UNIVERSITI MALAYSIA TERENGGANU

FINAL EXAMINATION
PEPERIKSAAN AKHIR

SEMESTER I SESSION 2025/2026 (STEM FOUNDATION)
SEMESTER I SESI 2025/2026 (ASASI STEM)

COURSE ***KURSUS***	**:**	**CHEMISTRY I** ***KIMIA I***
COURSE CODE ***KOD KURSUS***	**:**	**ASC1314**
DURATION ***TEMPOH***	**:**	**3 HOURS** ***3 JAM***

MATRIC NO. ***NO. MATRIK***	**:**	_____
PROGRAMME ***NAMA PROGRAM***	**:**	_____
SEAT NO. ***NO. MEJA***	**:**	_____

INSTRUCTIONS TO CANDIDATES
ARAHAN KEPADA CALON

i. Answer all questions.
Sila jawab semua soalan.

ii. Please answer questions **PART A** in the OMR sheet provided and questions **PART B** in this question paper.
*Sila jawab soalan **BAHAGIAN A** dalam helaian OMR yang disediakan dan soalan **BAHAGIAN B** dalam kertas soalan ini.*

DO NOT OPEN THE QUESTION PAPER UNTIL INSTRUCTED
JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIBERITAHU

THIS QUESTION PAPER CONSISTS OF TEN (10) PRINTED PAGES
KERTAS SOALAN INI MENGANDUNGI SEPULUH (10) MUKA SURAT BERCETAK

PART B/BAHAGIAN B (60 Marks/ 60 Markah)

Please answer all questions.
Sila jawab semua soalan.

1. a. Write the electronic configuration of Mg^{2+} ion. (1 mark)
Tulis konfigurasi elektron bagi ion Mg^{2+}. (1 markah)

b. Ammonium nitrate is formed by combination of NH_4^+ ion and NO_3^- ion.
Ammonium nitrat terhasil daripada gabungan ion NH_4^+ dan ion NO_3^-.

i. State the type of bond that form ammonium nitrate compound. (1 mark)
Nyatakan jenis ikatan yang menghasilkan sebatian ammonium nitrat. (1 markah)

ii. Draw the shape of NH_4^+ ion. Show the bond angle and write the name of the shape. (2 marks)
Lukiskan bentuk bagi ion NH_4^+, Tunjukkan sudut ikatan dan tulis nama bentuknya (2 markah)

c. Give one (1) assumption for ideal gas. (1 mark)
Berikan satu (1) andaian untuk gas unggul. (1 markah)

d. Calculate the enthalpy change of reaction for Haber Process using bond energy values for each bonds in the molecules. (2 marks)
Kira perubahan entalpi tindak balas bagi Proses Haber menggunakan tenaga ikatan untuk setiap ikatan molekul. (2 markah)

$$3H_2\,(g) + N_2\,(g) \rightleftharpoons 2NH_3\,(g)$$

2. a. i. This is the equation for a disproportionation reaction.
Ini adalah persamaan untuk tindak balas ketidakseimbangan.

$$Cl_2(g)+2NaOH(aq) \rightarrow NaCl(aq)+NaClO(aq)+H_2O(l)$$

Using oxidation numbers, state the change in oxidation number for both chlorine atoms respectively. (2 marks)
Menggunakan nombor pengoksidaan, tunjukkan perubahan nombor pengoksidaan bagi kedua-dua atom klorin . (2 markah)

ii. The reaction between magnesium and sulfuric acid is a redox reaction.
Tindak balas antara magnesium dan asid sulfurik ialah tindak balas redoks.

$$Mg(s) + H_2SO_4(aq) \rightarrow MgSO_4(aq) + H_2(g)$$

Use oxidation numbers to identify which element has been oxidised. Explain your answer. (3 marks)
Gunakan nombor pengoksidaan untuk mengenal pasti unsur yang telah teroksida. Terangkan jawapan anda. (3 markah)

b. State dua (2) conditions needed for the following half-cell, $2H^+ + 2e^- \rightarrow H_2$ to have E^o = 0.00V (3 marks)
Nyatakan dua (2) keadaan yang diperlukan untuk separuh sel berikut, $2H^+ + 2e- \rightarrow H_2$ mempunyai $E^o = 0.00V$ (3 markah)

