Now test yourself answers

### Chapter 1

1. electron
2. total number of protons and neutrons in (the nucleus of) an atom
3. 13 protons, 13 electrons and 14 neutrons
4. isotopes
5. 40; argon
6. 28.1
7. 2,6
8. magnesium and 2,8,2
9. phosphorus
10. 1 × 10⁻¹⁵ m
11. 0.165 nm
12. 7.64 fm
13. 16 protons and 18 electrons
14. 3+
15. 2,8

### Chapter 2

1. sodium ion and chloride ion
2. \( \text{Li}_2 \text{S} \)
3. calcium atom is 2,8,8,2; fluorine atom is 2,7 calcium ion is 2,8,8; fluoride ion is 2,8 calcium ion is Ca\(^{2+}\); fluoride ion is F\(^-\)
4. structure = ionic lattice bonding = ionic bonding
5. attraction between oppositely charged ions
6. ions can move and carry charge.
7. a shared pair of electrons
8. (a) 2; (b) 0; (c) 1
9. van der Waals’ forces of attraction
10. Layers of positive ions can slide over the top of each other without disrupting the bonding.
11. A mixture of elements, at least one of which is a metal and the resulting mixture has metallic properties.
12. 21 carat
13. diamond, graphite, graphene
14. Delocalised electrons can move and carry charge.
15. low density/flexible/good conductor of heat and electricity/transparent
16. surface area = 150 cm\(^2\); volume = 125 cm\(^3\); surface area-to-volume ratio = 1.2
17. 96 mm\(^2\)
18. 0.3
19. suncreams
20. unknown effects/may cause lung damage/may cause cell damage
21. larger surface area-to-volume ratio

### Chapter 3

1. \( \text{Cr(NO}_3\text{)}_3 \)
2. iron\((\text{iii})\) sulfate
3. Mg\(\text{I}_2\text{O}_3\)
4. \(2\text{Cu} + \text{O}_2 \rightarrow 2\text{CuO}\)
5. \(\text{Mg} \text{(OH)}_2 + 2\text{NH}_3\text{Cl} \rightarrow 2\text{NH}_4\text{Cl} + \text{MgCl}_2 + 2\text{H}_2\text{O}\)
6. \(4\text{NH}_3 + 5\text{O}_2 \rightarrow 4\text{NO} + 6\text{H}_2\text{O}\)
7. \(\text{Ba}^{2+}\text{(aq)} + \text{SO}_4^{2-}\text{(aq)} \rightarrow \text{BaSO}_4\text{(s)}\)
8. \(\text{Mg} + \text{Cu}^{2+} \rightarrow \text{Mg}^{2+} + \text{Cu}\)
9. ionic equation: \(\text{Zn} + \text{Cu}^{2+} \rightarrow \text{Zn}^{2+} + \text{Cu}\) half equations: \(\text{Zn} \rightarrow \text{Zn}^{2+} + 2\text{e}^-\) and \(\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}\)

### Chapter 4

1. no gaps/more elements in order of atomic number group 0 and lanthanides/actinides present block of transition metals present
2. A substance that consists of only one type of atom/cannot be broken down into anything simpler by chemical means.
3. The simplest particle of an element that can exist on its own in a stable environment.
4. alkali metals
5. alkaline earth metals
6. halogens
7. potassium; outer electron further from attractive power of nucleus/more shielding
8. any two from: hydrogen/nitrogen/oxygen/flourine/chlorine/bromine/iodine [also astatine]
9. \(\text{Li} \rightarrow \text{Li}^{+} + \text{e}^-\)
10. rubidium hydroxide and hydrogen
11. lilac
12. \(2\text{Cs} + 2\text{H}_2\text{O} \rightarrow 2\text{CsOH} + \text{H}_2\)
13. fluorine
14. red-brown liquid
Chapter 5

1 96
2 103
3  15.8%
4 0.2 g
5 0.81 g
6 25.92 g
7 magnesium
8 oxygen
9 K is limiting reactant and 22 g of K₂S formed
10 Ag₂O
11 CH₃
12 80%
13 43.9%
14 heating and weighing and repeat until no change in mass
15 n = 7

