revisionvillage | IB ⌄

IB Chemistry HL - Prediction Exams May 2025 - Paper 1

Paper 1 ⌄

? 42 questions   🕐 120 mins   ✓ 75 marks

Filters ⌃

Go to Question

Question Type   Difficulty

All ⌄   ☐ Easy   ☐ Medium   ☐ Hard

Section A

Question 1

👍 👎

Medium ● ● ● ○ ○

Which technique is most suitable for separating a mixture of ethanol and water?

    A.   gravity filtration

    B.   distillation

C. recrystallization

D. evaporation

▤ **Mark Scheme**

▷ **Video Solutions**   1

✧ **Newton AI**

[Formula Booklet](#)

Question 2   👍 👎
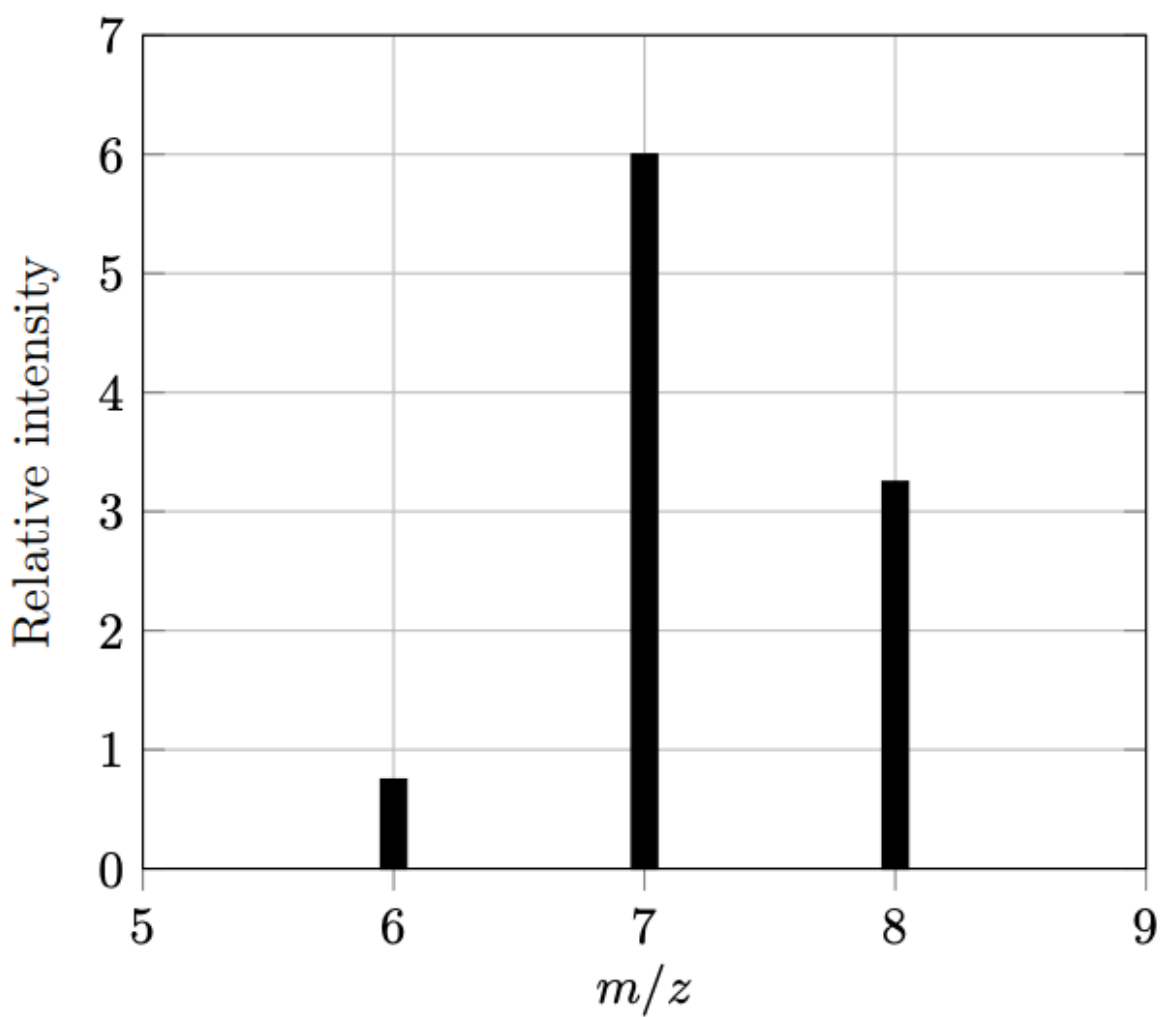
🖩   Easy ● ● ○ ○ ○   ⌞⌝

What is the relative atomic mass of an unknown element, according to its mass spectrum given below?

A. $\dfrac{6 \times 1 + 7 \times 6 + 8 \times 3}{100}$

B. $\dfrac{6 \times 0.75 + 7 \times 6 + 8 \times 3.25}{10}$

C. $\dfrac{6 \times 1 + 7 \times 6 + 8 \times 3}{10}$

D. $\dfrac{6 \times 0.75 + 7 \times 6 + 8 \times 3.25}{100}$

Revisit   ✓ Complete

☰ Mark Scheme

▷ Video Solutions   1

Question 3

👍 👎

🖩   Medium ● ● ● ◑ ○   ⛶

Which electron transition in a hydrogen atom emits the longest wavelength of light?

    A. $n = 3$ to $n = 2$

    B. $n = 4$ to $n = 3$

    C. $n = 5$ to $n = 4$

    D. $n = 2$ to $n = 1$

🔖 Revisit | ✓ Complete

📋 Mark Scheme

▶ Video Solutions   1

✧ Newton AI

Question 4

👍 👎

🖩   Medium ● ● ● ◑ ○   ⛶

Two elements, X and Y, have the following successive ionization energies (in kJ/mol):

Element	1st	2nd	3rd	4th	5th	6th
X	738	1451	7733	10543	13630	18020
Y	1012	1907	2914	4964	6247	21267

What is the most likely formula of the compound formed when X and Y combine?

A. XY

B. X_2Y_3

C. X_3Y_2

D. XY_2

Revisit   ✓ Complete

📄 Mark Scheme

▶ Video Solutions   1

✦ Newton AI

Formula Booklet

Question 5

🔲 Medium ● ● ● ○ ○

Which of the following solutions has the greatest quantity of moles of ions in solutions?

A.   200 cm^3 of 1.0 mol dm^{-3} NaCl

B.   200 cm^3 of 1.0 mol dm^{-3} MgCl$_2$

C.   100 cm^3 of 1.0 mol dm^{-3} NaCl

D.   100 cm^3 of 1.0 mol dm^{-3} MgCl$_2$

📖 **Mark Scheme**

▶️ **Video Solutions**   1

✦ **Newton AI**

Formula Booklet

Question 6   👍 👎

🖩   Medium ● ● ◑ ● ●   ⛶

A sample of gas at the top of a mountain has a pressure of 75 kPa and a volume of 4.0 dm^3. If that same sample is brought to the bottom of the mountain where the pressure is now 100 kPa, what is the new volume of the gas assuming that the temperature is kept constant?

A. 0.75 dm^3

B. 0.19 dm^3

C. 3.0 dm^3

D. 5.3 dm^3

📖 **Mark Scheme**

▶️ **Video Solutions**   1

✦ **Newton AI**

Formula Booklet

Question 7

Which of the following is the correct order for % ionic character from lowest to highest for the following compounds?

