

- 1 (a) explanation of evaporation e.g. particles (or molecules) with a lot of energy leave the liquid / bromine particles break free from each other / forces or bonds between bromine molecules broken / molecules (in liquid) have weak forces holding them together / weak intermolecular forces / Van der Waals forces between molecules (don't have to be stated as weak) / (weak intermolecular forces alone scores this mark);
- allow:** particles (or molecules) of bromine escape from liquid [1]
- diffusion / diffuse / movement of particles; [1]
- explanation of diffusion involving qualified movement of molecules / particles i.e. random movement of molecules / particles move in all direction [1]
- (b) air more dense / heavier / higher  $M_r$  than hydrogen; [1]  
hydrogen diffuses faster (than air diffuses out); [1]  
**accept:** diffusion in is faster than out (without naming gases)  
pressure inside pot is greater (than outside); [1]  
air less dense / lighter / lower  $M_r$  than carbon dioxide; [1]
- air diffuses / moves faster (than carbon dioxide); [1]  
**accept:** diffusion out is faster than in (without naming gases)
- pressure inside pot less (than outside); [1]
- ORA in both parts

[Total: 9]

- 2 (a) 27p 32n 27e [1]  
27p 32n 25e [1]
- (b) (i) same proton number / same number of protons / same atomic number [1]  
different nucleon number / different number of neutrons / different mass number [1]
- (ii) same electron distribution [1]  
**allow:** same proton number and same number of electrons  
**not:** same number of electrons / same number of shells
- (iii) industrial detection of leaks / thickness of paper etc. / nuclear fuel for generating  
electricity / nuclear weapons / radiographs of welds / measuring wear / sterilising food [1]  
**not:** carbon dating
- medical treatment of cancer, radiotherapy, treatment of thyroid gland, X rays, tracer  
studies in body, sterilising equipment, locating tumours  
**accept:** X-rays only once [1]

- 3 (a) E [1]
- (b) A C E need all three [1]
- (c) A [1]
- (d) F [1]
- (e) C [1]
- (f) D F need both but not more [1]

**[Total: 6]**

- 4 (a) (i) 6e between two nitrogen atoms (can be any combination of dots or crosses) [1]  
 1 lone pair on each nitrogen atom [1]
- (ii)
- |          | SOLID                                 | GAS                             |     |
|----------|---------------------------------------|---------------------------------|-----|
| PATTERN  | regular / lattice ( <b>not</b> fixed) | random / irregular / no pattern | [1] |
| DISTANCE | close                                 | far apart / spread out          | [1] |
| MOVEMENT | vibrate / fixed / no motion           | moving / translational          | [1] |
- (b) (i) **particles/molecules** have more energy / move faster [1]  
 collide harder / collide more frequently / more collisions / collide with more force (with the walls) [1]
- (ii) (1) nitrogen has smaller  $M_r$  / lighter molecules / lower density [1]  
 nitrogen **molecules** / **particles** move faster (than chlorine molecules) [1]
- (2) at higher temperature nitrogen **molecules or particles** (not atoms) move faster / have more energy [1]

[Total: 10]

- 5 (a) (i) darker **or** actual colours [1]  
 chlorine yellow, yellow/green  
 bromine orange, brown, brownish red  
 iodine black grey, purple
- (ii) gas, liquid, solid [1]  
 all three needed
- (iii) colourless **or** (pale) yellow [1]  
 gas [1]
- (b) Must have a correct reagent otherwise wc = 0
- add chlorine water **or** bubble in chlorine gas [1]  
 yellow **or** orange **or** brown [1]  
 dark brown **or** grey crystals  
 (**Accept** colour that is darker than for bromide) [1]
- OR** add (acidified) silver nitrate(aq) [1]  
 off white **or** pale yellow **or** cream precipitate **or** soluble in aqueous ammonia [1]  
 yellow precipitate insoluble in aqueous ammonia [1]  
 precipitate essential then either colour **or** solubility in aqueous ammonia
- OR** add lead nitrate(aq) [1]  
 pale yellow **or** off white **or** cream precipitate [1]  
 yellow precipitate insoluble in aqueous ammonia [1]
- Accept** any test that could work – electrolysis, iron(III) salt  
 bromine, potassium dichromate, potassium manganate(VII) etc.
- (c)  $I_2 + 3Cl_2 = 2ICl_3$  [2]  
 For having either reactants **or** products correct ONLY [1]
- (d) chlorine [1]  
**COND** lower  $M_r$  **or** lower density **or** lighter molecules **or** molecules move faster [2]
- OR** lighter **or** based on  $A_r$  MAX [1]  
 smaller with no additional comment **or** sieve idea [0]  
**N.B.** a total of [3] not [2]

**TOTAL = 12**

- 6 (a) Group II metals will lose 2e [1]  
Group VI elements will gain 2e [1]
- (b)  $SCl_2$  [1]  
**COND** 8e around both chlorine atoms [1]  
8e around sulphur with 2nbp and 2bp [1]  
If x and o reversed ignore if this is the only error
- (c) Ions cannot move in solid **or** can move in liquid [1]
- (ii) No ions in sulphur chloride **or** it is covalent **or** only molecules **or** only strontium chloride has ions [1]

**TOTAL = 7**