C4.3 Mastery Quiz: Quantitative Chemistry

Mark Scheme

Section A

Qu	Answer	Marks	Supporting information for fix-it tasks
1	C	1	Answering A suggests that the student has added together the relative atomic masses and has not considered that there are three bromines in the formula. Answering B suggests that the student has added together the relative atomic masses and multiplied the answer by 3, thinking that the subscript '3' in the formula refers to both the iron and bromine atoms. *To fix it, model for students how to work out this answer correctly. Then give students similar questions to calculate relative formula masses.*
2	A	1	Answering B or C indicates that students cannot recall the ions present in acidic solutions. *To fix-it, look at the formulae of some common acids and ask students to identify what they have in common (a H).*
3	C	1	Answering A, B or D means students are mixing up different reactions and cannot recall what a neutralisation reaction is. *To fix it, provide an example of each of these types of reaction (in equation form), with a definition of each, and ask students to match these up.*
4	C	1	Answering A or B suggests that students are unable to relate the pH of a solution to the colours of universal indicator solution. *To fix-it, use the coloured pH scale that comes with the universal indicator to help students to recall the standard colours for acidic, neutral and alkaline substances.*
5	C	1	Answering A or B suggests that students cannot recall the meaning of state symbols. *To fix-it, give students examples of common substances and the state symbols usually associated with them at room temperature. Ask students to suggest the state symbols associated with other substances they are familiar with.*
6	C	1	Answering A shows a gap in knowledge about when to convert units. *To fix it, model how A would be correct if the units were cm and not dm^3. Then give students similar practice questions to do.*

			Answering B shows a gap in knowledge about how to calculate concentration since this option is concentration/mass. *To fix it, reteach how to calculate concentration, focussing on how the units tell you what concentration is, i.e. 200 g in/per 1 dm^3 of volume. Then ask students to write out this question and label the mass, volume and then show how to calculate concentration i.e. 200/1.*
7	C	1	Answering A suggests that pupils are confusing the mass number of fluorine with the number of atoms in one mole. Answering B suggests students are misremembering Avogadro's number. *To fix-it, use examples of other substances to show the mass of one mole for each. Then point out that one mole of any substance contains exactly Avogadro's number of atoms/particles/molecules.*
8	B	1	Answering A or C suggests that students are unsure how to convert between cm^3 and dm^3. *To fix-it, model for students how to do this conversion, and then give students some similar conversions to try independently.*
9	C	1	Answering A or B suggests that students are unable to explain the use of a white tile in a titration. *To fix-it, demonstrate a simple colour change both using a white tile and on a dark wooden desk to demonstrate the purpose.*
10	B	1	Answering A suggests that students have used all of the figures to calculate the average titre, and not just those within 0.2 cm^3 of each other. Answering C suggests that students have used 4 of the 5 figures to calculate the average titre, even though only three are within 0.2 cm^3 of each other. *To fix-it, give students lists of numbers to circle the ones within within 0.2 cm^3 of each other.*
11	A	1	Answering B suggests that students are unsure how to work out the limiting reactant. Answering C suggests that students are unable to identify a reactant in an equation. *To fix-it, model for students how to work out the number of moles of each reactant, and to compare this to the molar ratio from the equation.*
12	A	1	Answering B suggests that students mistakenly think that strong acids only partially ionise in aqueous solution. Answering C suggests that students have not recognised the name of ethanoic acid (vinegar) as a weak acid.

