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JABATAN PELAJARAN JOHOR JA  
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## CHEMISTRY (KIMIA)

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PAPER 1 (KERTAS 1)

JABATAN PELAJARAN JOHOR JABATAN

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MULTIPLE-CHOICE (ANEKA PILIHAN)

PELAJARAN JOHOR JABATAN

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One hour and forty-five minutes (Satu jam empat puluh lima minit)

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## JABATAN PELAJARAN JOHOR

### SIJIL TINGGI PERSEKOLAHAN MALAYSIA

#### Instructions to candidates:

**DO NOT OPEN THIS QUESTION PAPER UNTIL YOU ARE TOLD TO DO SO.**

*There are fifty questions in this paper. For each question, four suggested answers are given. Choose one correct answer and indicate it on the multiple-choice answer sheet provided.*

*Read all instructions on the multiple-choice answer sheet very carefully.*

*Answer all questions. Marks will not be deducted for wrong answers.*

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**This question paper consists of 33 printed pages.**

**STPM 962/1**

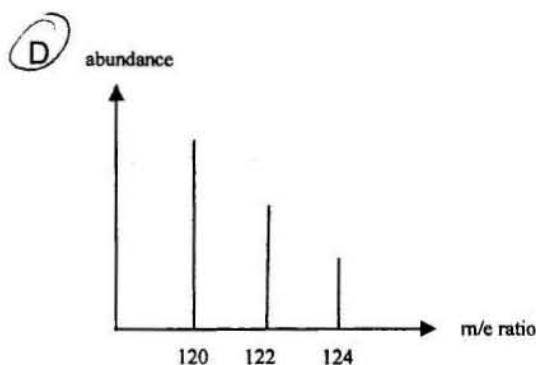
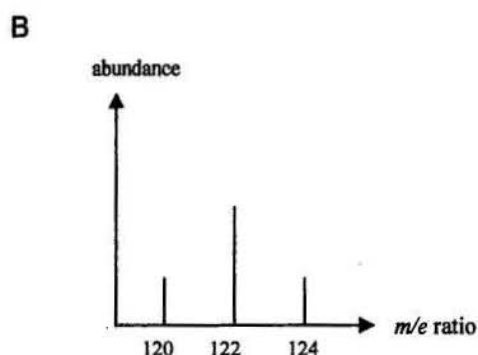
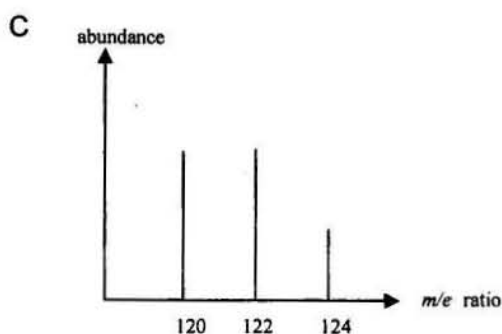
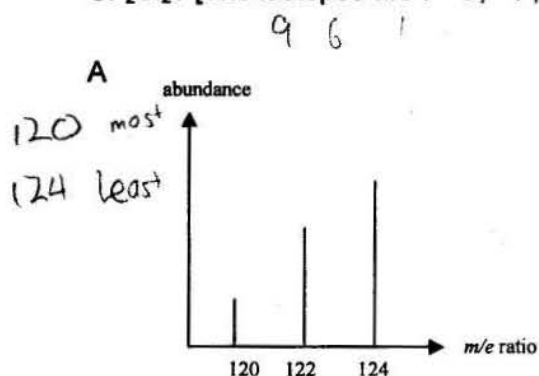
**\*This question paper is CONFIDENTIAL until the examination is over.**

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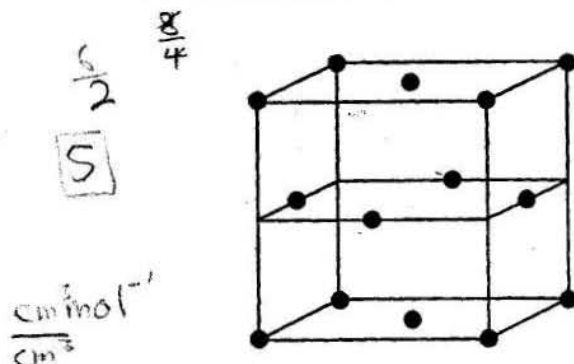
## Section A

Four suggested answers labelled A, B, C and D are given for each question. Choose **one** correct answer.

