohydride

- 14** Aqueous solutions **Y** and **Z** react according to the following equation:



The reaction rate of the above reaction is determined to follow the rate equation:

$$\text{rate} = k[\text{Y}][\text{Z}]$$

Which statements must be true regarding the above reaction?

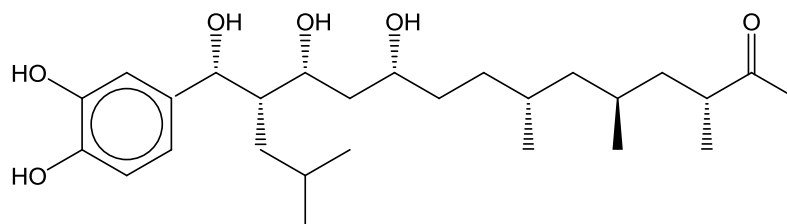
- 1** The reaction mechanism has at least 2 steps.
- 2** Adding water to the reaction will not affect the rate of reaction.
- 3** When **Y** is present in large excess, the half-life of **Z** is independent of **[Z]**.
- 4** The half-lives of **Y** and **Z** remain constant when an initial concentration of 1 mol dm^{-3} of each reactant is used.

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

- 15** Which statement about Group 2 metals is correct?

- A** Melting point increases down the group.
- B** Reducing strength increases down the group.
- C** Each ground state atom contains 2 unpaired electrons in its valence shell.
- D** The second electron is lost more easily than the first electron, forming the M^{2+} cation with a noble gas configuration.

- 16 Baulamycin B is found to halt the growth of methicillin-resistant *Staphylococcus aureus* (MRSA) and anthrax.



Baulamycin B

What is true of its enantiomer?

- A It has 256 stereoisomers.
 B It is inactive against MRSA.
 C It reacts with 5 mol of sodium hydroxide.
 D It forms a violet colouration with neutral iron(II) chloride.
- 17 Halothane, CF_3CHBrCl is a common anaesthetic.

Which reaction is a termination step in the chain reaction between chlorine and halothane, in the presence of ultraviolet light?

- A $\dot{\text{C}}\text{F}_2\text{CHBrCl} + \dot{\text{Cl}} \rightarrow \text{CF}_2\text{ClCHBrCl}$
 B $\text{CF}_3\dot{\text{C}}\text{HCl} + \dot{\text{H}} \rightarrow \text{CF}_3\text{CH}_2\text{Cl}$
 C $\text{CF}_3\dot{\text{C}}\text{BrCl} + \text{Cl}_2 \rightarrow \text{CF}_3\text{CBrCl}_2 + \dot{\text{Cl}}$
 D $2 \text{CF}_3\dot{\text{C}}\text{HBr} \rightarrow (\text{CF}_3\text{CHBr})_2$

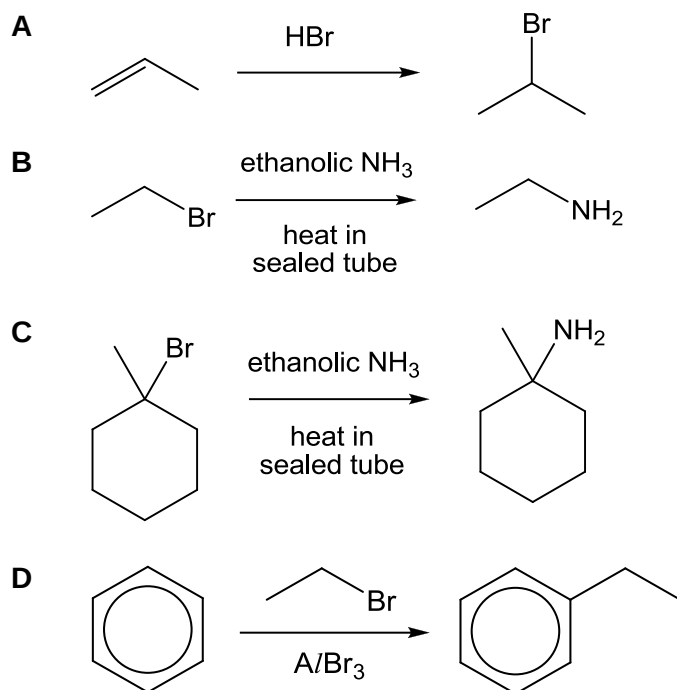
- 18 A comparison is made of the nitration reactions of some aromatic compounds.

