

Question 2

Sports academy near your school recently performed poorly in the recent concluded football tournament. They attributed the poor performance to acute muscle injuries that most of their influential players succumbed to. When the team manager shared the issue with the sports doctor, the doctor advised him to buy instant cold packs for use in the next tournament. However the academy lacks funds and the manager wants to locally prepare their own cold packs using one of the compounds Q or X from the nearby chemical lab suppliers.

Both Q & X dissolve in water with absorption of heat from the surrounding and can therefore be used in cold packs when squeezed on the affected muscles causing a cooling effect. The most suitable compound to use is the one that absorbs the highest amount of heat from the surrounding. You've been approached by the team manager for help in determining the most suitable compound to use in cold packs since he doesn't know how to do it. You're provided with compounds Q & X and some apparatus for use.

Task

As a chemistry learner, design an experiment you'll carryout to help the team manager to make the right choice.

Solution for question II

Aim: To compare the heat changes of dissolving substances Q & X in Water

Hypothesis: Q absorbs more heat than X when dissolved in water

Variables:

- Dependent : Temp

- Independent : Time

- Controlled : Volume of water

Materials used:

Procedure:

- Using the measuring cylinder, 50cm^3 of distilled water was measured and poured into a clean plastic beaker.
- Using a thermometer the water was stirred and its initial constant temp was recorded
- The whole substance Q was added at once into the water in the plastic beaker and at the same time the stop clock was started.
- The mixture was kept stirred and the temp of the content in the beaker was recorded after 10 sec interval for 50 sec.
- The results were recorded in the table below.
- The procedures (a) to (e) were repeated using substance X and the results were also recorded in the table below.

Table of results

Time (s)	0.0	10.0	20.0	30.0	40.0	50.0
Temp of Q and H_2O ($^{\circ}\text{C}$)	20.0	16.0	15.0	15.0	15.0	15.0
Temp of X and H_2O ($^{\circ}\text{C}$)	20.0	18.0	17.0	16.0	16.0	16.0

Risks and Mitigation:

Beaker Breakage of the thermometer. This can be mitigated by putting back the thermometer in its case after use and handling it with care.

Data analysis

A graph of temp against time.

Solid Q

minimum temp of Q and H_2O = 15.0

$$\text{Temp raise} = T_1 - T_2 = 20.0 - 15.0 = 5.0^{\circ}\text{C}$$

$$\text{mass of solution} = M_w + M_Q = 50 + 6 = 56\text{g}$$

$$\begin{aligned}\Delta Q &= m c \Delta T \\ &= 56 \times 4.2 \times 5 \\ &= 1176\text{J} \\ &= 1.176\text{KJ}\end{aligned}$$

Solid X

Minimum temp of mixture of X = 16.0°C

$$\text{Temp change} = T_1 - T_2 = 20 - 16 = 4.0^{\circ}\text{C}$$

$$\begin{aligned}\text{Heat absorbed} &= m c \Delta T \\ &= 56 \times 4.2 \times 4 \\ &= 940.8\text{J} \\ &= 0.9408\text{KJ}\end{aligned}$$

Conc

Q absorbs more heat than X
Therefore, Q is a better compound for use in making cold packs.