1. Which of the following sketches show part of the mass spectrum of the refrigerant,  $\text{CF}_2\text{Cl}_2$ ? [The isotopes are:  $^{12}\text{C}$ ,  $^{19}\text{F}$ ,  $^{35}\text{Cl}$ ,  $^{37}\text{Cl}$ ]



2. The unit cell of a metal M is shown below. Given the volume of the unit cell is  $V_1 \text{ cm}^3$  and the volume of 1 mol of M atoms is  $V_2 \text{ cm}^3$ . What is the value of the Avogadro constant?



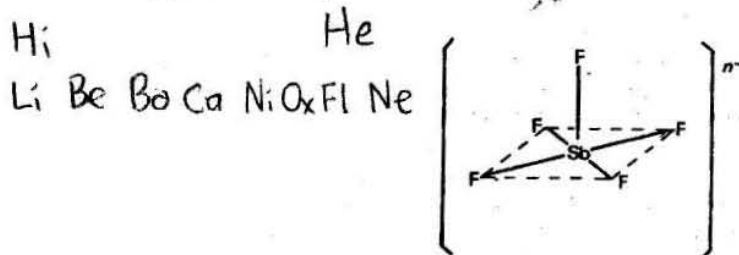
A.  $V_2/V_1$

B.  $(V_2/V_1) \times 4$

C.  $(V_2/V_1) \times 7$

C.  $(V_2/V_1) \times 14$

3. Antimony, Sb, is in Group 15 of the Periodic Table. The ion below has a square-based pyramidal shape.



Deduce the total number of electrons around the antimony atom and the value of  $n$ ?

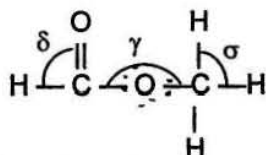
	Total number of electrons	value of $n$
<input checked="" type="checkbox"/> A	10	1
<input checked="" type="checkbox"/> B	10	2
<input checked="" type="checkbox"/> C	12	1
<input type="checkbox"/> D	12	2

$X: n(n-1) + 1$   
 $Y: (n+1)(n-1) + 2$

4. Gaseous particle X has a proton number  $n$  and a charge of  $+1$ . Gaseous particle Y has a proton number of  $(n+1)$  and is isoelectronic with X. Which statement correctly describes X and Y?

- ☒ A X has a larger radius than Y  
☐ B X requires more energy than Y when the second electron is removed from each particle  
☐ C X releases more energy than Y when an electron is added to each particle  
☒ D X and Y belong to the same group in the Periodic Table

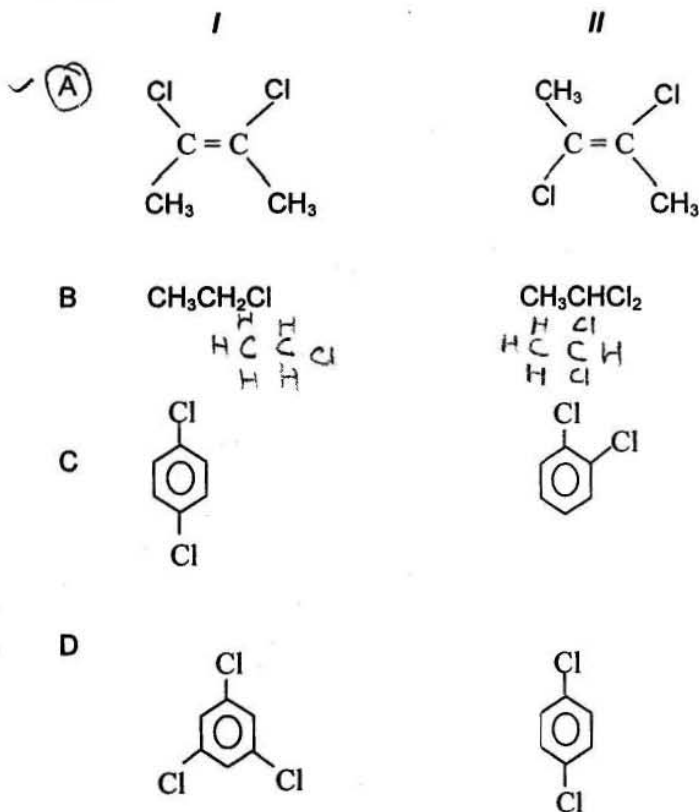
5.



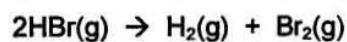
Which of the following correctly describes the approximate values of the bond angles in the molecule above?