Chapter 6

1 A substance that changes colour in acidic, alkaline and neutral solutions.
2 yellow
3 pink
4 OH⁻/hydroxide
5 H⁺[aq] + OH⁻[aq] → H₂O(l)
6 hydrochloric acid/nitric acid/sulfuric acid
7 calcium ethanoate
8 lit splint; pop
9 Ca + 2HNO₃ → Ca(NO₃)₂ + H₂
10 sodium sulfate, carbon dioxide, water
11 limewater/calcium hydroxide solution
12 sodium nitrate
13 potassium sulfate and K₂SO₄
14 between two sheets of filter paper/in a low temperature oven/in a desiccator
15 CuO + 2HNO₃ → Cu(NO₃)₂ + H₂O

Chapter 7

1 liquid
2 increases
3 The temperature at which a liquid changes to a gas.
4 residue
5 Liquids that do not mix.
6 filtered solution/liquid
7 to promote smooth boiling
8 evaporating basin; gauze; Bunsen burner; tripod; heatproof mat
9 fractional distillation
10 R_f = distance moved by spot/distance moved by solvent
11 spot has not moved
12 water
13 white
14 Water that can be consumed by humans as it is safe to drink.
15 filtration, sedimentation and chlorination
16 crimson
17 magnesium hydroxide and white
18 green
19 yellow ppt
20 BaCl₂ + K₂SO₄ → BaSO₄ + 2KCl
21 Ag⁺[aq] + Cl⁻[aq] → AgCl(s)

Chapter 8

1 Solubility is the mass of solid that saturates 100 g of water at a particular temperature.
2 A solution in which no more solute can dissolve at a particular temperature.
3 100 g
4 increases
5 decreases
6 48 g/100 g water
7 14.5 g
8 Saturated because 8.4 g are required to saturate 5 g of water.
9 5.1 g

Chapter 9

1 lilac
2 2Ca + O₂ → 2CaO
3 black
4 2Rb + 2H₂O → 2RbOH + H₂
5 calcium hydroxide and hydrogen
6 floats/fizzes/moves/melts to form a silvery ball/heat released/colourless solution formed/disappears
7 zinc oxide and hydrogen
8 \( \text{Mg} + \text{H}_2\text{O} \rightarrow \text{MgO} + \text{H}_2 \)
9 white
10 \( \text{Mg} + \text{Pb(NO}_3\text{)}_2 \rightarrow \text{Mg(NO}_3\text{)}_2 + \text{Pb} \)
11 zinc sulfate and copper
12 \( \text{Mg} + \text{Zn}^{2+} \rightarrow \text{Mg}^{2+} + \text{Zn} \)
13 electrolysis
14 extraction of metal compounds using plants
15 any two from: less mining/less noise and dust/uses scrap iron/less energy needed/less disposal of rocks/energy on burning can be harnessed/carbon dioxide absorbed as plants grow

Chapter 10

1 carbon/C
2 Sulfur gains oxygen and the gain of oxygen is oxidation.
3 Iodine gains hydrogen and the gain of hydrogen is reduction.
5 \( \text{Ag}^+ + \text{e}^- \rightarrow \text{Ag} \) [reduction] and \( \text{Cu} \rightarrow \text{Cu}^{2+} + 2\text{e}^- \) [oxidation]
6 copper(ii) ions
7 zinc
8 hydrated iron(iii) oxide
9 Magnesium is more reactive than iron, so magnesium reacts first.
10 Calcium silicate and \( \text{CaSiO}_3 \)
11 \( \text{C} + \text{O}_2 \rightarrow \text{CO}_2 \) and \( \text{CO}_2 + \text{C} \rightarrow 2\text{CO} \)
12 \( \text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2 \)

Chapter 11

1 rate increases
2 \( \text{Mg} + \text{H}_2\text{SO}_4 \rightarrow \text{MgSO}_4 + \text{H}_2 \)
3 manganese(iv) oxide (or manganese dioxide)
4 The minimum energy required for a reaction to occur.
5 Particles have more energy/move faster; more collisions and more successful collisions in a given period of time.
6 sulfur
7 A substance that increases the rate of a chemical reaction without being used up.
8 It provides an alternative reaction pathway of lower activation energy.
9 1.0 g

Chapter 12

1 A reaction in which the reactants can change into products and the products can change back into reactants.
2 The amounts of reactants and products remain constant and the rate of the forward reaction is equal to the rate of the reverse reaction.
3 \( \text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3 \)
4 All reactants and products are in the same state.
5 When a change is made to the conditions of a system at equilibrium, then the position of the equilibrium moves to oppose that change in conditions.
6 The position of equilibrium will move to the left.
7 concentration of \( \text{N}_2\text{O}_4 \) increases
8 no effect
9 A compromise for a reasonable yield but a relatively fast rate of reaction.

