



**NAMIBIA UNIVERSITY  
OF SCIENCE AND TECHNOLOGY**

**FACULTY OF HEALTH, NATURAL RESOURCES AND APPLIED SCIENCES**

**DEPARTMENT OF BIOLOGY, CHEMISTRY AND PHYSICS**

<b>QUALIFICATION: BACHELOR OF SCIENCE</b>	
<b>QUALIFICATION CODE: 07BOSC</b>	<b>LEVEL: 6</b>
<b>COURSE CODE: APP601S</b>	<b>COURSE NAME: ANALYTICAL PRINCIPLES AND PRACTICE</b>
<b>SESSION: JULY 2023</b>	<b>PAPER: THEORY</b>
<b>DURATION: 3 HOURS</b>	<b>MARKS: 100</b>

<b>SUPPLEMENTARY/SECOND OPPORTUNITY EXAMINATION PAPER</b>	
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**PERMISSIBLE MATERIALS**

Non-programmable Calculators

**ATTACHMENTS**

List of useful tables, formulas and constants

**THIS EXAMINATION PAPER CONSISTS OF 10 PAGES** (Including this front page and attachments)

**Question 1: Multiple Choice Questions**

**[30]**

- 1.1 Which of the following glassware is not recommended for accurate measurements of volumes? (3)
- (A) A graduated cylinder
  - (B) A volumetric flask
  - (C) A volumetric pipette
  - (D) A measuring pipette
- 1.2 NAMPOL needs a more reliable method than the breathalyser test for detecting the presence and the amount of alcohol in suspected drunk drivers. Solving this problem requires (3)
- (A) Qualitative analysis
  - (B) Quantitative analysis
  - (C) Fundamental analysis
  - (D) All of the above
- 1.3 A guideline specifying how procedure must be followed is called (3)
- (A) An analytical approach
  - (B) A protocol
  - (C) A technique
  - (D) A method
- 1.4 The middle value of a series of data ordered from the smallest to the largest value is called (3)
- (A) Average
  - (B) Median
  - (C) Arithmetic mean
  - (D) Geometric mean
- 1.5 Which substance, when added to water, will not change the pH? (3)
- (A)  $\text{NaHCO}_3$
  - (B)  $\text{NH}_4\text{Cl}$
  - (C) KCN
  - (D) KCl

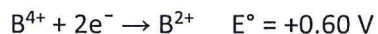
1.6 What is the pH of a saturated solution of milk of magnesia,  $\text{Mg}(\text{OH})_2$ , if the  $K_{sp}$  of this compound is  $1.2 \times 10^{-11}$ ? (3)

- (A) 3.5
- (B) 9.2
- (C) 10.5
- (D) 10.9

1.7 Bleaching powder reacts with iodide ion according to the following unbalanced equation:  $\text{OCl}^- + \text{I}^- + \text{H}^+ \rightarrow \text{I}_2 + \text{Cl}^- + \text{H}_2\text{O}$   
A 0.6000 g sample of bleaching powder requires 35.24 mL of 0.1084 M  $\text{Na}_2\text{S}_2\text{O}_3$  to titrate the liberated iodine. The percentage of Cl in the sample is (3)

- (A) 22.58% Cl
- (B) 5.15% Cl
- (C) 11.29% Cl
- (D) 45.16% Cl

1.8 Given the following half-reactions:



The only reaction that could be used in a titration would be (3)

- (A)  $\text{A}^+$  with  $\text{B}^{4+}$
- (B)  $\text{A}^+$  with  $\text{C}^{3+}$
- (C)  $\text{A}^{2+}$  with  $\text{C}^{2+}$
- (D)  $\text{C}^{2+}$  with  $\text{B}^{4+}$

1.9 During a potentiometric oxidation-reduction titration, the only place at which the  $E_{\text{cell}}$  equals the  $E^\circ$  of the substance being titrated is (3)

- (A) when the two half reactions are in equilibrium
- (B) when twice the stoichiometric amount of titrant has been added
- (C) at the equivalence point
- (D) half way to the equivalence point

1.10 A standard solution of 0.154 M HCl is used to determine the concentration of a NaOH solution whose concentration is unknown. If 33.5 mL of the acid solution are required to neutralize 25.0 mL of the base solution, the concentration of the NaOH in moles/liter is (3)

- (A)  $25.0 / (0.154)(33.5)$
- (B)  $(0.154)(25.0) / 33.5$
- (C)  $(33.5 + 25.0) / 0.514$
- (D)  $(0.514)(33.5) / 25.0$

**Question 2**

[15]

2.1 To test a spectrophotometer's accuracy a solution of 60.06 ppm  $K_2Cr_2O_7$  in 5.0 mM  $H_2SO_4$  is prepared and analysed. This solution has an expected absorbance of 0.640 at 350.0 nm in a 1.0-cm cell when using 5.0 mM  $H_2SO_4$  as a reagent blank. Several aliquots of the solution produce the following absorbance values.