	$\delta$	$\gamma$	$\sigma$
A	$90^\circ$	$180^\circ$	$90^\circ$
B	$105^\circ$	$180^\circ$	$90^\circ$
<input checked="" type="checkbox"/> C	$120^\circ$	$105^\circ$	$109^\circ$
D	$120^\circ$	$109^\circ$	$109^\circ$

6. In which pair of molecules is the permanent dipole in molecule I greater than that in molecule II?



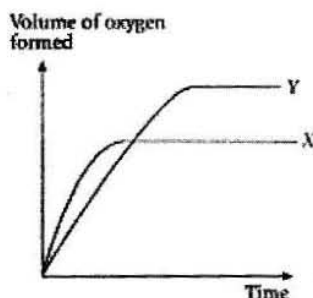
7. The rate equation for the decomposition of hydrogen bromide



is:  $\text{Rate} = k[\text{HBr}]^2$

Which of the following conclusions can be drawn from this information?

- × A The value of  $k$  depends on the concentration of  $\text{HBr}$ .
- (B) The rate of appearance of  $\text{Br}_2$  is half the rate of disappearance of  $\text{HBr}$ .
- × C Doubling the concentration of  $\text{HBr}$  will double the rate of reaction.
- D The presence of a suitable catalyst will increase the value of  $k$ .

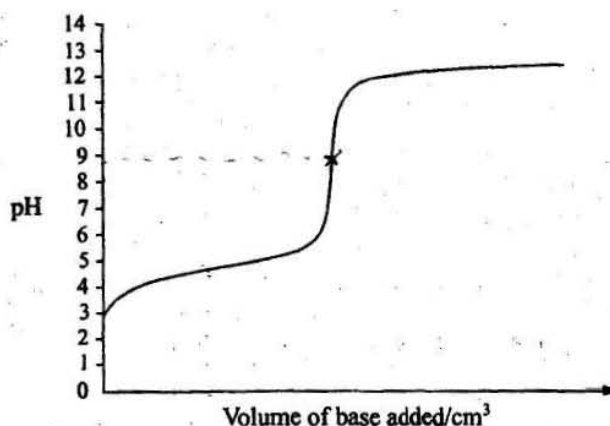


8. In the diagram above, curve X was obtained by observing the decomposition of  $100 \text{ cm}^3$  of  $1.0 \text{ mol dm}^{-3}$  hydrogen peroxide, catalysed by manganese (IV) oxide.

Which alteration to the original experimental condition would produce curve Y?

- A Adding water
- ☒ B Adding some  $0.1 \text{ mol dm}^{-3}$  hydrogen peroxide
- C Using less manganese(IV) oxide
- D Lowering the temperature

9. The graph below shows the variation of pH value with volume of base added in an acid-base titration.



Which of the following statements is **not true** about the titration above?

- ✓ A The acid and base used in the titration may probably be ethanoic acid and sodium hydroxide respectively.
- ✓ B The  $\text{pK}_a$  of the acid used is equal to 4.7.
- C The salt formed in the titration undergoes hydrolysis to produce  $\text{OH}^-$  ions.
- ☒ D A suitable indicator for the above titration is methyl orange.

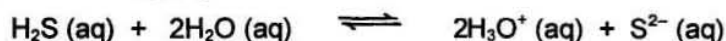
10. The pH of a  $1.0 \text{ mol dm}^{-3}$  solution of a weak monobasic acid is 5. What is the dissociation constant of the weak acid?

- A  $1.0 \times 10^{-4} \text{ mol dm}^{-3}$   
 B  $1.0 \times 10^{-8} \text{ mol dm}^{-3}$   
 (C)  $1.0 \times 10^{-10} \text{ mol dm}^{-3}$   
 D  $1.0 \times 10^{-14} \text{ mol dm}^{-3}$

$$\alpha = \sqrt{\frac{K_a}{C}} \quad pK_a = 1 \times 10^{-10}$$

$$[H^+] = \sqrt{K_a C}$$

11. Hydrogen sulphide reacts with water according to the following equation.



Which of the following aqueous solutions when added would cause the system at equilibrium to shift to the left?

- A Ammonium chloride  
 B Sodium carbonate  
 C Sodium ethanoate  
 (D) Ammonia  $\rightarrow$

$$K_p = e^{-\frac{\Delta H}{RT} + \frac{\Delta P}{RT}} \quad \frac{30}{x} = e^{-\frac{\Delta H}{PV} + \frac{\Delta H}{PV}}$$

12. When the system  $Cl_2(g) + PCl_3(g) \rightleftharpoons PCl_5(g)$  is in equilibrium at  $600^\circ\text{C}$ , at 1 atm pressure, the value of the equilibrium constant,  $K_p$  is 30.