c. i. Use half-equations to deduce an equation for the reduction of VO_2^+ to form VO^{2+} in an aqueous solution by Fe^{2+}/Fe. (3 marks)
Gunakan persamaan separuh untuk menyimpulkan persamaan bagi pengurangan VO_2^+ untuk membentuk VO^{2+} dalam larutan akueus oleh Fe^{2+}/Fe. (3 markah)

ii. Calculate the value of standard electrode potential for the above reaction. (2 marks)
Kira nilai keupayaan elektrod piawai bagi tindak balas di atas. (2 markah)

iii. Draw a diagram of an electrochemical cell consisting of VO_2^+/VO^{2+} half-cell and a Fe^{2+}/Fe half-cell. (5 marks)
Lukis gambar rajah sel elektrokimia yang terdiri daripada separuh sel VO_2^+/VO^{2+} dan separuh sel Fe^{2+}/Fe. (5 markah)

3. a. The reaction below is reversible.
Tindak balas di bawah adalah berbalik.

$$4NH_3(g) + 5O_2(g) \rightleftharpoons 4NO(g) + 6H_2O(g) \qquad \Delta H = -906 kJmol^{-1}$$

State the effect on the production of NO and explain each of the following cases using Le Chatelier's principle.
Nyatakan kesan ke atas penghasilan NO dan terangkan setiap kes berikut menggunakan prinsip Le Chatelier

i. Case 1: decreasing the temperature (3 marks)
Kes 1: menurunkan suhu (3 markah)

ii. Case 2: increasing the applied pressure (3 marks)
Kes 2: meningkatkan tekanan yang dikenakan (3 markah)

b. At equilibrium mixture, the number of mole present for three gases are as below;
Pada campuran keseimbangan, bilangan mol yang terdapat untuk tiga gas adalah seperti di bawah;

CO (g) = 0.03 mol
H_2 (g) = 0.06 mol
CH_3OH (g) = 0.97 mol

i. Calculate the mole fraction for the gases. (3 marks)
Kira pecahan mol bagi gas tersebut. (3 markah)

ii. Then, find partial presssure for the 3 gases. (3 marks)
Kemudian, cari tekanan separa untuk 3 gas. (3 markah)

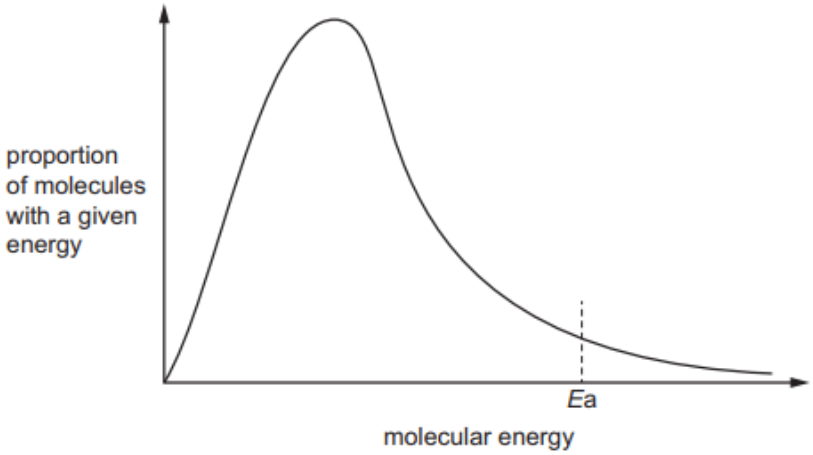
iii. Write Kp expression and calculate the K_p value. Deduce its unit. (3 marks)
Tulis ungkapan Kp dan hitung nilai Kp. Deduksi unitnya. (3 markah)

c. Ethanoic acid, CH_3COOH does not dissociate fully in water. Write it's dissociation equation. Then use the equation to deduce the acid dissociation constant, K_a. (2 marks)
Asid etanoik, CH_3COOH tidak terurai sepenuhnya dalam air. Tulis persamaan penceraiannya. Kemudian gunakan persamaan untuk menyimpulkan pemalar penceraian asid, K_a. (2 markah)

4. a. HBr can undergo thermal decomposition as equation below.
HBr boleh mengalami penguraian termal seperti persamaan di bawah.