0.639    0.638    0.640    0.639    0.640    0.639    0.638

- (a) Calculate the mean and standard deviation of the measured absorbance values. (2)
- (b) Determine whether there is a significant difference between the experimental mean and the expected value at  $\alpha = 0.01$  (i.e.  $P = 99\%$ ). (6)

2.2 One way to check the accuracy of a spectrophotometer is to measure absorbencies for a series of standard dichromate solutions obtained from the National Institute of Standards and Technology. Absorbencies (A) are measured at 257 nm and compared to the accepted values. The results obtained when testing a newly purchased spectrophotometer are shown below.

Standard	Measured A	Expected A
1	0.2872	0.2871
2	0.5773	0.5760
3	0.8674	0.8677
4	1.1623	1.1608
5	1.4559	1.4565

Determine if the tested spectrophotometer is accurate at  $\alpha = 0.05$ . (7)

**Question 3****[15]**

3.1 A solution containing 3.47 mM of analyte and 1.72 mM of standard gave peak areas of 3,473 and 10,222, respectively, in a chromatographic analysis. Then 1.00 mL of 8.47 mM standard was added to 5.00 mL of unknown solution, and the mixture was diluted to 10.0 mL. This solution gave peak areas of 5 428 and 4 431 for the analyte and standard, respectively.

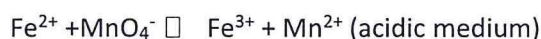
- (a) Calculate the response factor for the analyte. (2)
- (b) Find the concentration of the standard in the 10.0 mL of mixed solution. (2)
- (c) Find the analyte concentration in the 10.0 mL of mixed solution. (2)
- (d) Find the analyte concentration in the original unknown. (2)

3.2 The concentration of phenol in a water sample is determined by separating the phenol from non-volatile impurities by steam distillation, followed by reacting with 4-aminoantipyrine and  $K_3Fe(CN)_6$  at pH 7.9 to form a colored antipyrine dye. A phenol standard with a concentration of 4.00 ppm has an absorbance of 0.424. A water sample is steam distilled and a 50.00-mL aliquot of the distillate is placed in a 100-mL volumetric flask and diluted to volume with distilled water. The absorbance of this solution is found to be 0.394.

- (a) What is the concentration of phenol (in parts per million) in the water sample? (4)
- (b) What calibration method has been used here? (1)
- (c) Briefly explain your choice of the calibration method. (2)

**Question 4****[15]**

4.1 For the following unbalanced reaction at 25°C



$$(E^0_{Fe^{3+}/Fe^{2+}} = 0.771 \text{ V}; E^0_{MnO_4^-/Mn^{2+}} = 1.51 \text{ V})$$

- (a) Write the balanced oxidation and reduction half reactions as well as the overall reaction. (3)
- (b) Calculate the standard potential of the reaction. (1)
- (c) Calculate the equilibrium constant of the reaction. (2)
- (d) Calculate the potential under the following conditions:  $[Fe^{2+}] = 0.50 \text{ M}$ ,  $[Fe^{3+}] = 0.10 \text{ M}$ ,  $[MnO_4^-] = 0.025 \text{ M}$ ,  $[Mn^{2+}] = 0.015 \text{ M}$ , and a pH of 7.00. (2)

4.2 Calculate the pH of the solution that results from the addition of 0.040 moles of  $HNO_3$  to a buffer made by combining 0.500 L of 0.380 M  $HC_3H_5O_2$  ( $K_a = 1.30 \times 10^{-5}$ ) and 0.500 L of 0.380 M  $NaC_3H_5O_2$ . Assume addition of the nitric acid has no effect on volume. (5)

4.3 Calculate the ionic strength of a 0.025 M solution of  $CuCl_2$  (2)

**Question 5****[35]**

5.1 50.0 mL of 0.0400 M formic acid ( $\text{HCOOH}$ ,  $K_a = 1.80 \times 10^{-4}$ ) was titrated with 0.120 M NaOH.