What is the value of  $K_p$  at a pressure of 2 atm at the same temperature?

- A 20 (B) 30 C. 60 D 100

$$K_p = \frac{6}{1}$$

13. A solute, S exists in the same molecular state when dissolved in ether and water. When the two solutions are in equilibrium, the concentration of solute S in ether solution is 6 times higher than that of the aqueous solution. A solution containing 14.0 g of S in  $240 \text{ cm}^3$  of water is extracted with  $40 \text{ cm}^3$  of ether. Calculate the total mass of S extracted from water.

- A 2.0 g  
 B 6.0 g  
 (C) 7.0 g  
 D 8.0 g

$$\frac{40 \frac{x}{240}}{240 \frac{14-x}{240}} = \frac{1}{6}$$

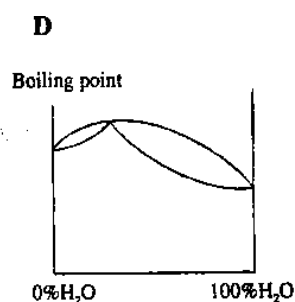
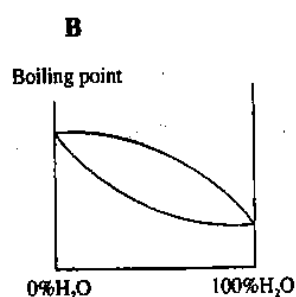
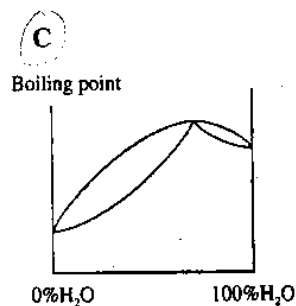
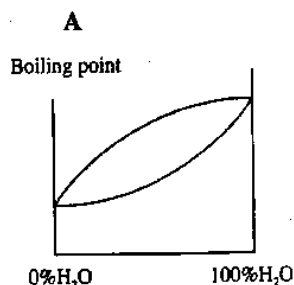
$$x = \frac{14}{13}$$

$$\frac{x}{14-x} = \frac{1}{12}$$

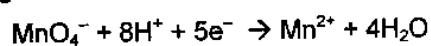
$$12x = 14 - x$$

$$13x = 14$$

14. Which of the following boiling point – composition diagrams represents a mixture of water and hydrogen chloride.

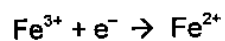


15. Which of the following statements is not true for a standard cell which consists of the two half-cells given below?



$$E^\ominus = +1.52 \text{ V}$$

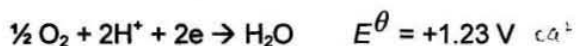
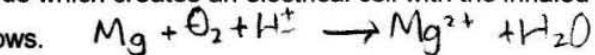
0.75



$$E^\ominus = +0.77 \text{ V}$$

- A The e.m.f. of the cell is 2.29 V
- B The  $\text{MnO}_4^-/\text{Mn}^{2+}$  cell undergoes oxidation.
- C** Electrons flow from the electrode in the  $\text{MnO}_4^-/\text{Mn}^{2+}$  cell to the electrode in the  $\text{Fe}^{3+}/\text{Fe}^{2+}$  cell.
- D Concentration of  $\text{Fe}^{3+}(\text{aq})$  ions in the  $\text{Fe}^{3+}/\text{Fe}^{2+}$  cell will increase

16. In the construction of cardiac pacemakers, it is possible to use a very small magnesium electrode which creates an electrical cell with the inhaled oxygen. The relevant half-cells are as follows.

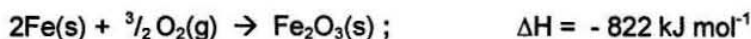


$$3.25 = E^\theta - \frac{RT}{zF} \ln \frac{[\text{Prod}]}{[\text{React}]}$$

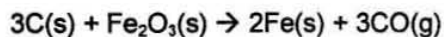
Under standard conditions, the cell e.m.f would be 3.61 V, but in the body a potential of 3.25 V is more usual. What is the best explanation of this lower e.m.f?

- A The small size of the magnesium electrode
- B The low concentration of  $\text{Mg}^{2+}$  ions surrounding the magnesium electrode
- C The high resistance of the body fluids surrounding the electrodes.
- ☒ D The pH between 7 and 8 of the body fluid surrounding the electrodes.

17. The enthalpy change for two reactions are given by the following equations.



What is the enthalpy change for the following reaction?



