Mark schemes

Q1.

(a) non-metallic element

1

(b) compound

1

(c) noble gases

1

(d) the boiling points increase down the group

1

(e) atoms

1

(f) XO2

1

(g) (2.8)2 × 6

1

= 47.04

1

= 47 (nm2)

allow an answer correct to 2 significant figures resulting from an incorrect attempt at the calculation

1

(h) the surface area to volume ratio of the fine particle is 10 times greater

1

[10]

Q2.

(a) (atoms with the) same number of protons

allow atoms with the same atomic number

allow atoms of the same element

ignore the same number of electrons

1

(but with) different numbers of neutrons

ignore (but with) different mass numbers

do not accept (but with) different relative atomic mass

1

(b) $(A_r =) \frac{(69 \times 60) + (71 \times 40)}{100}$

1

= 69.8

1

(c) (number of electrons) = 31

1

(number of neutrons) = 38

1

(d) Ga^{3+}

1

(e) (gallium) fitted in a gap (Mendeleev had left)

1

(gallium's) properties were predicted correctly (by Mendeleev)

allow (gallium's) properties matched the rest of the group

1

[9]

Q3.

(a) electron

1

(b) plum pudding

1

(c) alpha

1

(d) Bohr

1

(e) protons

1

neutrons

1

protons (and) electrons

either order

1

(f) a sports arena of radius 100 m

1

[8]

Q4.

(a) any three from: (nuclear model)

- mostly empty space

allow the plum pudding model has no empty space
allow the plum pudding model is solid

- the positive charge is (all) in the nucleus
  allow in the plum pudding model the atom is a ball of positive charge (with embedded electrons)
  do not accept reference to protons

- the mass is concentrated in the nucleus
  allow in the plum pudding model the mass is spread out
  do not accept reference to neutrons

- the electrons and the nucleus are separate
  allow in the plum pudding model the electrons are embedded
  allow in the nuclear model the electrons are in orbits

3

(b) electrons orbit the nucleus
do not accept reference to protons / neutrons
allow electrons are in energy levels around the nucleus
or
allow electrons are in shells around the nucleus

1

electrons are at specific distances from the nucleus

1

(c) atomic number is the number of protons

1

(and) protons were not discovered until later
ignore electrons / neutrons were not discovered until later

1

(d) so their properties matched the rest of the group
allow converse

1

[8]

Q5.

(a) A nucleus

1

B electron

1

(b) electron

1

(c) 3 / three

1

(d) (atomic number) 5

1

(mass number) 11

1

(e) isotope

1

(f) there are the same number of $^{79}_{35}Br$ atoms and $^{81}_{35}Br$ atoms

1

[8]

Q6.

(a) B

1

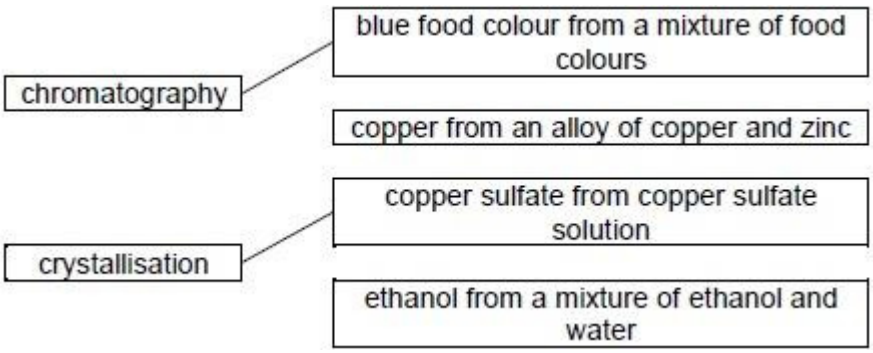
(b) D

1

(c) E

1

(d)



additional line from a box negates the mark for that box

2

(e) (filter) funnel containing filter paper

1

suitable vessel for collecting filtrate

1

sand and water labelled in correct place

1

(f) 100 °C

1

(g) any four from:

- solution is heated
- water evaporates
  allow water boils / vaporises
- the vapour cools in the condenser
- the vapour condenses
  or
  the vapour turns to a liquid
- (pure) water collects in the beaker

4

[13]

Q7.

(a) (neutron) 1 0

both needed
allow (neutron) *1* *neutral*

1

proton 1 (+1)

both needed

1

(b) number of protons plus neutrons

allow number of protons and neutrons
ignore protons and neutrons unqualified
do not accept references to mass or relative mass of protons and / or neutrons

1

(c) (the isotopes contain) different numbers of neutrons

1

(d) most (alpha) particles passed (straight) through (the gold foil)

1

(so) the mass of the atom is concentrated in the nucleus / centre
or
(so) most of the atom is empty space

1

some (alpha) particles were deflected / reflected

1

(so) the atom has a (positively) charged nucleus / centre

if not awarded for MP2 allow (so) the mass of the atom is concentrated in the

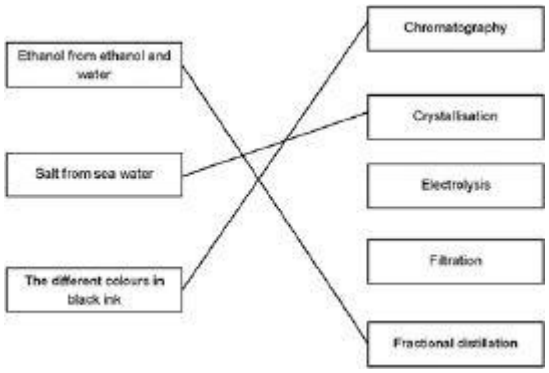
nucleus / centre.