A. $AlCl_3$, $LiCl$, $NaCl$, $MgCl_2$

B. $MgCl_2$, $LiCl$, $AlCl_3$, $NaCl$

C. $NaCl$, $LiCl$, $MgCl_2$, $AlCl_3$

D. $AlCl_3$, $MgCl_2$, $LiCl$, $NaCl$

Revisit | Complete

▤ Mark Scheme

⊙ Video Solutions   1

✧ Newton AI

Formula Booklet

Question 8
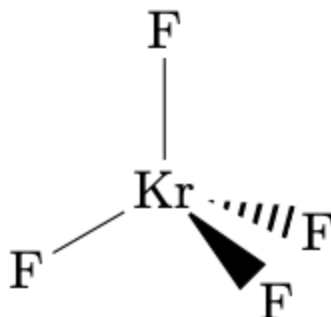
What is the correct representation of KrF_4?

A.

B.

C.

D.
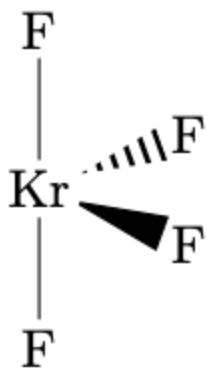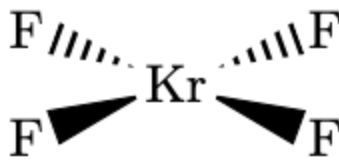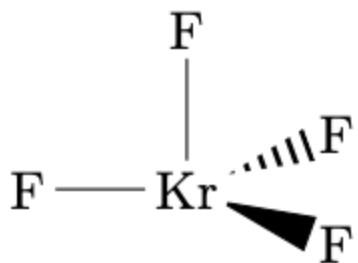
Revisit | ✓ Complete

📃 Mark Scheme

▷ Video Solutions   1

✧ Newton AI

Formula Booklet

Question 9

👍 👎

🧮   Medium ● ● ● ○ ○   ⌞⌝

Which chemical species has the highest boiling point?

A. hexane, C_6H_{14}

B. ethanoic acid, CH_3COOH

C. propanone, CH_3COCH_3

D. chloromethane, CH_3Cl

🔖 Revisit | ✅ **Complete**

📑 **Mark Scheme**

▶️ **Video Solutions**   1

✦ **Newton AI**

[Formula Booklet](#)

Question 10   👍 👎

🖩   Medium ● ● ● ○ ○   ⛶

Which statement about coordinate covalent bonds is correct?

A.   A coordinate covalent bond involves the transfer of electrons from one atom to another.

B.   Both atoms in a coordinate covalent bond contribute one electron to the shared bonding electrons.

C.   A coordinate covalent bond is weaker than a regular covalent bond.

D.   A coordinate covalent bond forms when one atom donates both electrons in a shared pair.

🔖 Revisit | ✅ **Complete**

📑 **Mark Scheme**

Formula Booklet

Question 11

👍 👎

🖩   Medium ●●◖●●   ⛶

What is the hybridization of carbon in graphene?

     A. sp

     B. sp^2

     C. sp^3

     D. sp^2 and sp^3

🔖 Revisit | ✅ Complete

Formula Booklet

Question 12

👍 👎

🖩   Medium ●●●◖●   ⛶

What is the correct overall number of $\sigma-$ and $\pi-$bonds in the limonene structure?
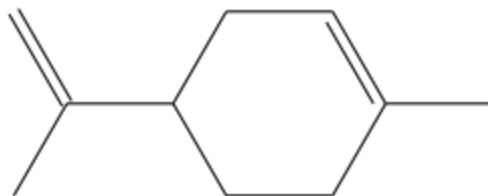
	$\sigma-$bonds	$\pi-$bonds
A.	10	2
B.	8	4
C.	26	2
D.	24	4

⚐ Revisit | ✓ Complete

▤ Mark Scheme

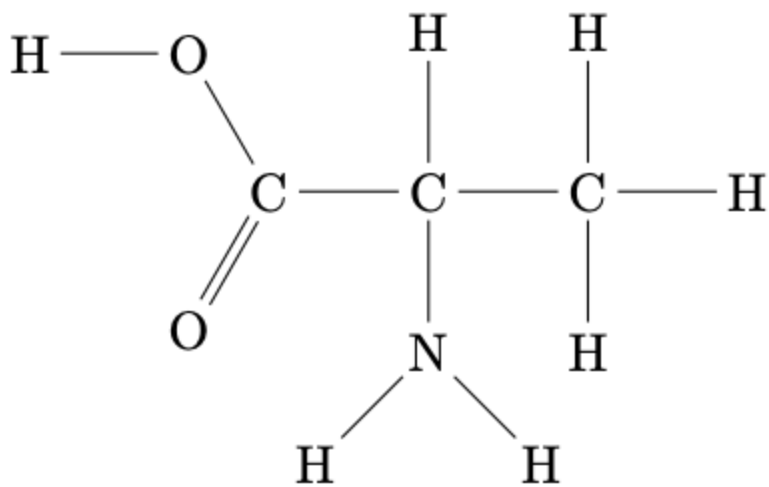▷ Video Solutions   1

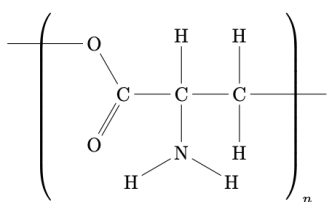✧ Newton AI

Formula Booklet

Question 13

👍 👎

Medium ● ● ◐ ● ●

⌞ ⌝
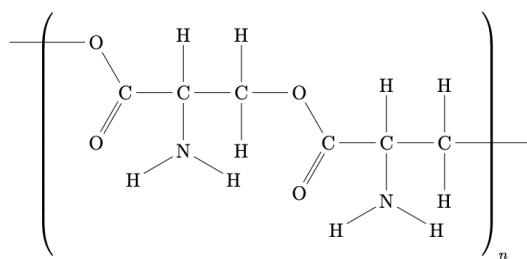
What is the correct repeating unit of the polymer produced from 2−aminopropanoic acid?

A.

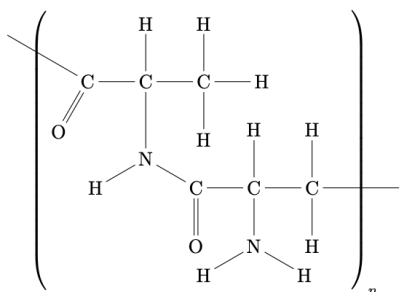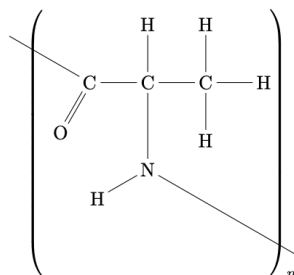B.

C.

D.

Revisit   Complete

Mark Scheme

Video Solutions   1

Newton AI

Formula Booklet

Question 14

Which statement about manganese is correct?

I. It has variable oxidation states because successive ionization energies are similar.
II. Its ions can be coloured due to the formation of complex ions with electrophiles.
III. The electronic configuration of Mn^{2+} is $[Ar]3d^5$.

A. I and III only

B. II and III only

C. I and II only

D. I only

Revisit | Complete

Mark Scheme

Video Solutions   1

Newton AI

Formula Booklet

Question 15

A complex ion is observed as blue. What is the wavelength of the light absorbed by the complex ion?