			To fix-it, ask students to sort the names of common acids into strong and weak acids. They should then label one list with 'partially ionises in aqueous solution' and another with 'fully ionises in aqueous solution'.
13	B	1	Answering A suggests that students can describe concentration in terms of the proportion of water molecules mixed with the acid, but they cannot relate this to the concentration of H^+ ions. Answering C suggests that students are mixing up the descriptions of a weak acid with that of a concentrated acid. *To fix-it, use particle diagrams to explain the difference between weak and concentrated acids. Ask students to explain this back to you by referring to the proportion of water molecules mixed with the acid, and the resulting concentration of H^+ ions.*
14	A	1	Answering B suggests that students have mistakenly divided the number of moles by the relative formula mass, either because they guessed or made a mistake when rearranging the formula that links mass, number of moles and relative formula mass. Answering C suggests that students have mistakenly divided the relative formula mass by the number of moles, either because they guessed or made a mistake when rearranging the formula that links mass, number of moles and relative formula mass. *To fix-it, give students more practise in using the the formula that links mass, number of moles and relative formula mass. Ensure students are given given enough practise in rearranging this formula to find each unknown.*
15	B	1	Answering A suggests that students divided concentration by volume in order to find number of moles, instead of multiplying. Answering C suggests that students have calculated the number of moles, and have not done the additional steps to convert this to a mass. *To fix it, model the steps of this calculation for students, pointing out how two different equations are used to get to the final answer. Give students some similar questions to answer.*
16a	C	1	Answering A or B suggests that students are unable to use the equation to determine the molar ratio, and to use this to calculate the number of moles of one substance when given the number of moles of another. *To fix-it, model how to work this out on the board. Substitute the number of moles of ethanedioic acid in the question with another number and repeat to find the number of moles of sodium hydroxide solution that would react with it. Repeat with more*

			numbers. *Give students similar questions with different equations to see if they can still apply their learning.*		
16b	A	1	Answering B suggests that students have used the correct formula to calculate concentration, however haven't correctly converted the units for volume. Answering C suggests that students have converted the unit for volume correctly, but have multiplied this number by the number of moles instead of dividing. *To fix-it, model how to calculate this answer on the board, and then give students some similar calculations to complete independently.*		
17	C	1	Answering A suggests that students have been distracted by the formula H_2 and have tried to suggest this would result in double the number of moles of gas being present. Answering B suggests that students have assumed the greater mass of gas has a greater volume, regardless of number of moles. *To fix-it, model for students how this calculation is made with the formula provided. Give students practice using this formula and a selection of different masses or number of moles of gases.*		

Section B

Qu	Answer	Marks	Supporting information *Suggestions for fix-it tasks*
1 (a)	• add potassium hydroxide solution to the conical flask/use a pipette to measure out the correct volume of potassium hydroxide • add a few drops of indicator • add the sulfuric acid from the burette • until the colour of the indicator changes • read the volume from the burette	5	To fix-it, model the steps to carry out the titration for students
1 (b)	H^+ ions	1	
1 (c)	Red	1	*To fix-it, demonstrate the*

			colour changes of universal indicator in solutions of various pH's. Allow students to use the coloured pH scale to attempt similar questions.
2 (a)	Mr sodium chloride = 23 + 35.5 = 58.5 g Number of moles sodium chloride: 11.5/58.5 = 0.19658 mol Number of moles sodium carbonate: 0.19658/2 = 0.098 mol Mr sodium carbonate = (2x23)+12+(3x16) = 106 Mass sodium carbonate = 0.098 x 106 = **10.42 g** *If students round earlier, they will get 10.39 g. Students should keep answers on calculator for as long as possible.*	1 1 1 1 1	To fix-it, model the steps taken to solve this calculation for students, giving each step a name. Gove students an opportunity to practise similar calculations with other equations.
2 (b)	H_2O = 1 + 1 + 16 = 18 g 36/18 = 2 moles	1	
2 (c)	1.0 x 10^{-3} mol/dm^3 is more concentrated than 1.0 x 10^{-5} mol/dm^3 by a factor of 100 (10 x 10) Therefore the pH of the second solution will be greater by 2. • So, the second solution has a pH of 4.	1 1 Allow an answer of pH 4 with no working for 2 marks	To fix-it, ask students to identify the bigger number from two numbers written in standard form. Then from here, explain how to tell by how many factors of 10 is one bigger than the other.
2 (d)	45/1000 = 0.045 dm^3 • 0.045/24.0 = 0.001875 moles • 0.00188 moles	3	