1

[8]

Q8.

(a)



1
1
1

(b) include a (filter) funnel

allow funnel drawn on the diagram
ignore clamp stand

1

(c) evaporate

1

condense

1

must be this order

(d) $\frac{2}{20} \times 100$

1

= 10 (%)

1

an answer of 10 (%) scores 2 marks
an answer of 11.1(%) or 90 (%) scores 1 mark

(e) an alloy

1

(f) the layers in the mixture are distorted

1

(g) 8000 nm3

1

[11]

Q9.

(a) nucleus

1

neutron

1

neutron

1

electron

1

proton

1

must be in this order

(b) $(A_r)\ \frac{(63 \times 70) + (65 \times 30)}{100}$

1

= 63.6

1

an answer of 63.6 scores 2 marks

(c) copper / Cu

allow ecf from answer to question (b)

1

(d) $\frac{1.2 \times 10^{-10}}{10\,000}$

or

$1.2 \times 10^{-10} \times 1 \times 10^{-4}$

1

$= 1.2 \times 10^{-14}$ (m)

1

an answer of 1.2 × 10−14 (m) scores 2 marks
a correct answer not in standard form scores 1 mark

[10]

Q10.

(a) B

1

(b) C

1

(c) A

1

(d) sum of protons and neutrons

allow number of protons and neutrons

1

(e) between 69.5 and 70.0

1

(f) Chadwick provided the evidence to show the existence of neutrons

allow Chadwick discovered neutrons

1

(this was necessary because) isotopes have the same number of protons

allow (this was necessary because) isotopes have the same atomic number

or
(this was necessary because) isotopes are atoms of the same element

ignore isotopes have the same number of electrons

1

but with different numbers of neutrons

allow but with different mass (numbers)

1

[8]

Q11.

(a) proton

1

(b) electron

1

(c) 7

1

4

1

in this order only

(d) isotopes

1

(e) neutron

1

(f) $\frac{(10 \times 20) + (11 \times 80)}{100}$

1

= 10.8

1

an answer of 10.8 scores 2 marks

(g) $\frac{0.2}{10000}$

1

$= 2 \times 10^{-5}$ (nm)

allow 0.00002 (nm)

1

an answer of 2 × 10−5 (nm) scores 2 marks

[10]

Q12.

(a) mass number

allow the number of protons + neutrons

1

(b) 6.02×10^{23}

1

(c) Level 2 (3-4 marks):
Scientifically relevant features are identified; the ways in which they are similar / different is made clear.
Level 1 (1-2 marks):

Relevant features are identified and differences noted.
Level 0

No relevant content.

Indicative content

similarities

- both have positive charges
- both have (negative) electrons
- neither has neutrons

differences

plum pudding model	nuclear model
ball of positive charge (spread throughout)	positive charge concentrated at the centre
electrons spread throughout (embedded in the ball of positive charge)	electrons outside the nucleus
no empty space in the atom	most of the atom is empty space
mass spread throughout	mass concentrated at the centre

4

(d) $\frac{(24 \times 78.6) + (25 \times 0.1) + (26 \times 11.3)}{100}$

or
(24 × 0.786) + (25 × 0.101) +
(26 × 0.113)

1

= 24.3

1

an answer of 24.3 scores 2 marks

[8]

Q13.

(a) B

1

(b) D

1

(c) E

1

(d) C

1

(e) 92.5 × 6 and
7× 7.5

1

$\frac{607.5}{100}$

1

6.075

1

6.08

1

allow 6.08 with no working shown for 4 marks

[8]

Q14.

(a) 13 (protons)

The answers must be in the correct order.
if no other marks awarded, award 1 mark if number of protons and electrons are equal

1

14 (neutrons)

1

13 (electrons)

1

(b) has three electrons in outer energy level / shell

allow electronic structure is 2.8.3

1

(c) Level 3 (5–6 marks):
A detailed and coherent comparison is given, which demonstrates a broad knowledge and understanding of the key scientific ideas. The response makes logical links between the points raised and uses sufficient examples to support these links.

Level 2 (3–4 marks):

A description is given which demonstrates a reasonable knowledge and understanding of the key scientific ideas. Comparisons are made but may not be fully articulated and / or precise.

Level 1 (1–2 marks):

Simple statements are made which demonstrate a basic knowledge of some of the relevant ideas. The response may fail to make comparisons between the points raised.

0 marks:

No relevant content.

