N.B que les pK_a's sont précis à deux chiffres significatifs

a) $H_2PO_4^-$

b) $K_{a1} = 10^{-1.33} = 0.0468$; $K_{a2} = 10^{-5.77} = 1.70 \times 10^{-6}$

$$H_2A(aq) \rightleftharpoons H^+(aq) + HA^-(aq)$$

	$H_2A(aq)$	$H^+(aq)$	$HA^-(aq)$
i:	0.12	–	–
c:	$-x$	$+x$	$+x$
e:	$0.12-x$	x	x

⇒ si on fait l'approximation $0.12 - x \approx 0.12$, on trouvera $x > 5\%$ de 0.12

$$K_{a1} = 0.0468 = \frac{[H^+][HA^-]}{[H_2A]} = \frac{(x)(x)}{0.12-x}$$

$$x^2 + 0.0468x - 0.005616 = 0 \implies x = [H^+] = [HA^-] = 0.0551M$$

$$[H_2A] = 0.12 - x = \underline{\underline{0.06M}}$$

$$HA^-(aq) \rightleftharpoons H^+(aq) + A^{2-}(aq)$$

	$HA^-(aq)$	$H^+(aq)$	$A^{2-}(aq)$
i:	0.0551	0.0551	–
c:	$-x$	$+x$	$+x$
e:	$0.0551-x \approx 0.0551$	$0.0551+x \approx 0.0551$	x

$$K_{a2} = 1.70 \times 10^{-6} = \frac{[H^+][A^{2-}]}{[HA^-]} = \frac{(0.0551)(x)}{(0.0551)}$$

$x = 1.70 \times 10^{-6} \implies [H^+] = \underline{\underline{0.055M}}$; $[HA^-] = \underline{\underline{0.055M}}$

$[A^{2-}] = \underline{\underline{1.7 \times 10^{-6} M}}$

a) HPO_4^{2-}

b)

$$H^+(aq) + NH_3(aq) \rightleftharpoons NH_4^+(aq)$$

	H^+	NH_3	NH_4^+
i:	0.280 mol	0.500 mol	–
c:	−0.280 mol	−0.280 mol	+0.280 mol
e:	–	0.220 mol	0.280 mol

$$pH = pK_a + \log\left([NH_3]/[NH_4^+]\right)$$

$$pH = -\log(5.5\times10^{-10}) + \log\left(\frac{0.220\,mol/2.000L}{0.280\,mol/2.000L}\right)$$

$$pH = \underline{\underline{9.15}}$$

⟹ calculer le nombre de moles de NaOH qu'on a ajouté

$$1.11g / (22.99 + 16.00 + 1.008)\,g/mol = 0.0278\,mol$$

$$OH^-(aq) + NH_4^+(aq) \rightleftharpoons NH_3(aq) + H_2O(l)$$

	OH^-	NH_4^+	NH_3
i:	0.028 mol	0.280 mol	0.220 mol
c:	−0.028 mol	−0.028 mol	+0.028 mol
e:	-	0.252 mol	0.248 mol

$$pH = pK_a + \log\left([NH_3]/[NH_4^+]\right)$$

$$pH = -\log(5.5\times10^{-10}) + \log\left(\frac{0.248\,mol/2.000L}{0.252\,mol/2.000L}\right)$$

$$pH = \underline{\underline{9.25}}$$

a) −2

b) $$ScF_3(s) \rightleftharpoons Sc^{3+}(aq) + 3F^-(aq)$$

		$Sc^{3+}(aq)$	$3F^-(aq)$
i:		—	—
c:		$+x$	$+3x$
e:		x	$3x$

$$K_{ps} = [Sc^{3+}][F^-]^3 \Rightarrow 5.8\times10^{-24} = (x)(3x)^3$$

$$5.8\times10^{-24} = 27x^4 \Rightarrow x = \sqrt[4]{\frac{5.8\times10^{-24}}{27}}$$

$$x = 6.808\times10^{-7}$$

$$\text{solubilité} = (6.808\times10^{-7}\ \text{mol/L})[44.96 + (3)(19.00)]\ \text{g/mol}$$
$$= \underline{\underline{6.9\times10^{-5}\ \text{g/L}}}$$

