**M1.**(a)     (i)      Z

**1**

(ii)     X

**1**

(b)     (i)      moving randomly

**1**

(ii)     stronger than

**1**

(c)     (i)      evaporation

**1**

(ii)     any **one** from:

•         becomes windy

•         temperature increases

*accept (becomes) sunny“the sun” alone is insufficient*

•         less humid

**1**

**[6]**

**M2.**(a)    there are strong forces (of attraction) between the particles in a solid

*accept molecules / atoms for particles throughout
accept bonds for forces*

**1**

(holding) the particles close together

*particles in a solid are less spread out is insufficient*

**1**

**or**

(holding) the particles in a fixed pattern / positions

but in a gas the forces between the particles are negligible

*accept very small / zero for negligible
accept bonds for forces*

**1**

so the particles spread out (to fill their container)

*accept particles are not close together
gas particles are not in a fixed position is insufficient*

**1**

(b)     (i)      particles are (shown) leaving (the liquid / container)

*accept molecules / atoms for particles throughout*

*accept particles are escapingparticles are getting further apart is insufficient*

**1**

(ii)                *accept molecules / atoms for particles throughout
          accept speed / velocity for energy throughout*

particles with most energy leave the (surface of the) liquid

*accept fastest particles leave the liquid*

**1**

so the mean / average energy of the remaining particles goes down

**1**

and the lower the average energy (of the particles) the lower the temperature (of the liquid)

**1**

**[8]**

**M3.**(a)     (black) is a good absorber of (infrared) radiation

**1**

(b)     (i)      amount of energy required to change (the state of a substance) from solid to liquid (with no change in temperature)

*melt is insufficient*

**1**

unit mass / 1kg

**1**

(ii)     5.1 × 106 (J)

*accept 5 x 106*

*allow* ***1*** *mark for correct substitution ie E = 15 × 3.4 × 105*

**2**

(c)     (i)      mass of *ice*

*allow volume / weight / amount / quantity of ice*

**1**

(ii)     to distribute the salt throughout the ice

**1**

to keep all the ice at the same temperature

**1**

(iii)    melting point decreases as the mass of salt is increased

*allow concentration for mass*

*accept negative correlation*

*do* ***not*** *accept inversely proportional*

**1**

(d)     60 000 (J)

*accept 60 KJ*

*allow* ***2*** *marks for correct substitution ie E = 500 × 2.0 × 60*

*allow* ***2*** *marks for an answer of 1000* ***or*** *60*

*allow* ***1*** *mark for correct substitution ie*

*E = 500 × 2.0* ***or*** *0.50 × 2.0 × 60*

*allow* ***1*** *mark for an answer of 1*

**3**

(e)     Marks awarded for this answer will be determined by the Quality of Communication (QC) as well as the standard of the scientific response. Examiners should also apply a ‘best-fit’ approach to the marking.

**0 marks**

No relevant content

**Level 1 (1–2 marks)**

There is *an attempt at a description of some advantages or disadvantages.*

**Level 2 (3–4 marks)**

*There is a basic description* of *some advantages* ***and / or*** *disadvantages for some of the methods*

**Level 3 (5–6 marks)**

There is a clear description of the advantages and disadvantages of all the methods.

**examples of the points made in the response**

***extra information***

**energy storage**

advantages:

•        no fuel costs

•        no environmental effects

disadvantages:

•        expensive to set up and maintain

•        need to dig deep under road

•        dependent on (summer) weather

•        digging up earth and disrupting habitats

**salt spreading**

advantages:

•        easily available

•        cheap

disadvantages:

•        can damage trees / plants / drinking water / cars

•        needs to be cleaned away

**undersoil heating**

advantages:

•        not dependent on weather

•        can be switched on and off

disadvantages:

•        costly

•        bad for environment

**6**

**[18]**

 **M4.**(a)     dependent

**1**

(b)     (probe) C

*allow 103.2*

**1**

largest difference between reading and actual temperature

*reason only scores if C chosen*

*accept larger*

*it is 3.2 greater is insufficient*

*comparing C with only one other probe is insufficient*

**1**

(c)     (i)      12(°C)

*accept a value between 12.0 and 12.2 inclusive*

**1**

(ii)     140 (seconds)

*accept an answer between 130 and 150 inclusive*

**1**

temperature starts to rise

*only scores if time mark awarded*

*accept the temperature was lowest (at this time)*

**1**

(iii)     increase

*accept faster (rate)*

**1**

**[7]**

**M5.**(a)     Student A’s measurements had a higher resolution

**1**

Student B was more likely to misread the temperature

**1**

(b)     a random error

**1**

(c)     8.4 °C

**1**

(d)     740 (seconds)

*allow answers in the range 730 – 780*

**1**

(e)     0.40 × 199 000

**1**

79 600 (J)

**1**

*accept 79 600 (J) with no working shown for* ***2*** *marks*

(f)     stearic acid has a higher temperature than the surroundings

*accept stearic acid is hotter than the surroundings*

**1**

temperature will decrease until stearic acid is the same as the room temperature / surroundings

**1**

**[9]**

**M6.**(a)     range of speeds

**1**

moving in different directions

*accept random motion*

**1**

(b)     internal energy

**1**

(c)     density = mass / volume

**1**

(d)     0.00254 / 0.0141

**1**

0.18

**1**

*accept 0.18 with no working shown for the* ***2*** *calculation marks*

kg / m3

**1**

**[7]**

**M7.Level 3 (5–6 marks):**

Clear and coherent description of both methods including equation needed to calculate density. Steps are logically ordered and could be followed by someone else to obtain valid results.

**Level 2 (3–4 marks):**

Clear description of one method to measure density **or** partial description of both methods. Steps may not be logically ordered.

**Level 1 (1–2 marks):**

Basic description of measurements needed with no indication of how to use them.

**0 marks:**

No relevant content.

**Indicative content**

**For both:**

•        measure mass using a balance

•        calculate density using ρ = m / V

**Metal cube:**

•        measure length of cube’s sides using a ruler

•        calculate volume

**Small statue:**

•        immerse in water

•        measure volume / mass of water displaced

•        volume of water displaced = volume of small statue

**[6]**