(a) Write the balanced reaction of the titration. (2)

(b) calculate the volume of added titrant at the equivalence point. (1)

(c) Calculate the pH after addition of the following volumes of the titrant

(i) 0.0 mL (4)

(ii) 10.0 mL (4)

(iii) 20.0 mL (4)

5.2 25.0 mL of 0.01 M  $\text{V}^{2+}$  is titrated using 0.01 M  $\text{Ce}^{4+}$

( $E^0_{\text{V}^{3+}/\text{V}^{2+}} = -0.255 \text{ V}$ ;  $E^0_{\text{Ce}^{4+}/\text{Ce}^{3+}} = +1.72 \text{ V}$ ).

(a) Write the two redox half-reactions, the overall reaction and the potential ( $E$ ) expressions for both redox half-reactions. (5)

(b) Calculate the potential of the titration after addition of

(i) 15.0 mL  $\text{Ce}^{4+}$  (5)

(ii) 25.0 mL  $\text{Ce}^{4+}$  (5)

5.3 (a) Define gravimetry. (1)

(b) List the different types of gravimetric methods. (4)

END

**Data Sheet**

$$t_{calculated} = \frac{|\bar{x} - \mu|}{s} \sqrt{N} \quad t_{calculated} = \frac{\bar{d}}{s_d} \sqrt{n} \quad t_{calculated} = \frac{|\bar{X}_a - \bar{X}_b|}{S_{pooled}} \times \sqrt{\frac{n_a \times n_b}{n_a + n_b}}$$

$$S_{pooled} = \sqrt{\frac{s_a^2(N_a - 1) + s_b^2(N_b - 1) + \dots}{N_a + N_b + \dots - N_{set\ of\ data}}}$$

$$\mu = \bar{x} \pm \frac{ts}{\sqrt{n}}$$

**Confidence**

degrees Freedom	50%	90%	95%	99%
1	1.000	6.314	12.706	63.656
2	0.816	2.920	4.303	9.925
3	0.765	2.353	3.182	5.841
4	0.741	2.132	2.776	4.604
5	0.727	2.015	2.571	4.032
6	0.718	1.943	2.447	3.707
7	0.711	1.895	2.365	3.499
8	0.706	1.860	2.306	3.355
9	0.703	1.833	2.262	3.250
10	0.700	1.812	2.228	3.169
11	0.697	1.796	2.201	3.106
12	0.695	1.782	2.179	3.055
13	0.694	1.771	2.160	3.012
14	0.692	1.761	2.145	2.977
15	0.691	1.753	2.131	2.947
16	0.690	1.746	2.120	2.921
17	0.689	1.740	2.110	2.898
18	0.688	1.734	2.101	2.878
19	0.688	1.729	2.093	2.861
20	0.687	1.725	2.086	2.845
21	0.686	1.721	2.080	2.831
22	0.686	1.717	2.074	2.819
23	0.685	1.714	2.069	2.807
24	0.685	1.711	2.064	2.797
25	0.684	1.708	2.060	2.787
26	0.684	1.706	2.056	2.779
27	0.684	1.703	2.052	2.771
28	0.683	1.701	2.048	2.763
29	0.683	1.699	2.045	2.756
30	0.683	1.697	2.042	2.750
31	0.682	1.696	2.040	2.744
32	0.682	1.694	2.037	2.738
33	0.682	1.692	2.035	2.733
34	0.682	1.691	2.032	2.728
35	0.682	1.690	2.030	2.724

**Critical Values for the Rejection Quotient**

N	Q <sub>crit</sub> (Reject if Q <sub>exp</sub> > Q <sub>crit</sub> )		
	90% Confidence	95% Confidence	99% Confidence
3	0.941	0.970	0.994
4	0.765	0.829	0.926
5	0.642	0.710	0.821
6	0.560	0.625	0.740
7	0.507	0.568	0.680
8	0.468	0.526	0.634
9	0.437	0.493	0.598
10	0.412	0.466	0.568

