**A. States of matter**

1. Explain why different substances have different melting points. (2)

***Strength of attractive forces between particles varies in different substances, [1] stronger forces of attraction → higher melting points [1]***

1. Describe the general properties of solids, liquids and gases, including the arrangement and movement of particles. (4)

***SOLID: fixed shape, incompressible, touching particles, regular pattern, vibrate on the spot***

***LIQUID: no fixed shape, very difficult to compress, most particles are touching, irregular and random arrangement, particles slip and slide over each other***

***GAS: no fixed shape, spreads out to fill a container, easily compressed, particles cover large distances, irregular pattern, move very quickly, move randomly***

***1 mark– correct arrangement***

***1 mark – correct movement***

***2 marks – any other correct statements***

1. **Extended response question:**

A gas is cooled down to a temperature below its freezing point. Describe what happens to particles during changes of state. (6)

* ***Level 3 (5-6 marks)***

***explanation of two changes of state using both particle arrangement and movement***

* ***Level 2 (3-4 marks)***

***explanation of one change of state using both particle arrangement and movement OR two changes of state using either particle arrangement OR movement***

* ***Level 1 (1-2 marks)***

***explanation of one change of state using either particle arrangement OR movement***

***Chemistry points:***

* ***as particles cool, average speed decreases***
* ***particles become much closer together at condensation point,***
* ***form liquid where particles move randomly, slipping over and around each other.***
* ***As liquid cools average speed of particles decreases***
* ***at freezing point particles remain in fixed positions,***
* ***vibrating,***
* ***vibrations decrease as solid cools.***
1. Evaporation is the change of state that occurs when some liquid changes into a gas. Many factors can affect the rate of evaporation. Plan an investigation into one factor that might affect the rate of evaporation using wet cotton wool and a high resolution digital balance. (5)

***Varying one factor, [1] e.g. temperature of water or surface area of paper towel, keeping all other variables constant, [1] monitor rate of evaporation by measuring mass of wet paper towel [1] on electric balance at regular time intervals [1] then calculate the difference/loss of mass from the paper towel [1]***

1. Predict the physical state of the following substances at 25oC. (4)

|  |  |  |  |
| --- | --- | --- | --- |
| Substance | Boiling point | Melting point | State at 25oC |
| Chloroform | 61.2 | -63.5 | ***Liquid*** |
| Cobalt | 2,870 | 1,495 | ***Solid*** |
| Phosphorus | 280.5 | 44.2 | ***Solid*** |
| Propane | -42 | -188 | ***Gas*** |

**B. Pure substances**

1. A student carried out an experiment in which they measured the temperature of two substances whilst they were heated. During the experiment both substances melted.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Time in seconds | 0 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 |
| Temperature of substance A OC | 30 | 35 | 39 | 40 | 40 | 40 | 40 | 44 | 49 | 54 | 59 |
| Temperature of substance B OC | 30 | 35 | 37 | 39 | 40 | 42 | 44 | 46 | 49 | 54 | 59 |

What can be concluded about each chemical from the results the student obtained? Explain your answer. (4)

 ***Substance A – pure [1]; temperature remained constant between 15oC and 30oC [1]***

***Substance B – not pure [1]; temperature gradually increased throughout [1]***

2. Why would a scientist not describe “pure milk” as pure? (2)

 ***It is not a single element or compound [1] it is mixed with other substances [1]***

**C. Separating techniques and chromatography**

1. What is a mixture? (2)

***Two or more substances (elements or compounds) [1] not chemically combined [1]***

1. Explain how the process of distillation can be used to remove dissolved impurities from a sample of water. (4)

***Heat water in flask attached to condenser. [1] Steam moves into condenser. [1] Pure water condenses and is collected in beaker. [1] Solid impurities left in flask. [1]***

1. **Extended response question:**

Sulfur is soluble in the flammable liquid xylene but not in water. Sodium nitrate is soluble in water but not xylene. Describe and explain two ways to separate a mixture of sulfur powder and sodium nitrate to collect pure samples of each solid. (6)

* ***Level 3 (5-6 marks)***

***TWO methods described AND explained.***

* ***Level 2 (3-4 marks)***

***ONE method described AND explained.***

* ***Level 1 (1-2 marks)***

***ONE method, but insufficient explanation.***

***Method A – any three from: add water to mixture, [1] stir and filter, [1] S insoluble in water so left as residue on filter paper, [1] wash S with distilled water to remove impurities then leave to dry***

***[1] evaporate NaNO3 solution [1] by heating on water bath until point of crystallisation, [1] leave to dry, crystallising NaNO3 [1]***

***Method B – any three from: add xylene to mixture, [1] stir and filter, [1] NaNO3 insoluble in xylene so left as residue on filter paper, [1] wash NaNO3 with xylene and leave to dry, [1] evaporate xylene from filtrate of S solution [1] by warming on water bath (electrically heated / no naked flame [1]) in fume cupboard to crystallise S [1]***

1. A mixture of inks is thought to contain three pure inks. The colours of these inks are red, green and blue. Describe, using a diagram, how a student could prove this. (4)

***A diagram and explanation to show – one spot of ink [1] near bottom of chromatography paper, [1] place in solvent, [1] allow solvent to soak up the paper, past ink, to (3) separate dyes. [1]***

**D. Waste, ground water and sea water treatment**

1. The two graphs below show the temperature as two samples of ice are heated until they melt. Which of these samples A or B is most likely to show potable water? Explain your choice. (3)

**A** **B**



***Sample B [1] potable water is not pure [1] so does not have a single melting point [1]***

1. **Extended response question:**

Describe and explain the stages used in the production of potable water from ground water. (6)

|  |  |  |  |
| --- | --- | --- | --- |
| ***0 marks***  | ***Level 1 (1–2 marks)***  | ***Level 2 (3–4 marks)***  | ***Level 3 (5–6 marks)***  |
| ***No relevant content***  | ***An appropriate choice of fresh water [1]*** ***Reduces the amount of treatment needed [1]******OR*** ***Passing the water through treatment beds [1]******Removes larger insoluble matter [1]******OR*** ***sterilising [1]******kills any remaining bacteria [1]*** | ***Two of the relevant pieces of information.*** | ***All three relevant pieces of information.***  |

1. **Extended response question:**

Describe the most common methods of producing potable water from salty water and explain why this method is not used in areas with adequate supplies of ground water. (6)

|  |  |  |  |
| --- | --- | --- | --- |
| ***0 marks***  | ***Level 1 (1–2 marks)***  | ***Level 2 (3–4 marks)***  | ***Level 3 (5–6 marks)***  |
| ***No relevant content***  | ***Distillation [1]*** ***Water is evaporated and condensed [1]******OR*** ***Desalination requires large amount of energy/purification of ground water requires far less energy [2]*** | ***Two of the relevant pieces of information.*** | ***All relevant pieces of information.***  |

1. Describe the similarities and differences between the processing of sewage, agricultural and industrial waste water. (4)

***All [1] require the removal of organic matter [1]***

***Sewage and agricultural waste [1] require the removal of harmful microbes [1]/ industrial waste [1] requires the removal of harmful chemicals [1]***

1. Give the stages in the treatment of sewage. (3)

 ***Sedimentation to remove the sediment [1]***

 ***Filtration to remove larger objects [1]***

 ***Chlorination to kill pathogens/ bacteria [1]***