A. 689 nm

B. 590 nm

C. 503 nm

D.   413 nm

📋 Mark Scheme

▶ Video Solutions   1

✨ Newton AI

Formula Booklet

Question 16   👍 👎
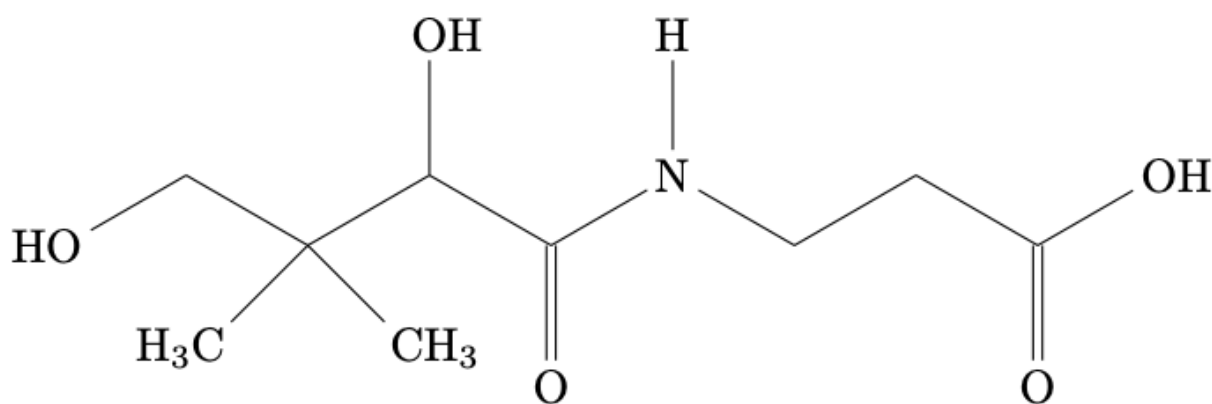
Medium ● ● ● ● ●   ⟦ ⟧

Which functional groups can be found in the molecule of vitamin B$_5$, pantothenic acid?

A.   Carboxyl, carbonyl, amino

B.   Carbonyl, hydroxy, amido

C.   Carboxyl, hydroxy, amido

D.   Carbonyl, alkoxy, amino

📋 **Mark Scheme**

▶ **Video Solutions**   1

✦ **Newton AI**

[Formula Booklet](#)

Question 17

👍 👎

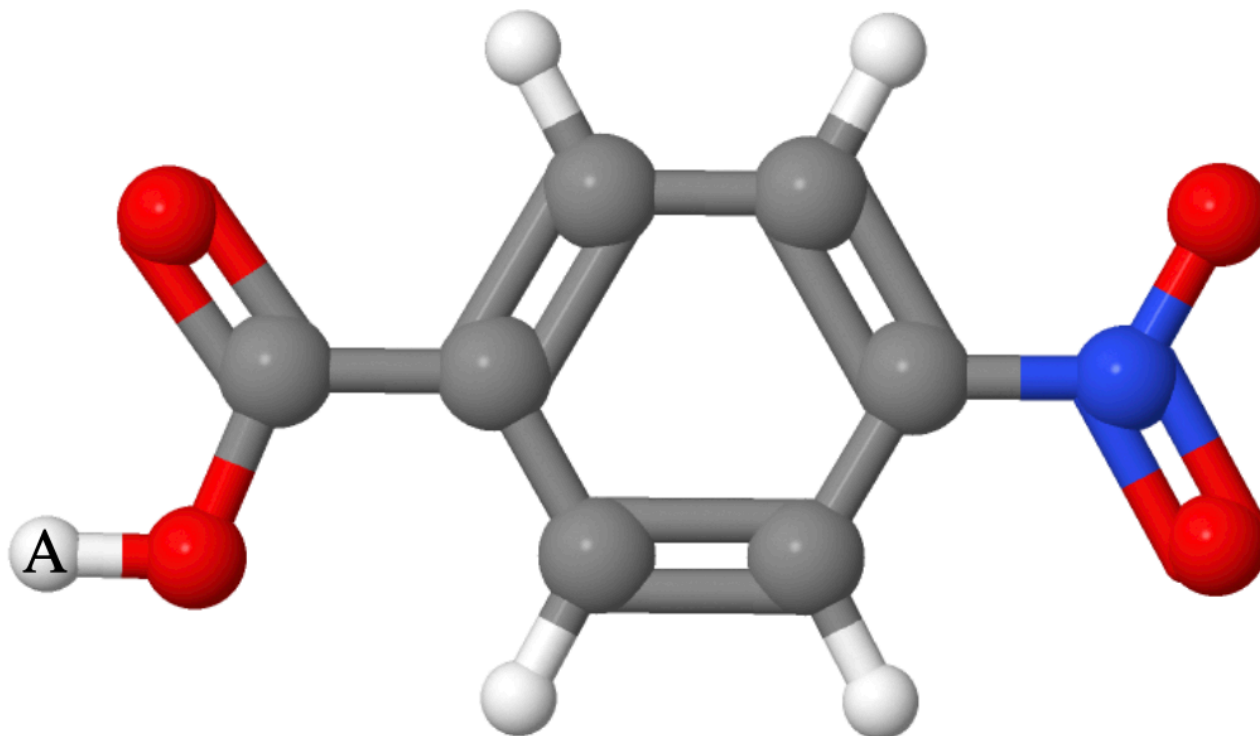🧮   Medium ● ● ● ● ●   ⛶

Which of the following correctly describes the ^{1}H NMR spectrum of 4−nitrobenzoic acid?

	Number of signals	Area ratio	Splitting pattern of hydrogen A
A.	5	1:1:1:1	double
B.	2	4:1	singlet
C.	2	4:1	doubler
D.	3	2:2:1	singlet

🔖 Revisit | ✓ Complete

📋 Mark Scheme

▶ Video Solutions   1

✦ Newton AI

Formula Booklet

Question 18

👍 👎

🖩   Medium ● ● ● ● ●   ⤢

How many chiral carbon atoms are present in cholesterol?

A. 5

B. 6

C. 8

D.   10

📄 Mark Scheme

▶ Video Solutions   1

✧ Newton AI

Formula Booklet

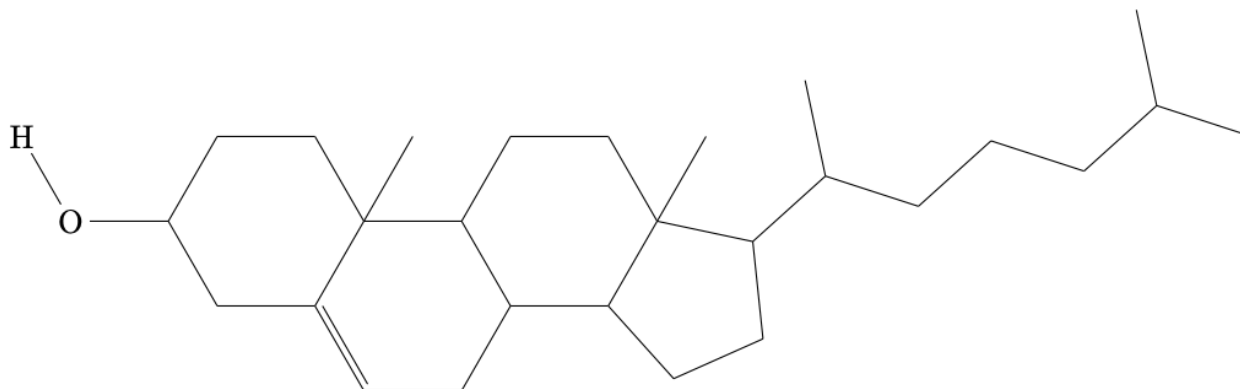## Question 19   👍 👎
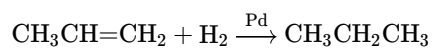
🖩   Medium ● ● ● ● ●   ⛶

Which of the following correctly shows the equation necessary to calculate the enthalpy of reaction for the hydrogenation of propene when considering bond enthalpies using Section 12 of the IB Chemistry data booklet?

$$CH_3CH=CH_2 + H_2 \xrightarrow{Pd} CH_3CH_2CH_3$$

A. $[614 + 436] - [414 + 346]$

B. $[(2 \times 614) + 436] - [(2 \times 414) + 346]$

C. $[(2 \times 414) + 346] - [614 + 436]$

D. $[614 + 436] - [(2 \times 414) + 346]$

📄 Mark Scheme

▶ Video Solutions   1

Formula Booklet

Question 20

Easy ● ● ○ ○ ○

Which enthalpy changes of the Born−Haber cycle are endothermic?

