Revision practice

International Baccalaureate · IB Diploma · Chemistry · HL

Original open focus revision; complete specification coverage remains unfinished.

1 Gas models and absolute temperature

- absolute temperature
- ideal gas

■ Question 1

Which scale belongs in a gas-law temperature ratio?

- Celsius
- Kelvin
- Either scale without conversion

Available marks: 2.

Worked answer

Kelvin

- At fixed amount and volume, pressure is proportional to kelvin temperature. At fixed temperature and amount, pressure is inversely proportional to volume. State which quantities are fixed before choosing a relationship.

■ Question 2

At fixed volume, pressure is 120 kPa at 300 K. Find pressure at 350 K.

Available marks: 4.

Worked answer

140 kPa

- Appropriate relation; consistent substitution; correct result; meaningful unit and interpretation.

An ideal gas is a model with conditions of validity. Celsius zero is not zero molecular motion, and internal energy is not determined by pressure alone.

2 Particles, bonding and bulk properties

- ionic bond
- delocalized electron

exercises.lol exercises.com.cn

■ Question 1

Why does molten sodium chloride conduct?

- Its ions can move
- Its atoms become electrons
- Its molecules contain no charge

Available marks: 2.

Worked answer

Its ions can move

- To explain a bulk property, name the structure, particles, forces and mobile charge carriers. Simple molecular substances can have strong covalent bonds inside molecules but weak attractions between molecules.

■ Question 2

An atom has atomic number 17 and mass number 35. Find its number of neutrons.

Available marks: 4.

Worked answer

18

- Appropriate relation; consistent substitution; correct result; meaningful unit and interpretation.

Melting a simple molecular substance usually overcomes intermolecular attractions; it does not require breaking all covalent bonds within each molecule.

3 Amounts, equations and limiting reagents

- mole
- limiting reagent

■ Question 1

Which step comes first in a reacting-mass calculation?

- Compare masses without an equation
- Use a balanced equation and convert mass to amount
- Assume every mole ratio is 1:1

Available marks: 2.

Worked answer

Use a balanced equation and convert mass to amount

- Calculate the amount available for each reactant and divide by its coefficient. The smaller ratio limits the reaction. Use that reactant to calculate the maximum product before comparing actual yield.

exercises.lol exercises.com.cn

Question 2

Calculate amount in 5.0 g of a substance with molar mass 100 g per mole.

Available marks: 4.

Worked answer

0.05 mol

- Appropriate relation; consistent substitution; correct result; meaningful unit and interpretation.

Excess acid means acid does not limit the stated calculation. A coefficient of 2 before HCl does not double the hydrogen amount.

4 Organic structures and reaction pathways

- functional group
- isomer

Question 1

What happens to the carbon skeleton when bromine adds to ethene?

- It remains two carbons long
- It becomes one carbon long
- It becomes a six-carbon ring

Available marks: 2.

Worked answer

It remains two carbons long

- Distinguish addition, substitution, oxidation and polymerization by tracing bonds before and after reaction. Conditions and reagents belong to the reaction arrow; they are not interchangeable labels.

Question 2

How many moles of bromine react completely with 0.15 mol ethene?

Available marks: 4.

Worked answer

0.15 mol

- Appropriate relation; consistent substitution; correct result; meaningful unit and interpretation.

Bromine decolourization provides evidence of unsaturation in an appropriate test. It is not proof that an unknown sample is specifically ethene.

5 Calorimetry and chemical energy

- exothermic
- enthalpy change

■ Question 1

Which process requires energy?

- Breaking a covalent bond
- Forming every chemical bond
- Cooling a hot solution

Available marks: 2.

Worked answer

Breaking a covalent bond

- Use energy transferred = mass × specific heat capacity × temperature change. Convert joules to kilojoules before dividing by reaction amount. An exothermic molar enthalpy change has a negative sign.

■ Question 2

50 g water rises 4 °C. Use c = 4.2 J per gram per degree to find q.

Available marks: 4.

Worked answer

840 J

- Appropriate relation; consistent substitution; correct result; meaningful unit and interpretation.

Heat loss usually lowers the observed temperature rise. The solution gaining heat and the reaction losing heat have opposite signs.

6 Atmosphere, resources and life-cycle decisions

- life-cycle assessment
- functional unit

■ Question 1

Which comparison uses a consistent functional unit?

- One bottle versus any number of bags
- The same volume delivered the same number of times
- Two items with the same colour

Available marks: 2.

Worked answer

exercises.lol exercises.com.cn

The same volume delivered the same number of times

- Define the functional unit before comparing products. The same delivered service, such as carrying one litre of water a hundred times, is fairer than comparing one object with another regardless of lifetime.

Question 2

A reusable item costs 600 energy units initially and 5 per use; disposables cost 35 per use. Find break-even uses.

Available marks: 4.

Worked answer

20 uses

- Appropriate relation; consistent substitution; correct result; meaningful unit and interpretation.

A break-even model is sensitive to cleaning, transport and disposal assumptions. Recyclable does not guarantee that an item is actually collected and recycled.

7 Entropy, Gibbs energy and feasibility

- entropy
- Gibbs energy

Question 1

What can remain small even when ΔG is negative?

