Mark schemes

1

(a) • made of layers / rows (atoms / ions / particles)

ignore free / delocalised electrons

1

• which can slide / slip (over each other)

*reference to incorrect particles / covalency / intermolecular forces = max **1***

or

particles / ions / atoms can slide over each other

ignore malleable / ductile / weak bonds

1

(b) (i) sulfuric

accept sulphuric

ignore formula

ignore hydrogen sulfate

1

(ii) any **two** from:

list principle applies for incorrect observations

• (hydrogen) gas produced (or any indication of a gas such as bubbles etc.)

ignore just hydrogen produced

ignore cloudiness / colour changes

• magnesium / solid disappears / goes into solution

accept magnesium / magnesium sulfate / solid / it dissolves

accept forms a liquid / solution

• gets hot

allow exothermic

ignore floats

2

(iii) crystallisation

accept detailed answers such as: evaporate to half volume and then allow the solution to crystallise.

or

evaporation / heating / boiling / cooling

ignore any references to filter

1

[6]

2

(a) gives out / releases / transfers to surroundings heat / energy

ignore light / burns

ignore the wire gets hot

1

(b) activation energy

1

(c) (aluminium +) oxygen (→) aluminium oxide

accept correct formulae

1

(d) C

1

(e) (i) a negative

1

(ii) loses

1

(iii) gains

1

two

1

[8]

3

(a) gives out heat / energy

allow more energy given out in making bonds than is used in breaking bonds

or

energy / heat transferred to surroundings

ignore light

1

(b) activation

allow phonetic spelling

1

(c) (i) 2 crosses on inner circle **and**

8 crosses on outer circle

accepts dots / e / – for electrons

1

(ii) opposite charges (attract)

allow electrostatic forces (attract)

*do **not** accept intermolecular attraction / shared electrons*

1

[4]

4 (a)

$\frac{6.21}{207}$ $\frac{0.64}{16}$

***1** mark for dividing mass by A_r*
*max **2** if A_r divided by mass*

1

= 0.03 = 0.04

***1** mark for correct proportions*

1

3 4

***1** mark for correct whole number ratio (allow multiples) can be awarded from correct formula*

1

Pb_3O_4

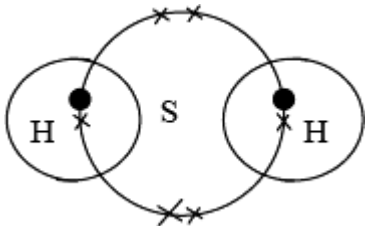
***1** mark for correct formula*

ecf** allowed from **step 2 to step 3** and **step 3 to step 4** if sensible attempt at **step 1

*correct formula with no working gains **2** marks*

1

(b) (i)



allow all dots ***or*** *all crosses* ***or*** *e* ***or*** e^-

ignore inner shells and any inner electrons

allow 4 non-bonded electrons anywhere on shell as long as not in overlap – need not be paired

1

(ii) forces of attraction / bonds <u>between</u> molecules are weak (owtte)

do ***not*** *accept intramolecular forces / covalent bonds are weak*

do ***not*** *accept reference to ions*

or

<u>intermolecular</u> forces / bonds are weak (owtte)

or

it is made of small molecules with weak forces of attraction

if ***2*** *marks not awarded*

made of small molecules / simple molecular gains ***1*** *mark*

forces of attraction are weak (without specifying between molecules / intermolecular) gains ***1*** *mark*

(accept easily broken / not much energy needed to break instead of weak)

bonds are weak without specifying intermolecular would not gain a mark and would be ignored

2

(iii) 4

1

[8]

5 (a) elements

1

(b) (i) nucleus

1

(ii) six

1

(c) (i) CH_4

1

(ii) bond

1

(d) (i) oxygen

1

(ii) any **one** from:

- (water) does not pollute
  accept no harmful gas(es)
  allow less pollution
- (only) water is produced
- no carbon dioxide / monoxide (is produced)
  *accept no greenhouse gas(es) / effect **or** no global warming*

1

[7]

6 (a) (i) protons

1

(ii) neutrons

1

(b) heavier than

1

H-2 atoms are heavier than H-1 atoms

can be awarded even if they do not circle heavier than

or

the hydrogen atoms are heavier / more particles in the nucleus of the hydrogen atoms / one more particle in each hydrogen atom / a neutron in each hydrogen atom etc

must be linked to heavier than

a correct explanation of the increase in mass by ref. to the particles in the hydrogen atoms

ignore reference to particles in the oxygen atoms

or

molecule A has more particles / neutrons

*do **not** accept incorrect numbers of particles*

accept molecule A has more protons and neutrons

molecule A has higher mass numbers

or

molecule A has a larger nuclear mass / atomic mass
A has two more neutrons than B

hydrogen has a greater mass number in A

all the numbers in the molecule A

add up to 6 and in molecule B add up to 4

molecule A has

$^{2}_{1}H$

and B

$^{1}_{1}H$

1

[4]

7

(a) (i) mix (owtte)

accept to allow more collisions / helps particles to collide (owtte)

idea of more efficient heat transfer

*do **not** allow heat is a catalyst*

1

(ii) higher **and** more

1

powder **and** big

1

concentrated **and** more

1

(b) electrons

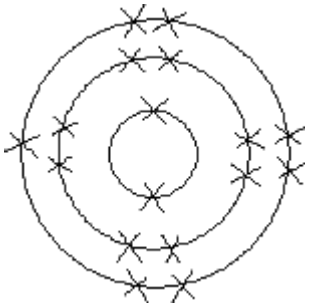
1

(c) H^+

1

[6]

