Essential Pre-Uni Physics G3.5

A Level

- Specific heat capacity of water: $4180\,\mathrm{J\,kg^{-1}\,K^{-1}}$
- Specific heat capacity of aluminium: $880\,\mathrm{J\,kg^{-1}\,K^{-1}}$
- Specific heat capacity of iron: $435\,\mathrm{J\,kg^{-1}\,K^{-1}}$
- Specific heat capacity of paraffin oil: $2130\,\mathrm{J\,kg^{-1}\,K^{-1}}$

These specific heat capacities can also be found within the hint tabs.

A radiator is made using $5.4\,\mathrm{kg}$ of iron. It is then filled with $7.3\,\mathrm{kg}$ of water. Calculate its heat capacity, that is the heat required to raise the temperature of the whole thing per kelvin.

Essential Pre-Uni Physics G3.6

A Level

- Specific heat capacity of water: $4180\,\mathrm{J\,kg^{-1}\,K^{-1}}$
- Specific heat capacity of aluminium: $880\,\mathrm{J\,kg^{-1}\,K^{-1}}$
- Specific heat capacity of iron: $435\,\mathrm{J\,kg^{-1}\,K^{-1}}$
- Specific heat capacity of paraffin oil: $2130\,\mathrm{J\,kg^{-1}\,K^{-1}}$

These specific heat capacities can also be found within the hint tabs.

In the following questions, two substances are mixed. In each case work out the missing mass or temperature, assuming no heat is lost to the surroundings.

First substance			Second substance			Mixture
Material	m_1 / kg	t_1 / °C	**Material**	m_2 / kg	t_2 / °C	t_{mix} /°C
Water	3.2	83	Paraffin	4.3	18	**(a)**
Water	0.34	14	Iron	0.15	230	**(b)**
Water	1.25	56	Paraffin	**(c)**	170	84
Aluminium	3.2	12	Paraffin	2.1	**(d)**	51

Part A Final temperature (a)

First substance			Second substance			Mixture
Material	m_1 / kg	t_1 / °C	**Material**	m_2 / kg	t_2 / °C	t_{mix} /°C
Water	3.2	83	Paraffin	4.3	18	**(a)**

a) What is the final temperature of the mixture in °C?

Part B Final temperature (b)

First substance			Second substance			Mixture
Material	m_1 / kg	t_1 / °C	**Material**	m_2 / kg	t_2 / °C	t_{mix} /°C
Water	0.34	14	Iron	0.15	230	**(b)**

b) What is the final temperature of the mixture in °C?

Part C Mass of paraffin (c)

First substance			Second substance			Mixture
Material	m_1 / kg	t_1 / °C	**Material**	m_2 / kg	t_2 / °C	t_{mix} /°C
Water	1.25	56	Paraffin	**(c)**	170	84

c) What is the mass of paraffin in kg?

Part D Temperature of paraffin (d)

First substance			Second substance			Mixture
Material	m_1 / kg	t_1 / °C	**Material**	m_2 / kg	t_2 / °C	t_{mix} /°C
Aluminium	3.2	12	Paraffin	2.1	**(d)**	51

d) What is the initial temperature of the paraffin in °C?

Gameboard:

STEM SMART Physics 47 - Revision - Thermal Physics

Essential Pre-Uni Physics G4.4

A Level

- Specific heat capacity of water: $4180\,\mathrm{J\,kg^{-1}\,K^{-1}}$
- Specific heat capacity of ice: $2030\,\mathrm{J\,kg^{-1}\,K^{-1}}$
- Specific latent heat of fusion of ice: $3.35 \times 10^{5}\,\mathrm{J\,kg^{-1}}$
- Specific latent heat of vaporization of water: $2.26 \times 10^{6}\,\mathrm{J\,kg^{-1}}$

In all questions, assume that the heat capacities given above remain constant at all temperatures.

$2.25\,\mathrm{kg}$ of ice, initially at $-40\,^{\circ}\mathrm{C}$, is heated using a $3.2\,\mathrm{kW}$ heater without loss to the surroundings.

Part A Time to reach melting point

How much time elapses before the ice reaches melting temperature? Give your answer in seconds.

Part B Time to melt

How much more time elapses before the ice has all melted (after it has reached melting temperature)? Give your answer in seconds.

Part C Time to reach boiling point

How much more time elapses before the water reaches boiling point? Give your answer in seconds.

Part D Time to vaporize

How much more time elapses before the water has all vaporized? Give your answer in seconds.

Gameboard:

STEM SMART Physics 47 - Revision - Thermal Physics

Essential GCSE Physics 1.6

Year 9 GCSE

Units with powers: please note that $1\,\mathrm{cm}^2$ means $1\,\mathrm{cm} \times 1\,\mathrm{cm} = 0.01\,\mathrm{m} \times 0.01\,\mathrm{m} = 10^{-4}\,\mathrm{m}^2$.

One litre $(1\,\mathrm{L}) = 10\,\mathrm{cm} \times 10\,\mathrm{cm} \times 10\,\mathrm{cm} = 1000\,\mathrm{cm}^3$. It is also equal to $0.1\,\mathrm{m} \times 0.1\,\mathrm{m} \times 0.1\,\mathrm{m} = 0.001\,\mathrm{m}^3 = 1\,\mathrm{dm}^3$.

Convert the following volumes to cubic metres (m^3).

Part A $2\,500\,\mathrm{cm}^3$

Convert $2\,500\,\mathrm{cm}^3$ into cubic metres (m^3).

Part B $68\,\mathrm{cm}^3$

Convert $68\,\mathrm{cm}^3$ into cubic metres (m^3).

Part C $3\,700\,\mathrm{litres}$

Convert $3\,700\,\mathrm{litres}$ into cubic metres (m^3).

Gameboard:

STEM SMART Physics 47 - Revision - Thermal Physics

Essential Pre-Uni Physics G2.7

A Level

C C C

Physical constants which may be necessary to answer the problems on this page can be found within the hint tabs.

Don't forget that one mole of gas contains 6.02×10^{23} molecules, and that the mass of this amount is called the 'molar mass'.

A water fire extinguisher contains about four litres of air at $10^7\,\mathrm{Pa}$ and $20\,^\circ\mathrm{C}$. When the extinguisher is used, this gas forces the water out. Calculate the pressure when the volume has increased to ten litres and the temperature has dropped to about $3.0\,^\circ\mathrm{C}$. Give your answer to 2 significant figures.

Gameboard:

STEM SMART Physics 47 - Revision - Thermal Physics

Gas Laws, Density and Kinetic Energy 32.4

A Level

What is the density of a gas at a pressure of $150\,\mathrm{kPa}$ if the mean-square speed of the particles is $9.0 \times 10^4\,\mathrm{m^2\,s^{-2}}$?

Gameboard:

STEM SMART Physics 47 - Revision - Thermal Physics

Gas Laws, Density and Kinetic Energy 32.7

A Level

Calculate the temperature at which the mean molecular kinetic energy is $1.60 \times 10^{-21}\,\mathrm{J}$.