How will the reaction temperatures required compare?

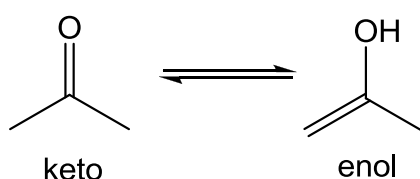
	lowest	—————→	highest
A	benzoic acid	benzene	phenylamine
B	phenylamine	benzene	ethylbenzene
C	phenylamine	ethylbenzene	benzaldehyde
D	benzoic acid	benzaldehyde	ethylbenzene

- 19 As a reaction progresses, there is no change in the hybridisation state of a reactive carbon from the reactant to the **reaction intermediate**.

Which reaction does this statement apply to?



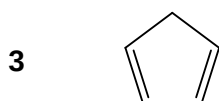
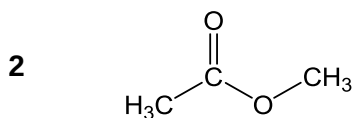
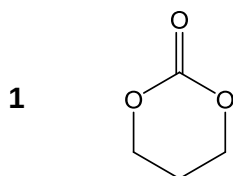
- 20 Carbonyl compounds exist as an equilibrium between its keto and enol forms. For propanone, the K_c of the tautomerism process is 3×10^{-7} .



Which statement explains the equilibrium position for the tautomerism of propanone?

- A** The C=O bond is stronger than the C=C bond.
- B** The O–H bond is stronger than the C–H bond.
- C** The hydroxyl group exerts an electron-withdrawing effect.
- D** A lone pair of electrons on oxygen moves to the C–O bond in enol, resulting in partial double bond character.

- 21 Which compounds liberate carbon dioxide gas when heated with acidified potassium manganate(VII)?

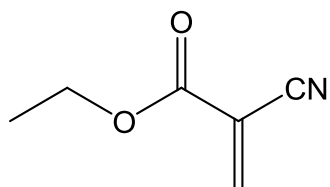


- A 3 only
 B 1 and 2 only
 C 2 and 3 only
 D 1, 2 and 3

- 22 How may the ester, phenyl 2-methylpropanoate, be made in the laboratory?

- A $\text{CH}_3\text{CH}(\text{CH}_3)\text{COOH} + \text{C}_6\text{H}_5\text{OH} \xrightarrow[\text{heat}]{\text{conc. H}_2\text{SO}_4} \text{ester} + \text{H}_2\text{O}$
 B $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_2\text{OH} + \text{C}_6\text{H}_5\text{COOH} \xrightarrow[\text{heat}]{\text{conc. H}_2\text{SO}_4} \text{ester} + \text{H}_2\text{O}$
 C $\text{CH}_3\text{CH}(\text{CH}_3)\text{COCl} + \text{C}_6\text{H}_5\text{OH} \longrightarrow \text{ester} + \text{HCl}$
 D $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_2\text{OH} + \text{C}_6\text{H}_5\text{COCl} \longrightarrow \text{ester} + \text{HCl}$

- 23 Ethyl cyanoacrylate, $C_6H_7O_2N$, is the major component of superglue.



ethyl cyanoacrylate

Which statements about the molecule are true?

- 1 It contains 3 lone pairs of electrons.
- 2 It reacts with H_2 in the presence of Ni catalyst to form $C_6H_{11}O_2N$.
- 3 It contains 4 π bonds.
- 4 It is hydrolysed by dilute H_2SO_4 to give a diacid and an alcohol.