   I.   Ionization energy
   II. Enthalpy of atomization
   III. Lattice enthalpy

   A.   I and II only

   B.   I and III only

   C.   II and III only

   D.   I, II and III

Revisit | Complete

Mark Scheme

Video Solutions   1

Newton AI

Formula Booklet

Question 21

What is the correct order of specific energy from highest to lowest for four unknown fuels (1, 2, 3, 4) using the enthalpies of combustion, molar masses, and densities shown below?

Fuel	$\Delta H_c^\ominus$ (kJ mol^{-1})	M (g mol^{-1})	density (g dm^{-3})
1	-800	50	4
2	-1000	125	1
3	-500	25	10
4	-700	100	70

A. 1, 2, 3, 4

B. 3, 1, 2, 4

C. 2, 1, 4, 3

D. 4, 3, 1, 2

Revisit | Complete

Mark Scheme

Video Solutions   1

Newton AI

Formula Booklet

Question 22

Which reaction causes the greatest increase in entropy in the system?

A. condensation

B.   sublimation

C.   deposition

D.   vaporization

Revisit   Complete

📑 Mark Scheme

▶ Video Solutions   1

✦ Newton AI

Formula Booklet

Question 23

🖩   Medium ● ● ● ◔ ○   ⛶

What is the limiting reactant and how many moles of water would be expected from the reaction of 2.0 moles of oxygen gas and 5.0 moles of hydrogen gas?

A.   Oxygen gas is limiting, 5.0 mol of water is formed

B.   Hydrogen gas is limiting, 5.0 mol of water is formed

C.   Oxygen gas is limiting, 4.0 mol of water is formed

D.   Hydrogen gas is limiting, 4.0 mol of water is formed

Revisit   ✅ Complete

📑 Mark Scheme

Formula Booklet

Question 24   👍 👎

🖩   Medium ● ● ● ○ ○   ⌞ ⌝

A 25.00 cm^3 sample of monoprotic strong acid is titrated with 10.00 cm^3 of 0.75 mol dm^{-3} NaOH to reach the equivalence point. What is the concentration of the unknown acid?

   A. 0.75 mol dm^{-3}

   B. 0.30 mol dm^{-3}

   C. 0.0075 mol dm^{-3}

   D. 1.88 mol dm^{-3}

🔖 Revisit | ⊘ Complete

Formula Booklet

Question 25   👍 👎

Which is the correct empirical formula for a compound that is composed of 40% sulfur and 60% oxygen by mass?

    A. SO

    B. S_2O_3

    C. SO_2

    D. SO_3

🔖 Revisit | ✅ Complete

▤ Mark Scheme

▷ Video Solutions   1

✧ Newton AI

Formula Booklet

Question 26

👍 👎

Which of the following factors would increase the rate of reaction for calcium carbonate reacting with hydrochloric acid?

$$CaCO_3(s) + HCl(aq) \longrightarrow CaCl_2(aq) + CO_2(g) + H_2O(l)$$

    A. increased pressure

    B. increased particle size of calcium carbonate

    C. decreased concentration of hydrochloric acid

    D. increased surface area of calcium carbonate
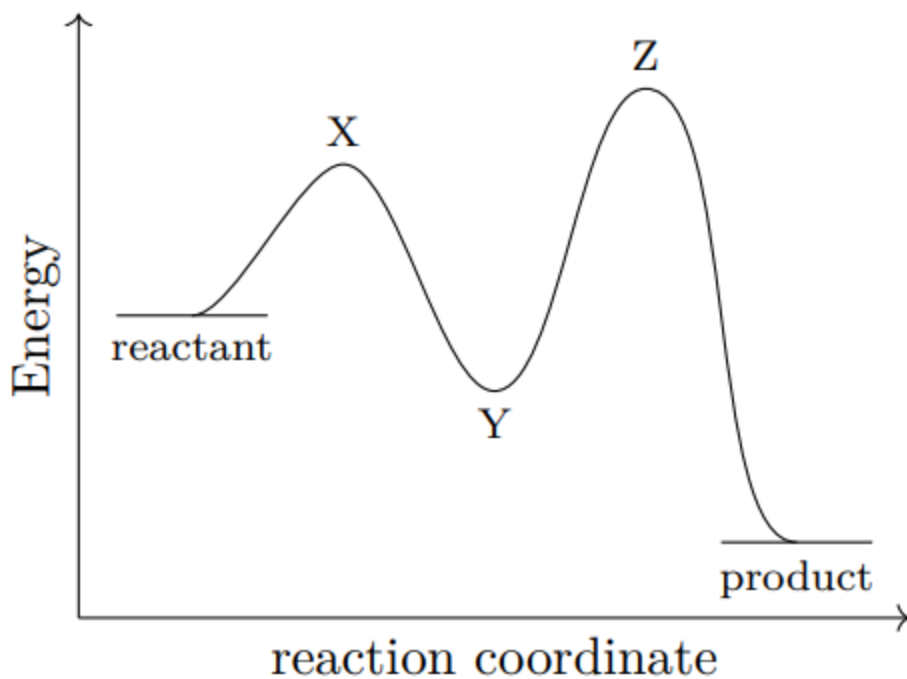
Formula Booklet

Question 27

Medium ● ● ● ● ●

Which statement about the chemical reaction that has the energy profile below is correct?

X and Z	Y	Rate−determining step
A.	Intermediates	Transition state	First step
B.	Intermediates	Transition state	Second step

	X and Z	Y	Rate−determining step
C.	Transition states	Intermediate	First step
D.	Transition states	Intermediate	Second step

Revisit | Complete

🗏 Mark Scheme

▷ Video Solutions   1
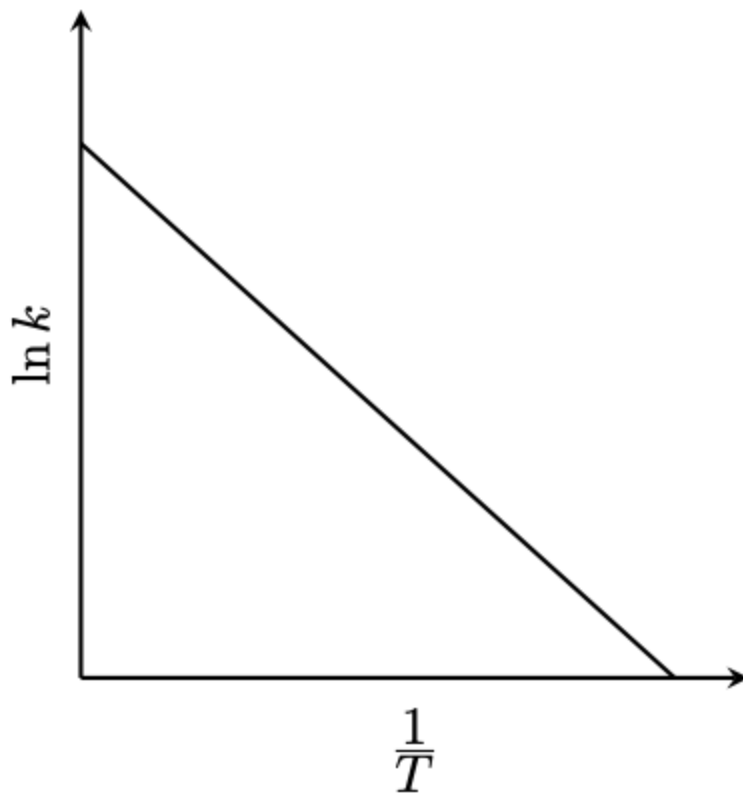
✧ Newton AI

Formula Booklet

Question 28

👍 👎

Easy ●●○○○

A student plotted the rate constants of a reaction at different temperatures. The graph obtained is shown below.