Chapter 13

1 carboxylic acids
2 A family of organic compounds with the same general formula/differ by a \( \text{CH}_2 \) unit/similar chemical properties/gradation in physical properties.
3 \( \text{C}_2\text{H}_4\text{O} \)
4 butane
5 \( \text{C}_2\text{H}_6 \)
6 \( \text{C}_3\text{H}_6 \)
7 fractional distillation
8 Breaking up longer/larger less useful saturated hydrocarbons into smaller/shorter more useful ones, some of which are unsaturated.
9 \( \text{C}_3\text{H}_8 \)
10 propene
11 \( \text{C}_2\text{H}_4 \)
12 but-1-ene and but-2-ene
13 butanoic acid
14 \( \text{CH}_3\text{COOH} \)
15 propanoic acid
16 carbon monoxide, water and soot (carbon)
17 Carbon monoxide is toxic.
18 \( \text{CH}_3\text{OH} + \frac{1}{2}\text{O}_2 \rightarrow \text{CO} + 2\text{H}_2\text{O} \) or \( 2\text{CH}_3\text{OH} + 3\text{O}_2 \rightarrow 2\text{CO}_2 + 4\text{H}_2\text{O} \)
19 ethanol
20 bromine water; orange/brown to colourless addition
21 Sugar solution is mixed with yeast in warm conditions and the absence of oxygen; ethanol and carbon dioxide are produced.
23 orange to green
24 propanoic acid
25 sodium ethanoate
26 bubbles/fizzing, heat released, grey solid disappears, solution remains colourless
27 \(2\text{C}_2\text{H}_5\text{COOH} + \text{CaCO}_3 \rightarrow [\text{C}_2\text{H}_5\text{COO}]_2\text{Ca} + \text{CO}_2 + \text{H}_2\text{O}\)
28 global warming/melting ice caps/rising sea levels/flooding of low-lying areas/climate change
29 sulfur dioxide
30 It destroys limestone buildings and statues/kills fish in rivers and lakes/defoliates trees.

Chapter 14

1. \(0.96 \text{ mol/dm}^3\)
2. \(0.75 \text{ mol/dm}^3\)
3. \(1.6 \text{ mol/dm}^3\)
4. \(2.5 \times 10^{-4}/0.00025 \text{ mol}\)
5. \(5.04 \text{ g}\)
6. \(12\)
7. yellow
8. pipette and pipette filler
9. pink to colourless
10. \(25 \text{ cm}^3\)
11. \(13.2 \text{ g/dm}^3\)
12. \(0.272 \text{ mol/dm}^3\)
13. potassium
14. \(x = 4\)
15. rubidium
16. Equal volumes of gases under the same conditions of temperature and pressure contain the same number of particles.
17. \(696 \text{ cm}^3\)
18. \(15.4\%\)

Chapter 15

1. The decomposition of a liquid electrolyte using a direct current of electricity.
2. cathode
3. anode
4. zinc and chlorine
5. \(2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2\)
6. colourless, odourless gas evolved
7. cryolite
8. \(2\text{O}^{2-} \rightarrow \text{O}_2 + 4\text{e}^-\)
9. \(\text{Al}^{3+} + 3\text{e}^- \rightarrow \text{Al}\)

Chapter 16

1. exothermic
2. activation energy
3. energy and progress of reaction
4. bond breaking
5. \(-536 \text{ kJ}\)
6. \(-1317 \text{ kJ}\)

Chapter 17

1. oxygen
2. The strong triple covalent bond \([\text{N}=\text{N}]\) requires substantial energy to break it.
3. ammonium chloride
4. any three from: colourless/odourless/gas/insoluble in water/less dense than air
5. \(\text{Zn} + 2\text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2\)
6. lit splint; pop
7. hydrogen peroxide solution and manganese(\(\text{iv}\)) oxide
8. The black solid burns with an orange sooty flame and a colourless gas is produced.
9. basic
10. \(\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{CO}_2 + \text{H}_2\text{O}\)
11. any two from: colourless/odourless/low solubility in water/denser than air
12. calcium carbonate