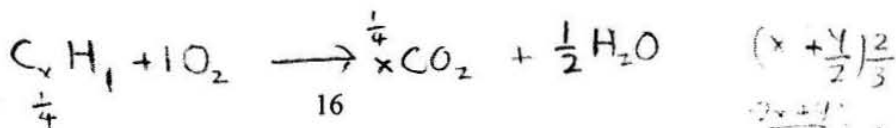
- A +712 kJ mol<sup>-1</sup>
- ☒ B +492 kJ mol<sup>-1</sup>
- C -492 kJ mol<sup>-1</sup>
- D -712 kJ mol<sup>-1</sup>

18. Which value would be required to estimate the lattice energy for the hypothetical ionic compound, MgH?

- ☒ A The electron affinity of hydrogen
- B The first ionisation energy of hydrogen
- C The magnesium-hydrogen bond energy
- D The standard enthalpy change of formation of  $\text{MgH}_2$



$$1 = \frac{2x}{3} + \frac{1}{2} \quad \frac{x+1}{2}$$



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19. 4.0 g of a hydrocarbon required 16.0 g of oxygen for complete combustion and 9.0 g of water was produced in the reaction. What was the mass of carbon dioxide produced?

[Relative atomic mass of O=16, C=12, H=1]

- A 4.0 g B 9.0 g  
 (C) 11.0 g D 22.0 g

20. The values of  $pK_b$  of several substance are given below.

Substance	$pK_b$
$NH_3$	4.75
$CH_3NH_2$	3.36
$CH_3CH_2NH_2$	3.27
$C_6H_5NH_2$	9.38

Which of the following is the strongest acid?

- A  $NH_4^+$  B  $CH_3NH_3^+$   
 C  $CH_3CH_2NH_3^+$  (D)  $C_6H_5NH_3^+$

21. Consider the sequence of oxides given below. Which series shows an increasing order of melting point?

- A  $Cl_2O_7, Al_2O_3, SO_3, SiO_2$   
 B  $SO_3, Cl_2O_7, Al_2O_3, SiO_2$   
 (C)  $SO_3, Cl_2O_7, SiO_2, Al_2O_3$   
 D  $SiO_2, Al_2O_3, Cl_2O_7, SO_3$

22. The process of chemical etching consists of partially dissolving a metal in a suitable solvent. By careful masking of the metal, it is possible to produce a pattern in or on the metal.

Which of the following aqueous solutions could be used to etch a pattern in aluminium?

- A Ethanoic acid  
 B Dilute nitric acid  $H^+ NO_3^-$   
 (C) Sodium hydroxide  $Na^+ OH^-$   
 D Concentrated nitric acid

23. Which of the following statements regarding lead(IV) oxide is **not** true?

- ~ A It is amphoteric
- ~ B It easily decomposes when heated
- C It has ionic bonding with covalent characteristics.
- ☒ D It is formed by heating strongly lead(II) oxide in oxygen

24. Which reaction of ammonia does **not** involve the non-bonding pair of electrons on the nitrogen atom?

- A  $\text{NH}_3(\text{g}) + \text{CH}_3\text{I}(\text{g}) \rightarrow \text{CH}_3\text{NH}_3^+\text{I}^-(\text{s})$
- B  $\text{NH}_3(\text{g}) + \text{HCl}(\text{g}) \rightarrow \text{NH}_4\text{Cl}(\text{s})$
- C  $2\text{NH}_3(\text{l}) + 2\text{Na}(\text{s}) \rightarrow 2\text{NaNH}_2(\text{s}) + \text{H}_2(\text{g})$
- ☒ D  $2\text{NH}_3(\text{aq}) + \text{Ag}^+(\text{aq}) \rightarrow [\text{Ag}(\text{NH}_3)_2]^+(\text{aq})$

25. P, Q, and R are three elements in Group 17. Q is a solid at room temperature.  $\text{P}^-$  ion is the weakest reducing agent among  $\text{P}^-$ ,  $\text{Q}^-$  and  $\text{R}^-$ .

What is the arrangement of the elements in increasing intensity of colour?