What does the $y-$intercept represent?

A. E_a

B. $-\dfrac{E_a}{RT}$

C. A

D. $\ln A$

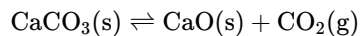Revisit | Complete

Mark Scheme

Video Solutions   1

Newton AI

Formula Booklet

Question 29

Which of the following shows the equilibrium constant expression for the decomposition of calcium carbonate?

$$CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$$

A. $K_c = \dfrac{[CaO][CO_2]}{[CaCO_3]}$

B. $K_c = \dfrac{1}{[CO_2]}$

C. $K_c = \dfrac{[CaCO_3]}{[CaO][CO_2]}$

D. $K_c = [CO_2]$

🔖 Revisit | ⊘ Complete

▤ Mark Scheme

⊙ Video Solutions   1

✧ Newton AI

Formula Booklet

Question 30

The following equilibrium reaction is investigated.

$$A(aq) + 2\,B(aq) \rightleftharpoons 3\,C(aq)$$
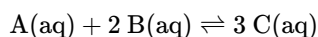
The concentrations are plotted against time at a constant temperature, as shown below.
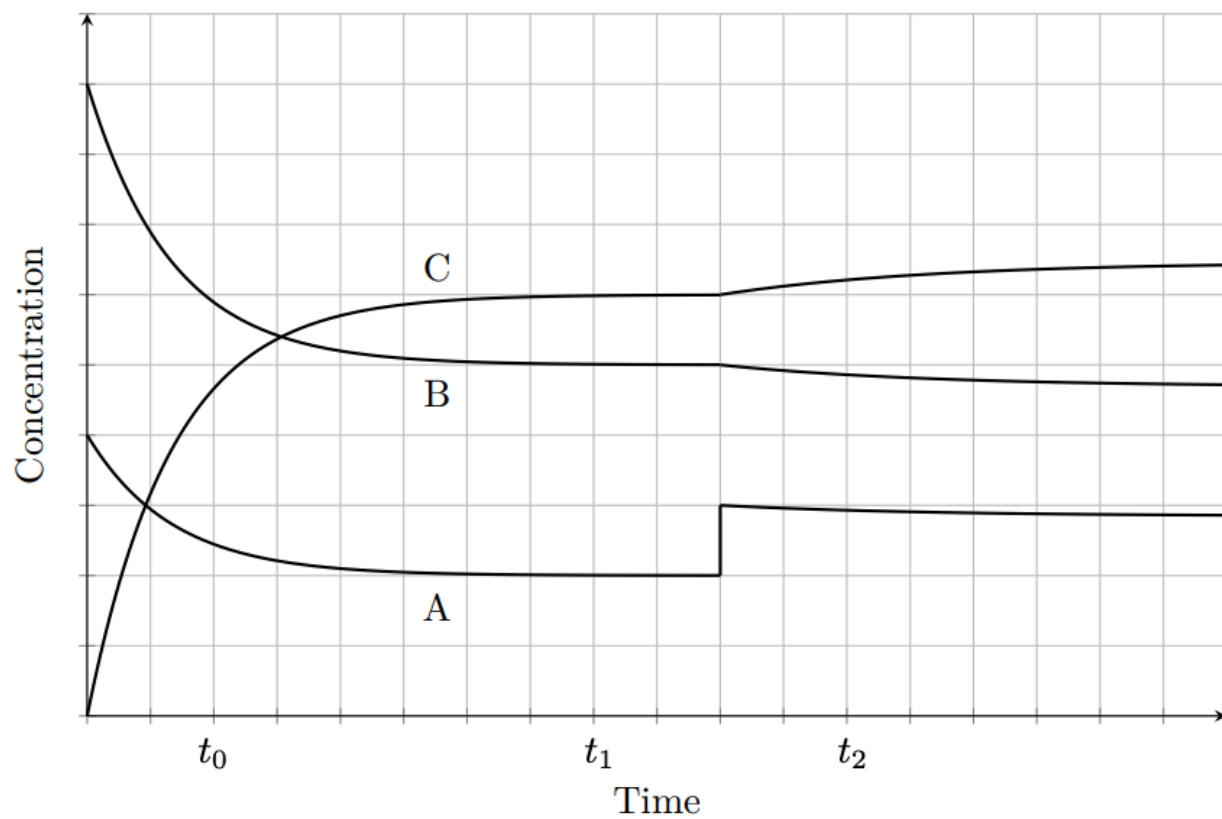
Which combination is correct?

	At t_0	At t_1	At t_2
A.	$Q_c < K_c$	$Q_c = K_c$	$Q_c > K_c$
B.	$Q_c < K_c$	$Q_c = K_c$	$Q_c < K_c$
C.	$Q_c = K_c$	$Q_c < K_c$	$Q_c = K_c$
D.	$Q_c > K_c$	$Q_c = K_c$	$Q_c > K_c$

Revisit   Complete

Mark Scheme

Video Solutions   1

Newton AI

Formula Booklet

Question 31

Which reaction can be characterized as a Bronsted−Lowry acid−base reaction?