N = number of observations

<b><i>F</i>(0.05, <math>\sigma_{num}</math>, <math>\sigma_{denom}</math>) for a Two-Tailed F-Test</b>													
$\sigma_{num} \Rightarrow$	1	2	3	4	5	6	7	8	9	10	15	20	$\infty$
$\sigma_{denom} \Downarrow$													
1	647.8	799.5	864.2	899.6	921.8	937.1	948.2	956.7	963.3	968.6	984.9	993.1	1018
2	38.51	39.00	39.17	39.25	39.30	39.33	39.36	39.37	39.39	39.40	39.43	39.45	39.50
3	17.44	16.04	15.44	15.10	14.88	14.73	14.62	14.54	14.47	14.42	14.25	14.17	13.90
4	12.22	10.65	9.979	9.605	9.364	9.197	9.074	8.980	8.905	8.444	8.657	8.560	8.257
5	10.01	8.434	7.764	7.388	7.146	6.978	6.853	6.757	6.681	6.619	6.428	6.329	6.015
6	8.813	7.260	6.599	6.227	5.988	5.820	5.695	5.600	5.523	5.461	5.269	5.168	4.894
7	8.073	6.542	5.890	5.523	5.285	5.119	4.995	4.899	4.823	4.761	4.568	4.467	4.142
8	7.571	6.059	5.416	5.053	4.817	4.652	4.529	4.433	4.357	4.259	4.101	3.999	3.670
9	7.209	5.715	5.078	4.718	4.484	4.320	4.197	4.102	4.026	3.964	3.769	3.667	3.333
10	6.937	5.456	4.826	4.468	4.236	4.072	3.950	3.855	3.779	3.717	3.522	3.419	3.080
11	6.724	5.256	4.630	4.275	4.044	3.881	3.759	3.644	3.588	3.526	3.330	3.226	2.883
12	6.544	5.096	4.474	4.121	3.891	3.728	3.607	3.512	3.436	3.374	3.177	3.073	2.725
13	6.414	4.965	4.347	3.996	3.767	3.604	3.483	3.388	3.312	3.250	3.053	2.948	2.596
14	6.298	4.857	4.242	3.892	3.663	3.501	3.380	3.285	3.209	3.147	2.949	2.844	2.487
15	6.200	4.765	4.153	3.804	3.576	3.415	3.293	3.199	3.123	3.060	2.862	2.756	2.395
16	6.115	4.687	4.077	3.729	3.502	3.341	3.219	3.125	3.049	2.986	2.788	2.681	2.316
17	6.042	4.619	4.011	3.665	3.438	3.277	3.156	3.061	2.985	2.922	2.723	2.616	2.247
18	5.978	4.560	3.954	3.608	3.382	3.221	3.100	3.005	2.929	2.866	2.667	2.559	2.187
19	5.922	4.508	3.903	3.559	3.333	3.172	3.051	2.956	2.880	2.817	2.617	2.509	2.133
20	5.871	4.461	3.859	3.515	3.289	3.128	3.007	2.913	2.837	2.774	2.573	2.464	2.085
$\infty$	5.024	3.689	3.116	2.786	2.567	2.408	2.288	2.192	2.114	2.048	1.833	1.708	1.000

### ***Physical Constants***

Gas constant	$R$	= 8.315 J K <sup>-1</sup> mol <sup>-1</sup> = 8.315 kPa dm <sup>3</sup> K <sup>-1</sup> mol <sup>-1</sup> = 8.315 Pa m <sup>3</sup> K <sup>-1</sup> mol <sup>-1</sup> = 8.206 x 10 <sup>-2</sup> L atm K <sup>-1</sup> mol <sup>-1</sup>
Boltzmann constant	$k$	= 1.381 x 10 <sup>-23</sup> J K <sup>-1</sup>
Planck constant	$h$	= 6.626 x 10 <sup>-34</sup> J K <sup>-1</sup>
Faraday constant	$F$	= 9.649 x 10 <sup>4</sup> C mol <sup>-1</sup>
Avogadro constant	$L$ or $N_A$	= 6.022 x 10 <sup>23</sup> mol <sup>-1</sup>
Speed of light in vacuum	$c$	= 2.998 x 10 <sup>8</sup> m s <sup>-1</sup>
Mole volume of an ideal gas	$V_m$	= 22.41 L mol <sup>-1</sup> (at 1 atm and 273.15 K) = 22.71 L mol <sup>-1</sup> (at 1 bar and 273.15 K)
Elementary charge	$e$	= 1.602 x 10 <sup>-19</sup> C
Rest mass of electron	$m_e$	= 9.109 x 10 <sup>-31</sup> kg
Rest mass of proton	$m_p$	= 1.673 x 10 <sup>-27</sup> kg
Rest mass of neutron	$m_n$	= 1.675 x 10 <sup>-27</sup> kg
Permittivity of vacuum	$\epsilon_0$	= 8.854 x 10 <sup>-12</sup> C <sup>2</sup> J <sup>-1</sup> m <sup>-1</sup> (or F m <sup>-1</sup> )
Gravitational acceleration	$g$	= 9.807 m s <sup>-2</sup>