8

(a) 

accept dots / crosses / e
must be drawn on diagram
electrons do not need to be paired
ignore brackets or + or -charges
ignore 2,8,7

1

(b) (one) electron

recognition that electrons are involved

1

lost / given away / transferred from sodium / transferred to chlorine owtte

must be linked to electrons
*accept loses electron(s) for **2** marks*
*NB loses 2 or more electrons gains **1** mark*
*reference to sharing / covalent max **1** mark*
ignore charges on ions formed

1

(c) (i) any **one** from:

- ions / atoms / they are / it is negatively charged / anions
  accept they are negative
- opposite (charges) attract
  accept they are <u>attracted</u> or it is oppositely charged
  ignore opposite forces attract

1

(ii) hydrogen

accept H_2

ignore H or H^+

1

(d) (i) poisons released into environment (owtte)

accept any sensible idea of harm / harmful / poisons / poisonous / pollution / damaging

*do **not** accept answers such as global warming / ozone layer etc.*

ignore safety unless qualified

1

(ii) any **one** sensible idea eg

- loss of work / unemployment

  eg shops / house prices etc.

  or

  company goes out of business

- any adverse effect on local economy (owtte)

- any adverse effect on paper production / cost of paper / cost of water (treatment)

  allow less expensive to use chlorine or converse

- chlorine (compounds) have been used (for many years) without causing harm owtte

- only a tiny amount of chlorine is released so it would not cause harm

  ignore uses of chlorine to treat drinking water unless qualified

1

(iii) ideas related to bias

accept more reliable or valid or fair

ignore more accurate / fair test

1

[8]

9 (a)

2 and 1 must be on the left

2 must be above half-way on the H and the 1 below half-way

accept diagram with 2 <u>different</u> particles in centre and 1 particle on circle

1

(b) (i) 18

ignore working

ignore units

1

(ii) forces (of attraction) between molecules **or**
bonding between molecules **or**
intermolecular forces /intermolecular bonds

1

are weak **or** not much energy needed to break them **or** easily overcome

must be linked to first mark

*if no other mark awarded allow small molecules / small M_r for **1** mark*

*allow forces / bonds are weak for **1** mark*

*do **not** allow covalent bonding is weak*

1

(c) *any reference to more protons = **0** marks*

H-2 atoms have 1 proton and 1 neutron

*allow H-2 has more neutrons / particles for **1** mark*

1

H-1 atoms have one proton

*allow H-2 has two particles and H-1 has one particle for **1** mark*

or

H-2 atom has one neutron (1)

*allow H-2 atom has one more neutron for **2** marks*

H-1 atom has no neutrons (1)

***NB** heavy water (molecule) has 2 more neutrons = **2** marks*

*heavy water (molecule) has more neutrons / particles = **1** mark*

*if no other mark awarded then heavy water molecule has **M_r** of 20 = **1** mark*

ignore reference to electrons

1

[6]

10

(a) (i) nucleus

1

(ii) neutron

1

(iii) electron

1

(b) (i) 6

1

(ii) 12

1

(c) $^{14}_{6}C$

1

(d) (i) CH_4

1

(ii) compound

1

(iii) covalent

1

[9]

11 (a) (i) precipitation

1

(ii) filtration

1

(iii) lead nitrate

1

sodium iodide

1

(b) *sharing / covalent / metallic = max **3***

any **four** from:

- magnesium (atom) reacts with **two** iodine (atoms)
- magnesium (atom) loses
- **2** electrons
- iodine (atom) gains
- **1** electron **or** an electron
- iodide ion formed
  allow iodine ion
  allow iodine
  ignore I^{2-}
- iodide has negative charge / is a negative ion / particle
- magnesium ion formed
- magnesium has positive charge
- oppositely charged ions attract
- a giant structure / lattice is formed
  *if reference to ions being formed is made unqualified, allow **1** mark*

4

[8]

12

(a) 2,4 (drawn as crosses) on shells
accept dots / e / - etc.

1

(b) (i) hard
allow rigid / high melting point
*do **not** allow references to bonding*
ignore strong
ignore unreactive
ignore structure

1

(ii) any **three** from

*max **2** if ionic / metallic / molecule / intermolecular bonds **or** incorrect number of bonds*

- giant structure / lattice / macromolecular
  allow many bonds
- covalent (bonds)
- (covalent) bonds are strong
  accept needs lots of energy to break bonds (owtte)
- (each) carbon / atom forms four bonds

  or

  (each) carbon / atom bonded to four other atoms

3

(c) any **three** from:

*max **2** if ionic / ions / metallic / molecule*

'it' needs to be qualified

graphite

- has delocalised / free electrons

  *do **not** accept the electrons move unless qualified (around structure etc)*

  or

  electrons that can move through / around the structure

- each carbon is joined to three other carbon atoms

  allow graphite has three bonds

  or

  one electron from each atom is free / delocalised

diamond

- has no free / delocalised electrons

  *do **not** accept the electrons do not move*

  or

  no electrons that move around the structure

- all the electrons are used for bonding

  allow diamond has 4 bonds

  or

  each carbon joined to four other carbon atoms

3

[8]

