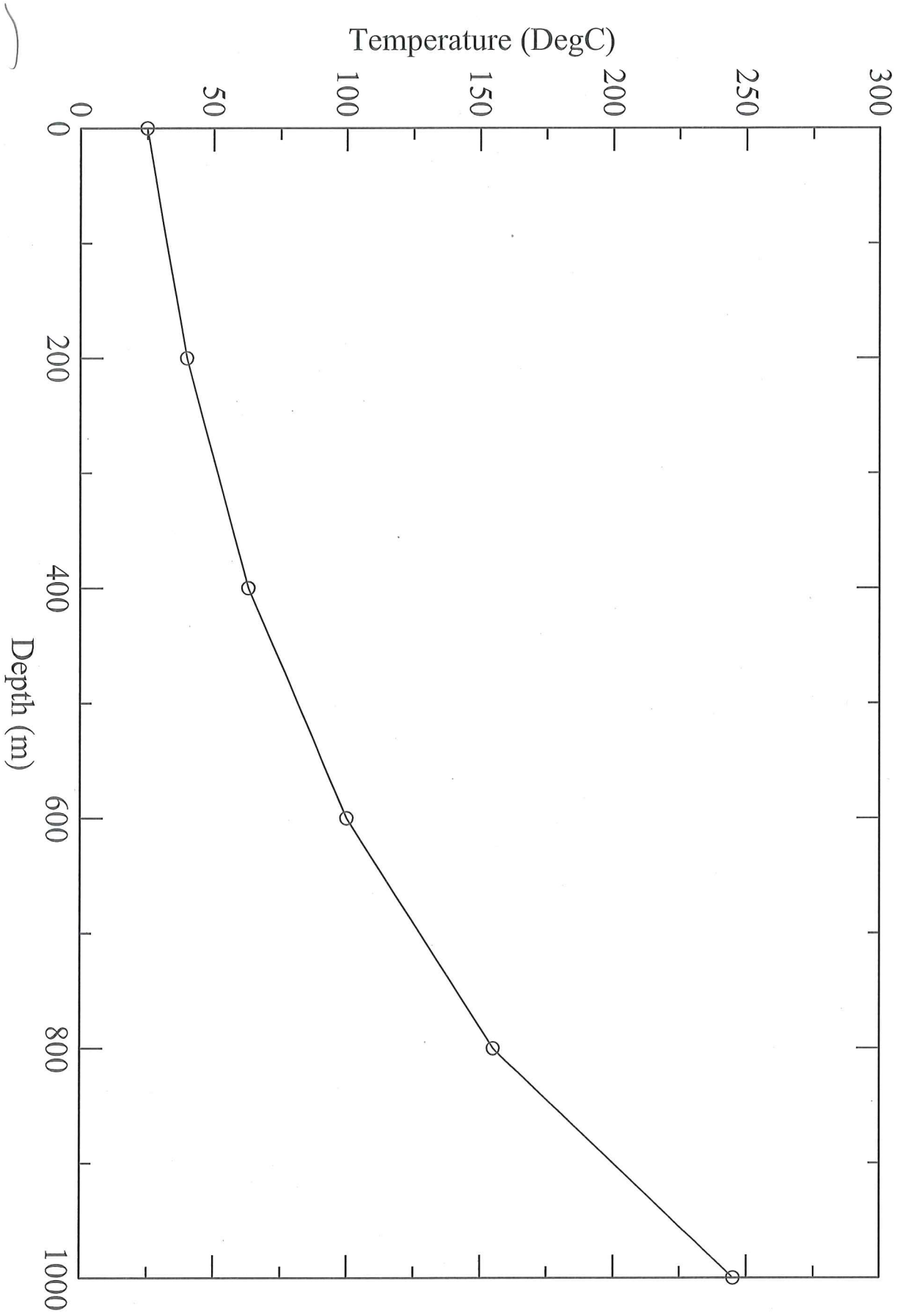
(a)


Temperature (DegC)
0
50
100
150
200
250
300
Depth (m)
0
200
400
600
800
1000

Problem 1:

(b) We can find the required depth through linear interpolation. Thus at 225°C,

$$(245-155)^\circ C \;\_\_\; (1000-800)\,m$$

$$(245-225)^\circ C \;\_\_\; (1000-H)\,m$$

$$(245-155)^\circ C \times (1000-H)\,m = (245-225)^\circ C \times (1000-800)\,m$$

$$90^\circ C \times (1000-H)\,m = 20^\circ C \times 200\,m$$

$$\boxed{H = 955.56\,m}$$

(c)

- Total heat to be supplied (allowing for distribution loss): $20\,MW / 0.9 = 22.22\,MW$
- Total net energy supplied in day: $22.22 \times 10^6 \frac{J}{s} \times 24h \times \frac{3600s}{1h}$

$$= 1.92 \times 10^{12} J = 1.92\,TJ$$

- Coal consumed in a day (allowing for efficiency): $\frac{1.92 \times 10^{12} J}{24 \times 10^9 \frac{J}{ton}} \times \frac{1}{0.8} = \boxed{100\,ton}$

(d)

- Energy supplied by geothermal heat : Flow rate × Temperature Difference × $C_{p\,water}$

$$E = \dot{m}_w C_{pw} \Delta T$$

$$E_{geot} = 71.65 \frac{kg}{s} \times 4.18 \frac{kJ}{kg.°C} (80-60)°C$$

$$E_{geot} = 5989.94 \frac{kJ}{s} \quad (\sim 6\,MW)$$

Per day, we could save:

- Energy supplied per day : $5989.94 \frac{kJ}{s} \times 24h \times \frac{3600s}{1h}$

$$= 5.1753 \times 10^8\ kJ$$

- Equivalent in Coal : $\frac{5.1753 \times 10^8\ kJ}{24 \frac{GJ}{ton}} \times \frac{1}{0.8}$

$$= \boxed{26.95\ ton}$$

Coal Consumption w Geothermal : $100 - 26.95 = \boxed{73.05\ ton}$