Neap

Trial Examination 2021

Question and response booklet

QCE Physics Units 1&2

Paper 1

Student's Name: _____

Teacher's Name: _____

Time allowed

- Perusal time – 10 minutes
- Working time – 90 minutes

General instructions

- Answer all questions in this question and response booklet.
- QCAA-approved calculator permitted.
- Formula and data booklet provided.
- Planning paper will not be marked.

Section 1 (20 marks)

- 20 multiple choice questions

Section 2 (25 marks)

- 7 short response questions

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SECTION 1

Instructions

- Choose the best answer for Questions 1–20.
- This section has 20 questions and is worth 20 marks.
- Use a 2B pencil to fill in the A, B, C or D answer bubble completely.
- If you change your mind or make a mistake, use an eraser to remove your response and fill in the new answer bubble completely.

	A	B	C	D
Example:	●	○	○	○

	A	B	C	D
1.	○	○	○	○
2.	○	○	○	○
3.	○	○	○	○
4.	○	○	○	○
5.	○	○	○	○
6.	○	○	○	○
7.	○	○	○	○
8.	○	○	○	○
9.	○	○	○	○
10.	○	○	○	○
11.	○	○	○	○
12.	○	○	○	○
13.	○	○	○	○
14.	○	○	○	○
15.	○	○	○	○
16.	○	○	○	○
17.	○	○	○	○
18.	○	○	○	○
19.	○	○	○	○
20.	○	○	○	○

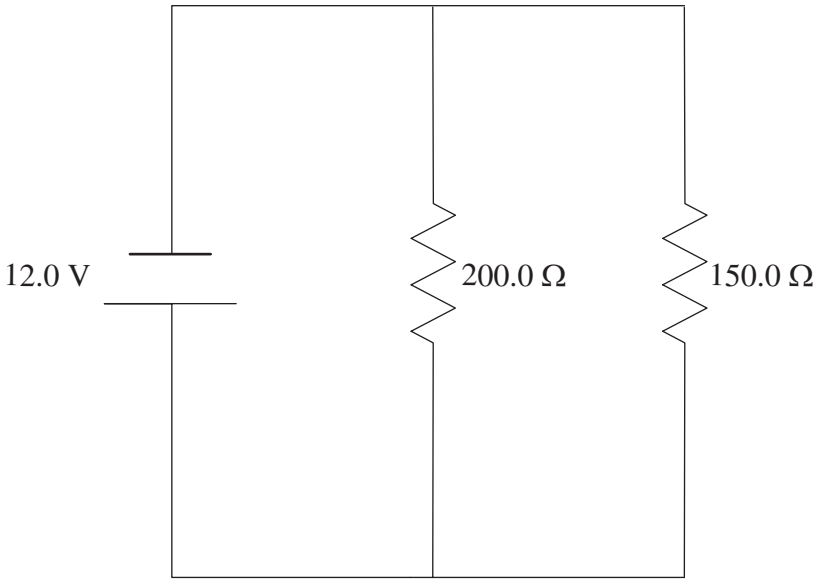
SECTION 2

Instructions

- Write using black or blue pen.
- If you need more space for a response, use the additional pages at the back of this booklet.
  - On the additional pages, write the question number you are responding to.
  - Cancel any incorrect response by ruling a single diagonal line through your work.
  - Write the page number of your alternative/additional response, i.e. See page …
  - If you do not do this, your original response will be marked.
- This section has seven questions and is worth 25 marks.

QUESTION 21 (4 marks)

A current flows out of the 12.0 V cell in the parallel circuit shown below.



a) Determine the total parallel resistance (R_t). Show your working. *[2 marks]*

Total resistance R_t = _____ Ω (to 2 decimal places)

b) Determine which resistor has the greater current flowing through it. Show your working. *[2 marks]*

Resistor with greater current = _____

QUESTION 22 (4 marks)

A 71.46 g piece of metal is heated by being placed in boiling water, which has a temperature of 100.0°C.