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

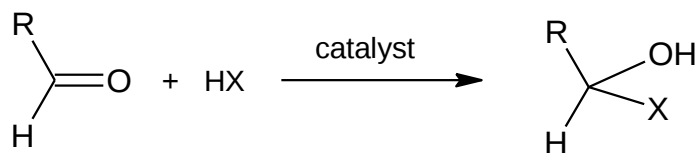
- 24 When a compound **O** is heated in a tube containing reagent **P**, a colour change is observed. The product formed is then heated with reagent **Q**, giving compound **R**. **R** can react with reagent **S** to give an observable change.

Which combination could be **O**, **P**, **Q** and **S**?

	O	P	Q	S
1	$CH_2=CH_2$	Br_2 in CCl_4	excess conc. NH_3	$Cu^{2+}(aq)$
2	$CH_2=CHCH_3$	acidified $KMnO_4(aq)$	methanolic $NaBH_4$	Tollens' reagent
3	$CH_2=CH_2$	$HBr(g)$	$NaOH(aq)$	hot alkaline $I_2(aq)$

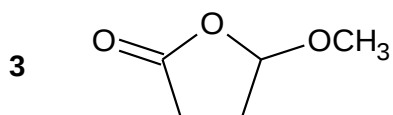
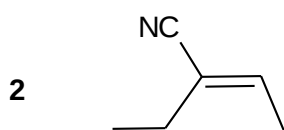
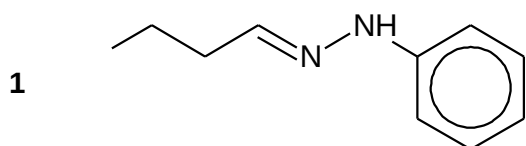
- A 1 only
- B 1 and 2 only
- C 2 and 3 only
- D 1, 2 and 3

- 25 There is a range of reactions of the aldehyde group which have the pattern



of which the formation of the cyanohydrin (where X = CN) is one.

Which compounds could be obtained by such an addition to an aldehyde group, followed by dehydration?