- ☒ A P, R, Q
- B R, Q, P
- C P, Q, R
- D Q, R, P

A x B

26. Which of the following complexes does **not** exhibit optical isomerism?

- A  $[\text{Cr}(\text{C}_2\text{O}_4)_2(\text{H}_2\text{O})_2]^-$
- B  $[\text{Cr}(\text{C}_2\text{O}_4)_3]^{3-}$
- C  $[\text{Co}(\text{en})_2\text{Cl}_2]$
- ☒ D  $[\text{Co}(\text{NH}_3)_3(\text{NO}_2)_3]$



27. The intermediate species formed in the mechanism of the reaction between methane and chlorine in the presence of light is

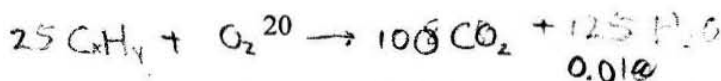
- A  $\text{CH}_3^+$
- B  $\text{Cl}^\cdot$
- C  $\text{CHCl}_3$
- ☒ D  $\cdot\text{CH}_2\text{Cl}$



(2x+3) =



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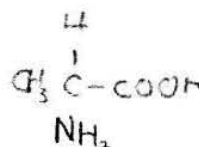
28. When 60 cm<sup>3</sup> of a hydrocarbon were burnt completely in oxygen, 240 cm<sup>3</sup> of carbon dioxide and 0.0125 mol of water were produced. What is the molecular formula of the hydrocarbon? (The volumes of all gases were measured at room conditions. The molar volume of any gas at room conditions is 24.0 dm<sup>3</sup>)

A C<sub>2</sub>H<sub>6</sub>

B C<sub>3</sub>H<sub>8</sub>

C C<sub>3</sub>H<sub>8</sub>

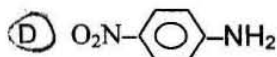
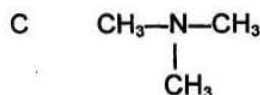
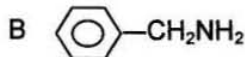
(D) C<sub>4</sub>H<sub>10</sub>



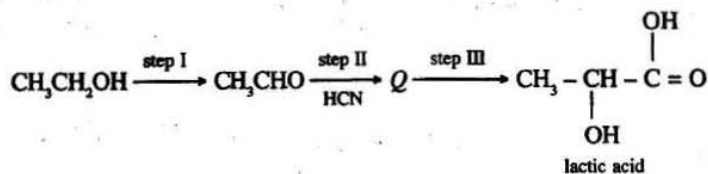
29. Which type of isomerism is shown by each of the following organic compounds?

CH <sub>3</sub> CH=CHCH <sub>3</sub>	CH <sub>3</sub> CH(NH <sub>2</sub> )COOH	C <sub>2</sub> H <sub>5</sub> CH=CHBr
Optical	Geometric	Geometric
Optical	Geometric	Optical
Geometric	Optical	Geometric
Geometric	Geometric	Optical

30. Which one of the following compounds has the highest pK<sub>b</sub> value?



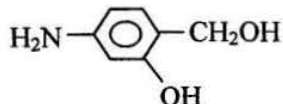
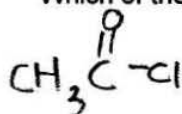
31. Lactic acid can be formed from ethanol as shown in the reaction scheme below.



Name the types of reaction that occur in step I and step III.

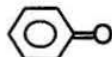
	Step I	Step III
(A)	Oxidation	Hydrolysis
B	Reduction	Esterification
C	Condensation	Oxidation
D	Dehydration	Condensation

32. Which of the following compound is formed when ethanoyl chloride is reacted with



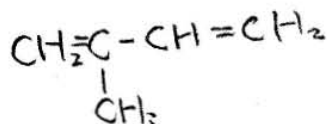
- A
- B
- C
- ☒ D

33. The structure of cyclohexanone is shown below.



Which statement is true about cyclohexanone?

- A It is an aromatic ketone.
- B Its molecular formula is  $\text{C}_6\text{H}_{12}\text{O}$ .
- C It can be oxidised to benzoic acid.
- ☒ D It will give a precipitate with 2,4-dinitrophenylhydrazine.
34. Natural rubber is a polymer made up of isoprene units with the structural formula  $\text{CH}_2 = \text{C}(\text{CH}_3)\text{CH} = \text{CH}_2$ . Which of the following is not true about this statement?
- A The IUPAC name for isoprene is 2-methylbuta-1,3-diene
- B Natural rubber is made from unsaturated molecules
- C Natural rubber becomes hard when vulcanized
- ☒ D Natural rubber is a mixture of cis polymers and trans polymers

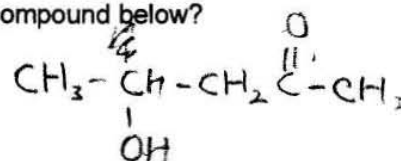


35. X, Y and Z are three different compounds. X reacts with sodium to give off hydrogen gas. X and Y react to form an ester. X and Z also react to form the same ester but at a much slower rate. Compound Y is probably

- A propan-1-ol  
 B propanal  
 C propanoic acid  
 D propanoyl chloride

X ~~carboxy~~ propanoyl  
 Y alcohol  
 Z propanoic

36. Which of the following statements is incorrect regarding the compound below?



- A It will decolourise acidified potassium manganate(VII).  
 B It can react with alkaline iodine to give a yellow precipitate.  
 C It is optically active.  
 D It will produce a brick-red precipitate with Fehling's solution.