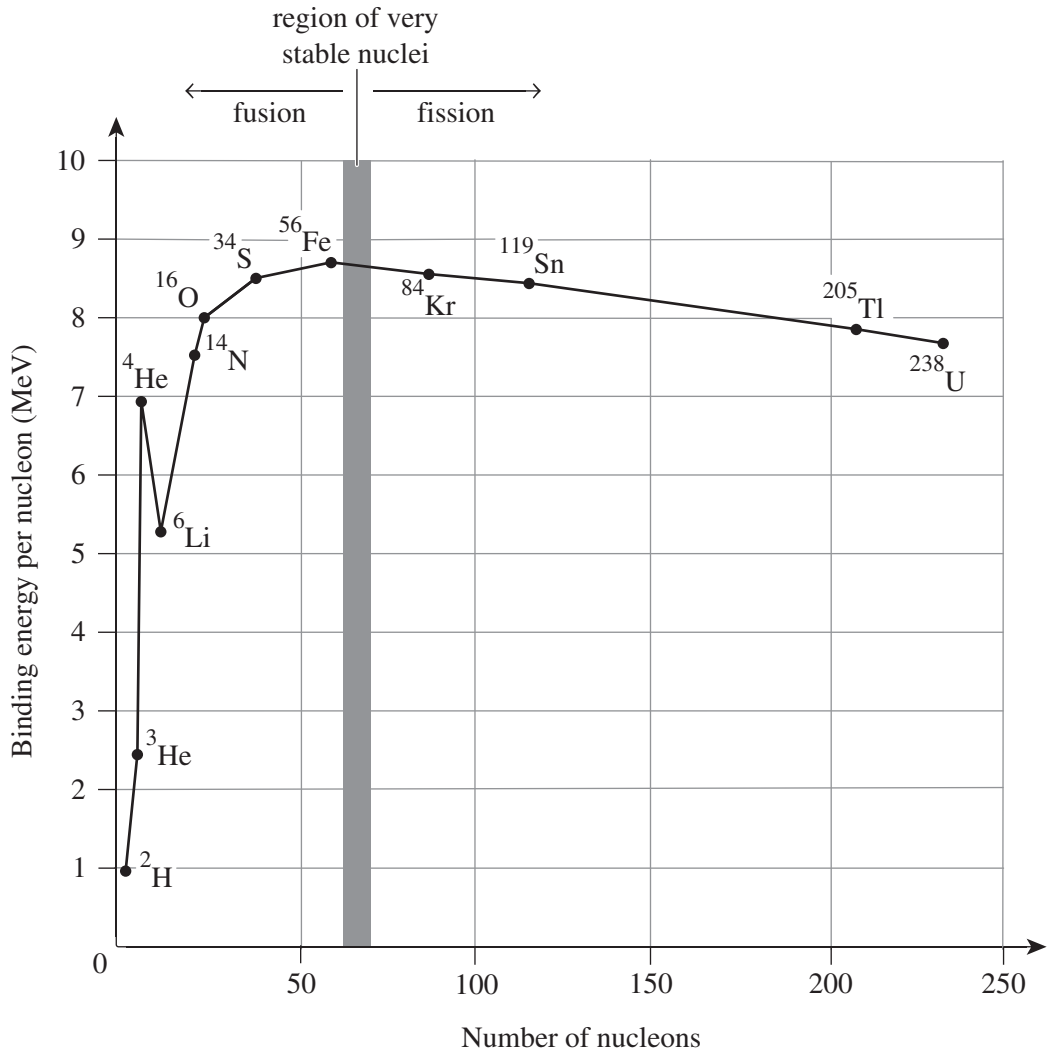
The piece of metal is then placed in a polystyrene cup that contains 98.69 mL of water of temperature 25.2°C. No thermal energy passes to the cup. The final temperature of the water and the metal is 30.0°C.

Calculate the specific heat capacity of the metal. Show your working.