A. $CH_4(g) + 2\,O_2(g) \longrightarrow CO_2(g) + 2\,H_2O(g)$

B. $BaCl_2(aq) + Na_2SO_4(aq) \longrightarrow BaSO_4(s) + 2\,NaCl(aq)$

C. $2\,Al(s) + 3Cl_2(g) \longrightarrow AlCl_3(aq)$

D. $NH_3(l) + HCl(aq) \longrightarrow NH_4Cl(aq)$

Revisit | Complete

Mark Scheme

Video Solutions   1

Newton AI

Formula Booklet

Question 32

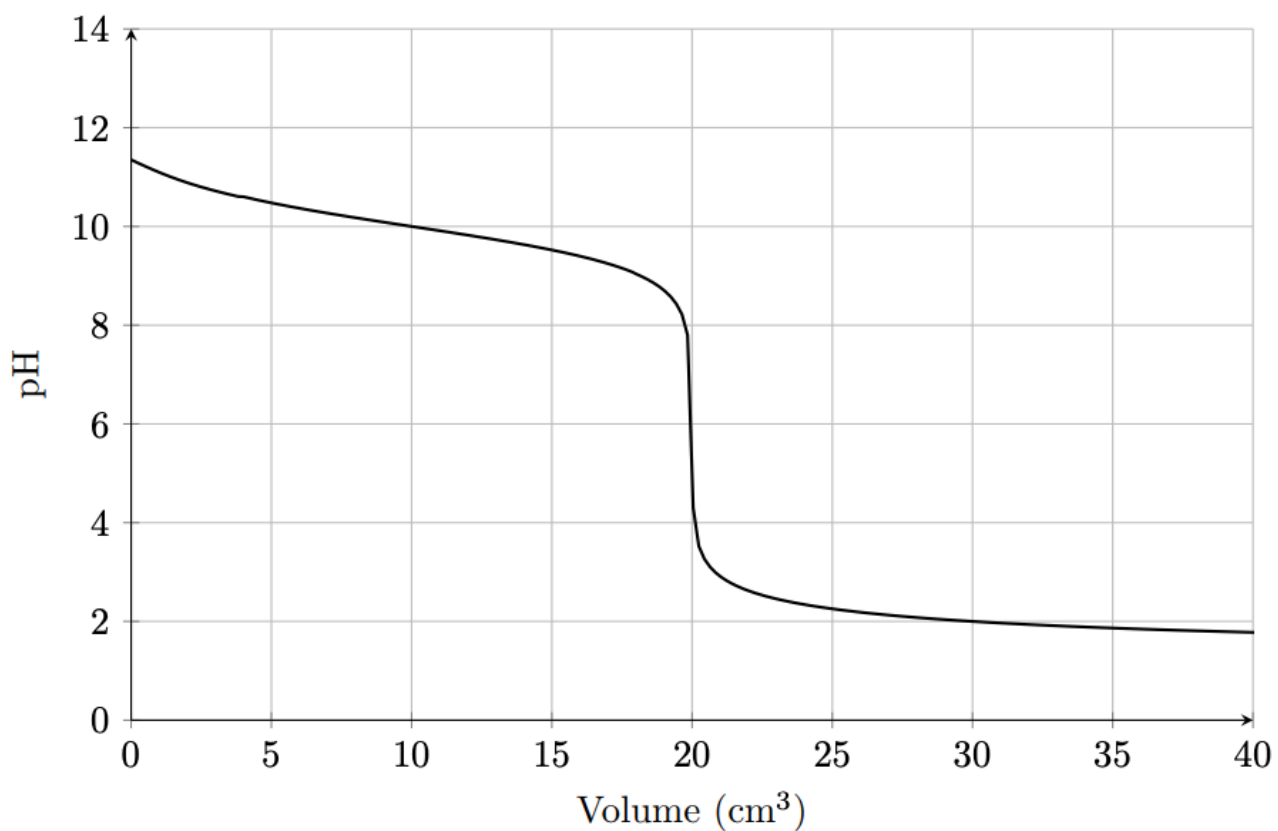Consider the titration curve below at 298 K.

Which statement is correct?

I.   The endpoint can be detected with methyl orange ($pK_a = 3.7$).
II. The pK_b is approximately 4.
III. The equivalence point occurs at 20 cm³ of added titrant.

A. I, II and III

B. II only

C. I and III only

D. II and III only

Revisit   Complete

Mark Scheme

Video Solutions   1

Newton AI

Question 33

Hard ● ● ● ● ●

Which aqueous solution would have a pH below 7 at 298 K?

    A. Sodium carbonate

    B. Potassium nitrate

    C. Lithium ethanoate

    D. Aluminium chloride

Revisit   ✓ Complete

🗐 Mark Scheme

▷ Video Solutions   1

✧ Newton AI

Question 34

Medium ● ● ● ● ●

Which combination of substances formed at the electrodes is true for the electrolysis of molten aluminum oxide?

	anode	cathode
A.	Oxygen gas (O_2)	Aluminum (Al)

	anode	cathode
B.	Oxygen ion (O^{2-})	Aluminum ion (Al^{3+})
C.	Aluminum (Al)	Oxygen gas (O_2)
D.	Aluminum (Al)	Oxygen ion (O^{2-})

Revisit   Complete

Mark Scheme

Video Solutions   1

Newton AI
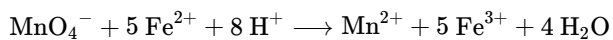
Formula Booklet

Question 35

Hard ● ● ● ● ●

The following data was collected for the redox titration of iron(II) sulfate ($FeSO_4$) with acidified potassium permanganate ($KMnO_4$):

$$MnO_4^- + 5\,Fe^{2+} + 8\,H^+ \longrightarrow Mn^{2+} + 5\,Fe^{3+} + 4\,H_2O$$

$[FeSO_4] = 0.0500$ mol dm^{-3}
Volume of $FeSO_4$ to reach equivalence $= 20.00$ cm^3
Volume of $KMnO_4 = 50.00$ cm^3

What is the concentration of $KMnO_4$ in the 50.0 cm^3 sample?

A. 0.00400 mol dm^{-3}

B. 0.0200 mol dm^{-3}

C. 0.0500 mol dm^{-3}

D. 0.00250 mol dm^{-3}

Formula Booklet

Question 36

Medium ● ● ◖ ● ●

Which statement about copper(II) sulfate electrolysis using graphite electrodes is correct?

A.   The blue intensity of the solution remains constant, and the mass of the cathode increases.

B.   The blue intensity of the solution remains constant, and the mass of the cathode decreases.

C.   The blue colour of the solution fades away, and the mass of the cathode increases.

D.   The blue colour of the solution fades away, and the mass of the cathode decreases.

Formula Booklet

Question 37

Which of the following correctly represents a propagation step in the free−radical substitution reaction between methane and chlorine gas when exposed to UV light?

A. $CH_3Cl + Cl\bullet \longrightarrow \bullet CH_3 + Cl_2$

B. $\bullet CH_3 + Cl_2 \longrightarrow CH_3Cl + Cl\bullet$

C. $Cl_2 \longrightarrow 2\ Cl\bullet$

D. $CH_4 + Cl_2 \longrightarrow CH_3Cl + HCl$

Revisit | ✓ Complete

Mark Scheme

Video Solutions   1

Newton AI

Formula Booklet

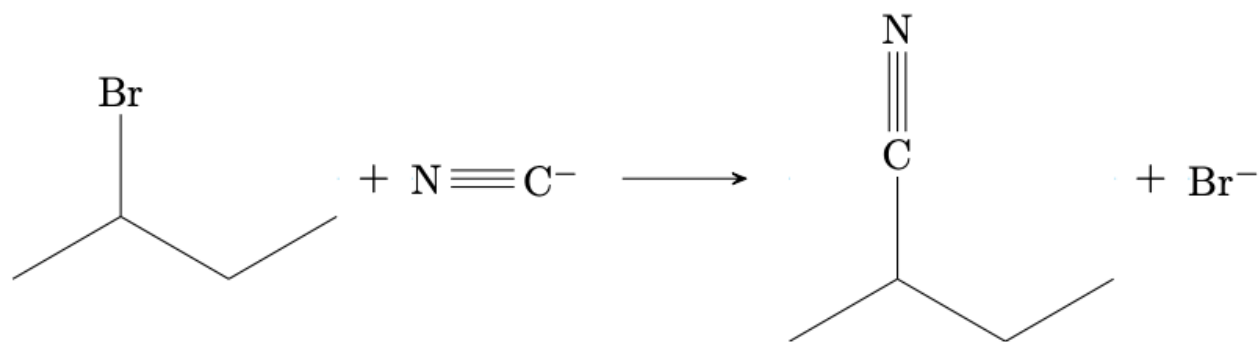# Question 38

In the reaction of 2−bromobutane with cyanide ion (CN^-), what are the correct identities of the nucleophile, electrophile, and leaving group?

	Nucleophile	Electrophile	Leaving Group
A.	CN⁻	Br⁻	2−bromobutane
B.	CN⁻	2−bromobutane	Br⁻
C.	2−bromobutane	CN⁻	Br⁻
D.	Br⁻	2−bromobutane	CN⁻

🔖 Revisit | ✅ Complete

📑 Mark Scheme

▶ Video Solutions   1

✦ Newton AI

Formula Booklet

Question 39   👍 👎

▦   Hard ●●●●◖   ⌞⌝

One enantiomer of 2−chlorobutane undergoes nucleophilic substitution with warm, aqueous sodium hydroxide, producing a racemic mixture of products. Which statement about this reaction is correct?