37. When X (a gas) reacts with Y, a mixture of  $\text{CH}_2\text{BrCH}_2\text{Br}$  and  $\text{CH}_2\text{BrCH}_2\text{OH}$  are produced. X and Y are probably

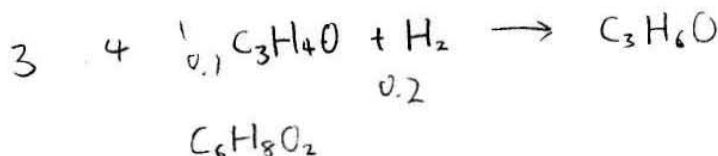
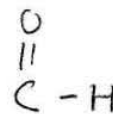
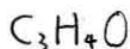
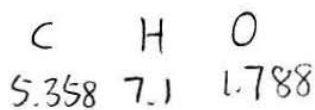
- |   | X                    | Y                       |
|---|----------------------|-------------------------|
| A | Ethene               | Bromine water           |
| B | Ethene               | Sodium bromide solution |
| C | HBr(g)               | Ethene                  |
| D | $\text{Br}_2$ vapour | Ethene                  |

Q = aldehyde

38. A compound Q has the following composition by mass. Carbon, 64.3%; hydrogen, 7.1%; oxygen, 28.6%. Q reduces Fehling's solution to copper(I) oxide. 0.1 mol Q reacts with  $4480 \text{ cm}^3$  hydrogen gas at s.t.p. with nickel as catalyst. Q is

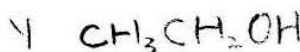
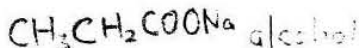
[Relative atomic mass: H, 1; C, 12; O, 16. 1 mol gas occupies  $22.4 \text{ dm}^3$  at s.t.p.]

- A  $\text{CH}_2 = \text{CHCHO}$       C  $\text{CH}_3\text{CH} = \text{CHCH} = \text{CHCHO}$   
 B  $\text{CH} \equiv \text{CCH}_2\text{OH}$       D  $\text{CH}_3\text{COCH} = \text{CHCH} = \text{CHOH}$

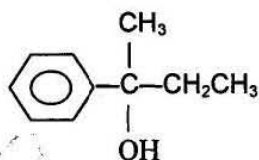


39. An organic compound, *W*, is boiled with aqueous sodium hydroxide and the reaction mixture is allowed to cool. Upon cooling, compound *X* and compound *Y* (an alcohol) are produced. On acidification, compound *X* is converted to compound *Z* ( $C_3H_6O_2$ ). Compound *Y* gives a positive triiodomethane (iodoform) test. Compound *W* is likely to have the structural formula

- A  $CH_3CH_2COOCH_3$   
 B  $CH_3COOCH_3$   
 C  $CH_3CH_2COOCH_2CH_3$   
 D  $CH_3CH(OH)CH_2COCl$



40. Which of the following pairs of reactants will **not** produce the compound with the structural formula shown below.



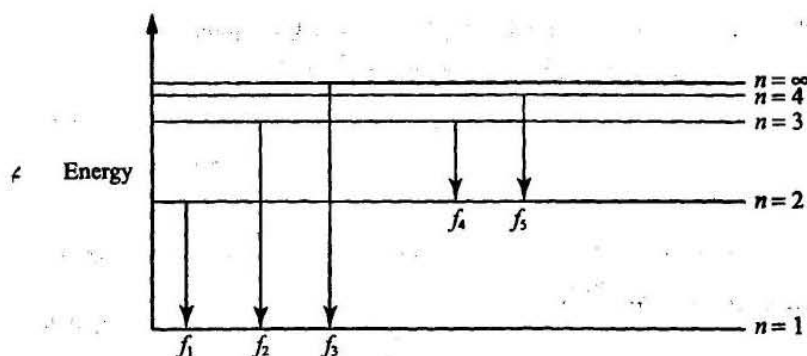
- A  $CH_3CH_2MgBr$  and
- B and
- C and  $CH_3MgBr$
- D and  $CH_3CHO$

## Section B

For each question in this section, one or more of the three numbered statements 1 to 3 may be correct. The responses A to D should be selected as follows:

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

41 The energy-level diagram for a hydrogen atom shows several electronic transitions with frequencies  $f_1$ ,  $f_2$ ,  $f_3$ ,  $f_4$  and  $f_5$ .