13 (a) (i) lead nitrate

accept $Pb(NO_3)_2$

*do **not** accept nitride*

1

sodium iodide / potassium iodide

accept NaI / KI

accept other correct soluble iodides

*do **not** accept sodium iodine / potassium iodine*

1

(ii) filter / filtration / filtering

accept decant / decanting etc.

accept centrifugation

*ignore evaporation **or** heating if after filtration*

1

(b) *metallic / sharing / covalent **or** molecule = max **3***

magnesium loses **2** electrons

all three underlined ideas must be present

*two underlined ideas = **1** mark*

eg magnesium loses electrons

or

magnesium gains 2 electrons

or

magnesium loses 2 ions

*nb magnesium **ion** loses 2 electrons = **1** mark*

*2 errors = **0** marks*

eg magnesium gains electrons

all four underlined ideas must be present

2

iodine gains **1** / **an** electron

*three underlined ideas = **1** mark*

eg iodine gains electron(s)

or

iodine loses 1 / an electron

or

iodine gains 1 / an ion

or

iodide (ion) gains 1 / an electron

*2 errors = **0** marks*

2

(c) any **two** from:

*mention of molecules / intermolecular / covalent / atoms = max **1***

- forces (of attraction) / bonds are strong **or** lot of energy needed to break bonds
- oppositely charged ions attract **or** electrostatic attraction between ions
- giant structure **or** lattice

allow many bonds

ignore ionic bonding unqualified

2

[9]

14 (a) atoms

1

(b) mixture

1

metal

1

structure

1

smart

1

(c) (i) any **two** from:

- saves raw materials / iron ore
- saves energy / fuels

accept cheaper / saves money

- make new / useful items
- make money / it is economic
- reduces pollution

allow less harmful for the environment

- decreases cost of steel cans
- reduces carbon dioxide emissions
- decreases waste materials / use of landfill

2

(ii) any **one** from:

- provide information / education of the need to recycle
- legislate against / charge for waste
- reward / pay people to recycle
  accept fine people for not recycling
- put labels on the cans
- provide recycling bags / bins / areas

1

[8]

15 (a) (Chromium =) 20

1

in correct order

(Nickel =) 8

accept Chromium = 8 ***and*** *Nickel = 20 for* ***1*** *mark*

1

(b) (i) (because iron is made up of only) one type of atom

1

(ii) not strong

ignore soft / corrosive / flexible
accept it rusts / corrodes ***or*** *that it could wear away*
accept could change shape / bend
accept layers / atoms could slide (over each other)

1

(iii) has different sized atoms / particles
or
structure is different/distorted / disrupted

accept not in layers ***or*** *not regular*

1

so it is difficult for layers / atoms / particles to slip / slide (over each other)

accept layers cannot slip / slide

1

[6]

16 (a) C_3H_8

capital letters for symbols numbers must be halfway or lower down the element symbol

allow H_8C_3

*do **not** allow 3:8 **or** C_3 and H_8*

1

(b) (i) electron

1

(ii) covalent

1

(c) low **and** small

*both for **1** mark*

1

[4]

17 (a) (i) increase

1

(ii) high melting point

1

(b) (i) decreases

1

increases

1

(ii) it gives the particles more energy

1

it makes the particles move faster

1

[6]

18 (a) 152 correct answer with **or** without working = **2 marks**

56 + 32 + (4 ×16) gains **1** mark

ignore any units

2

(b) 152g(rams)

ecf from the answer to (a) and g

must have unit g / gram / gramme / grams etc

accept g / mol ***or*** *g per mole* ***or*** *g mole^{-1}* ***or*** *g/mol* ***or*** *g per mol* ***or*** *g mol^{-1}*

do ***not*** *accept g m*

do ***not*** *accept G*

1

(c) 76(g)

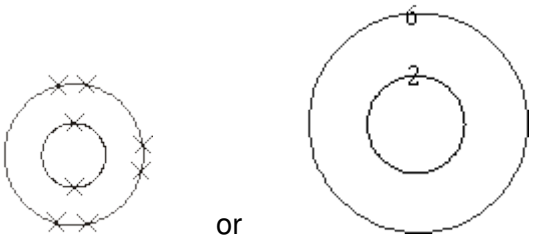
ecf from their answer to (a) or (b) divided by 2

ignore units

1

[4]

19 (a) (i)



or

1

allow any arrangement of electrons on the shells

accept o, x, - ***or*** *e as representing electrons*

(ii) nucleus

accept nucleus (protons plus neutrons)

do ***not*** *accept protons plus neutrons on its own*

allow nuclei / nucles / neucleus / phonetic spelling

do ***not*** *accept neutron*

1

(b) it has **2** more neutrons **or** converse

*accept 'it has more neutrons' **or** 'different number of neutrons' for **1 mark***

*'2 more protons / electrons + correct number of neutrons' = max **1** mark*

or

O-16 has 8 neutrons (**1 mark**)(*)

O-18 has 10 neutrons (**1 mark**)(*)

*(*)if incorrectly calculated but shows more neutrons in 0-18 allow for **1** mark*

accept it has more particles

or

*it has 2 more particles for **1** mark*

ignore any reference to charges

*just 2 more without reference to particles = **0** marks*

2

[4]

20 (a) (i) increase (owtte) **or** gets hotter

ignore gives out heat / takes in heat

1

(ii) any **two** from:

- bonds are strong
  accept hard to break
- a lot of energy needed to break bonds
  allow heat for energy
- all atoms are joined by (covalent bonds
  accept forms lattice
- a large number of bonds would need to be broken
  *reference to ionic / metallic = **1** mark*
  *intermolecular forces /forces between molecules = max **1** mark*
  ignore electrostatic
  *many strong bonds need to be broken = **2** marks*
  accept 'double bonds' as equivalent to bonds

2

(b) any **two** from:

- particles have more energy

  ignore more vibrations

- particles move faster

  ignore move more

- particles collide more often **or**
  more collisions

  accept answers such as hit / bump

- more particles / particle collisions
  have the activation energy
  or
  more of the particles / particle collisions have
  enough energy to react
  or
  collisions are more energetic / harder (owtte)
  or
  more of the collisions are successful

  *if electrons rather than particles stated then max **1** mark*

  *there are more collisions and more of the collisions are successful = **2** marks*

  *accept more collisions per second / unit of time for **2** marks*

  *accept 'more successful collisions' for **1** mark*

2

[5]

21 (a) 2.61 / range 2.5 to 2.7

*correct answer with **or** without **or** with wrong working gains **2** marks*

(accept answers between 2.5 and 2.7)

if answer incorrect moles of salicylic acid = 2/138 = 0.0145 moles
*ie 2/138 **or** 0.0145 gains **1** mark*
or
*(180/138) × 2 gains **1** mark*
or
*1 g → 180/138 = (1.304 g) gains **1** mark*
*(**not** 1.304g alone)*

2

(b) 42.1 range 40.7 to 42.3

*accept correct answer with **or** without **or** with wrong working for **2** marks*

*ecf ie (1.1 / their answer from (a)) × 100 correctly calculated gains **2** marks*

*if answer incorrect percentage yield = 1.1 / 2.61 × 100 gains **1** mark*

if they do not have an answer to part (a)
or
they choose not to use their answer then:

- yield = (1.1 / 2.5) × 100 (1)
- = 44

*accept 44 for **2** marks with no working*

2

(c) any **one** from:

- errors in weighing
- some (of the aspirin) lost

*do **not** allow 'lost as a gas'*

- not all of the reactant may have been converted to product

eg reaction didn't go to completion

allow loss of some reactants

- the reaction is reversible

accept other products / chemicals

- side reactions

ignore waste products

- reactants impure
- not heated for long enough
- not hot enough for reaction to take place

1

(d) any **one** from:

- use lower temperature
- use less fuel / energy
  ignore references to use of catalyst
- produce product faster **or** speed up reaction
- more product produced in a given time (owtte)
- increased productivity
- lowers activation energy

1

[6]

22 (a) conducts (electricity) **or**
accept flexible

allows electrons / current to flow
ignore conducts heat

1

(b) electron

1

(c) (i) lithium>copper>tungsten **or**

Li>Cu>W
all correct
*allow **1** mark for one metal in the correct position*

2

(ii) has high / highest melting point
accept has high / highest boiling point

or

can withstand the highest temperature

1

(d) unreactive

1

[6]

23 (a) 4

1

(b) 9

1

[2]

24 (a) covalent

1

(b) (i) liquid

1

(ii) fluorine

accept F / F_2

*do **not** accept fluoride*

1

(c) (i) should fluoride ions be added to drinking water?

1

(ii) any **one** from:

- not enough reliable/valid evidence
- may be other factors involved
- it is an opinion / choice / belief / ethics issue
- it can't be scientifically investigated

allow can't do an experiment

ignore test

mark independently of (c) (i)

1

[5]

25 (a) (i) gives out a <u>large amount</u> of energy

1

<u>only</u> water produced / product is non polluting (owtte)

allow it does not harm the environment

1

(ii) does not explode / burst into flames owtte

ignore will not react

1

(iii) hydrogen absorbed and released much faster

allow more efficient

allow can store a larger amount

1

(b) (i) B

1

(ii) a lithium atom loses an electron

1

(iii) C

1

(c) reversible

1

(d) (i) much smaller

1

(ii) surface area

1

[10]

26 (a) (i) any **one** from:

- they are positive / cations
- they are H^+
- opposite charges attract

ignore atom

1

(ii) potassium is more reactive (or reverse)

assume 'it' refers to hydrogen

allow potassium reacts <u>with</u> water

*allow potassium is very reactive **or** most reactive metal / element*

allow hydrogen gains electrons more easily / is reduced more easily

accept potassium is higher up the reactivity series

1

(b) 6 **and** 2

accept correct multiples and fractions

1

(c) (i) the reaction / it is reversible **or** a description of a reversible reaction

allow 'it is an equilibrium'

allow reversible symbol drawn correctly

allow 'the reverse / back reaction'

1

(ii) **lithium nitride**

assume that 'it' or if they do not specify means lithium nitride

assume lithium / lithium nitrate refers to lithium nitride

- hydrogen is bonded / held / absorbed / has formed a compound / reacted with lithium nitride

1

plus **one** of:

- does not explode / cause a fire
- is not free / less hydrogen
- is not under pressure
- does not leak
- is only released slowly

1

- compound of hydrogen with lithium nitride / product is (more) stable / less reactive / less chance of a reaction

accept converse for hydrogen as below

assume that gas / hydrogen means gas in the cylinder

- *hydrogen (in cylinder) / gas is not bonded / held absorbed / in a compound / reacted with lithium nitride*