Indicative content

Physical

Transition elements

- high melting points
- high densities
- strong
- hard

Group 1

- low melting points
- low densities
- soft
-

Chemical

Transition elements

- low reactivity / react slowly (with water or oxygen)
- used as catalysts
- ions with different charges
- coloured compounds

Group 1

- very reactive / react (quickly) with water / non-metals
- not used as catalysts
- white / colourless compounds
- only forms a +1 ion
-
-

6

[10]

Q15.

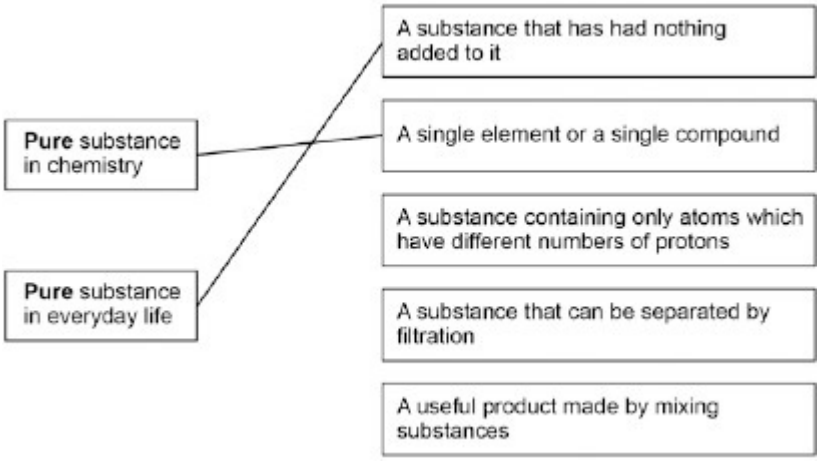
(a) Air

2

Steel

1

(b)



Allow 1 mark for the correct meanings linked to context but incorrect way around

1

(c) Damp litmus paper turns white

1

(d) Iron(III)

1

[6]

Q16.

(a) (i) 7

1

(ii) –1

1

(iii) neutrons

1

(b) number of protons

1

(c) atom Y

1

(d) (i) Ne

allow neon

1

(ii) has a full outer shell

allow in Group 0
allow a noble gas

or

full outer energy level

allow the shells are full

or

has 8 electrons in its outer shell

ignore in Group 8

1

[7]

Q17.

(a) (i) electronic structure 2,3 drawn

allow any representation of electrons, such as, dots, crosses, or numbers (2,3)

1

(ii) nucleus

1

(iii) protons and neutrons

do not allow electrons in nucleus

1

(relative charge of proton) +1

allow positive

1

(relative charge of neutron) 0

allow no charge/neutral ignore

1

number of particles

(b) too many electrons in the first energy level or inner shell

allow inner shell can only have a maximum of 2 electrons

1

too few electrons in the second energy level or outer shell

allow neon has 8 electrons in its outer shell or neon does not have 1 electron in its outer shell

allow neon has a stable arrangement of electrons or a full outer shell

1

neon does not have 9 electrons or neon has 10 electrons

allow one electron missing

allow fluorine has 9 electrons

1

ignore second shell can hold (maximum) 8 electrons or 2,8,8 rule or is a noble gas or in Group 0

max 2 marks if the wrong particle, such as atoms instead of electrons

if no other mark awarded allow 1 mark for the electronic structure of neon is 2,8

[8]

Q18.

(a) (i) 7 / seven

1

(ii) 1

do not accept –1

1

Electron

1

(iii) isotopes

1

(b) (i) (sodium +) fluorine → sodium fluoride

1

(ii) compounds

1

(iii) mole

1

(iv) sodium (atom) loses

1

fluorine (atom) gains

1

one electron

1

ions formed

1

allow sodium forms positive (ion) or fluorine forms negative (ion)
allow form ionic bond
allow to gain a full outer shell of electrons
allow forms noble gas structure
max 3 if reference to incorrect particle / bonding

(v) Dissolve in water

1

High melting point

1

[13]

Q19.

(a) (i) (mass number = 16) because there are 8 protons and 8 neutrons (in the nucleus)

accept mass number is total number of protons and neutrons for 1 mark

2

(ii) same number of protons or both have 6 protons

accept same atomic number

1

^{12}C has 6 neutrons

1

^{14}C has 8 neutrons

1

accept different number of neutrons for 1 mark
numbers, if given, must be correct
incorrect reference to electrons = max 2 marks

(b) (i) 2 bonding pairs

1

additional unbonded electrons negates this mark

4 unbonded electrons around oxygen

1

accept dot, cross or e or – or any combination

(ii) covalent

1

(iii) any one from:
- no delocalised / free electrons
- *ignore mobile electrons*
- no overall electric charge
accept no charge (carriers)
no ions

1

do not accept any implications of the presence of ions

(c) (i) larger

accept the size of a few hundred atoms
accept atoms are smaller (than nanoparticles)
allow up to 1000 atoms)

1

(ii) (nanoparticles have) large(r) surface area

1

[11]