A 1 and 2 only

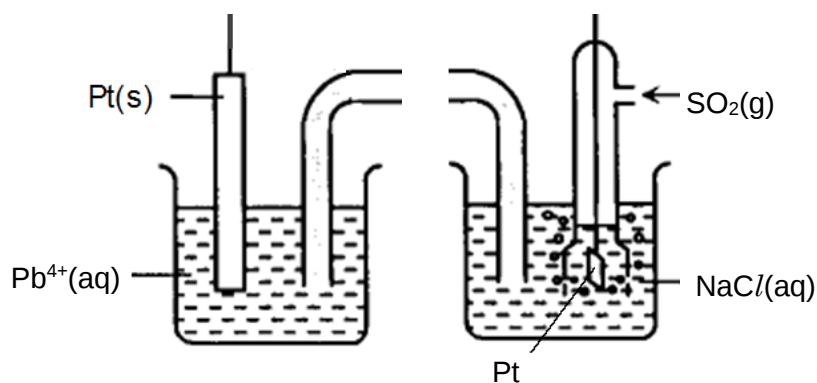
B 1 and 3 only

C 2 and 3 only

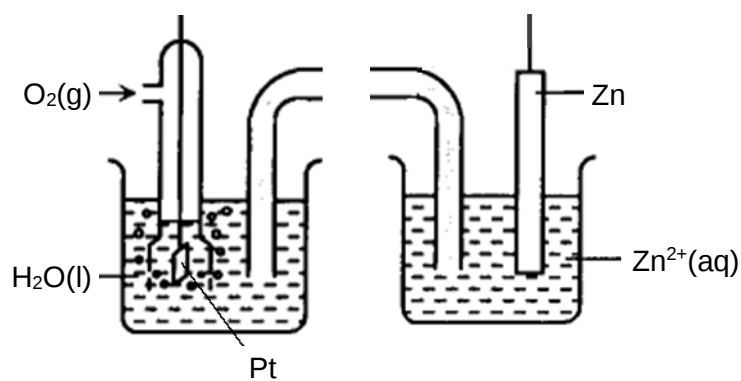
D 1 only

26 Which pair of half-cells will form an electrochemical cell that generates electricity?

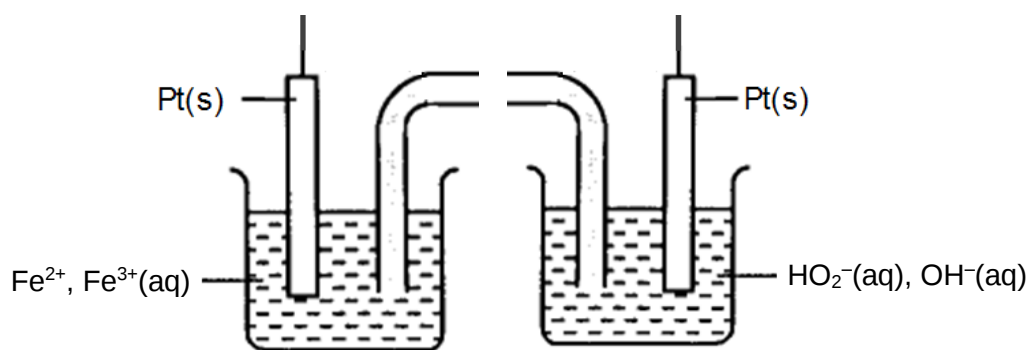
A



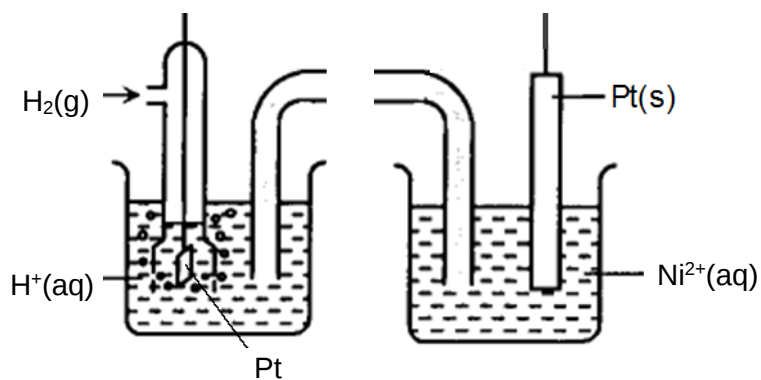
B



C

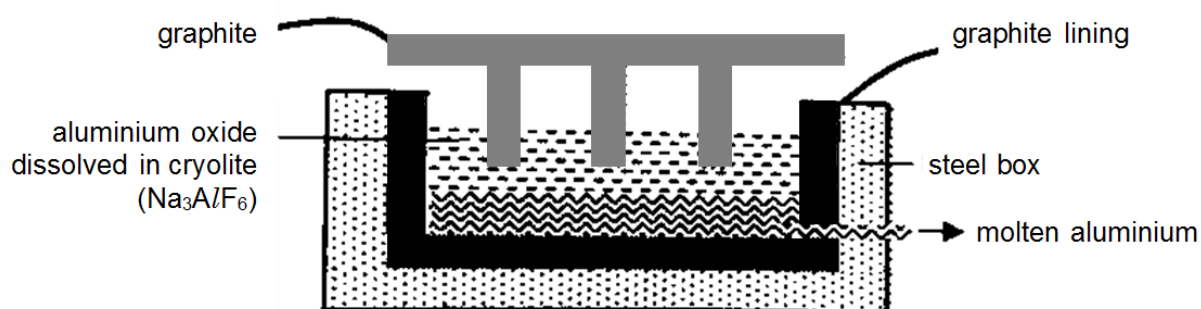


D



27 Use of the Data Booklet is relevant to this question.

Aluminium ore is called bauxite. The bauxite can be purified to yield a white powder, aluminium oxide, from which aluminium can be extracted by electrical means. A current of 100 A is passed through the cell for 15 minutes. At the end of the extraction, one of the graphite electrodes has decreased in mass.