1

*plus **one** of:*

- *can explode / cause a fire*
- *is free*
- *is under pressure*
- *can leak*
- *releases quickly*

1

(d) (i) loss of an electron **or** loses electrons

do not accept any ref. to oxygen

1

(ii) full outer shell of 8 electrons on circle

need not be paired

can be ×, dot or e

*do **not** accept if extra electrons added to inner shell*

1

[10]

27 (a) (i) made up of one sort of atom

accept it is in the periodic table

or

has its own symbol

1

(ii) nitrogen / N / N_2 **or** oxygen / O / O_2

*do **not** accept argon **or** helium*

*do **not** accept oxide*

1

(b) (i) compound

1

carbon

1

(ii) bond

1

[5]

28 (a) CH_4

4 should be below halfway up H / tail of 4 below the dotted line

1

(b) molecule

1

(c) covalent

1

[3]

29 (a) gives out (heat)

1

(b) D

1

(c) L

1

(d) magnesium chloride

1

[4]

30 (a) N_2O

1

(b) 13.8 to 14

gains full marks without working

if answer incorrect
*13 gains **1** mark*
or
*14/101 × 100 gains **1** mark*

2

[3]

31 (a) electric current / electricity

1

plus **one** from:

- is passed through ionic compound / substance / electrolyte
- passed through molten/aqueous compound / substance
  must be linked to electricity
  allow liquid compound / substance
  *do **not** allow solution / liquid alone*
- causing decomposition
  accept split up / breakdown / breaking up owtte
  ignore separated
  accept elements are formed
  ignore new substances form

1

(b) hydrogen

accept H_2

*do **not** accept H / H^2*

1

(c) one electron from each atom

accept each carbon is bonded to three other carbon atoms leaving one (unbonded) electron owtte

1

is delocalised / free (to move)

must be linked to electrons

*answers of delocalised / free electrons only, gains **1** mark*

*accept each carbon is bonded to three other carbon atoms leaving delocalised / free electrons = **2** marks*

***maximum 1** mark if graphite described as a metal / giant ionic lattice*

1

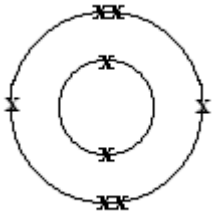
[5]

32 (a) $2Mg + O_2 \rightarrow 2MgO$

accept correct multiples / fractions

1

(b)



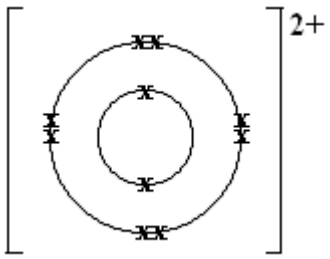
electrons do not need to be paired

accept dots / circles / e instead of crosses

*do **not** allow 2.6 without diagram*

1

(c)



electrons do not need to be paired
allow without bracket s/ must have the charge
accept dots / circles / e instead of crosses
ignore extra empty outer shells
ignore nucleus
*do **not** allow [2.8]$^{2+}$ without diagram*

1

(d) oppositely charged (ions / atoms)
allow positive and negative(ions / atoms)

1

(they) attract
must be in correct context
accept held by electrostatic forces
ignore ionic bonding
***maximum 1** if they refer to intermolecular forces / attractions / covalent bonds*

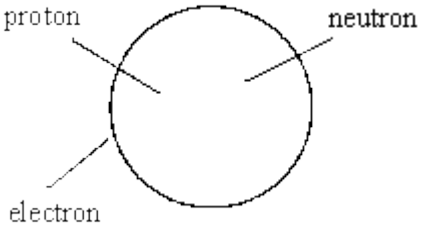
1

(e) magnesium chloride
accept $MgCl_2$ (if correctly written)

1

[6]

33 (a) (i)



*all three correct **2** marks*
*one correct **1** mark*

2

(ii) 14

1

(b) A

1

[4]

34 (a) (i) small **or** few atoms thick **or** size in the range 1–100 nanometres
owtte

1

(ii) sensible idea of passing through smaller gaps owtte
*eg can pass through skin / pores / cells **or** more easily <u>absorbed</u>*

1

(b) any **two** from:

- good at absorbing UV light / radiation
- spread more easily
- cover better
- save money / use less
- transparent
- less chance of getting skin cancer **or** stops skin cancer
ignore more effective alone

2

(c) toxic to (cells / specific cells)
*allow harm / damage / kill **or** cause cancer*

1

[5]

35 (a) 157

*correct answer with **or** without working*
*(2 × 19 + 119) for **1** mark only*
*allow (119 + 19 =) 138 for **1** mark only*
ignore units

2

(b) 24.2

accept answers in the range 24 to 24.2038.....
ignore incorrect rounding after correct answer
*25 only without working gains **1** mark **or***
*38/157 × 100 gains **1** mark **or***
*(19/157 × 100 =) 12 to 12.1 gains **1** mark*
allow error carried forward from part(a)
*38/(a) × 100 gains **2** marks if calculated correctly*
*(19/138 × 100 =) 13.8 gains **1** mark*

2

(c) 0.29

accept answers in the range 0.28 to 0.3
allow error carried forward from part (b)
(b)/100 × 1.2 correctly calculated
ignore units

1

(d) an electron

allow electrons
*allow electron shared / lost for **1** mark*
apply list principle for additional particles