$$2HBr\ (g) \rightarrow H_2\ (g) + Br_2\ (g)$$

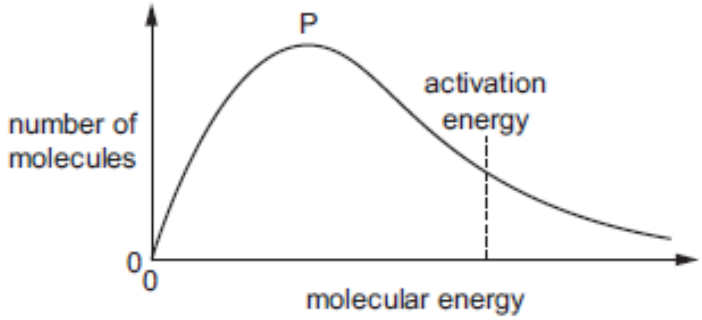
The Boltzmann distribution for a sample of HBr is shown. E_a represents the activation energy for the reaction.
Taburan Boltzmann untuk sampel HBr ditunjukkan. Ea mewakili tenaga pengaktifan untuk tindak balas.



i. Using the same axes, redraw the graph and sketch a second curve using dotted line to indicate the Boltzmann distribution at a higher temperature. (1 mark)
Dengan menggunakan paksi yang sama, lukis semula graf dan lakarkan lengkung kedua menggunakan garis putus-putus untuk menunjukkan taburan Boltzmann pada suhu yang lebih tinggi. (1 markah)

ii. With reference to the curves, state and explain the effect of increasing temperature on the rate of reaction of HBr. (3 marks)
Dengan merujuk kepada lengkung, nyatakan dan terangkan kesan peningkatan suhu bagi kadar tindak balas HBr. (3 markah)

b. The diagram below shows a Boltzmann distribution of molecular energies for a gaseous mixture. The distribution has a peak, labelled P on the diagram.
Rajah di bawah menunjukkan taburan Boltzmann tenaga molekul bagi gas campuran. Taburan mempunyai puncak, berlabel P pada rajah.



i. Choose the correct condition that occurs when an effective catalyst is added to the mixture. (3 marks)
Pilih keadaan yang betul berlaku apabila pemangkin berkesan ditambah kepada campuran. (3 markah)

Items *Perkara*	Remains *Kekal*	Decreases *Berkurang*	Increases *Bertambah*
The height of the peak P *Ketinggian puncak P*			
The total number of molecules *Jumlah bilangan molekul*			
The activation energy, E_a *Tenaga pengaktifan. E_a*			

ii. Explain how the use of a catalyst results in reactions occurring at a faster rate. (2 marks)
Terangkan bagaimana penggunaan mangkin menghasilkan tindak balas yang berlaku pada kadar yang lebih cepat. (2 markah)

c. NO reacts readily with oxygen.
NO bertindak balas dengan mudah dengan oksigen.

$$2NO(g) + O_2(g) \text{ -- } 2NO_2(g)$$

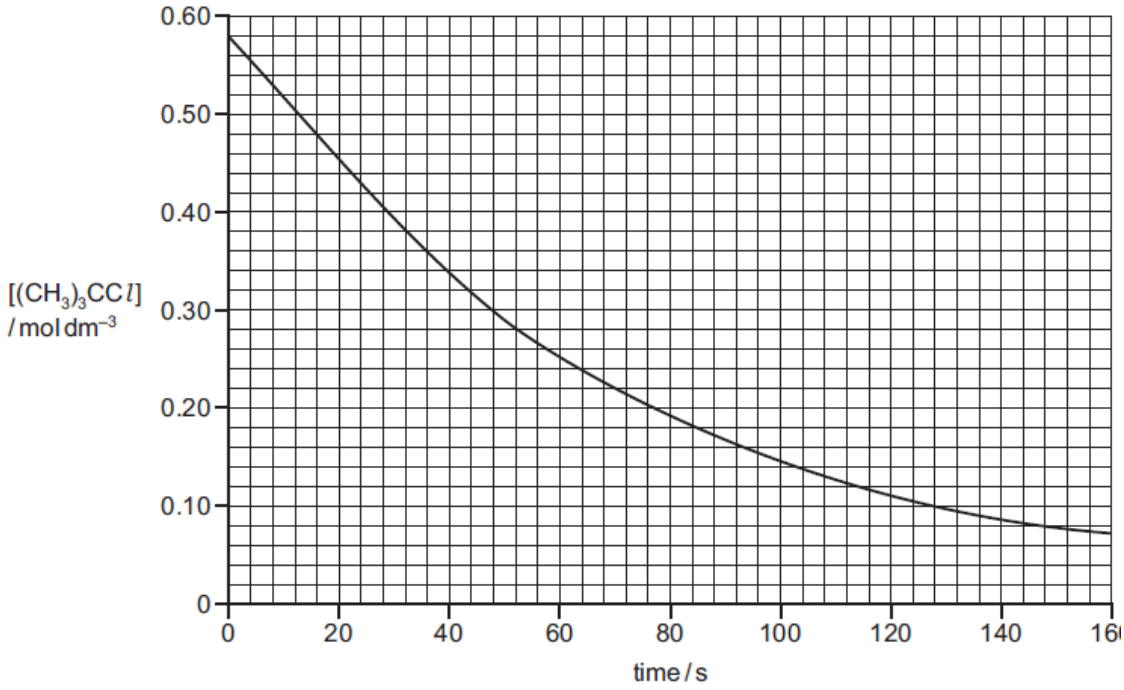
The table shows how the initial rate of this reaction at 25 °C depends on the initial concentrations of the reactants. The graph below shows the results of the experiment.
Jadual menunjukkan bagaimana kadar awal tindak balas ini pada 25 °C bergantung kepada kepekatan awal bahan tindak balas. Graf di bawah menunjukkan keputusan bagi eksperimen.