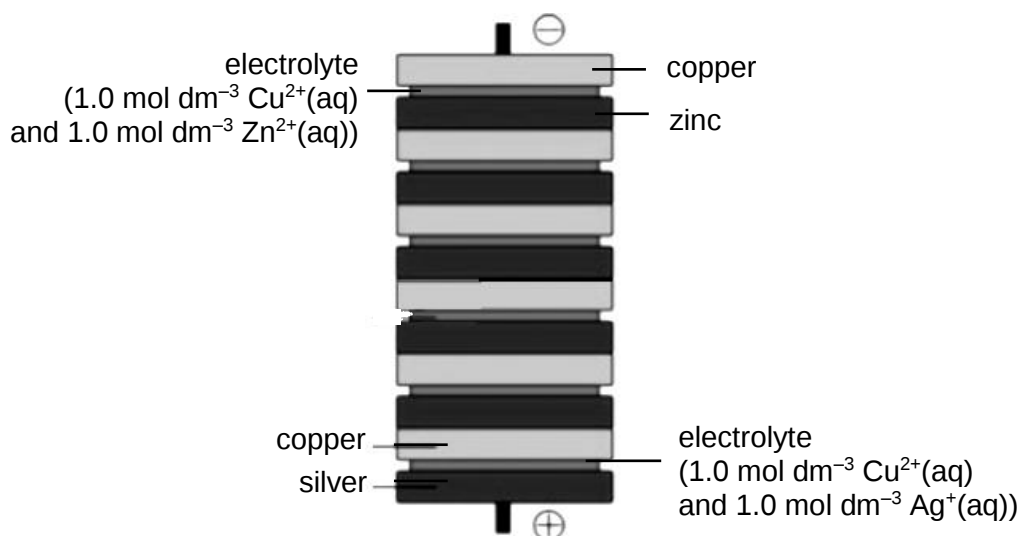


Which statement about the extraction is correct?

- A Cryolite should not be used as its sodium ions will be discharged in the process.
- B Molten aluminium is obtained at the cathode and oxygen is produced at the anode.
- C A maximum mass of 16.8 g of aluminium can be obtained from this extraction process.
- D The graphite cathode reacts with oxygen produced to give CO_2 , hence its mass decreases.

28 Use of the Data Booklet is relevant to this question.

The voltaic pile was the first modern electric battery invented by Alessandro Volta in 1800. The pairs of alternating discs of copper, silver and zinc are separated by cardboard soaked in an aqueous electrolyte to increase the conductivity.

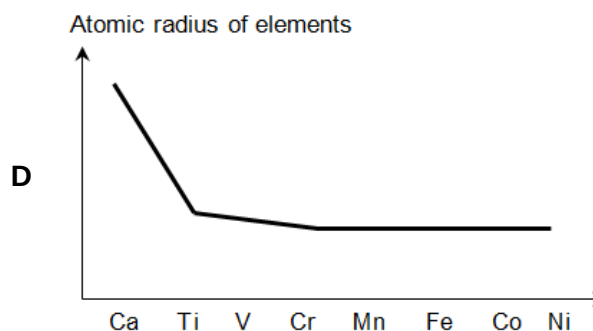
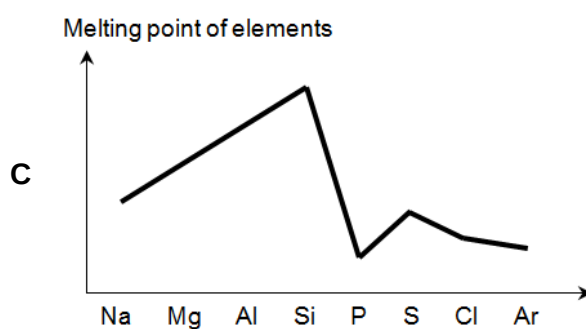
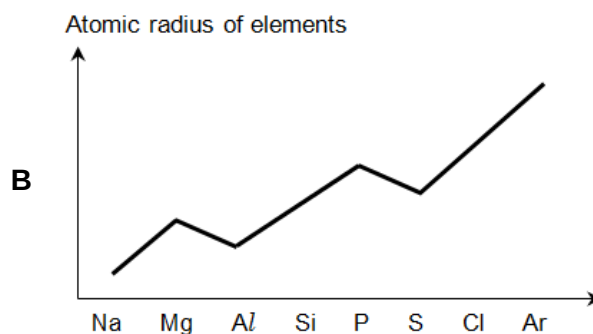
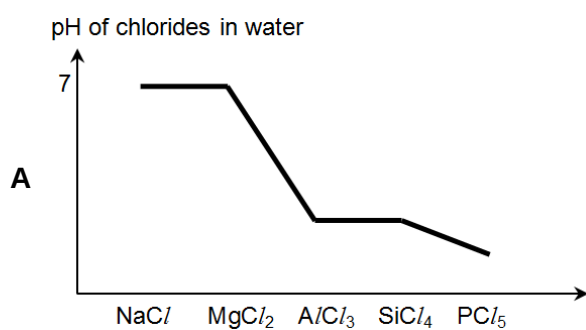


