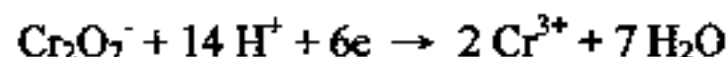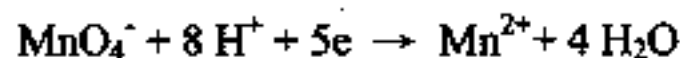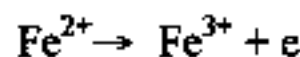1. Express the results of the following calculations using only significant figures. (6%)

    (A)   (39.64)(0.1001)(55.85)/(22.272)

    (B)   236.30 + 12.2 − 1.6342

2. The chromium in 1.0254 g of an ore was oxidized to $Cr_2O_7^{2-}$ which was treated with 25.00 cm^3 of 0.4000M Fe(II) solution (an excess). This excess Fe(II) required 34.85 cm^3 of 0.02642 M KMnO$_4$. What is the percentage of chromium in the ore? (10%)

Note: atomic mass Cr = 52.00

           $Fe^{2+} \rightarrow Fe^{3+} + e$

           $MnO_4^- + 8 H^+ + 5e \rightarrow Mn^{2+} + 4 H_2O$

           $Cr_2O_7^- + 14 H^+ + 6e \rightarrow 2 Cr^{3+} + 7 H_2O$

3. The atomic mass of the four most common elements found in organic compounds are $^{12}C = 12.000$; $^1H = 1.008$; $^{16}O = 15.995$; $^{14}N = 14.003$. What resolving power of a mass spectrometer would be needed to distinguish between the molecular ions of a mixture of methanol and oxygen? (4 %)

4. In the HPLC determination of the vitamin C and the saccharin content of a soft-drink concentrate, Caffeine was used as the internal standard. A standard solution containing vitamin C (250 ppm w/v), saccharin (100 ppm w/v), and caffeine (150 ppm w/v) was prepared. The corresponding HPLC results show the peak height (cm) of 15.15 (for vitamin C), 10.50 (for saccharine) and 12.25 (for caffeine). 20.0 cm^3 of a soft-drink was pipetted into a 100.0 cm^3 volumetric flask, and to it was added a 5.00 mg of pure caffeine. The mixture in the flask was diluted to volume with distilled water. The corresponding HPLC results show the peak height (cm) of 6.95 (for vitamin C), 5.00 (for saccharine) and 8.30 (for caffeine). Assuming a linear relationship exists between the measured peak height and concentrations for all three components over the concentration range examined, calculate the concentration (mg dm^{-3}) of vitamin C and of saccharin in the soft-drink concentrate. (20 %)

5. Complete the A to H in the following table: (8 %)

Type of Chromatography	Polarity of stationary phase	Polarity range of mobile phase	Order of elution polarity/non-polar	Effect of increase of polarity of mobile phase
Normal Phase	A	C	E	G
Reverse Phase	B	D	F	H

6. Suggest an appropriate HPLC detector for the following analytes. Explain your selection. (16 %)

(A) The determination of vitamin C in a multivitamin.

(B) The separation of polystyrene into fractions of different molecular mass, using size exclusion chromatography.

(C) The determination of phenols as contaminants in a sample of river water.

(D) The determination of vitamin B2 in milk.

7. Why is source modulation employed in atomic absorption spectrometry? (6 %)

8. What are the inherent advantages of transform spectrometry? Draw a schematic of a Michelson interferometer for illustration. (14 %)

9. Briefly describe the means to calibrate a volumetric flask. (10 %)

10. Convert decimal number 79 into its binary and octal equivalent. (6 %)