

## Redox Questions on oxidising and reducing agents

Table of standard electrode potentials for use in the questions below.

$\text{Br}_2(\text{l}) + 2\text{e}^- \rightleftharpoons 2\text{Br}^-(\text{aq})$	$E^\ominus = +1.09 \text{ V}$
$\text{Ce}^{4+}(\text{aq}) + \text{e}^- \rightleftharpoons \text{Ce}^{3+}(\text{aq})$	$E^\ominus = +1.61 \text{ V}$
$\text{Co}^{2+}(\text{aq}) + 2\text{e}^- \rightleftharpoons \text{Co}(\text{s})$	$E^\ominus = -0.28 \text{ V}$
$\text{Co}^{3+}(\text{aq}) + \text{e}^- \rightleftharpoons \text{Co}^{2+}(\text{aq})$	$E^\ominus = +1.82 \text{ V}$
$\text{Cr}^{2+}(\text{aq}) + 2\text{e}^- \rightleftharpoons \text{Cr}(\text{s})$	$E^\ominus = -0.74 \text{ V}$
$\text{Cr}^{3+}(\text{aq}) + \text{e}^- \rightleftharpoons \text{Cr}^{2+}(\text{aq})$	$E^\ominus = -0.41 \text{ V}$
$\text{Cr}_2\text{O}_7^{2-}(\text{aq}) + 14\text{H}^+(\text{aq}) + 6\text{e}^- \rightleftharpoons 2\text{Cr}^{3+}(\text{aq}) + 7\text{H}_2\text{O}(\text{l})$	$E^\ominus = +1.36 \text{ V}$
$\text{Cu}^{2+}(\text{aq}) + 2\text{e}^- \rightleftharpoons \text{Cu}(\text{s})$	$E^\ominus = +0.34 \text{ V}$
$\text{Cu}^{2+}(\text{aq}) + \text{e}^- \rightleftharpoons \text{Cu}^+(\text{aq})$	$E^\ominus = +0.15 \text{ V}$
$\text{Cu}^+(\text{aq}) + \text{e}^- \rightleftharpoons \text{Cu}(\text{s})$	$E^\ominus = +0.52 \text{ V}$
$\text{Eu}^{3+}(\text{aq}) + \text{e}^- \rightleftharpoons \text{Eu}^{2+}(\text{aq})$	$E^\ominus = -0.43 \text{ V}$
$\text{F}_2(\text{g}) + 2\text{e}^- \rightleftharpoons 2\text{F}^-(\text{aq})$	$E^\ominus = +2.87 \text{ V}$
$\text{Fe}^{2+}(\text{aq}) + 2\text{e}^- \rightleftharpoons \text{Fe}(\text{s})$	$E^\ominus = -0.45 \text{ V}$
$\text{Fe}^{3+}(\text{aq}) + \text{e}^- \rightleftharpoons \text{Fe}^{2+}(\text{aq})$	$E^\ominus = +0.77 \text{ V}$
$\text{Ho}^{3+}(\text{aq}) + \text{e}^- \rightleftharpoons \text{Ho}(\text{s})$	$E^\ominus = -2.32 \text{ V}$
$\text{PbO}_2(\text{s}) + 4\text{H}^+(\text{aq}) + 2\text{e}^- \rightleftharpoons \text{Pb}^{2+}(\text{aq}) + 2\text{H}_2\text{O}(\text{l})$	$E^\ominus = +1.46 \text{ V}$
$\text{I}_2(\text{s}) + 2\text{e}^- \rightleftharpoons 2\text{I}^-(\text{aq})$	$E^\ominus = +0.54 \text{ V}$
$2\text{IO}_3^-(\text{aq}) + 12\text{H}^+(\text{aq}) + 10\text{e}^- \rightleftharpoons \text{I}_2(\text{s}) + 6\text{H}_2\text{O}(\text{l})$	$E^\ominus = +1.19 \text{ V}$
$\text{MnO}_4^-(\text{aq}) + 8\text{H}^+(\text{aq}) + 5\text{e}^- \rightleftharpoons \text{Mn}^{2+}(\text{aq}) + 4\text{H}_2\text{O}(\text{l})$	$E^\ominus = +1.51 \text{ V}$
$\text{Na}^+(\text{aq}) + \text{e}^- \rightleftharpoons \text{Na}(\text{s})$	$E^\ominus = -2.71 \text{ V}$
$\text{Ag}^+(\text{aq}) + \text{e}^- \rightleftharpoons \text{Ag}(\text{s})$	$E^\ominus = +0.80 \text{ V}$
$\text{Pu}^{4+}(\text{aq}) + \text{e}^- \rightleftharpoons \text{Pu}^{3+}(\text{aq})$	$E^\ominus = +0.97 \text{ V}$
$\text{Pu}^{3+}(\text{aq}) + 3\text{e}^- \rightleftharpoons \text{Pu}(\text{s})$	$E^\ominus = -2.03 \text{ V}$
$\text{U}^{4+}(\text{aq}) + \text{e}^- \rightleftharpoons \text{U}^{3+}(\text{aq})$	$E^\ominus = -0.61 \text{ V}$
$\text{U}^{3+}(\text{aq}) + 3\text{e}^- \rightleftharpoons \text{U}(\text{s})$	$E^\ominus = -1.79 \text{ V}$
$\text{UO}_2^{2+}(\text{aq}) + 4\text{H}^+(\text{aq}) + 2\text{e}^- \rightleftharpoons \text{U}^{4+}(\text{aq}) + 2\text{H}_2\text{O}(\text{l})$	$E^\ominus = +0.33 \text{ V}$

