For Examiner's Use

1 **FB 1** is zinc powder, Zn.

FB 2 is 0.8 mol dm^{-3} copper sulphate, $CuSO_4$.

You are required to determine the temperature and enthalpy changes for the following reaction.

$$Zn(s) + CuSO_4(aq) \longrightarrow Cu(s) + ZnSO_4(aq)$$

(a) Accurately weigh, to two decimal places, an empty weighing bottle. Place between 2.90 g and 3.00 g of **FB 1**, zinc powder, into the weighing bottle. Record your weighings in Table 1.1 below. If your balance has a Tare facility, do **not** use it.

Table 1.1 – Weighing of FB 1

mass of empty weighing bottle	/ g	10.000
mass of weighing bottle + **FB 1**	/ g	12.957
mass of weighing bottle + residual **FB 1**	/ g	10.004
mass of **FB 1** placed in plastic cup	/ g	

[2]

(b) Place the plastic cup in the 250 cm^3 beaker provided and pipette 25.0 cm^3 of **FB 2** into the plastic cup.

Stir gently with the thermometer and take the temperature of the solution every half minute for 2½ minutes. Record the temperature readings in Table 1.2 overleaf on page 4.

At exactly 3 minutes, add the **FB 1** from the weighing bottle to the plastic cup.

Do not try to read the temperature at 3 minutes.

Stir the mixture thoroughly, and continue to stir and record the temperature every half minute from 3½ minutes to 15 minutes.

(c) Reweigh the weighing bottle and any residual zinc powder and record the mass in Table 1.1 above.

For Examiner's Use

Table 1.2 – Temperature readings

time / min	temperature / °C	time / min	temperature / °C
0	22.5	8	42.8
½	22.5	8½	42.8
1	22.5	9	42.6
1½	22.5	9½	42.6
2	22.5	10	42.6
2½	22.5	10½	42.4
3		11	42.4
3½	48.2	11½	42.4
4	46.5	12	42.2
4½	45.1	12½	42.0
5	44.4	13	42.0
5½	43.9	13½	42.0
6	43.5	14	42.0
6½	43.2	14½	42.0
7	43.0	15	42.0
7½	43.0		

[1] + [8]

(d) Plot a graph of temperature against time on the grid opposite. [3]

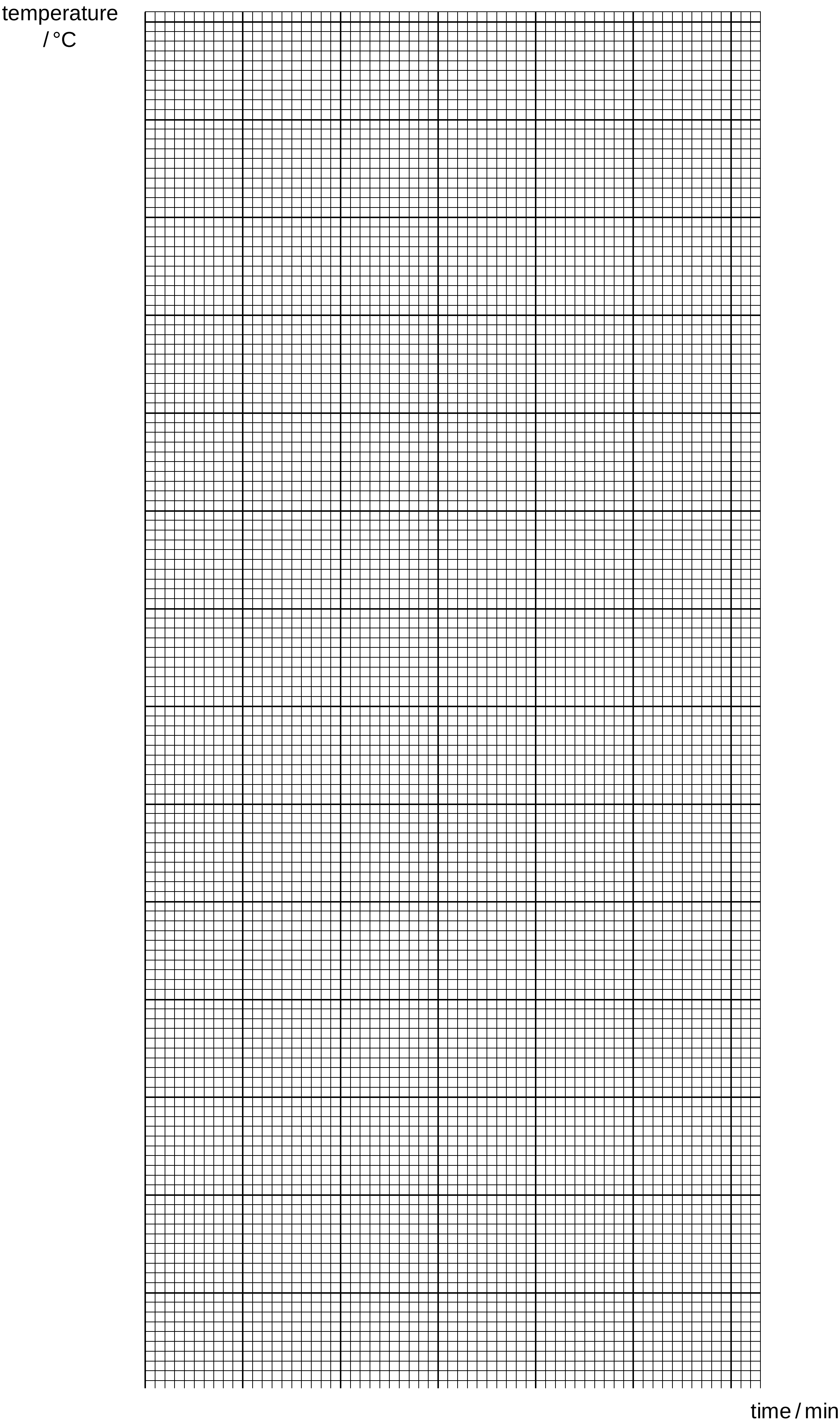
(e) Extrapolate the cooling section of your graph back to time = 3 minutes and read the corresponding temperature.

Estimated temperature = ... °C

Use this value to obtain the temperature change produced by the reaction.

Temperature change = ... °C

[1]


temperature / °C
time / min

(f) Calculate how many moles of zinc were added to the plastic cup.
[A_r: Zn, 65.4.]

[1]

(g) Calculate how many moles of copper sulphate, $CuSO_4$, were added to the plastic cup.

[1]

(h) Calculate the heat energy produced when the zinc is added to the aqueous copper sulphate in the plastic cup.
[You may assume that 4.3 J are required to raise the temperature of 1 cm^3 of any dilute solution by 1 °C.]

[1]

(i) Calculate the enthalpy change, H, for the reaction. Include the sign and units in your answer.

$$Zn(s) + CuSO_4(aq) \longrightarrow Cu(s) + ZnSO_4(aq)$$

H = ... [1]

[Total: 19]