Specific heat capacity = _____ J kg^{-1} K^{-1} (to 2 decimal places)

QUESTION 23 (3 marks)

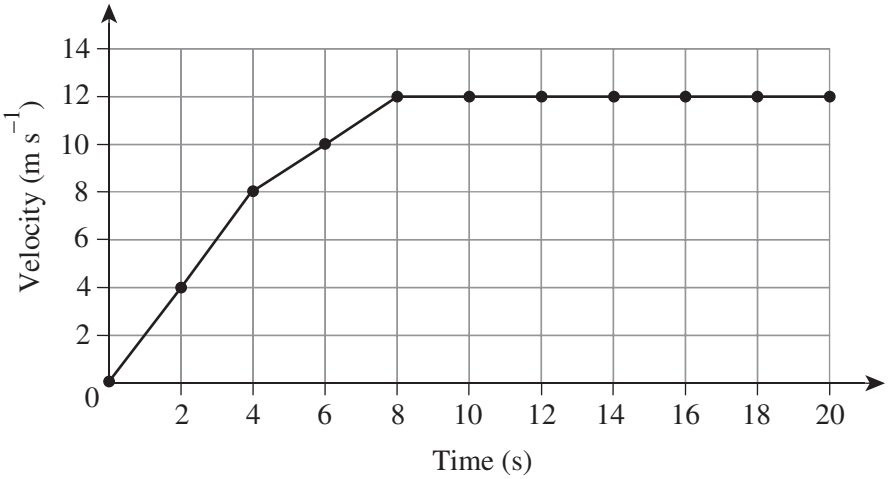
The graph below shows the binding energy per nucleon against the number of nucleons for some elements.



Use one element shown in the graph as an example of fusion and another element shown in the graph as an example of fission to explain why more energy is released per nucleon during nuclear fusion than during nuclear fission.

QUESTION 24 (3 marks)

A bus is initially at rest on a road, then starts moving forward. The following graph shows how the velocity of the bus changes over time.



Determine the displacement of the bus after 20 seconds. Show your working.

Displacement = _____ m (to the nearest whole number)

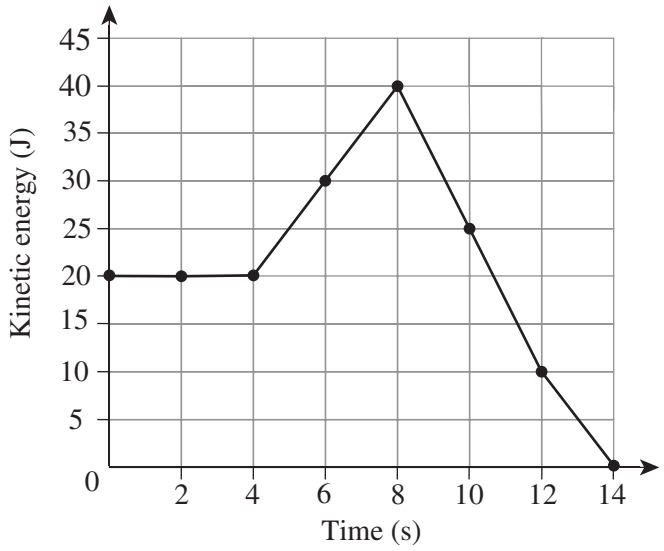
QUESTION 25 (3 marks)

Thomas Young conducted experiments about the diffraction and interference of light.

Explain how Young's double slit experiment supports the wave model of light.

QUESTION 26 (4 marks)

The graph below shows how the kinetic energy of a 10.0 kg object changes over time.



a) Determine the rate at which the object's energy changed during the last 6 seconds of its journey. Show your working. *[2 marks]*

Rate of change = _____ J s^{-1} (to 1 decimal place)

b) Calculate the total work done from 4 seconds to 14 seconds. Show your working. *[2 marks]*

Total work done = _____ J (to the nearest whole number)

QUESTION 27 (4 marks)

Car A has a mass 1200 kg and car B has a mass of 800 kg. Car A is travelling at 16.66 m s^{-1} when it collides with car B, which is stationary. As a result of the collision, car B is pushed forward with a velocity of 11 m s^{-1}.

Determine the velocity of car A after the collision. Show your working.

Velocity = _____ m s^{-1} (to 1 decimal place)

END OF PAPER

ADDITIONAL PAGE FOR STUDENT RESPONSES

Write the question number you are responding to.

ADDITIONAL PAGE FOR STUDENT RESPONSES

Write the question number you are responding to.

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Write the question number you are responding to.

