

## State Examination Commission – Physics Higher Level, 2014

### Question 12C

Define specific latent heat. (6)

A drinking glass contains 500 g of water at a temperature of 24 °C. Three cubes of ice, of side 2.5 cm, are removed from a freezer and placed in the water. The temperature of the ice is –20 °C.

Calculate the mass of the ice. (6)

Calculate the minimum temperature of the water when the ice has melted. (16)

density of ice = 0.92 g cm<sup>-3</sup>

specific heat capacity of water = 4200 J kg<sup>-1</sup> K<sup>-1</sup>

specific heat capacity of ice = 2100 J kg<sup>-1</sup> K<sup>-1</sup>

specific latent heat of fusion of ice = 3.3 × 10<sup>5</sup> J kg<sup>-1</sup>

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(6)

#### Textbook

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Calculate the mass of the ice. (6)

$$\begin{aligned} \text{Volume of ice} &= 3 \times 2.5^3 = 46.875 \text{ cm}^3 \\ \text{mass of ice, } m &= \rho V = 0.92 \times 46.875 = 43.125 \text{ g} \end{aligned}$$

Calculate the minimum temperature of the water when the ice has melted.

(16)

Heat gained			=	Heat lost		
Heat gained by 43.125 g of ice warming from –20 to 0 °C	+	Heat gained by 43.125 g ice at 0 °C melting to water at 0 °C	+	Heat gained by 43.125 g melt water rising from 0 °C to final temperature, $\theta$ °C	=	Heat lost by 500 g of water cooling from 24 °C to final temperature, $\theta$ °C
$(mc\Delta\theta)_{ice}$	+	$ml_{ice}$	+	$(mc\Delta\theta)_{melt\ water}$	=	$(mc\Delta\theta)_{water}$
$0.043125 \times 2100 \times 20$	+	$0.043125 \times 3.5 \times 10^5$	+	$0.043125 \times 4200 \times \theta$	=	$0.500 \times 4200 \times (24 - \theta)$

Solving gives,  $\theta = 15.6$  °C