### Conversion Factors

1 W	= 1 J s <sup>-1</sup>
1 J	= 0.2390 cal = 1 N m = 1 V C = 1 Pa m <sup>3</sup> = 1 kg m <sup>2</sup> s <sup>-2</sup>
1 cal	= 4.184 J
1 eV	= 1.602 x 10 <sup>-19</sup> J
1 L atm	= 101.3 J
1 atm	= 1.013 x 10 <sup>5</sup> N m <sup>-2</sup> = 1.013 x 10 <sup>5</sup> Pa = 760 mmHg
1 bar	= 1 x 10 <sup>5</sup> Pa
1 L	= 10 <sup>-3</sup> m <sup>3</sup> = 1 dm <sup>3</sup>
1 Angstrom	= 1 x 10 <sup>-10</sup> m = 0.1 nm = 100 pm
1 micron (μ)	= 10 <sup>-6</sup> m = 1 μm
1 Poise	= 0.1 Pa s = 0.1 N sm <sup>-2</sup>
1 ppm	= 1 μg g <sup>-1</sup> = 1 mg kg <sup>-1</sup> = 1 mg L <sup>-1</sup> (dilute aqueous solutions only)

$$\frac{S_{\text{samp}}}{C_A \frac{V_o}{V_f}} = \frac{S_{\text{spike}}}{C_A \frac{V_o}{V_f} + C_{\text{std}} \frac{V_{\text{std}}}{V_f}}$$

$$\frac{S_{\text{samp}}}{C_A} = \frac{S_{\text{spike}}}{C_A \frac{V_o}{V_o + V_{\text{std}}} + C_{\text{std}} \frac{V_{\text{std}}}{V_o + V_{\text{std}}}}$$

$$\Delta G^\circ = -RT \ln K \quad E^\circ = \frac{0.05916}{n} \log K \quad E^\circ = E^\circ_{\text{red}} - E^\circ_{\text{ox}} \quad E = E^\circ - \frac{0.05916}{n} \log Q$$

