Mark schemes

Q1.

(a) line of best fit using the first five points

*max **1** mark if the lines do not intersect*

1

line of best fit using the last four points

1

(b) the temperature rises because the reaction is exothermic
or
the temperature rises because energy is transferred to the surroundings

allow heat for energy

1

until 0.8 g (zinc) is added

allow a tolerance of ± ½ a small square

allow until the temperature reaches 47 °C

allow a correctly determined value for mass of zinc or temperature from the intersection of drawn lines of best fit

1

(so) there is no additional reaction

allow (when) the reaction has finished

1

(because) zinc is in excess
or
(because) copper sulfate is used up

1

(c) polystyrene is a better (thermal) insulator

allow converse statements for glass

1

(so) there is less energy transfer to the surroundings

allow (so) less energy is lost (to the surroundings)

allow heat for energy

1

(d) $Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$

allow **1** mark for $Zn^{2+} + Cu$

2

(e)

(mean highest temperature =)
$$\frac{37.6 + 37.2 + 37.8 + 37.4}{4}$$

allow

(mean highest temperature =) $\frac{150}{4}$

1

= 37.5 (ºC)

1

37.5 (ºC) ± 0.3 (ºC)

1

(f) any **one** from:

- starting temperature may be different
  ignore room temperature
- inconsistent stirring
  allow inconsistent use of a lid

1

[14]

Q2.

(a) propane is a small molecule

allow propane is a simple molecule

1

(so) the forces between molecules are weak
or
(so) the intermolecular forces are weak

*do **not** accept covalent bonds are weak*

1

(which) require little energy to overcome

*do **not** accept answers in terms of breaking covalent bonds*

1

(b) **B**

1

(c) (bonds broken =
2(347) + 8**X** + 5(498) =)
3184 + 8**X**

1

(bonds made =
6(805) + 8(464) =)
8542

1

(energy released = bonds made – bonds broken =)
2219 = 8542 – (3184 + 8**X**)

allow correct use of incorrectly determined values of bonds broken and/or bonds made

1

(8**X** =) 3139 (kJ/mol)

allow correct evaluation of the expression

energy released =

bonds broken – bonds made

1

(**X** =) 392 (kJ/mol)

allow 392.375 correctly rounded to at least 3 significant figures

*allow correct use of an incorrectly determined value for 8**X***

1

[9]

Q3.

(a) 436 + 346 - (2 × 432) kJ/mol

1

(b) energy is needed to break bonds
and
energy is released when bonds form

1

(and) the energy released is greater than the energy needed

allow the energy transferred in bond making is greater than the energy transferred in bond breaking

allow 2 x 432 (kJ/mol) is greater than 436 + 346 (kJ/mol)

allow the overall energy change is negative

1

(c) profile completed with product energy below reactant energy

1

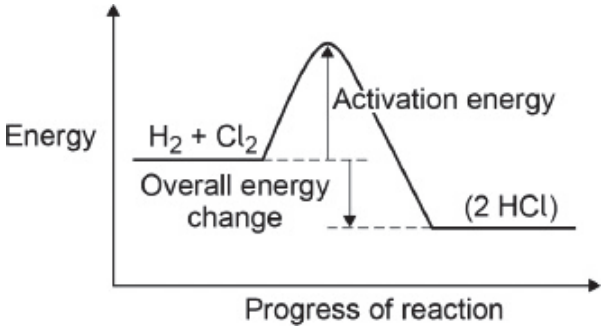
activation energy labelled from reactant energy to top of curve

1

overall energy change labelled from reactant energy to product energy

1

an answer of



scores **3** marks

ignore arrow heads

(d) bonded pair of electrons in the overlap

*allow any combination of x, o, $e^{(-)}$, * for electrons*

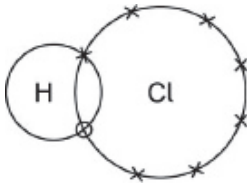
*do **not** accept molecules containing more than 2 atoms*

1

chlorine with 6 non-bonded electrons

*do **not** accept if extra electrons on H*

an answer of



*scores **2** marks*

or

an answer of

*scores **2** marks*

1

(e) (methane)

methane has (much) smaller molecules

1

(so) has weaker intermolecular forces

*do **not** accept reference to weak(er) covalent bonds*

1

(so the intermolecular forces) need less energy to overcome

*do **not** accept reference to breaking covalent bonds*

1

(so) the boiling / melting point is lower (and methane is a gas)

1

OR

(poly(ethene))

poly(ethene) has (much) larger molecules (1)

(so) has stronger intermolecular forces (1)

*do **not** accept reference to weak(er) covalent bonds*

(so the intermolecular forces) need more energy to break (1)

*do **not** accept reference to breaking covalent bonds*

(so) the melting / boiling point is higher (and poly(ethene) is a solid) (1)

[12]