Mark schemes

(a) nanotubes can slide (over each other)
   allow nanotubes can roll (over each other)
   because no (covalent) bonds between the nanotubes
   accept weak forces between the nanotubes or weak intermolecular forces
   allow layers for nanotubes throughout

(b) delocalised electrons
   accept free electrons
   so (delocalised) electrons can move through the graphite
   accept so (delocalised) electrons can carry charge through the graphite

[4]
(a) (i) any two from:

- ignore any conclusion drawn referring to data below 7.5 nm or above 20 nm
- 100% of (type 1 and type 2) bacteria are killed with a particle size of 7.5 to 8.5 nm
- accept nanoparticles in the range of 7.5 to 8.5 nm are most effective at killing (type 1 and type 2) bacteria
- as the size increases (beyond 8.5 nm), nanoparticles are less effective at killing (type 1 and type 2) bacteria
- type 1 shows a linear relationship or type 2 is non-linear
- type 1 bacteria more susceptible than type 2 (at all sizes of nanoparticles shown on the graph)
  allow type 2 bacteria are harder to kill

(ii) (yes) because you could confirm the pattern that has been observed

- allow would reduce the effect of anomalous points / random errors
- allow would give better line of best fit
- ignore references to reliability / precision / accuracy / reproducibility / repeatability / validity

  or

  (no) because trend / conclusion is already clear

(b) magnesium loses electron(s)

- oxygen gains electron(s)

- two electrons (per atom)

- gives full outer shells (of electrons) or eight electrons in highest energy level
  reference to incorrect particles or incorrect bonding or incorrect structure = max 3

  or

- (electrostatic) attraction between ions or forms ionic bonds

  accept noble gas structure
(a) weaker bonds

allow (other substances) react with the silicon dioxide

or

fewer bonds

ignore weaker / fewer forces

or

disruption to lattice

do not accept reference to intermolecular forces / bonds

(b) (i) Na₂O

do not accept brackets or charges in the formula

(ii) lone pairs on each oxygen

accept 4 non-bonding electrons on each oxygen

(c) lattice / regular pattern / layers / giant structure / close-packed arrangement

(of) positive ions or (of) atoms

(with) delocalised / free electrons

reference to incorrect particles or incorrect bonding or incorrect structure = max 2

(a) four

covalent
(b) because it has a high melting point
   accept it won't melt
   accept it won't decompose or react
   allow withstand high temperatures
   ignore boiling point

(c) thin

(a) exothermic

(b) ‘Should people use kelp instead of oil as an energy source?’
   ‘Will kelp be more popular than coal in the next 10 years?’

(c) (i) any four from:
   If atom or ion omitted = max 3
   sharing / covalent / metallic
   = max 3
   ignore reference to full outer shells
   • potassium (atom) loses (an electron) and iodine (atom) gains (an electron)
   • 1 electron
   • iodide (ion) has negative charge
      allow iodine ion
   • potassium (ion) has positive charge
   • electrostatic attraction or ionic bonding
      accept stable (structure) or noble gas (structure)

(ii) because a solid is formed (from two aqueous solutions)

(iii) filtering or centrifuging or decanting

(a) would melt
    accept they have a low melting point
    allow lose their shape
    ignore would soften when hot
    ignore boiling point
(b) to speed up the reaction
   accept can use a lower temperature
   accept less energy needed

(c) (i) mass spectrometer
    allow mass spectroscopy

   (ii) any one from:
        ignore reliable
        ignore more precise
        • accurate
        • sensitive
        • rapid / quicker
        • small amount of sample

(d) any two from:
    allow concentration
    • pressure
    • temperature
    • catalyst or initiator
    • solvent

(a) (i) because they are positively charged
    accept they are positive / $H^+$
    accept oppositely charged or opposites attract
    ignore they are attracted

   (ii) gains one / an electron
        accept $H^+ + e^- \rightarrow H$ or multiples
        allow gains electrons

(b) 3 bonding pairs
    1 lone pair
    accept 2 non-bonding electrons on outer shell of nitrogen
(c) (i) hydroxide / OH$^-$

*do not accept sodium hydroxide*

(ii) $\text{H}^+ + \text{OH}^- \rightarrow \text{H}_2\text{O}$

*ignore state symbols*

*ignore word equation*

(d) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information in the Reference material.

0 marks
No relevant content.

Level 1 (1-2 marks)
There are basic descriptions of advantages or disadvantages of the electrolysis cells.

Level 2 (3-4 marks)
There are clear descriptions of environmental or economic advantages or disadvantages of the electrolysis cells. Comparisons may be implied.

Level 3 (5-6 marks)
There are detailed descriptions of environmental and economic advantages and disadvantages, comparing the electrolysis cells.

Examples of chemistry points made in the response:

Accept converse where appropriate.

- mercury cell is more expensive to construct
- mercury is recycled but membranes must be replaced
- mercury is toxic but membrane / polymer is not
- removing traces of mercury from waste is expensive
- mercury cell uses more electricity
- mercury cell produces chlorine that is purer
- mercury cell produces higher concentration / better quality of sodium hydroxide (solution)

(a) Will kelp last longer than coal as an energy source?
(b) any two from:

• cannot be determined by experiment
  
  allow can’t predict how long kelp / coal will last
  allow more testing needed

• based on opinion

• ethical or environmental or economic reason
  
  allow could damage ecosystem allow reference to cost

(c) (i) 7

(ii) sodium (atom) loses (electron) and iodine (atom) gains (an electron)

  reference to incorrect bonding or incorrectly named particle
  
  = max 2

  any or all marks can be obtained from a labelled diagram
  ignore inner shell electrons if shown

  1 electron

  (electrostatic) attraction or forms ionic bond(s)

(iii) ions can move (in the solution)

(iv) \[ 2 \text{I}^- \rightarrow \text{I}_2 + 2 \text{e}^- \]

(v) hydrogen is formed

  because sodium is more reactive (than hydrogen)

  [11]

9 high melting point

  reference to incorrect bonding or incorrect particles or incorrect structure = max 3

  accept will not melt (at high temperatures)

  ignore withstand high temperatures

  because a lot of energy needed to break bonds

  because it is covalent or has strong bonds

  accept bonds are hard to break
and because it is a giant structure or a macromolecule or a lattice

ignore many bonds