## PERIODIC TABLE OF THE ELEMENTS

1																	18					
<b>1</b> <b>H</b> 1.00794																	<b>2</b> <b>He</b> 4.00260					
2																	13	14	15	16	17	
<b>3</b> <b>Li</b> 6.941	<b>4</b> <b>Be</b> 9.01218											<b>5</b> <b>B</b> 10.81	<b>6</b> <b>C</b> 12.011	<b>7</b> <b>N</b> 14.0067	<b>8</b> <b>O</b> 15.9994	<b>9</b> <b>F</b> 18.9984	<b>10</b> <b>Ne</b> 20.179					
<b>11</b> <b>Na</b> 22.9898	<b>12</b> <b>Mg</b> 24.305	3	4	5	6	7	8	9	10	11	12	<b>13</b> <b>Al</b> 26.9815	<b>14</b> <b>Si</b> 28.0855	<b>15</b> <b>P</b> 30.9738	<b>16</b> <b>S</b> 32.06	<b>17</b> <b>Cl</b> 35.453	<b>18</b> <b>Ar</b> 39.948					
<b>19</b> <b>K</b> 39.0983	<b>20</b> <b>Ca</b> 40.08	<b>21</b> <b>Sc</b> 44.9559	<b>22</b> <b>Ti</b> 47.88	<b>23</b> <b>V</b> 50.9415	<b>24</b> <b>Cr</b> 51.996	<b>25</b> <b>Mn</b> 54.9380	<b>26</b> <b>Fe</b> 55.847	<b>27</b> <b>Co</b> 58.9332	<b>28</b> <b>Ni</b> 58.69	<b>29</b> <b>Cu</b> 63.546	<b>30</b> <b>Zn</b> 65.38	<b>31</b> <b>Ga</b> 69.72	<b>32</b> <b>Ge</b> 72.59	<b>33</b> <b>As</b> 74.9216	<b>34</b> <b>Se</b> 78.96	<b>35</b> <b>Br</b> 79.904	<b>36</b> <b>Kr</b> 83.8					
<b>37</b> <b>Rb</b> 85.4678	<b>38</b> <b>Sr</b> 87.62	<b>39</b> <b>Y</b> 88.9059	<b>40</b> <b>Zr</b> 91.22	<b>41</b> <b>Nb</b> 92.9064	<b>42</b> <b>Mo</b> 95.94	<b>43</b> <b>Tc</b> (98)	<b>44</b> <b>Ru</b> 101.07	<b>45</b> <b>Rh</b> 102.906	<b>46</b> <b>Pd</b> 106.42	<b>47</b> <b>Ag</b> 107.868	<b>48</b> <b>Cd</b> 112.41	<b>49</b> <b>In</b> 114.82	<b>50</b> <b>Sn</b> 118.69	<b>51</b> <b>Sb</b> 121.75	<b>52</b> <b>Te</b> 127.6	<b>53</b> <b>I</b> 126.9	<b>54</b> <b>Xe</b> 131.29					
<b>55</b> <b>Cs</b> 132.905	<b>56</b> <b>Ba</b> 137.33	<b>71</b> <b>Lu</b> 174.967	<b>72</b> <b>Hf</b> 178.49	<b>73</b> <b>Ta</b> 180.948	<b>74</b> <b>W</b> 183.85	<b>75</b> <b>Re</b> 186.207	<b>76</b> <b>Os</b> 190.2	<b>77</b> <b>Ir</b> 192.22	<b>78</b> <b>Pt</b> 195.08	<b>79</b> <b>Au</b> 196.967	<b>80</b> <b>Hg</b> 200.59	<b>81</b> <b>Tl</b> 204.383	<b>82</b> <b>Pb</b> 207.2	<b>83</b> <b>Bi</b> 208.908	<b>84</b> <b>Po</b> (209)	<b>85</b> <b>At</b> (210)	<b>86</b> <b>Rn</b> (222)					
<b>87</b> <b>Fr</b> (223)	<b>88</b> <b>Ra</b> 226.025	<b>103</b> <b>Lr</b> (260)	<b>104</b> <b>Rf</b> (261)	<b>105</b> <b>Db</b> (262)	<b>106</b> <b>Sg</b> (263)	<b>107</b> <b>Bh</b> (264)	<b>108</b> <b>Hs</b> (265)	<b>109</b> <b>Mt</b> (268)	<b>110</b> Uun (269)	<b>111</b> Uuu (272)	<b>112</b> Uub (269)		<b>114</b> Uuq		<b>116</b> Uuh		<b>118</b> Uuo					

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<b>Lanthanides:</b>	<b>57</b> <b>La</b> 138.906	<b>58</b> <b>Ce</b> 140.12	<b>59</b> <b>Pr</b> 140.908	<b>60</b> <b>Nd</b> 144.24	<b>61</b> <b>Pm</b> (145)	<b>62</b> <b>Sm</b> 150.36	<b>63</b> <b>Eu</b> 151.96	<b>64</b> <b>Gd</b> 157.25	<b>65</b> <b>Tb</b> 158.925	<b>66</b> <b>Dy</b> 162.50	<b>67</b> <b>Ho</b> 161.930	<b>68</b> <b>Er</b> 167.26	<b>69</b> <b>Tm</b> 166.934	<b>70</b> <b>Yb</b> 173.04
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<b>Actinides:</b>	<b>89</b> <b>Ac</b> 227.028	<b>90</b> <b>Th</b> 232.038	<b>91</b> <b>Pa</b> 231.036	<b>92</b> <b>U</b> 238.029	<b>93</b> <b>Np</b> 237.048	<b>94</b> <b>Pu</b> (244)	<b>95</b> <b>Am</b> (243)	<b>96</b> <b>Cm</b> (247)	<b>97</b> <b>Bk</b> (247)	<b>98</b> <b>Cf</b> (251)	<b>99</b> <b>Es</b> (252)	<b>100</b> <b>Fm</b> (257)	<b>101</b> <b>Md</b> (258)	<b>102</b> <b>No</b> (259)
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