The voltaic pile above has four pairs of Cu and Ag discs and two pairs of Cu and Zn discs, which will be connected to a voltmeter. The voltage of the voltaic pile is the sum of the voltages of each component cell.

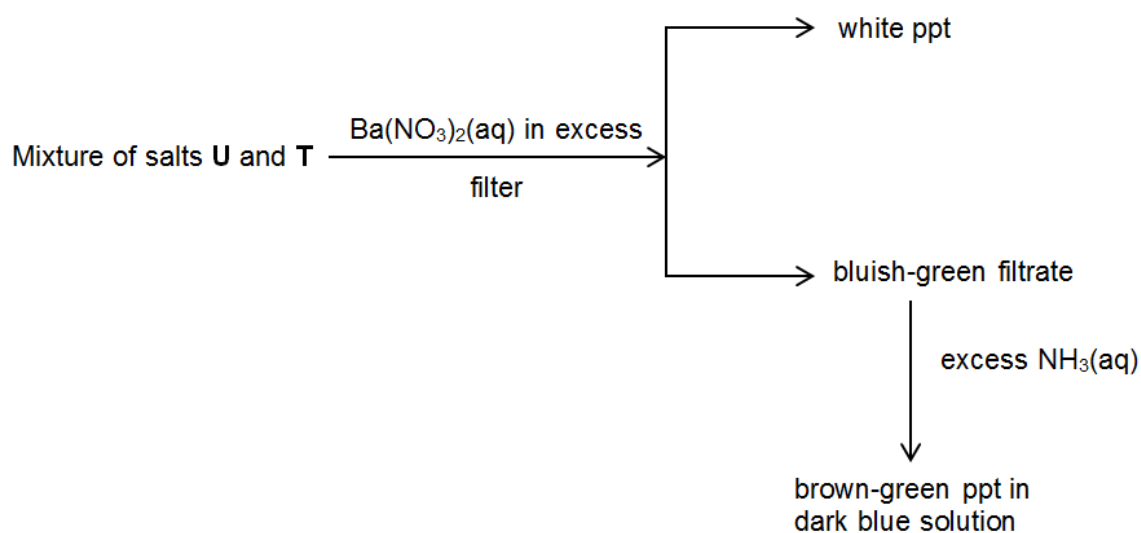
What is the reading on the voltmeter?

- | | |
|-----------------|-----------------|
| A 1.00 V | B 1.56 V |
| C 4.04 V | D 6.76 V |

29 Which sketch below is correct?



30 Below is a reaction scheme of salts **U** and **T**.



What are the identities of salts **U** and **T**?

- A** chromium(III) chloride and copper(II) chloride
- B** chromium(III) sulfate and copper(II) sulfate
- C** copper(II) chloride and iron(II) chloride
- D** copper(II) sulfate and iron(II) sulfate

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