1

is gained owtte

must be linked to electron
accept can hold / take in if in correct context
*eg it can hold another electron (in its outer shell) = **2** marks*
*it can take an electron (from another atom) = **2** marks*
ignore reference to fluoride ions
*incorrect number of electrons gained does **not** gain the second mark*

1

[7]

36 (a) 2.8.3 on diagram as Xs / dots

or e

*accept paired **or** unpaired*

1

(b) any **two** from:

- electrons in highest energy level **or** electrons in outer shell
- electrons are delocalised **or** sea of electrons
- electrons are free **or** electrons move around / flow
- electrons carry charge / current

ignore carry electricity

2

[3]

37 (a) made of one sort of atom

accept it is in the periodic table

accept it only has lithium atoms

1

(b) nucleus labelled correctly

1

electron labelled correctly

1

[3]

38 (a) water (molecules) contain two hydrogen atoms and one oxygen atom

*all water molecules have the formula H_2O for **2** marks*

*water molecules contain hydrogen and oxygen (atoms) for **1** mark*

*water is H_2O for **1** mark*

2

(b) atom A has no <u>neutrons</u> / atom B has one <u>neutron</u>

allow different numbers of <u>neutrons</u>

1

[3]

39 (i) 160 ignore units

(2 × 56) + (3 × 16) for **1** mark

2

(ii) 70

$\frac{2 \times 56}{160} (\times 100)$ *for **1** mark*

allow ecf from part (i)

2

(iii) 700

allow ecf from part (ii)

1

[5]

40 (a) carbon

accept C

1

(b) protons

1

[2]

41 (a) 100

ignore units

*40 + 12 + (3 × 16) for **1** mark*

1

(b) 40

*(**ecf** from part (a) can get **2** marks)*

$\frac{40}{\text{their (a)}} \times 100$ *for **1** mark*

1

(c) 0.5

*(**ecf** from part (b) can get **2** marks)*

$1.25 \times \left(\frac{\text{their (b)}}{100} \right)$ ***or** other correct working for **1** mark*

2

(d) gas produced **or** carbon dioxide / CO_2 produced

1

[7]

42 (a) react with oxygen / oxidise / burn in oxygen / burning / combustion **or** tungsten to tungsten oxide **or** makes an oxide

key idea is oxidation
ignore breaking ignore fire / flames / exothermic
ignore react with air

1

(b) it is (very) unreactive / not reactive / inert / does not react with tungsten **or** it is a noble gas **or** it is in group 0 or 8 or 18

*do **not** accept unreactive / inert metal **or** argon is not <u>very</u> reactive*

1

full outer shell (of electrons) / 8 electrons in outer shell

1

does not need to gain / lose / swap / transfer / share electrons **or** does not need to form bonds

does not bond ionically / covalently

1

[4]

43

(a) M_r (SiO_2) = 60

if M_r incorrect ecf for max 2

1

60 g SiO_2 → 28 g Si

*correct answer for **3** marks*

1

2.14 g SiO_2 → 1 g Si

allow 2, 2.1, 2.14 (or anything rounding to 2.14), 2.16 or 2.2

a unit is not required but an incorrect unit loses the third mark

OR M_r (SiO_2) = 60 (1)

moles if silicon needed = $\frac{1}{28}$ = 0.0357

mass of SiO_2 needed = 0.0357 × 60 (1)

= 2.14 g (1)

allow 2, 2.1, 2.14 (or anything rounding to 2.14), 2.16 or 2.2

OR M_r (SiO_2) = 60 (1)

mass SiO_2 = 1 × $\left(\frac{60}{28}\right)$ (1)

= 2.14 g (1)

allow 2, 2.1, 2.4 (or anything rounding to 2.14), 2.16 or 2.2

3

(b) (i) $MgO(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2O(l)$

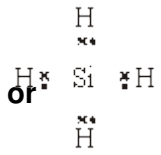
*penalise incorrect symbols correctly balanced equation for **1** mark*

*state symbols for **1** mark*

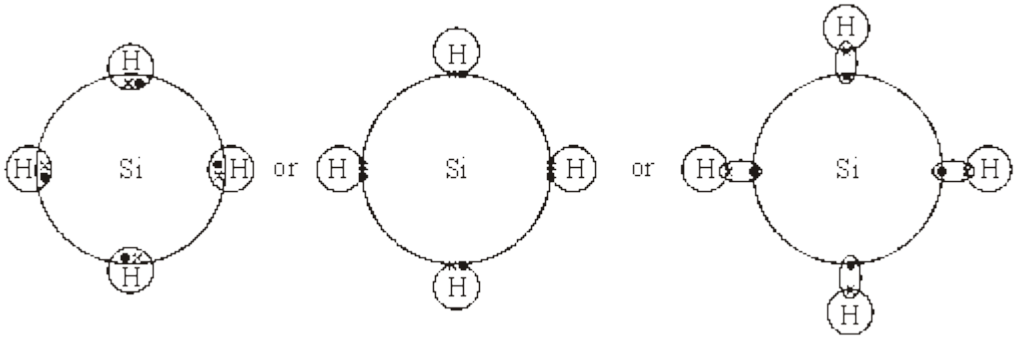
allow correct multiples / fractions

2

(ii)



or



ignore inner shell electrons of silicon
allow correct drawings without symbols
must clearly indicate four shared pairs of electrons with one electron from each atom

(iii)