Experiment	[NO] mol dm^{-3}	[O_2] mol dm^{-3}	Initial rate / mol dm^{-3} s^{-1}
1	0.10	0.05	3.500
2	0.05	0.1	1.750
3	0.05	0.05	0.875

i. Calculate the order of reaction with respect to each reactant. Explain your reasoning in order with respect to [NO(g)] and [O_2(g)] respectively. (4 marks)
Kira tertib tindak balas berkenaan dengan setiap bahan tindak balas. Terangkan susunan tertib berkenaan dengan [NO(g)] dan [O_2(g)] masing-masing. (4 markah)

ii. Calculate a value of the rate constant, k. (2 marks)
Hitung nilai pemalar k. (2 markah)

d. The reaction is first order with respect to $[(CH_3)_3CCl]$. This can be confirmed from the graph using half-lives.
Tindak balas adalah tertib pertama berkenaan dengan $[(CH_3)_3CCl]$. Ini boleh disahkan daripada graf menggunakan separuh hayat.



i. Explain by using graph that the order with respect to $[(CH_3)_3CCl]$ is 1. (2 marks)
Terangkan dengan menggunakan graf bahawa tertib berkenaan dengan $[(CH_3)_3CCl]$ ialah 1. (2 markah)

ii. Rate also can be determined from the slope of the graph. Calculate rate of the reaction by using the graph. (2 marks)
Kadar juga boleh ditentukan daripada kecerunan graf. Kira kadar bagi tindak balas dengan menggunakan graf. (2 markah)

End of Question paper
Kertas Soalan Tamat

(a) $E^{\ominus}$ in alphabetical order

Electrode reaction	$E^{\ominus}$/V
$Ag^+ + e^- \rightleftharpoons Ag$	+0.80
$Al^{3+} + 3e^- \rightleftharpoons Al$	−1.66
$Ba^{2+} + 2e^- \rightleftharpoons Ba$	−2.90
$Br_2 + 2e^- \rightleftharpoons 2Br^-$	+1.07
$Ca^{2+} + 2e^- \rightleftharpoons Ca$	−2.87
$Cl_2 + 2e^- \rightleftharpoons 2Cl^-$	+1.36
$2HOCl + 2H^+ + 2e^- \rightleftharpoons Cl_2 + 2H_2O$	+1.64
$ClO^- + H_2O + 2e^- \rightleftharpoons Cl^- + 2OH^-$	+0.89
$Co^{2+} + 2e^- \rightleftharpoons Co$	−0.28
$Co^{3+} + e^- \rightleftharpoons Co^{2+}$	+1.82
$[Co(NH_3)_6]^{2+} + 2e^- \rightleftharpoons Co + 6NH_3$	−0.43
$Cr^{2+} + 2e^- \rightleftharpoons Cr$	−0.91
$Cr^{3+} + 3e^- \rightleftharpoons Cr$	−0.74
$Cr^{3+} + e^- \rightleftharpoons Cr^{2+}$	−0.41
$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightleftharpoons 2Cr^{3+} + 7H_2O$	+1.33
$Cu^+ + e^- \rightleftharpoons Cu$	+0.52
$Cu^{2+} + 2e^- \rightleftharpoons Cu$	+0.34
$Cu^{2+} + e^- \rightleftharpoons Cu^+$	+0.15
$[Cu(NH_3)_4]^{2+} + 2e^- \rightleftharpoons Cu + 4NH_3$	−0.05
$F_2 + 2e^- \rightleftharpoons 2F^-$	+2.87
$Fe^{2+} + 2e^- \rightleftharpoons Fe$	−0.44
$Fe^{3+} + 3e^- \rightleftharpoons Fe$	−0.04
$Fe^{3+} + e^- \rightleftharpoons Fe^{2+}$	+0.77
$[Fe(CN)_6]^{3-} + e^- \rightleftharpoons [Fe(CN)_6]^{4-}$	+0.36
$Fe(OH)_3 + e^- \rightleftharpoons Fe(OH)_2 + OH^-$	−0.56
$2H^+ + 2e^- \rightleftharpoons H_2$	0.00
$2H_2O + 2e^- \rightleftharpoons H_2 + 2OH^-$	−0.83
$I_2 + 2e^- \rightleftharpoons 2I^-$	+0.54