- Reaction rate
- The fact that kelvin is used
- Every activation barrier

Available marks: 2.

Worked answer

Reaction rate

- Use $\Delta G = \Delta H - T\Delta S$ with consistent energy units. A negative Gibbs energy change indicates thermodynamic favourability for the stated conditions, not a fast rate. An activation barrier can make a favourable process slow.

Question 2

ΔH=30 kJ per mole, ΔS=0.10 kJ per kelvin per mole and T=400 K. Find ΔG.

Available marks: 4.

Worked answer

-10 kJ/mol

exercises.lol exercises.com.cn

- Appropriate relation; consistent substitution; correct result; meaningful unit and interpretation.

Thermodynamic favourability does not establish reaction rate. Celsius cannot replace kelvin in $T\Delta S$, and a unit conversion error can change the result by a factor of 1,000.

8 Titration and a defensible concentration

- titre
- equivalence point

■ Question 1

Why rinse the pipette with the solution it will transfer?

- To avoid dilution by residual water
- To create more moles of analyte
- To make the solution neutral

Available marks: 2.

Worked answer

To avoid dilution by residual water

- Calculate the known amount first, apply the stoichiometric ratio, then divide by the unknown solution volume in cubic decimetres. Use concordant titres as required by the school method and report the accepted values.

■ Question 2

Burette readings are 1.40 and 23.65 cubic centimetres. Calculate titre.

Available marks: 4.

Worked answer

22.25 cm^3

- Appropriate relation; consistent substitution; correct result; meaningful unit and interpretation.

Adding distilled water to the flask changes volume but not the transferred amount of analyte. Do not average a rough titre with carefully measured concordant values.

9 Rates, catalysts and reliable endpoints

- activation energy
- rate

exercises.lol exercises.com.cn

■ Question 1

Two reactions reach the same final gas volume. Which can still differ?

- Their rates
- Their total mass of products
- Their limiting reactant amount

Available marks: 2.

Worked answer

Their rates

- A product-time graph has a steeper gradient where rate is larger. A tangent estimates instantaneous rate; a secant gives average rate over an interval. The final plateau reflects the total collected product under the stated conditions.

■ Question 2

A reaction makes 24 cubic centimetres of gas in 40 s. Find average rate.

Available marks: 4.

Worked answer

0.6 cm^3/s

- Appropriate relation; consistent substitution; correct result; meaningful unit and interpretation.

A catalyst does not change the equilibrium constant at a fixed temperature. A mass-loss method cannot detect all reactions, and losing gas through a leak biases a collection experiment.

10 Equilibrium and changing conditions

- equilibrium
- reversible reaction

■ Question 1

What is equal at dynamic equilibrium?

- Concentrations of all species
- Forward and reverse reaction rates
- Masses of every reactant and product

Available marks: 2.

Worked answer

Forward and reverse reaction rates

exercises.lol exercises.com.cn

- A concentration or pressure change disturbs the balance. The system responds toward a new equilibrium. Temperature changes can also change the equilibrium constant; a catalyst changes how quickly equilibrium is reached.

■ Question 2

For A $\rightleftharpoons$ B, calculate [B]/[A] when [B]=0.8 and [A]=0.2.

Available marks: 4.

Worked answer

4

- Appropriate relation; consistent substitution; correct result; meaningful unit and interpretation.

Do not use a catalyst to claim a larger equilibrium yield. For heterogeneous equilibria, pure solids are omitted from the usual equilibrium expression.

11 Redox and electrolysis

- oxidation
- reduction

■ Question 1

What happens to Cu^{2+} at the cathode?

- It gains electrons
- It loses two protons
- It gains neutrons

Available marks: 2.

Worked answer

It gains electrons

- Predict products using the specified electrolyte and electrode material. In an aqueous solution, hydrogen or oxygen may form because water-related species compete. Molten salts contain only the ions of the salt.

■ Question 2

How many moles of electrons reduce 0.20 mol of Cu^{2+} to copper?

Available marks: 4.

Worked answer

0.4 mol

- Appropriate relation; consistent substitution; correct result; meaningful unit and interpretation.

exercises.lol exercises.com.cn

Electrode signs depend on the cell type. In an electrolytic cell the cathode is negative; reduction remains the defining process at a cathode in every cell.

12 Uncertainty, gradients and model testing

- uncertainty
- systematic error

■ Question 1

Which is most likely a systematic error?

- A balance reads 0.20 g when empty
- Repeated values fluctuate either side of the mean
- Random differences in reaction time

Available marks: 2.

Worked answer

A balance reads 0.20 g when empty

- For a product or quotient, adding fractional uncertainties is a common maximum-uncertainty approximation. For a difference, add absolute uncertainties. A nonzero intercept can reveal an offset or an incomplete model.

■ Question 2

A 40 cm reading has an absolute uncertainty of 1 cm. Find percentage uncertainty.

Available marks: 4.

Worked answer

2.5 %

- Appropriate relation; consistent substitution; correct result; meaningful unit and interpretation.

Repeating readings reduces random uncertainty in a mean but does not automatically remove a zero error. Do not quote more decimal places than your measurement can support.

exercises.lol exercises.com.cn