Si	**H**	
$\frac{1.4}{28}$	$\frac{0.15}{1}$	**1**
= 0.05	= 0.15	**1**
1	3	

for whole number ratio can be implied **1**

SiH_3

accept H_3Si ***or*** *any correct formula with 1:3 ratio*

if in step 1 they get either of ratios incorrect they lose first 2 marks but can be ecf for 3rd and 4th mark

evidence of mass / A_r ***1*** *mark*

proportions of each ***1*** *mark*

whole number ratio ***1*** *mark*

correct formula ***1*** *mark* **1**

(iv) **C**

accept c

1

(c) any **four** from:

- giant structure / macromolecule / lattice / giant molecule

  allow giant molecular / giant atomic structure

- each silicon atom joined to four other atoms

  (or diagram)

- covalent bonds

- bonds are strong **or** large amount of energy needed to break bonds

  accept hard to break bonds

- large number of bonds to be broken

  *mention of giant **ionic** structure **or** intermolecular forces **or** intermolecular bonds max **1** mark*

  *diamond **or** carbon discussion max **3** marks unless clearly linked to silicon*

4

[15]

44 (a) nucleus

1

electron

1

(b) correct number of electrons (12)

accept dots and circles

1

2.8.2

1

[4]

45 (a) sodium
hydrogen
phosphorus
oxygen

***2** marks for all 4*
***1** mark for 2 or 3*
***0** marks for 0 or 1*
not symbols / formulae

2

(b) (i) gives out

gets hot(ter) / temperature rises (1)

1

heat / energy

independent mark

1

(ii) **Quality of written communication**

for clearly expressed ideas

1

take temperature of water at start

owtte

1

take temperature after adding soup powder

1

plus any **one** from:

- using a thermometer
- mix / stir / shake etc
- in beaker / conical flask / test tube / plastic cup
- temperature will rise (indicates an exothermic reaction)

1

[8]

46 (a) all electrons correct (inner shell need not be shown)

three bond pairs and two electrons anywhere else

can use dots, crosses or e's in any combination

1

(b) covalent

accept phonetic spelling

*do **not** accept convalent*

1

[2]

47

(a) (i) all points plotted to ± $\frac{1}{2}$ square

1

sensible line of best fit extended

could be curve
*must **not** join dots, ie zig zag*
if they draw 2 lines then lose second mark,
but can still gain marks in (a)(ii)

1

(ii) as read from their graph ± ½ square

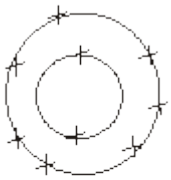
1

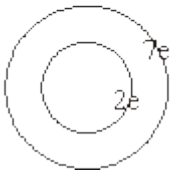
(iii) iodine **and** astatine I/I_2 At/At_2

*must give **both** 1*

1

(b) (i)





ignore symbol
ignore nucleus / lack of nucleus

accept dots / crosses etc / e / e^-
***not** 2.7 alone*

1

(ii) same number of electrons in **outer** shell **or**
seven electrons in **outer** shell (owtte)

accept missing one electron in outer shell / energy level / orbit
accept trying to gain one electron

accept they all form 1^- ions
*do **not** accept orbital / rings*

1

(c) (i) 8 electrons in outer shell **or** full outer shell / energy level

1

does not need to lose / gain / share electrons **or** don't need to form bonds

accept don't bond ionically or covalently
*they do not react is **not** enough*

1

(ii) fluorine atom is smaller / fewer shells (owtte) **or** outer shell closer to nucleus

accept answers argued in terms of iodine

1

more strongly attracted (to nucleus) **or** less shielding

accept holds electrons tighter (to the nucleus)

1

gains electron(s) more easily

accept easier to gain electrons

1

[11]

48 (i) nucleus

1

(ii) they both have seven electrons in the outer shell

accept they both have the same number of electrons in the outer shell

both need one electron to make full outer shell

1

[2]

49 (a) group seven/7VII

accept halogens

1

(b) (i) in light **bulbs**/lasers

accept any other specified use as an inert atmosphere e.g. (argon) welding, storing explosives, fluorescent lights

1

(ii) 2.8.8/has a full/8 in/outer shell

1

electrons

accept does not need to share/gain/lose electrons

1

(c) (i) any one from:

disinfectant

bleaching agent

sterilising water/kills bacteria

manufacture of HCl

water treatment

1

not: *cleaning/in pools*
purification of water
kills germs
warfare
antiseptic

(ii) inner shells 2,8

1

outer shell 7

1

(iii) fluorine:

accept the converse reasons for chlorine

gains **one**/an electron easier/is more

strongly attracted

not *more strongly held*

1

less shielding of nucleus by inner electron shells

1

less distance from (attraction of)

nucleus/less shells

1

[10]

50 (i) convection currents

accept a suitable description of convection currents

1

move the Earth's plates

accept a suitable description of 'movement' of Earth's plates

1

at plate boundary one plate or a slab of rock can be pushed down forming magma/molten rock

accept at subduction zones magma/molten rock is formed – deconstructive boundary

1

magma/molten rock rising and cooling at the Earth's surface reforms as part of the plate

accept magma/molten rock rising and cooling at the Earth's surface forms igneous rock – constructive boundary

accept Earth's crust or lithosphere for Earth's surface

1

(ii) isotopes are atoms of the same element

do not accept that isotopes have the same atomic number but a different atomic mass