Electrode reaction	$E^{\ominus}$/V
$K^+ + e^- \rightleftharpoons K$	−2.92
$Li^+ + e^- \rightleftharpoons Li$	−3.04
$Mg^{2+} + 2e^- \rightleftharpoons Mg$	−2.38
$Mn^{2+} + 2e^- \rightleftharpoons Mn$	−1.18
$Mn^{3+} + e^- \rightleftharpoons Mn^{2+}$	+1.49
$MnO_2 + 4H^+ + 2e^- \rightleftharpoons Mn^{2+} + 2H_2O$	+1.23
$MnO_4^- + e^- \rightleftharpoons MnO_4^{2-}$	+0.56
$MnO_4^- + 4H^+ + 3e^- \rightleftharpoons MnO_2 + 2H_2O$	+1.67
$MnO_4^- + 8H^+ + 5e^- \rightleftharpoons Mn^{2+} + 4H_2O$	+1.52
$NO_3^- + 2H^+ + e^- \rightleftharpoons NO_2 + H_2O$	+0.81
$NO_3^- + 3H^+ + 2e^- \rightleftharpoons HNO_2 + H_2O$	+0.94
$NO_3^- + 10H^+ + 8e^- \rightleftharpoons NH_4^+ + 3H_2O$	+0.87
$Na^+ + e^- \rightleftharpoons Na$	−2.71
$Ni^{2+} + 2e^- \rightleftharpoons Ni$	−0.25
$[Ni(NH_3)_6]^{2+} + 2e^- \rightleftharpoons Ni + 6NH_3$	−0.51
$H_2O_2 + 2H^+ + 2e^- \rightleftharpoons 2H_2O$	+1.77
$HO_2^- + H_2O + 2e^- \rightleftharpoons 3OH^-$	+0.88
$O_2 + 4H^+ + 4e^- \rightleftharpoons 2H_2O$	+1.23
$O_2 + 2H_2O + 4e^- \rightleftharpoons 4OH^-$	+0.40
$O_2 + 2H^+ + 2e^- \rightleftharpoons H_2O_2$	+0.68
$O_2 + H_2O + 2e^- \rightleftharpoons HO_2^- + OH^-$	−0.08
$Pb^{2+} + 2e^- \rightleftharpoons Pb$	−0.13
$Pb^{4+} + 2e^- \rightleftharpoons Pb^{2+}$	+1.69
$PbO_2 + 4H^+ + 2e^- \rightleftharpoons Pb^{2+} + 2H_2O$	+1.47
$SO_4^{2-} + 4H^+ + 2e^- \rightleftharpoons SO_2 + 2H_2O$	+0.17
$S_2O_8^{2-} + 2e^- \rightleftharpoons 2SO_4^{2-}$	+2.01
$S_4O_6^{2-} + 2e^- \rightleftharpoons 2S_2O_3^{2-}$	+0.09
$Sn^{2+} + 2e^- \rightleftharpoons Sn$	−0.14
$Sn^{4+} + 2e^- \rightleftharpoons Sn^{2+}$	+0.15
$V^{2+} + 2e^- \rightleftharpoons V$	−1.20
$V^{3+} + e^- \rightleftharpoons V^{2+}$	−0.26
$VO^{2+} + 2H^+ + e^- \rightleftharpoons V^{3+} + H_2O$	+0.34
$VO_2^+ + 2H^+ + e^- \rightleftharpoons VO^{2+} + H_2O$	+1.00
$VO_3^- + 4H^+ + e^- \rightleftharpoons VO^{2+} + 2H_2O$	+1.00
$Zn^{2+} + 2e^- \rightleftharpoons Zn$	−0.76