⇒ dans une solution $ZrF_4(aq)$ 0.050 M, la concentration de $F^-(aq)$ est 4×0.050 M = 0.20 M

$$ScF_3(s) \rightleftharpoons Sc^{3+}(aq) + 3F^-(aq)$$

		$Sc^{3+}(aq)$	$3F^-(aq)$
i:		—	0.20
c:		$+x$	$+3x$
e:		x	$0.20 + 3x \approx 0.20$

$$K_{ps} = [Sc^{3+}][F^-]^3 \Rightarrow 5.8\times10^{-24} = (x)(0.20)^3 \Rightarrow x = 7.25\times10^{-22}$$

$$\text{solubilité} = (7.25\times10^{-22}\ \text{mol/L})[44.96 + (3)(19.00)]\ \text{g/mol}$$
$$= \underline{\underline{7.4\times10^{-20}\ \text{g/L}}}$$

a) > 7

b)

$$C_2H_5OH \rightarrow C_2H_3O_2^-$$
$$H_2O + C_2H_5OH \rightarrow C_2H_3O_2^-$$
$$H_2O + C_2H_5OH \rightarrow C_2H_3O_2^- + 5H^+$$
$$5OH^- + H_2O + C_2H_5OH \rightarrow C_2H_3O_2^- + 5H^+ + 5OH^-$$
$$5OH^- + H_2O + C_2H_5OH \rightarrow C_2H_3O_2^- + 5H_2O$$
$$\boxed{C_2H_5OH + 5OH^- \rightarrow C_2H_3O_2^- + 4H_2O + 4e^-}$$

$$MnO_4^- \rightarrow MnO_2$$
$$MnO_4^- \rightarrow MnO_2 + 2H_2O$$
$$4H^+ + MnO_4^- \rightarrow MnO_2 + 2H_2O$$
$$4OH^- + 4H^+ + MnO_4^- \rightarrow MnO_2 + 2H_2O + 4OH^-$$
$$4H_2O + MnO_4 \rightarrow MnO_2 + 2H_2O + 4OH^-$$
$$\boxed{MnO_4^- + 2H_2O + 3e^- \rightarrow MnO_2 + 4OH^-}$$

$\Rightarrow$ on triple le premier et on quadruple le deuxième

$$3C_2H_5OH + 15OH^- \rightarrow 3C_2H_3O_2^- + 12H_2O + 12e^-$$
$$4MnO_4^- + 8H_2O + 12e^- \rightarrow 4MnO_2 + 16OH^-$$

$$3C_2H_5OH + 4MnO_4^- \rightarrow 3C_2H_3O_2^- + 4MnO_2 + 4H_2O + OH^-$$

a) $Ca_3(PO_4)_2$

b) ⇒ calculez le nombre de moles de CaF_2

$$\frac{0.2333\ g}{[40.08 + (2)(19.00)]\ g/mol} = 0.0029880\ mol$$

⇒ pour chaque mole de CaF_2, on a deux moles de F^-

$$n_{F^-} = (2)(0.0029880\ mol) = 0.0059760\ mol$$

$$\text{masse } F^- = (0.0059760\ mol)(19.00\ g/mol)$$

$$\text{masse } F^- = 0.11354\ g$$

$$\%\ \text{massique} = \frac{0.11354\ g}{0.7277\ g} \times 100\% = \underline{\underline{15.60\%}}$$

⇒ pour avoir $[F^-] = 1.0 \times 10^{-5}$:

$$K_{ps} = [Ca^{2+}][F^-]^2$$

$$3.5 \times 10^{-11} = [Ca^{2+}](1.0 \times 10^{-5})^2$$

$$[Ca^{2+}] = \underline{\underline{0.35\ M}}$$