A. The rate equation is rate $= k[C_4H_9Cl][OH^-]$, and the hydroxide ion acts as a nucleophile.

B. The rate equation is rate $= k[C_4H_9Cl][OH^-]$, and a secondary carbocation intermediate is formed.

C. The rate equation is rate $= k[C_4H_9Cl]$, and the hydroxide ion acts as an electrophile.

D. The rate equation is rate $= k[\mathrm{C_4H_9Cl}]$, and the relative rate of substitution of $2-$iodobutane is greater.

🔖 Revisit   ✓ Complete

▤ **Mark Scheme**

▷ **Video Solutions**   1

✧ **Newton AI**

Formula Booklet

Question 40   👍 👎

▦   Medium ● ● ◑ ● ●   ⌞⌝

What is the major product of the reaction of HCl with $3-$methylpent$-2-$ene?

    A. $1-$chloro$-3-$methylpentane

    B. $3-$chloro$-2-$methylpentane

    C. $3-$chloro$-3-$methylpentane

    D. $2-$chloro$-3-$methylpentane

🔖 Revisit   ✓ Complete

▤ **Mark Scheme**

✧ **Newton AI**

Section B

Question 41

👍 👎

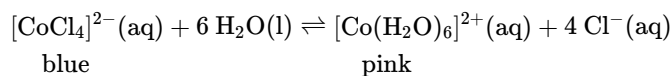🖩   Medium ● ● ● ◑ ○   ⛶

[Maximum marks: 20]

Cobalt chloride paper is primarily used to detect the presence of moisture or water vapor due to its color-changing property, turning from blue to pink when exposed to humidity. This property is based on the following equilibrium:

$$[CoCl_4]^{2-}(aq) + 6\ H_2O(l) \rightleftharpoons [Co(H_2O)_6]^{2+}(aq) + 4\ Cl^-(aq)$$
$$\text{blue} \qquad\qquad\qquad \text{pink}$$

(a) Explain why $[CoCl_4]^{2-}$ and $[Co(H_2O)_6]^{2+}$ are different colors. [2]

(b) To determine the equilibrium constant of the reaction, a student first constructed a calibration curve.

   (i) Identify two pieces of laboratory equipment required to make a 250 cm^3 of a 1.000 mol dm^{-3} solution of $Co(NO_3)_2$. [1]

   (ii) Explain, using calculations, how this stock solution can be used to make 50 cm^3 of 0.800 mol dm^3 solution. [2]

   (iii) The following data was collected on the absorption of the standard solutions of $[Co(H_2O)_6]^{2+}$ at 500 nm.

Concentration $\pm5\%$ mol dm^{-3}	Absorption ±0.005 a.u.
1.000	0.159
0.800	0.133
0.600	0.116
0.400	0.098
0.200	0.075
0.000	0.046

$$y = 0.115x + 0.045$$
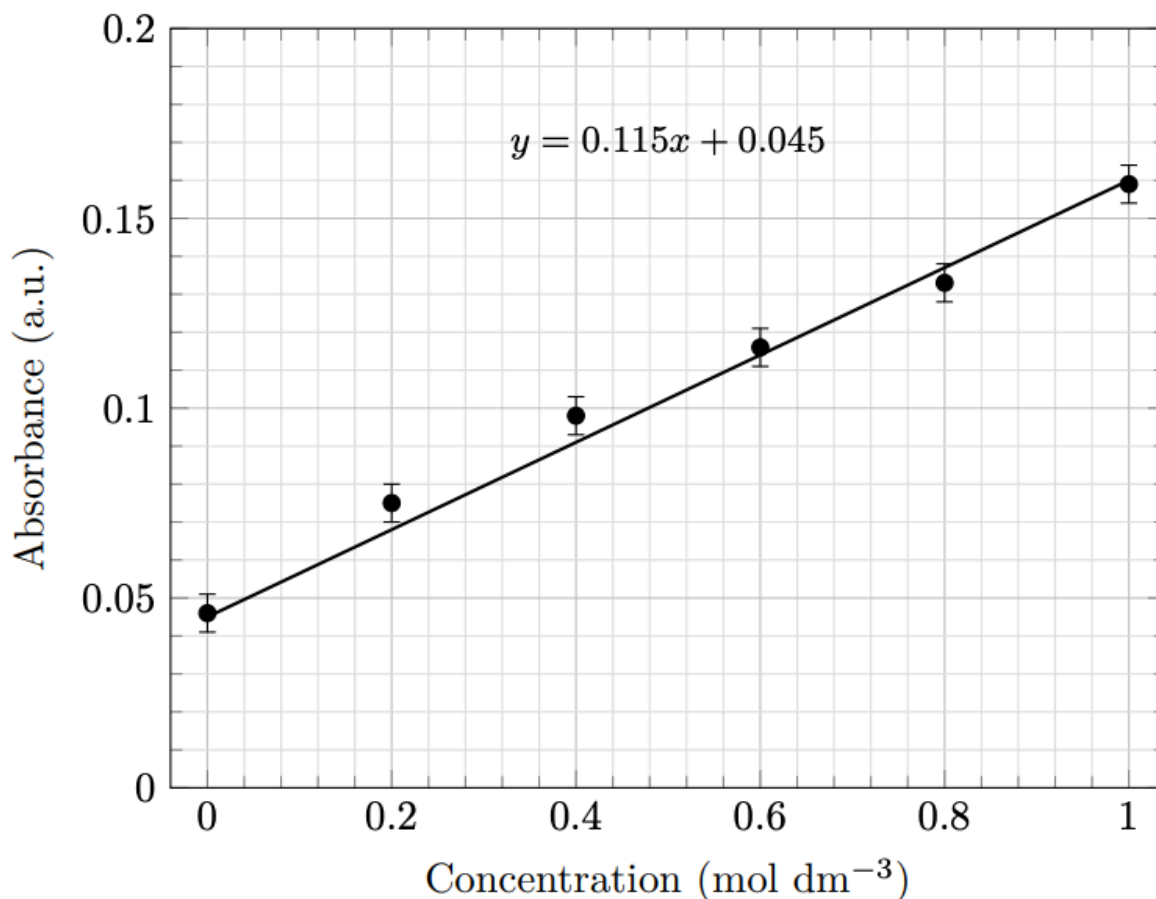
What is the percent uncertainty in the absorption of the 0.200 mol dm^{-3} solution? [1]

(iv) The Beer$-$Lambert Law, often written as $A = \varepsilon bC$, relates the absorbance, A, to the concentration, C. The constants ε, the molar absorptivity, and b, the path length, are specific to the analyte and the experimental set up, respectively. Evaluate whether the data in (b)(iii) support this relationship. [2]

(v) Discuss whether it is valid to extrapolate the absorbance for a 1.2 mol dm^{-3} solution based on the given data. [1]

(c) Write the equilibrium constant expression for the reaction. [1]

(d) A lab technician mixes 10 cm^3 of the 1.000 mol dm^{-3} stock solution of $[Co(H_2O)_6]^{2+}$ with 10 cm^3 of the 12.0 mol dm^{-3} concentrated hydrochloric acid. The solution is stored in a water bath held at 298 K.

(i) Determine the initial concentrations of the chloride ion and the $[Co(H_2O)_6]^{2+}$ ion in the reaction mixture. [2]

(ii) Once equilibrium is established, the absorbance of the solution, measured at 500 nm, is 0.082 a.u. Using the calibration curve in part (a), calculate the equilibrium concentration of $[Co(H_2O)_6]^{2+}$, in mol dm^{-3}, to two significant figures. [2]

(iii) Determine the equilibrium concentration of $[CoCl_4]^{2-}$ and hence the value of the equilibrium constant at 298 K. (If you did not get an answer to part (d)(ii) use $[Co(H_2O)_6]^{2+} = 0.25$ mol dm^{-3} though that is not the correct answer.) [2]

(e) The temperature of the water bath is raised to 340 K.

