RT · Extra practice

Worked solutions | Items 1-2

Extra practice for this lesson. Original questions, not released diploma items. Select one option for multiple choice; other tasks state the required response.

Use the givens and conditions in each prompt. Enter the requested count, coefficient, oxidation number or potential with the stated unit and precision.

RT-D01 · Numerical response

Initial buret reading 1.35 mL; final reading 20.85 mL. What is the titre in mL? Enter to two decimal places.

1. Titre = final − initial = 20.85 − 1.35 = 19.50 mL.

2. The readings increase as liquid leaves the buret. Subtract the initial reading from the final reading.

RT-D02 · Multiple choice

In a redox titration, which solution is placed in the buret?

A. The solution of unknown concentration
B. The solution of known concentration
C. Distilled water
D. The indicator only

1. The titrant has a known concentration and goes in the buret. The analyte is in the flask. B is correct.

2. The unknown solution is measured into the flask with a pipette.

RT · Extra practice

Worked solutions | Items 3-4

RT-D03 · Numerical response

Trials of 18.40 mL and 18.50 mL agree within the limit of 0.20 mL. What is their average in mL? Enter to two decimal places.

1. Average = (18.40 + 18.50) ÷ 2 = 18.45 mL.

2. Both trials are within the limit, so both are used.

RT-D04 · Numerical response

Given $MnO_4^- + 8H^+ + 5Fe^{2+} \rightarrow Mn^{2+} + 4H_2O + 5Fe^{3+}$. A reaction uses 0.30 mmol of MnO_4^-. How many millimoles of Fe^{2+} react? Enter to one decimal place.

1. The ratio is 5 Fe^{2+} per 1 MnO_4^-, so 5 × 0.30 = 1.5 mmol.

2. Millimoles scale in the same ratio as moles.

RT · Extra practice

Worked solutions | Items 5-6

RT-D05 · Select all that apply

Select every correct statement about a permanganate titration of iron(II).

A. MnO_4^- is purple and Mn^{2+} in dilute solution is almost colourless
B. A faint pink that stays marks the endpoint
C. A deep purple flask means the titre is too small
D. No extra indicator is needed

1. Purple permanganate turns almost colourless as it reacts. A faint lasting pink marks the endpoint, and the titrant is its own indicator.

2. A deep purple flask means too much titrant was added, so the titre is too large, not too small.

RT-D06 · Numerical response

Given $MnO_4^- + 8H^+ + 5Fe^{2+} \rightarrow Mn^{2+} + 4H_2O + 5Fe^{3+}$. A 20.00 mL sample of $Fe^{2+}(aq)$ needs 16.00 mL of 0.0100 mol/L $MnO_4^-(aq)$. Find $c(Fe^{2+})$ in mol/L to four decimal places.

1. $n(MnO_4^-) = 0.0100 \times 0.01600 = 1.60 \times 10^{-4}$ mol. $n(Fe^{2+}) = 5 \times 1.60 \times 10^{-4} = 8.00 \times 10^{-4}$ mol.

2. $c = 8.00 \times 10^{-4} \div 0.02000 = 0.0400$ mol/L.

RT · Extra practice

Worked solutions | Items 7-8

RT-D07 · Numerical response

Given $5H_2C_2O_4 + 2MnO_4^- + 6H^+ \rightarrow 10CO_2 + 2Mn^{2+} + 8H_2O$. A 25.00 mL sample of $H_2C_2O_4(aq)$ needs 20.00 mL of 0.0100 mol/L $MnO_4^-(aq)$. Find $c(H_2C_2O_4)$ in mol/L to four decimal places.

1. $n(MnO_4^-) = 0.0100 \times 0.02000 = 2.00 \times 10^{-4}$ mol. The ratio is 5 to 2, so multiply by 5/2: $n(H_2C_2O_4) = 5.00 \times 10^{-4}$ mol.

2. $c = 5.00 \times 10^{-4} \div 0.02500 = 0.0200$ mol/L.

RT-D08 · Numerical response

A 25.00 mL aliquot from a 250.0 mL solution contains 4.00×10^{-4} mol of Fe^{2+}. What mass of iron, in grams, is in the whole 250.0 mL solution (Fe: 55.85 g/mol)? Enter to three decimal places.

1. The whole solution holds $250.0 \div 25.00 = 10.00$ times as much: 4.00×10^{-3} mol.

2. Mass $= 4.00 \times 10^{-3} \times 55.85 = 0.2234$ g, which is 0.223 g to three decimal places.

RT · Extra practice

Worked solutions | Items 9-10

RT-D09 · Multiple choice

A student records the final buret reading smaller than the true reading. What is the effect on the calculated analyte concentration?

A. Too high
B. Too low
C. Unchanged
D. Cannot be determined

1. The titre is final − initial, so a final reading that is too small gives a titre that is too small. Then every later number in the chain is too small.

2. Follow the chain from the titre to the concentration to decide the direction.

RT-D10 · Ordering / ranking

Arrange the steps of the titration calculation from first to last.

First to last

1. Find the moles of analyte using the mole ratio
2. Calculate the moles of titrant from c × V
3. Convert the titre to litres
4. Divide the moles of analyte by the analyte volume

1. Convert the titre to litres, find the moles of titrant, use the ratio to find the moles of analyte, then divide by the analyte volume.

2. The ratio step must come after the titrant moles are known.

RT · Extra practice

Worked solutions | Items 11-12

RT-D11 · Matching

Match each error to its effect on the calculated c(Fe^{2+}) in a permanganate titration.

Items to match:

1. Too much titrant added
2. Flask rinsed with water and left wet
3. Buret rinsed with water, not titrant

Targets:

A. Too high
B. Unchanged
C. Too high (titrant made weaker)

1. Adding too much titrant makes the titre too large. A wet flask adds no moles of analyte. A water-rinsed buret makes the titrant weaker, so more volume is needed.

2. The calculation still uses the given titrant concentration, so the extra volume gives a result that is too high.

RT-D12 · Written response

Explain the difference between the equivalence point and the endpoint in a permanganate titration.

1. Equivalence is the exact point where the moles of titrant and analyte are in the equation ratio. It is calculated.

2. The endpoint is the colour change we see, a faint pink that stays, ideally one drop after equivalence.