Neap

Trial Examination 2021

Formula and data booklet

QCE Physics Units 1&2

FORMULAS

Processing of data
Percentage uncertainty (%) $= \dfrac{\text{absolute uncertainty}}{\text{measurement}} \times 100$
Percentage error (%) $= \left\lvert \dfrac{\text{measured value} - \text{true value}}{\text{true value}} \right\rvert \times 100$

Heating processes	
$T_K = T_C + 273$	$Q = mL$
$Q = mc\Delta T$	$\Delta U = Q + W$
$\eta = \dfrac{\text{energy output}}{\text{energy input}} \times \dfrac{100}{1}\%$	

Ionising radiation and nuclear reactions	
$N = N_0\left(\dfrac{1}{2}\right)^n$	$\Delta E = \Delta m c^2$

Electrical circuits	
$I = \dfrac{q}{t}$	$P = I^2R$
$V = \dfrac{W}{q}$	$V_t = V_1 + V_2 + \ldots V_n$
$P = \dfrac{W}{t}$	$R_t = R_1 + R_2 + \ldots R_n$
$R = \dfrac{V}{I}$	$I_t = I_1 + I_2 + \ldots I_n$
$P = VI$	$\dfrac{1}{R_t} = \dfrac{1}{R_1} + \dfrac{1}{R_2} + \ldots \dfrac{1}{R_n}$

Linear motion and force	
$v = u + at$	$W = \Delta E$
$s = ut + \frac{1}{2}at^2$	$W = Fs$
$v^2 = u^2 + 2as$	$E_{\text{k}} = \frac{1}{2}mv^2$
$a = \frac{F_{\text{net}}}{m}$	$\Delta E_{\text{p}} = mg\Delta h$
$p = mv$	$\sum \frac{1}{2}mv^2_{\text{before}} = \sum \frac{1}{2}mv^2_{\text{after}}$
$\sum mv_{\text{before}} = \sum mv_{\text{after}}$	

Waves	
$v = f\lambda$	$L = (2n-1)\frac{\lambda}{4}$
$f = \frac{1}{T}$	$\frac{\sin i}{\sin r} = \frac{v_1}{v_2} = \frac{\lambda_1}{\lambda_2} = \frac{n_1}{n_2}$
$L = n\frac{\lambda}{2}$	$I \propto \frac{1}{r^2}$

Gravity and motion	
$v_y = gt + u_y$	$v = \frac{2\pi r}{T}$
$s_y = \frac{1}{2}gt^2 + u_y t$	$a_{\text{C}} = \frac{v^2}{r}$
$v_y^2 = 2gs_y + u_y^2$	$F_{\text{net}} = \frac{mv^2}{r}$
$v_x = u_x$	$F = \frac{GMm}{r^2}$
$s_x = u_x t$	$g = \frac{F}{m} = \frac{GM}{r^2}$
$F_g = mg$	$\frac{T^2}{r^3} = \frac{4\pi^2}{GM}$

Electromagnetism	
$F = \frac{1}{4\pi\varepsilon_0}\frac{Qq}{r^2}$	$F = qvB\sin\theta$
$E = \frac{F}{q} = \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}$	$\phi = BA\cos\theta$
$V = \frac{\Delta U}{q}$	$\text{emf} = -\frac{n\Delta\left(BA_{\perp}\right)}{\Delta t}$
$B = \frac{\mu_0 I}{2\pi r}$	$\text{emf} = -n\frac{\Delta\phi}{\Delta t}$
$B = \mu_0 nI$	$I_\text{p}V_\text{p} = I_\text{s}V_\text{s}$
$F = BIL\sin\theta$	$\frac{V_\text{p}}{V_\text{s}} = \frac{n_\text{p}}{n_\text{s}}$

Special relativity	
$t = \frac{t_0}{\sqrt{\left(1-\frac{v^2}{c^2}\right)}}$	$p_v = \frac{m_0 v}{\sqrt{\left(1-\frac{v^2}{c^2}\right)}}$
$L = L_0\sqrt{\left(1-\frac{v^2}{c^2}\right)}$	$\Delta E = \Delta mc^2$

Quantum theory	
$\lambda_{\max} = \frac{b}{T}$	$\lambda = \frac{h}{p}$
$E = hf$	$n\lambda = 2\pi r$
$E_k = hf - W$	$mvr = \frac{nh}{2\pi}$
$\frac{1}{\lambda} = R\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)$	