## Redox Questions on oxidising and reducing agents

1 Which is the strongest oxidising agent in this table? .....

2 Which is the strongest reducing agent in this table? .....

3 State whether each of the following is *TRUE* or *FALSE*

(a)  $F_2$  is a stronger oxidising agent than  $Br_2$  TRUE or FALSE

(b)  $Co$  is a stronger reducing agent than  $Cr$  TRUE or FALSE

(c)  $Cr^{2+}$  is a stronger reducing agent than  $Co^{2+}$  TRUE or FALSE

(d)  $Pu$  will reduce  $Cr^{2+}$  to  $Cr$  TRUE or FALSE

(e)  $MnO_4^-/H^+$  will oxidise  $Pu^{3+}$  to  $Pu^{4+}$  TRUE or FALSE

(f)  $Ce^{4+}$  will oxidise  $F^-$  to  $F_2$  TRUE or FALSE

(g)  $Br_2$  is a stronger oxidising agent than  $Pu^{4+}$  TRUE or FALSE

4 Deduce whether each of the following reactions will be spontaneous or not

(a)  $2Cr^{2+}(aq) + I_2(s) \rightarrow 2Cr^{3+}(aq) + 2I^-(aq)$  SPONTANEOUS or NOT SPONTANEOUS

(b)  $Pu(s) + Ho^{3+}(aq) \rightarrow Pu^{3+}(aq) + Ho(s)$  SPONTANEOUS or NOT SPONTANEOUS

(c)  $MnO_4^-(aq) + 8H^+(aq) + 5Fe^{3+}(aq) \rightarrow Mn^{2+}(aq) + 4H_2O(l) + 5Fe^{2+}(aq)$   
SPONTANEOUS or NOT SPONTANEOUS

5 (a) Identify a species that can be oxidised by  $MnO_4^-/H^+$  but not by  $Cr_2O_7^{2-}/H^+$ .....

(b) Identify a species that will oxidise  $Fe^{2+}$  to  $Fe^{3+}$  but not  $Pu^{3+}$  to  $Pu^{4+}$ .....

6 (a) By considering the following electrode potentials



deduce what will happen to  $Cu^+$  ions in solution – write an equation.

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(b) Deduce whether  $U^{3+}(aq)$  do a similar reaction to the reaction in (a)

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7 Deduce an equation for a spontaneous reaction involving  $Ag$ .

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