1

19/the same number of protons

1

19/the same number of electrons

*do **not** penalise for incorrect*

1

20 and 21 neutrons/different numbers of neutrons

arithmetic if concept is correct

1

[8]

51 160

ignore units if answer incorrect then (2 × 56) + (3 × 16)
or
*112 + 48 for **one** mark*

[2]

52 (a) calcium atom loses two electrons

accept diagrams with correct labelling

1

(each) fluorine atom gains one electron

*accept two electrons transfer from a calcium atom to the two fluorine atoms for these first **two** marks*

1

forming full (outer) shells of electrons

*accept forming full (outer) energy levels **or** noble gas electronic structures*

*do **not** accept stable unless qualified*

1

giving the ions Ca^{2+} and F^-

1

attraction between ions of opposite charges

accept electrostatic attraction between ions

*if candidate mentions sharing **or** pairing of electrons then no credit*

*if explanation is entirely correct but they state this is called covalent bonding, the maximum mark is **four***

1

(b) atoms of the same element

1

atomic number is same

accept each contains 92 or same number of protons

1

mass numbers differ **or** each has a different number of neutrons

1

one has 146 neutrons the other has 143 neutrons

*accept one has three more **or** less neutrons than the other*

1

(c) (i) 349

1

(ii) 349g UF_2 produces 235g U [1]

first mark can be awarded if answer is incorrect

answer = 117.5

1

[12]

53 (a) (i) **all** correct **two** marks **one or two** correct **one** mark

electron
proton
neutron

2

(ii) (argon has) a full outer shell (of electrons)

accept energy level for shell

accept does not lose or gain electrons

*do **not** accept does not form bonds*
***or** react **or** is a noble **or** inert gas*

1

(b) <u>oxygen</u> would react (with metal)

accept oxygen is reactive

*do **not** accept metal would react (neutral)*

1

metal would burn

accept metal would be 'destroyed'
***or** metal oxide formed **or** metal is oxidised*

*do **not** accept it would explode **or***
would not last long

accept filament for metal

1

[5]

54 (a) made of atoms which contain the same number of protons

accept made of only one type of atom

accept cannot be broken down into anything simpler by chemical means

1

(b) non-metals

1

metals

1

(c) sodium

1

<u>too</u> reactive (with water **or** air)

*accept has a low melting point **or***
*will melt **or** not strong **or** will explode **or** will burn*

*do **not** accept dangerous (neutral)*

*do **not** accept iron as rusting **or***
*copper **or** sodium as expensive (neutral)*

*do **not** accept not a good conductor of heat*

1

[5]

55 (a) (i) low density

accept floats (on water)

1

(ii) forms an alkaline solution with water

*accept alkali (metal) **or** basic*

*do **not** accept group 1 metal*

1

(b) 3 **or** three (protons)

1

3 **or** three (electrons)

1

4 **or** four (neutrons)

1

[5]

56 (a) fractional distillation

1

boiling point or use

1

(b) (i) mixture: compounds **or** elements **or** substances together but not chemically combined

ignore references to separation

1

compound: (different) elements **or** different atoms together and chemically combined

ignore references to separation

1

(ii) element: contains only one type of atom

accept made of atoms which contain the same number of protons

1

compound: contains different types of atom chemically combined

'chemically combined' not needed here if already stated in (b)(i)

1

[6]

57 (i) same number of protons and electrons

accept equal numbers of protons and electrons

*do **not** accept they are neutral*

1

(ii) same element

accept all atoms are potassium

1

same number of protons

accept same atomic number

accept they all have 19+

1

different number of neutrons

accept different mass numbers

*do **not** accept different atomic masses*

1

[4]

58 (a) (i) H_2SO_4 **or** red (acidic) pH < 7

accept names of compounds

accept correct use of acidic

1

NaOH **or** purple (alkaline) pH > 7

*alkaline and neutral without any mention of pH for **1** mark only*

1

NaCl **or** green (neutral) pH 7

*ignore high **or** low pH*

1

(ii) hydrogen (ion)

accept proton

accept hydroxonium ion

1

H^+

accept H_3O^+ for hydroxonium ion

1

(b) (i) neutralisation

1

(ii) NaOH + HCl

ignore state symbols

1

NaCl + H_2O

ignore state symbols

*maximum of **1** mark if incorrectly balanced*

1

(c) (i) sodium – 2 . 8 . 1

accept 2.8.1 written

1

chlorine – 2 . 8 . 7

accept 2.8.7 written

1

(ii) ion(s)

1

(iii) attraction between oppositely charged particles (ions)

accept attraction between + and – particles (ions)

accept electrostatic attraction

1

(d) chloride ions lose electrons to form chlorine

$Cl^- - e^- \rightarrow Cl$

1

hydrogen ions gain electrons to form hydrogen

$H^+ + e^- \rightarrow H$

1

sodium hydroxide remains in solution

Na + and OH^- remain in solution to form sodium hydroxide

1

[15]

59 (a) (i) B

1

(ii) D

1

(b) A and B – only one type of atom

1

C and D – more than one type of atom

accept element for atom

ignore the word 'mixture'

1

(chemically) bonded

accept (chemically) joined or similar idea of joined

1

[5]

60 (a) (i) proton

1

(ii) neutron

1

(iii) nucleus

1

(b) there are shells **or** energy levels **or** orbitals

do not accept ring

1

the maximum number of electrons
found in the first shell **or** energy level is 2

accept first shell is full with 2 electrons

1

[5]