PHYSICAL CONSTANTS AND UNIT CONVERSIONS

Heating processes	
Latent heat of fusion for water	$L_f = 3.34 \times 10^5$ J kg^{-1}
Latent heat of vaporisation for water	$L_v = 2.26 \times 10^6$ J kg^{-1}
Specific heat capacity of ice	$c_i = 2.05 \times 10^3$ J kg^{-1} K^{-1}
Specific heat capacity of steam	$c_s = 2.00 \times 10^3$ J kg^{-1} K^{-1}
Specific heat capacity of water	$c_w = 4.18 \times 10^3$ J kg^{-1} K^{-1}

Ionising radiation and nuclear reactions	
Atomic mass unit	1 amu = 1.66×10^{-27} kg
Electron volt	1 eV = 1.60×10^{-19} J
Mass of an alpha particle	$m_\alpha = 6.6446572 \times 10^{-27}$ kg
Mass of an electron	$m_e = 9.1093835 \times 10^{-31}$ kg
Mass of a neutron	$m_n = 1.6749275 \times 10^{-27}$ kg
Mass of a proton	$m_p = 1.6726219 \times 10^{-27}$ kg
Speed of light in a vacuum	$c = 3 \times 10^8$ m s^{-1}

Electrical circuits	
Charge on an electron	$e = -1.60 \times 10^{-19}$ C

Linear motion and force	
Mean acceleration due to gravity on Earth	$g = 9.8$ m s^{-2}

Waves	
Speed of sound in air at 25°C	$v_s = 346$ m s^{-1}

Gravity and motion	
Gravitational constant	$G = 6.67 \times 10^{-11}$ N m^2 kg^{-2}
Mass of the Earth	$m_E = 5.97 \times 10^{24}$ kg

Electromagnetism	
Coulomb's constant	$\frac{1}{4\pi\varepsilon_0} = 9\times10^{9}\ \text{N m}^2\ \text{C}^{-2}$
Magnetic constant	$\mu_0 = 4\pi \times 10^{-7}\ T\,A^{-1}\ \text{m}$

Quantum theory	
Wien's displacement constant	$b = 2.898 \times 10^{-3}\ \text{m K}$
Planck's constant	$h = 6.626 \times 10^{-34}\ \text{J s}$
Rydberg's constant	$R = 1.097 \times 10^{7}\ \text{m}^{-1}$

SCIENTIFIC NOTATION

Ratio to basic unit	Prefix	Abbreviation
10^{-18}	atto	a
10^{-15}	femto	f
10^{-12}	pico	p
10^{-9}	nano	n
10^{-6}	micro	μ
10^{-3}	milli	m
10^{-2}	centi	c
10^{-1}	deci	d
10	deca	da
10^{2}	hecto	h
10^{3}	kilo	k
10^{6}	mega	M
10^{9}	giga	G
10^{12}	tera	T

LIST OF ELEMENTS

Name	Atomic no.	Symbol
Hydrogen	1	H
Helium	2	He
Lithium	3	Li
Beryllium	4	Be
Boron	5	B
Carbon	6	C
Nitrogen	7	N
Oxygen	8	O
Fluorine	9	F
Neon	10	Ne
Sodium	11	Na
Magnesium	12	Mg
Aluminium	13	Al
Silicon	14	Si
Phosphorus	15	P
Sulfur	16	S
Chlorine	17	Cl
Argon	18	Ar
Potassium	19	K
Calcium	20	Ca
Scandium	21	Sc
Titanium	22	Ti
Vanadium	23	V
Chromium	24	Cr
Manganese	25	Mn
Iron	26	Fe
Cobalt	27	Co
Nickel	28	Ni
Copper	29	Cu
Zinc	30	Zn
Gallium	31	Ga
Germanium	32	Ge
Arsenic	33	As
Selenium	34	Se
Bromine	35	Br