(i) As the temperature rises, the reaction mixture appears more blue. State and explain the sign of ΔH for the reaction. [2]

(ii) A student reasoned that two equations in Section 1 of the IB Chemistry data booklet $\Delta G^\ominus = -RT \ln K$ and $\Delta G^\ominus = \Delta H^\ominus - T\Delta S^\ominus$ could be used to find a quantitative model of how the equilibrium constant changes with temperature.

$$\ln K = -\frac{\Delta H^\ominus}{RT} + \frac{\Delta S^\ominus}{R}$$

The student measured the equilibrium constant at several temperatures and decided a graph would be the best way to process the data. Suggest what should be graphed on the $x-$ and $y-$axes and state the meaning of the gradient and $y-$intercept. [2]

🔖 Revisit   ✓ Complete

📰 **Mark Scheme**

▷ **Video Solutions**   12

✧ **Newton AI**

Formula Booklet

Question 42   👍 👎

🖩   Medium ● ● ● ◑ ●   ⌞⌝

[Maximum marks:15]

Dipole moments are crucial in explaining the physical and chemical properties of molecules. The debye (D) is a unit used to measure dipole moments: $1 \text{ D} = 3.33 \times 10^{-30}$ Cm.

Consider data collected by Roland Stenutz (http://www.stenutz.eu) comparing the dipole moment and boiling points of the hydrides.

Molecule
Dipole Moment (± 0.01 D)
Boiling Point ($\pm 2°$C)

CH$_4$	NH$_3$	H$_2$O	HF
0.00	1.47	1.87	1.82
−164	−33	100	20
SiH$_4$	PH$_3$	H$_2$S	HCl
0.00	0.58	0.97	1.04
−112	−88	−60	−85
GeH$_4$	AsH$_3$	H$_2$Se	HBr
0.00	0.20	0.24	0.82
−89	−63	−41	−67
SnH$_4$	SbH$_3$	H$_2$Te	HI
0.00	0.12	0.20	0.44
−52	−17	−2	127

(a) Deduce the electron domain geometry and the molecular shape of hydrogen selenide, H$_2$Se. [2]

(b) Explain the trend in boiling points of the Group 14 hydrides: CH$_4$, SiH$_4$, GeH$_4$, and SnH$_4$. [1]

(c) Explain the trend in the dipole moment of the Group 17 hydrides: HF, HCl, HBr and HI using Section 9 of the IB Chemistry data booklet. [2]

(d) Suggest an explanation for the high boiling point of water compared to ammonia, NH$_3$, and hydrogen fluoride, HF. [1]

(e) It is the nature of science to evaluate claims based on evidence. Another reliable source lists the boiling point of hydrogen iodide, HI, as −35°C. Based on the patterns and trends in the data table above, suggest upper and lower bounds for the expected boiling point of hydrogen iodide. Determine if this value should be accepted. [2]

(f) Consider the Van Arkel−Ketelaar triangle.
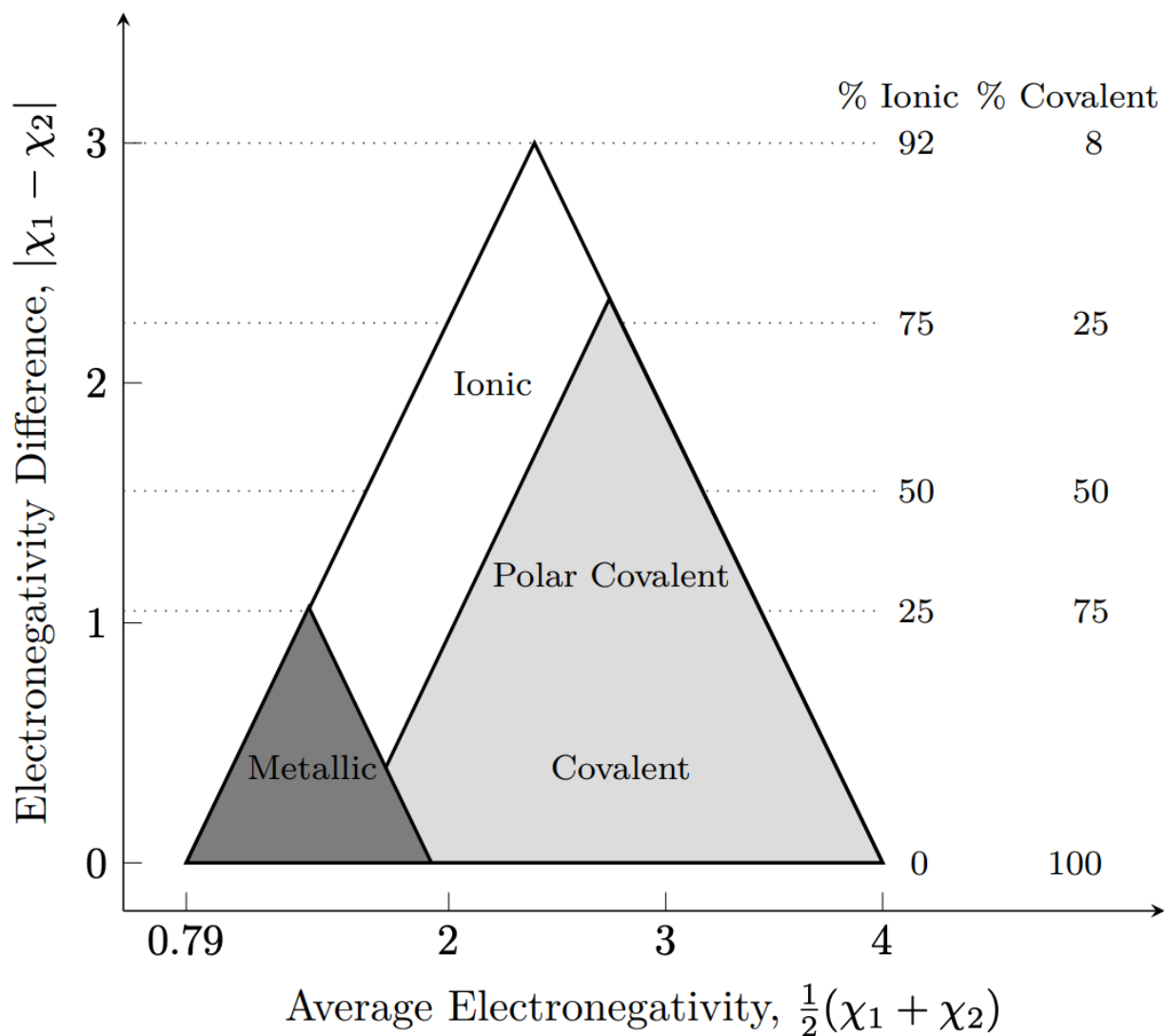
(i) Plot the Period 3 hydrides on the triangle above. [2]

(ii) Evaluate the relationship between the percent ionicity and the dipole moment in part (a). [2]

(iii) Identify a limitation of the van Arkel−Ketelaar triangle in predicting the dipole moment of molecules. [1]

(g) Linus Pauling devised a formula for the percent ionic character, I,

$$I = 100 \times \left(1 - e^{-\frac{\Delta\chi^2}{4}}\right)$$

where $\Delta\chi$ represents the difference in electronegativity.

(i) Calculate the percent ionic character of hydrogen chloride using Section 9 of the IB Chemistry data booklet. [1]

(ii) Identify an advantage of Pauling's formula over the percent ionicity scale in Section 17 of the IB Chemistry data booklet. [1]

Revisit | Complete

Mark Scheme

Video Solutions   10

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Formula Booklet

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