Which of the following statements is/are true of the above diagram?

- D
- ①  $f_4$  and  $f_5$  represent lines in the Balmer series.
  - ② The lines represented by  $f_1$ ,  $f_2$  and  $f_3$  are non-visible.
  - ③  $f_3$  can be used to calculate the ionisation energy of hydrogen.

42. Which of the following mixtures would produce a solution of pH greater than 7.

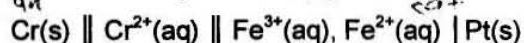
- weak acid, str base
- A
- ① 25 cm<sup>3</sup> of 1.0 mol dm<sup>-3</sup> NaOH(aq) and 25 cm<sup>3</sup> of 1.0 mol dm<sup>-3</sup> CH<sub>3</sub>COOH(aq).
  - 2. 25 cm<sup>3</sup> of 1.0 mol dm<sup>-3</sup> NH<sub>4</sub>Cl(aq) and 25 cm<sup>3</sup> of 1.0 mol dm<sup>-3</sup> NH<sub>3</sub>(aq).
  - 3. 25 cm<sup>3</sup> of 1.0 mol dm<sup>-3</sup> NaOH and 25 cm<sup>3</sup> of 1.0 mol dm<sup>-3</sup> CH<sub>3</sub>COONa.

43. Which of the following can be determined by using a mass spectrometer?

- D
- ① The relative molecular mass of an organic compound
  - ② The accurate mass of a nuclide (isotope)
  - ③ The proton number of an unidentified element

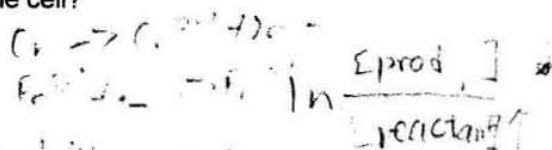
A	B	C	D
1 only is correct	1 and 2 only are correct	2 and 3 only are correct	1, 2 and 3 are correct

- ★ 44. A cell is represented by the cell diagram below.



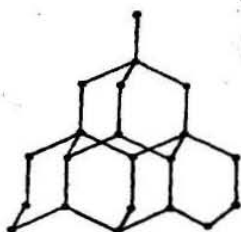
Which of the following will increase the e.m.f of the cell?

- 1 Increase the concentration of  $\text{Cr}^{2+}$   
 ② Decrease the concentration of  $\text{Fe}^{2+}$   
 ③ Increase the concentration of  $\text{Fe}^{3+}$



45. The element X has a proton number of 25. Which of the following statements is/are true of X?

- ① The metal X has a high density  
 D ② X forms coloured complex ions  
 ③ The highest oxidation number of X in its ion is +7



46. Which of the following element(s) has/have the above arrangement of atoms in its

- B ① diamond  
 ② silicon  
 3. boron

47. Which of the following reagents react(s) with both benzene and methylbenzene?

- A ① Chlorine gas in the presence of anhydrous aluminium chloride  
 2 Concentrated sulphuric acid on reflux  
 3 Acidified potassium manganate(VII) on reflux



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

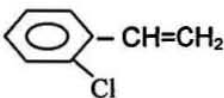
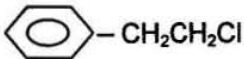
48.

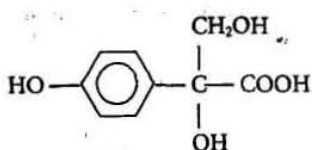


What type(s) of reaction would the above compound undergo?

- ☒ ① Nucleophilic substitution  
☒ ② Electrophilic addition  
☒ ③ Free radical substitution

49. A compound *P* decolourise bromine water and does not form a white precipitate with ethanolic silver nitrate solution. Compound *P* is

- A ☒ ①   
 × ②   
 ③  $\text{CH}_2=\text{CHCH}_2\text{Cl}$



50. Which of the following statements is/are true regarding the compound above?

- B ☒ ① It can form condensation homopolymer.  
☒ ② It can rotate the plane of plane-polarised light.  
 ③ 1 mol of the compound would react with sodium to produce 2 moles of hydrogen gas.