Name	Atomic no.	Symbol
Krypton	36	Kr
Rubidium	37	Rb
Strontium	38	Sr
Yttrium	39	Y
Zirconium	40	Zr
Niobium	41	Nb
Molybdenum	42	Mo
Technetium	43	Tc
Ruthenium	44	Ru
Rhodium	45	Rh
Palladium	46	Pd
Silver	47	Ag
Cadmium	48	Cd
Indium	49	In
Tin	50	Sn
Antimony	51	Sb
Tellerium	52	Te
Iodine	53	I
Xenon	54	Xe
Cesium	55	Cs
Barium	56	Ba
Lanthanum	57	La
Cerium	58	Ce
Praseodymium	59	Pr
Neodymium	60	Nd
Promethium	61	Pm
Samarium	62	Sm
Europium	63	Eu
Gadolinium	64	Gd
Terbium	65	Tb
Dysprosium	66	Dy
Holmium	67	Ho
Erbium	68	Er
Thulium	69	Tm
Ytterbium	70	Yb

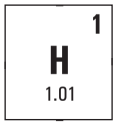
LIST OF ELEMENTS (CONTINUED)

Name	Atomic no.	Symbol
Lutetium	71	Lu
Hafnium	72	Hf
Tantalum	73	Ta
Tungsten	74	W
Rhenium	75	Re
Osmium	76	Os
Iridium	77	Ir
Platinum	78	Pt
Gold	79	Au
Mercury	80	Hg
Thallium	81	Tl
Lead	82	Pb
Bismuth	83	Bi
Polonium	84	Po
Astatine	85	At
Radon	86	Rn
Francium	87	Fr
Radium	88	Ra
Actinium	89	Ac
Thorium	90	Th
Protactinium	91	Pa
Uranium	92	U
Neptunium	93	Np
Plutonium	94	Pu

Name	Atomic no.	Symbol
Americium	95	Am
Curium	96	Cm
Berkelium	97	Bk
Californium	98	Cf
Einsteinium	99	Es
Fermium	100	Fm
Mendelevium	101	Md
Nobelium	102	No
Lawrencium	103	Lr
Rutherfordium	104	Rf
Dubnium	105	Db
Seaborgium	106	Sg
Bohrium	107	Bh
Hassium	108	Hs
Meitnerium	109	Mt
Darmstadtium	110	Ds
Roentgenium	111	Rg
Copernicium	112	Cn
Nihonium	113	Nh
Flerovium	114	Fl
Moscovium	115	Mc
Livermorium	116	Lv
Tennessine	117	Ts
Oganesson	118	Og

PERIODIC TABLE OF THE ELEMENTS

KEY



atomic number
symbol
relative atomic mass*

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 H 1.01																	2 He 4.00
3 Li 6.94	4 Be 9.01											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.06	17 Cl 35.45	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.87	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.38	31 Ga 69.72	32 Ge 72.63	33 As 74.92	34 Se 78.97	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.95	43 Tc (98.91)	44 Ru 101.07	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.76	52 Te 127.60	53 I 126.90	54 Xe 131.29
55 Cs 132.91	56 Ba 137.33	57–71 Lanthanoids	72 Hf 178.49	73 Ta 180.95	74 W 183.84	75 Re 186.21	76 Os 190.23	77 Ir 192.22	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.2	83 Bi 208.98	84 Po (210.0)	85 At (210.0)	86 Rn (222.0)
87 Fr (223.0)	88 Ra (226.1)	89–103 Actinoids	104 Rf (261.1)	105 Db (262.1)	106 Sg (263.1)	107 Bh (264.1)	108 Hs (265.1)	109 Mt (268)	110 Ds (281)	111 Rg (272)	112 Cn (285)	113 Nh (284)	114 Fl (289)	115 Mc (288)	116 Lv (293)	117 Ts (294)	118 Og (294)

Lanthanoids

57 La 138.91	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm (146.9)	62 Sm 150.36	63 Eu 151.96	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.05	71 Lu 174.97

Actinoids

89 Ac (227.0)	90 Th 232.0	91 Pa 231.0	92 U 238.0	93 Np (237.0)	94 Pu (239.1)	95 Am (241.1)	96 Cm (244.1)	97 Bk (249.1)	98 Cf (252.1)	99 Es (252.1)	100 Fm (252.1)	101 Md (258.1)	102 No (259.1)	103 Lr (262.1)

Groups are numbered according to IUPAC convention 1–18.
*Values in brackets are for the isotope with the longest half-life.