BOND ENERGY

Homonuclear

Bond	Energy / kJ mol^{-1}
H—H	436
D—D	442
N≡N	944
O=O	496
P≡P	485
S=S	425
F—F	158
Cl—*Cl*	242
Br—Br	193
I—I	151
C—C	350
C=C	610
C≡C	840
C⋯C (benzene)	520
N—N	160
N=N	410
O—O	150
Si—Si	222
P—P	200
S—S	264

Heteronuclear

Bond	Energy / kJ mol^{-1}
H—F	562
H—*Cl*	431
H—Br	366
H—I	299
C≡O	1077
C—H	410
C—*Cl*	340
C—Br	280
C—I	240
C—N	305
C=N	610
C≡N	890
C—O	360
C=O	740
C=O in CO_2	805
N—H	390
N—*Cl*	310
O—H	460
Si—*Cl*	359
Si—H	320

Key

atomic number
atomic symbol
name
relative atomic mass

Group

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
							1 H hydrogen 1.0										2 He helium 4.0
3 Li lithium 6.9	4 Be beryllium 9.0											5 B boron 10.8	6 C carbon 12.0	7 N nitrogen 14.0	8 O oxygen 16.0	9 F fluorine 19.0	10 Ne neon 20.2
11 Na sodium 23.0	12 Mg magnesium 24.3											13 Al aluminium 27.0	14 Si silicon 28.1	15 P phosphorus 31.0	16 S sulfur 32.1	17 Cl chlorine 35.5	18 Ar argon 39.9
19 K potassium 39.1	20 Ca calcium 40.1	21 Sc scandium 45.0	22 Ti titanium 47.9	23 V vanadium 50.9	24 Cr chromium 52.0	25 Mn manganese 54.9	26 Fe iron 55.8	27 Co cobalt 58.9	28 Ni nickel 58.7	29 Cu copper 63.5	30 Zn zinc 65.4	31 Ga gallium 69.7	32 Ge germanium 72.6	33 As arsenic 74.9	34 Se selenium 79.0	35 Br bromine 79.9	36 Kr krypton 83.8
37 Rb rubidium 85.5	38 Sr strontium 87.6	39 Y yttrium 88.9	40 Zr zirconium 91.2	41 Nb niobium 92.9	42 Mo molybdenum 95.9	43 Tc technetium –	44 Ru ruthenium 101.1	45 Rh rhodium 102.9	46 Pd palladium 106.4	47 Ag silver 107.9	48 Cd cadmium 112.4	49 In indium 114.8	50 Sn tin 118.7	51 Sb antimony 121.8	52 Te tellurium 127.6	53 I iodine 126.9	54 Xe xenon 131.3
55 Cs caesium 132.9	56 Ba barium 137.3	57–71 lanthanoids	72 Hf hafnium 178.5	73 Ta tantalum 180.9	74 W tungsten 183.8	75 Re rhenium 186.2	76 Os osmium 190.2	77 Ir iridium 192.2	78 Pt platinum 195.1	79 Au gold 197.0	80 Hg mercury 200.6	81 Tl thallium 204.4	82 Pb lead 207.2	83 Bi bismuth 209.0	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89–103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 138.9	58 Ce cerium 140.1	59 Pr praseodymium 140.9	60 Nd neodymium 144.4	61 Pm promethium –	62 Sm samarium 150.4	63 Eu europium 152.0	64 Gd gadolinium 157.3	65 Tb terbium 158.9	66 Dy dysprosium 162.5	67 Ho holmium 164.9	68 Er erbium 167.3	69 Tm thulium 168.9	70 Yb ytterbium 173.1	71 Lu lutetium 175.0
actinoids	89 Ac actinium –	90 Th thorium 232.0	91 Pa protactinium 231.0	92 U uranium 238.0	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –