

## Second Term Evaluation - 2025

Grade

13

Subject

Chemistry I

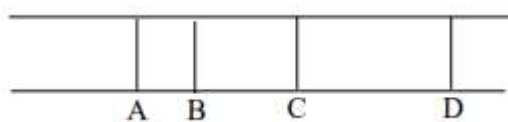
Time

02 hours

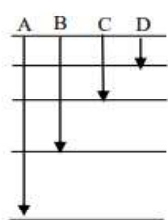
- ★ Answer all the questions.  
 ★ In each of the questions 1 - 50 pick one of the alternatives (1) , (2) , (3) , (4) , (5) which is correct of most appropriate and mark your response on the answer sheet with a cross (x) on the number of the correct option.

- ★ Universal gas constant  $R = 8.314 \text{ J K}^{-1}\text{mol}^{-1}$       ★ Plank's constant  $h = 6.626 \times 10^{-34} \text{ J s}$   
 ★ Avogadro constant  $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$       ★ Velocity of light  $C = 3 \times 10^8 \text{ ms}^{-1}$

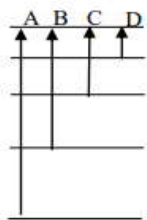
- (01) The species having primary interactions only at pure state is ,  
 (1)  $\text{CCl}_4$                       (2)  $\text{NaH}$                       (3)  $\text{CH}_3\text{COOH}$                       (4)  $\text{Ar}$                       (5) graphite
- (02) A series of dark lines in a bright background in the atomic spectrum of hydrogen is given below.



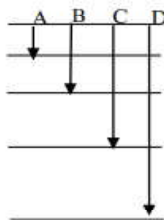
Correct electron transmissions relevant to above lines is given in



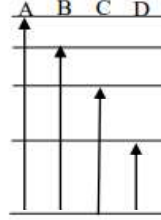
(1)



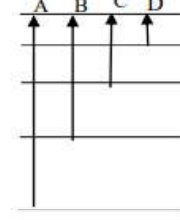
(2)



(3)



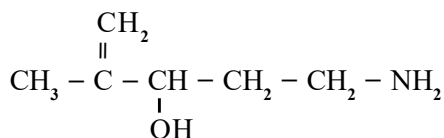
(4)



(5)

- (03) The quantum number or set of quantum numbers that could be used to compare the energy of electrons is ,  
 (1) Main quantum number  
 (2) Azimuthal quantum number + magnetic quantum number  
 (3) Magnetic quantum number  
 (4) Main quantum number + azimuthal quantum number  
 (5) Main quantum number + magnetic quantum number
- (04) Which pair is not an iso electronic pair ?  
 (1)  $\text{BeCl}_2$  and  $\text{CS}_2$                       (2)  $\text{NO}_3^-$  and  $\text{BF}_3$   
 (3)  $\text{CF}_4$  and  $\text{SO}_3^{2-}$                       (4)  $\text{CH}_3\text{COOH}$  and  $\text{CH}_3\text{CONH}_2$   
 (5)  $\text{NCO}$  and  $\text{CN}_2^{2-}$

(05) IUPAC name of the compound below is ,



- (1) 3 - hydroxy - 4 - pentenamine
- (2) 5 - methyl - 3 - hydroxypent - 4 - en - 1 - amine
- (3) 1 - amino - 4 - methyl - 1 - penten - 3 - ol
- (4) 5 - amino - 2 - methyl - 1 - penten - 3 - ol
- (5) 5 - amino - 2 - methyl - 2 - penten - 3 - ol

(06) False statement regarding the element in s - block is ,

- (1) Be metal react with  $\text{HNO}_3$  as well as with  $\text{KOH}$ .
- (2)  $\text{Ca}(\text{HCO}_3)_2$  is found only in aqueous solutions.
- (3) Water solubility of alkali earth metal sulfides decreases down the group.
- (4) Na is naturally found in borax.
- (5)  $\text{HNO}_3$  react with  $\text{Na}_2\text{CO}_3$  in two steps.

(07) The solubility product of  $\text{Ca}(\text{OH})_2$  is  $6.25 \times 10^{-5} \text{ mol}^3 \text{ dm}^{-9}$  at  $25^\circ\text{C}$  concentration of  $\text{OH}^-$  ions in a saturated solution of  $\text{Ca}(\text{OH})_2$  could be , ( in  $\text{mol dm}^{-3}$  )

- (1)  $2 \times 10^{-3}$
- (2)  $2.5 \times 10^{-2}$
- (3)  $1.25 \times 10^{-2}$
- (4)  $5 \times 10^{-2}$
- (5)  $1 \times 10^{-1}$

(08) Molecular formulae of the hydrocarbon having the lowest molecular weight and showing diastereomerism is ,

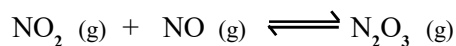
- (1)  $\text{C}_9\text{H}_{16}$
- (2)  $\text{C}_6\text{H}_{12}$
- (3)  $\text{C}_7\text{H}_{14}$
- (4)  $\text{C}_6\text{H}_{10}$
- (5)  $\text{C}_6\text{H}_8$

(09) When  $200 \text{ cm}^3$  of a solution and of  $0.05 \text{ mol dm}^{-3} \text{ Al}_2(\text{SO}_4)_3$  solution and  $200 \text{ cm}^3$  of  $0.05 \text{ mol dm}^{-3} \text{ MgSO}_4$  solution were mixed up with water , the concentration of  $\text{SO}_4^{2-}$  ions in the solution obtained was 3840 ppm.

What is the volume of pure water added and during the preparation of the above solution ?

- (1)  $0 \text{ cm}^3$
- (2)  $100 \text{ cm}^3$
- (3)  $200 \text{ cm}^3$
- (4)  $500 \text{ cm}^3$
- (5)  $600 \text{ cm}^3$

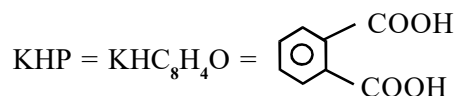
(10) The reaction given below is reversible at temperature T.



Which of the following is correct regarding the thermodynamics of above reaction at temperatures below T ?

	$\Delta\text{H}$	$\Delta\text{S}$	$\Delta\text{G}$
(1)	—	—	—
(2)	+	+	+
(3)	+	+	—
(4)	—	+	—
(5)	—	—	+

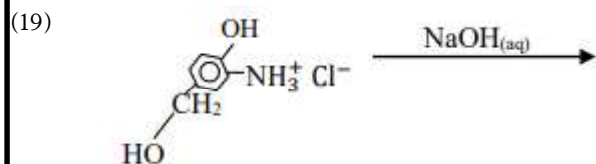
- (11) Potassium hydrogen thalate (KHT) is used to determine the concentration of NaOH aqueous solution used in the laboratory correctly. Its structure is shown below.



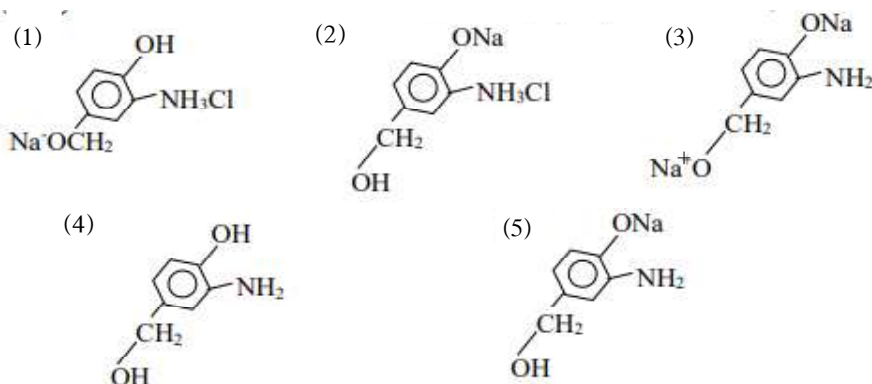
Which is not a reason for selecting KHP for the above test.

- (1) Shows acidic properties.
  - (2) Having a higher molecular mass.
  - (3) Being a water soluble compound
  - (4) Completely ionize in water.
  - (5) Exist as a pure compound.
- (12) To determine the concentration of a  $\text{CuSO}_4$  aqueous solution,  $10 \text{ cm}^3$  of that solution was measured and excess KI solution was added into it. Then that mixture of solutions was titrated with a  $0.05 \text{ mol dm}^{-3}$   $\text{Na}_2\text{S}_2\text{O}_3$  solution and the expected colour change was obtained at  $12 \text{ cm}^3$  composition of  $\text{CuSO}_4$  solution in  $\text{mol dm}^{-3}$  is,
- (1) 0.05
  - (2) 0.06
  - (3) 0.03
  - (4) 1.2
  - (5) 0.12
- (13) Incorrect statement regarding 2-bromobutane is ,
- (1) Exist as two types of compounds.
  - (2) Forms two different compounds when react with dilute NaOH.
  - (3) Forms two types of compounds as the major product , when warmed with alcoholic KOH.
  - (4) Molecular weight of the organic compound forms , when  $\text{CH}_3\text{MgBr}$  is added increases.
  - (5) Could be formed through addition of HBr with two different alkenes.
- (14) An s-block salt gives the following observations,
- (a) Found only a aqueous solutions.
  - (b) Does not give colour change with phenolphthalein.
  - (c) When warmed , a turbidity forms in the aqueous solution.
- The salt could be,
- (1)  $\text{Ca(OH)}_2$
  - (2)  $\text{CaCO}_3$
  - (3)  $\text{Ca(HCO}_3)_2$
  - (4)  $\text{Ca(NO}_3)_2$
  - (5)  $\text{CaC}_2\text{O}_4$
- (15)  $\text{NO (g)} + \frac{1}{2} \text{O}_2 \text{ (g)} \rightleftharpoons \text{NO}_2 \text{ (g)}$   
 Equilibrium constant for the equilibrium shown above is  $5 \times 10^{-3} \text{ Pa}^{-1/2}$ . The equilibrium constant for the reaction  $2 \text{NO}_2 \text{ (g)} \rightleftharpoons 2 \text{NO (g)} + \text{O}_2 \text{ (g)}$  is,
- (1)  $5 \times 10^3 \text{ Pa}$
  - (2)  $1 \times 10^4 \text{ Pa}$
  - (3)  $2 \times 10^4 \text{ Pa}$
  - (4)  $4 \times 10^4 \text{ Pa}$
  - (5)  $1.414 \times 10^2 \text{ Pa}$
- (16) Near the anode of a fuel cell , propane ( $\text{C}_3\text{H}_8$ ) gas react in alkaline medium giving  $\text{CO}_2$  and  $\text{H}_2\text{O}$  . The number of  $\text{H}_2\text{O}$  molecules included in the half reaction of one molecule of propane is ,
- (1) 1
  - (2) 6
  - (3) 14
  - (4) 10
  - (5) 8
- (17) Which response correctly shows the variation of the characteristic feature given in brackets.
- (1)  $\text{HCl} > \text{HBr} > \text{HI}$  (boiling point)
  - (2)  $\text{HCl} < \text{HBr} < \text{HI}$  (dipole moment)
  - (3)  $\text{HCl} < \text{HBr} < \text{HI}$  (bond energy)
  - (4)  $\text{HCl} < \text{HBr} < \text{HI}$  (acidity)
  - (5)  $\text{HCl} < \text{HBr} < \text{HI}$  (energy released in formation)

- (18) Correct statement regarding the half life of a reaction is,
- (1) When the temperature at which the reaction occurs increases , half - life also increases.
  - (2) Rate constant affects the half - life of a reaction inversely.
  - (3) Half - life of two first order reactions would be equal.
  - (4) The order of a reaction does not affect the half - life of a reaction.
  - (5) During one half - life , concentration of all the reactants drop up to half.



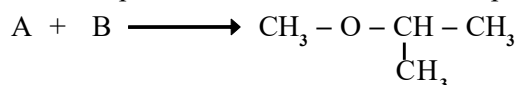
The correct organic product obtained during the above reaction is ,



- (20) The reaction  $A(g) \longrightarrow B(g) + C(g)$  was initiated inside a rigid container at pressure  $P^0$  using gas A. After 30 s , the pressure of the system was P. Rate of the reaction is proportional at 30 s to,

- (1)  $P - P^0$       (2)  $2P - P^0$       (3)  $P^0 - P$       (4)  $2P^0 - P$       (5)  $2(P^0 - P)$

- (21) Consider the production reaction of the compound below



False statement regarding the above reaction is ,

- (1) It is a nucleophilic substitution reaction.
- (2)  $\text{CH}_3\text{ONa}$  and  $\text{CH}_3 - \underset{\text{Br}}{\text{CH}} - \text{CH}_3$  could be used as A and B.
- (3)  $\text{CH}_3 - \underset{\text{ONa}}{\text{CH}} - \text{CH}_3$  and  $\text{CH}_3\text{Br}$  could be used as A and B.
- (4) It occurs in a single step or two steps mechanism.
- (5) Any combination of reactants give organic bi - products.

- (22) 5 g of Ne is included in a rigid vessel at  $27^\circ\text{C}$  and pressure P. It was connected with a vessel of equal volume containing He gas and the temperature was increased upto  $127^\circ\text{C}$  and then the pressure of the system was  $2P$ . The mass of He gas in the system is , (Ne = 20 , He = 4)

- (1) 0.4 g      (2) 1.2 g      (3) 2.4 g      (4) 2.0 g      (5) 0.6 g

(23) The steps shown below were carried out in order to identify the metal ions included in an aqueous solution.

- The precipitate obtained when dilute HCl was added, was filtered and separated and it dissolved in concentrated HCl.

- When  $\text{H}_2\text{S}$  was bubbled through above filtrate a black colour precipitate was given.

The ions identified are,

- (1)  $\text{Pb}^{2+}$  and  $\text{Ni}^{2+}$                       (2)  $\text{Ag}^+$  and  $\text{Ni}^{2+}$                       (3)  $\text{Ag}^+$  and  $\text{Cu}^{2+}$   
 (4)  $\text{Pb}^{2+}$  and  $\text{Cu}^{2+}$                       (5)  $\text{Hg}^{2+}$  and  $\text{Ni}^{2+}$ .

(24) When 7 g of the gaseous hydrocarbon  $\text{C}_5\text{H}_{10}$  was combusted in 32 g (excess) of oxygen, the resultant gaseous mixture included the gases  $\text{O}_2$ , CO and  $\text{CO}_2$  and the total number of moles was 0.9. The number of  $\text{O}_2$  moles in the balanced combustion reaction is,

- (1) 4                      (2) 5                      (3) 6                      (4) 7                      (5) 8

(25) Which is **not** suitable to identify  $\text{SO}_2$  and  $\text{CO}_2$  separately?

- (1)  $\text{KMnO}_4$  / dil  $\text{H}_2\text{SO}_4$                       (2) Methyl Orange  
 (3) Wet blue litmus papers                      (4)  $\text{K}_2\text{CrO}_4$  / KOH  
 (5)  $\text{K}_2\text{Cr}_2\text{O}_7$  / dil  $\text{H}_2\text{SO}_4$

(26) True statement regarding 3d elements is,

- (1) all the elements form colourful compounds.  
 (2) all the elements form oxo-cations.  
 (3) all the atoms / stable ions contain unpaired electrons.  
 (4) Electronegativity of all the elements is greater than the s-block elements in the corresponding period.  
 (5) all the elements react with dilute acids.

(27) At  $25^\circ\text{C}$ , NO gas and  $\text{O}_3$  gas react with each other reversibly to form  $\text{NO}_2$  gas and  $\text{O}_2$  gas and reaches equilibrium. Equilibrium constant for this at  $25^\circ\text{C}$  is 16. When 1 mol of each gas is included in a container of  $5\text{ dm}^3$  volume and allowed to reach equilibrium, what is the concentration of  $\text{O}_2$  gas in the system in  $\text{mol dm}^{-3}$

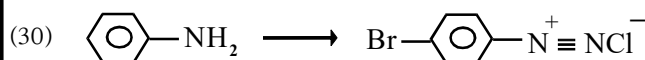
- (1) 0.6                      (2) 0.12                      (3) 0.15                      (4) 0.2                      (5) 0.32

(28) Correct chemical formulae of tetraaquacarbonylthiocyanatoiron(II) nitrate.

- (1)  $[\text{Fe}(\text{CO})(\text{SCN})(\text{H}_2\text{O})_4]\text{NO}_3$                       (2)  $[\text{Fe}(\text{H}_2\text{O})_4(\text{CO})(\text{SCN})]\text{NO}_3$   
 (3)  $[\text{Fe}(\text{H}_2\text{O})_4(\text{SCN})(\text{CO})]\text{NO}_3$                       (4)  $[\text{Fe}(\text{SCN})(\text{CO})(\text{H}_2\text{O})_4]\text{NO}_3$   
 (5)  $[\text{Fe}(\text{SCN})(\text{H}_2\text{O})_4(\text{CO})]\text{NO}_3$

(29) When 4.64 g of the homogenous mixture of  $\text{Fe}_2\text{O}_3$ , FeO and  $\text{FeCO}_3$  only was treated with dilute HCl completely, the volume of the gas evolved at standard temperature and pressure conditions was  $448\text{ cm}^3$ . The mass percentage of Fe in that mixture is

- (1) 10                      (2) 20                      (3) 40                      (4) 60                      (5) 80



Which of the following is not essential in order to complete the above reaction pathway?

- (1) NaOH (aq)                      (2)  $\text{NaNO}_2$  / HCl                      (3)  $\text{CH}_3 - \overset{\text{O}}{\parallel} \text{C} - \text{Cl}$                       (4)  $\text{Br}_2$  (l)                      (5)  $\text{H}_2\text{O}$

★ Answer the questions from (31) to (40) according to the instructions given below.

(1)	(2)	(3)	(4)	(5)
only (a) and (b) correct	only (b) and (c) correct	only (c) and (d) correct	only (d) and (a) correct	any other number or combination of responses are correct

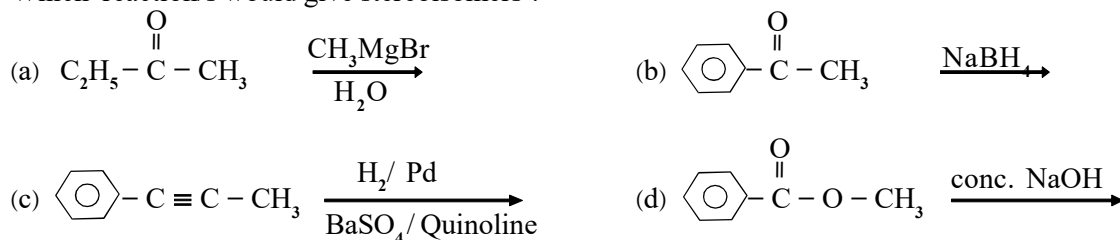
(31) Incorrect statement/s regarding dimerization of  $\text{AlCl}_3$  is /are

- (a) does not occur in gaseous state
- (b) hybridization of Al changes
- (c) electrostatic bonds form between  $\text{AlCl}_3$  molecules
- (d) all the atoms exist in a same plane.

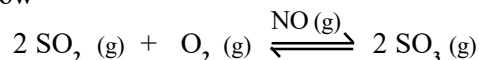
(32) Correct statement/s regarding ideal gases is /are

- (a) ideal gases do not possess a volume
- (b) ideal gas particles do not possess a mass
- (c) no intermolecular forces exist between ideal gas molecules
- (d) an ideal gas particle does not possess a mass.

(33) Which reaction/s would give stereoisomers ?



(34) A situation of carrying out a reversible chemical reaction in the presence of a catalyst is shown below



Correct statement/s regarding the catalyst is / are

- (a) Decreases the activation energy of the reaction.
- (b) Change the enthalpy change of the reaction.
- (c) Increase the (-) value of Gibb's energy change of the reaction.
- (d) Increase the effective collision fraction.

(35) The situation/s where a precipitate/ turbidity is/are given by an aqueous  $\text{Ca}(\text{HCO}_3)_2$  solution is /are,

- (a) adding dilute HCl
- (b) warming the solution
- (c) adding dilute NaOH
- (d) adding water

(36) Correct statement/s regarding the molecular and ionic species given below is /are

- (a) atoms in  $\text{OF}_4^{2+}$  have arranged in two planes which are perpendicular to each other.
- (b) Oxygen shows similar valencies in both  $\text{H}_3\text{O}^+$  and  $\text{CO}$ .
- (c) bond angle in  $\text{NO}_2$  is a value less than  $120^\circ$ .
- (d) The number of resonance structures that could be drawn for  $\text{SO}_2$  is 3.

- (37) Gas /es that could be dried using concentrated  $\text{H}_2\text{SO}_4$  is/are,  
 (a)  $\text{H}_2\text{S}$  (b)  $\text{HCl}$  (c)  $\text{Cl}_2$  (d)  $\text{HBr}$
- (38) The volume decrease was  $15\text{ cm}^3$ , when  $5\text{ cm}^3$  of the hydrocarbon  $\text{C}_n\text{H}_{2n-2}$  was mixed and combusted with excess oxygen. If all the volumes have been taken at room temperature and pressure conditions, what could be the structure/s of the hydrocarbon ?  
 (a)  $\text{CH}_3 - \text{C} \equiv \text{C} - \text{H}$   
 (b)  $\text{CH}_3 - \text{C} \equiv \text{C} - \text{CH}_2 - \text{CH}_3$   
 (c)  $\text{CH}_2 = \text{CH} - \text{CH}_2 - \text{CH} = \text{CH}_2$   
 (d)  $\text{CH}_2 = \text{C} = \text{CH}_2$
- (39) When chloroform mixed with  $\text{Cl}_2$  gas was added into a portion of the solution obtained by dissolving a solid ionic salt in water, and mixed vigorously and allowed to settle, no colour was observed in the organic layer. The conclusions that could be made regarding the above salt is /are  
 (a) do not contain halide ions.  
 (b) do not contain bromide and iodide.  
 (c) chloride ions could exist.  
 (d) no fluoride ions exist.
- (40) True statement regarding the chemistry of  $\text{H}_2\text{O}_2$  is,  
 (a) undergoes disproportionation in the presence of sunlight.  
 (b) treating with acidic  $\text{KI}$  is the initial step in the determination of composition.  
 (c) shows oxidizing features by giving a silver colour with  $\text{Ag}_2\text{O}$ .  
 (d) decolorizes an acidic  $\text{KMnO}_4$  solution.

★ Answer the questions from (41) to (50) according to the instructions given below.

Response	The First statement	The Second statement
(1)	True	True and correctly explains the first statement well
(2)	True	True but does not correctly explain the first statement well
(3)	True	False
(4)	False	True
(5)	False	False

	The First statement	The Second statement
(41)	Nitrobenzene is given as the only organic product during the nitration of benzene.	All the C atoms in a benzene molecule are in an identical bonding environment.
(42)	When NO <sub>2</sub> gas is compressed the colour increases instantly.	At higher pressures NO <sub>2</sub> gas turns in to N <sub>2</sub> O <sub>4</sub> gaseous molecules.
(43)	Aqueous NH <sub>3</sub> is suitable for the identification of AgNO <sub>3</sub> and Zn(NO <sub>3</sub> ) <sub>2</sub> separately.	Although Zn(NO <sub>3</sub> ) <sub>2</sub> forms a precipitate with NH <sub>3</sub> and then dissolves, AgNO <sub>3</sub> does not.
(44)	Molality of a solution does not depend on temperature	Number of moles of the solute or the mass does not change with the temperature.
(45)	Bond dissociation enthalpy at atomization enthalpy of chlorine at standard conditions are same.	Gaseous atoms are given through the bond dissociation in chlorine.
(46)	CH <sub>2</sub> = CH – CH <sub>2</sub> – Br react with NaOH through a single step mechanism.	CH <sub>2</sub> = CH – CH <sub>2</sub> – Br is a primary alkyl halide.
(47)	CO <sub>2</sub> undergoes sublimation at atmospheric pressure and atmospheric temperature.	Pressure of CO <sub>2</sub> at the tripple point is greater than the atmospheric pressure and equilibrium between dry ice and CO <sub>2</sub> (g) exist under atmospheric pressure.
(48)	When a mono basic weak acid is diluted at constant temperature, its pH value increases.	When a weak acid is diluted with water its molar dissociation increases.
(49)	The colour change of I <sub>3</sub> <sup>-</sup> → I <sup>-</sup> is suitable to obtain the end point of an iodometric titration.	During an iodometric titration, the brown colour in the brown colour in the flask turns into colourless due to the conversion of I <sub>3</sub> <sup>-</sup> ions into I <sup>-</sup> .
(50)	When He is added into the system 2 NO <sub>2</sub> (g) ⇌ N <sub>2</sub> O <sub>4</sub> (g) at constant volume and temperature value of K <sub>p</sub> increases.	When an external effect is made on an equilibrium system, a new equilibrium develops in away that the effect would be cancelled.



# Periodic Table

1 <b>H</b> Hydrogen 1.008																		2 <b>He</b> Helium 4.003			
3 <b>Li</b> Lithium 6.94	4 <b>Be</b> Beryllium 9.012															5 <b>B</b> Boron 10.81	6 <b>C</b> Carbon 12.011	7 <b>N</b> Nitrogen 14.007	8 <b>O</b> Oxygen 15.999	9 <b>F</b> Fluorine 18.998	10 <b>Ne</b> Neon 20.180
11 <b>Na</b> Sodium 22.990	12 <b>Mg</b> Magnesium 24.305															13 <b>Al</b> Aluminum 26.982	14 <b>Si</b> Silicon 28.085	15 <b>P</b> Phosphorus 30.974	16 <b>S</b> Sulfur 32.06	17 <b>Cl</b> Chlorine 35.45	18 <b>Ar</b> Argon 39.948
19 <b>K</b> Potassium 39.098	20 <b>Ca</b> Calcium 40.078	21 <b>Sc</b> Scandium 44.956	22 <b>Ti</b> Titanium 47.867	23 <b>V</b> Vanadium 50.942	24 <b>Cr</b> Chromium 51.996	25 <b>Mn</b> Manganese 54.938	26 <b>Fe</b> Iron 55.845	27 <b>Co</b> Cobalt 58.933	28 <b>Ni</b> Nickel 58.693	29 <b>Cu</b> Copper 63.546	30 <b>Zn</b> Zinc 65.38	31 <b>Ga</b> Gallium 69.723	32 <b>Ge</b> Germanium 72.630	33 <b>As</b> Arsenic 74.922	34 <b>Se</b> Selenium 78.97	35 <b>Br</b> Bromine 79.904	36 <b>Kr</b> Krypton 83.798				
37 <b>Rb</b> Rubidium 85.468	38 <b>Sr</b> Strontium 87.62	39 <b>Y</b> Yttrium 88.906	40 <b>Zr</b> Zirconium 91.224	41 <b>Nb</b> Niobium 92.906	42 <b>Mo</b> Molybdenum 95.95	43 <b>Tc</b> Technetium [97]	44 <b>Ru</b> Ruthenium 101.07	45 <b>Rh</b> Rhodium 102.906	46 <b>Pd</b> Palladium 106.42	47 <b>Ag</b> Silver 107.868	48 <b>Cd</b> Cadmium 112.411	49 <b>In</b> Indium 114.818	50 <b>Sn</b> Tin 118.710	51 <b>Sb</b> Antimony 121.760	52 <b>Te</b> Tellurium 127.60	53 <b>I</b> Iodine 126.904	54 <b>Xe</b> Xenon 131.293				
55 <b>Cs</b> Cesium 132.905	56 <b>Ba</b> Barium 137.327	* 57 - 70	71 <b>Lu</b> Lutetium 174.967	72 <b>Hf</b> Hafnium 178.49	73 <b>Ta</b> Tantalum 180.948	74 <b>W</b> Tungsten 183.84	75 <b>Re</b> Rhenium 186.207	76 <b>Os</b> Osmium 190.23	78 <b>Ir</b> Iridium 192.217	79 <b>Pt</b> Platinum 195.084	80 <b>Au</b> Gold 196.967	81 <b>Hg</b> Mercury 200.592	82 <b>Tl</b> Thallium 204.38	83 <b>Pb</b> Lead 207.2	84 <b>Bi</b> Bismuth 208.980	85 <b>Po</b> Polonium [209]	86 <b>At</b> Astatine [210]	87 <b>Rn</b> Radon [222]			
87 <b>Fr</b> Francium [223]	88 <b>Ra</b> Radium [226]	** 89 - 102	103 <b>Lr</b> Lawrencium [262]	104 <b>Rf</b> Rutherfordium [267]	105 <b>Db</b> Dubnium [270]	106 <b>Sg</b> Seaborgium [269]	107 <b>Bh</b> Bohrium [270]	108 <b>Hs</b> Hassium [270]	109 <b>Mt</b> Meitnerium [278]	110 <b>Ds</b> Darmstadtium [281]	111 <b>Rg</b> Roentgenium [281]	112 <b>Cn</b> Copernicium [285]	113 <b>Nh</b> Nihonium [286]	114 <b>Fl</b> Flerovium [289]	115 <b>Mc</b> Moscovium [289]	116 <b>Lv</b> Livermorium [293]	117 <b>Ts</b> Tennessine [293]	118 <b>Og</b> Oganesson [294]			
*Lanthanide series			57 <b>La</b> Lanthanum 138.905	58 <b>Ce</b> Cerium 140.116	59 <b>Pr</b> Praseodymium 140.908	60 <b>Nd</b> Neodymium 144.242	61 <b>Pm</b> Promethium [145]	62 <b>Sm</b> Samarium 150.36	63 <b>Eu</b> Europium 151.964	64 <b>Gd</b> Gadolinium 157.25	65 <b>Tb</b> Terbium 158.925	66 <b>Dy</b> Dysprosium 162.500	67 <b>Ho</b> Holmium 164.930	68 <b>Er</b> Erbium 167.259	69 <b>Tm</b> Thulium 168.934	70 <b>Yb</b> Ytterbium 173.046					
**Actinide series			89 <b>Ac</b> Actinium [227]	90 <b>Th</b> Thorium 232.038	91 <b>Pa</b> Protactinium 231.036	92 <b>U</b> Uranium 238.029	93 <b>Np</b> Neptunium [237]	94 <b>Pu</b> Plutonium [244]	95 <b>Am</b> Americium [243]	96 <b>Cm</b> Curium [247]	97 <b>Bk</b> Berkelium [247]	98 <b>Cf</b> Californium [251]	99 <b>Es</b> Einsteinium [252]	100 <b>Fm</b> Fermium [257]	101 <b>Md</b> Mendelevium [258]	102 <b>No</b> Nobelium [259]					