

### Essential Pre-Uni Chemistry F1.1



Specific heat capacity of water  $=4.18\,J\,g^{-1}\,K^{-1}.$ 

#### Part A (a)

Calculate the heat capacity of an object with mass  $1.80\,\mathrm{kg}$  and specific heat capacity  $0.32\,\mathrm{J\,g^{-1}\,K^{-1}}$ .

#### Part B (b)

Calculate the heat capacity of a calorimeter if its temperature is raised  $2.5\,\mathrm{K}$  by  $35\,\mathrm{kJ}$  of heat.

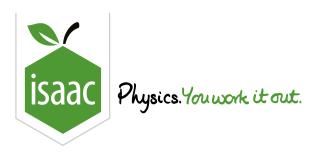
#### Part C (c)

Calculate the expected increase in temperature when  $2.4\,\mathrm{kJ}$  of heat is transferred to a calorimeter of heat capacity  $720\,\mathrm{J\,K^{-1}}$ .

#### Part D (d)

Calculate the heat required to raise the temperature of a calorimeter of heat capacity  $1.6\,{\rm kJ\,K^{-1}}$  by  $3.8\,^{\circ}{\rm C}.$ 

Part E	(e)
	alculate the specific heat capacity of a calorimeter if it has a mass of $375\mathrm{g}$ and its temperature is aised $4.2\mathrm{K}$ by $2160\mathrm{J}$ of heat.
Part F	(f)
Ca	alculate the heat required to raise the temperature of $3.14\mathrm{kg}$ of water by $12.2\mathrm{K}$ .
Part G	(g)
Ca	alculate the mass of water whose temperature is raised through $16.0\mathrm{K}$ by $6.7\mathrm{kJ}$ of heat.
Part H	(h)
	calorimeter consists of $140\mathrm{g}$ of aluminium and $300\mathrm{g}$ of water. $6100\mathrm{J}$ of heat raises its temperature y $4.42\mathrm{K}$ . Calculate to three significant figures:
its	s heat capacity;
th	ne specific heat capacity of aluminium.



### Essential Pre-Uni Chemistry F1.3

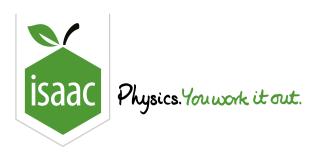


Specific heat capacity of water  $=4.18\,\mathrm{J\,g^{-1}\,K^{-1}}$ .

The enthalpy change of combustion of naphthalene is  $-5156\,\mathrm{kJ\,mol^{-1}}$ . Its molar mass is  $128.2\,\mathrm{g\,mol^{-1}}$ . Calculate the temperature change expected when  $1.00\,\mathrm{mmol}$  is burnt in excess oxygen in a calorimeter containing  $4.0\,\mathrm{kg}$  of water.

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## Essential Pre-Uni Chemistry F1.5

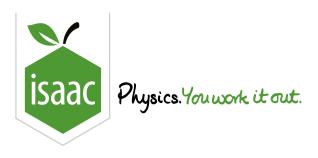


Specific heat capacity of water  $=4.18\,\mathrm{J\,g^{-1}\,K^{-1}}.$ 

Complete combustion of  $0.020\,\mathrm{mol}$  of ethane, with a standard enthalpy of combustion of  $-1410.8\,\mathrm{kJ\,mol^{-1}}$  raises the temperature of the water in an insulated calorimeter from  $17.4\,^{\circ}\mathrm{C}$  to  $22.4\,^{\circ}\mathrm{C}$ . Calculate the mass of the water in the calorimeter.

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### Essential Pre-Uni Chemistry F1.7



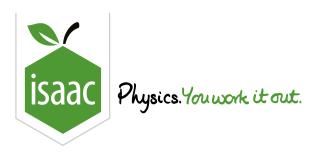
Specific heat capacity of water  $=4.18\,\mathrm{J\,g^{-1}\,K^{-1}}$ .

 $25.0\,\mathrm{cm^3}$  of sulfuric acid at  $1.00\,\mathrm{mol\,dm^{-3}}$  and  $19.10\,^\circ\mathrm{C}$  is placed in an insulated polystyrene cup. When  $25.0\,\mathrm{cm^3}$  of sodium hydroxide at  $2.00\,\mathrm{mol\,dm^{-3}}$  and  $19.10\,^\circ\mathrm{C}$  is added, the temperature rises to  $32.45\,^\circ\mathrm{C}$ .

Assuming that no heat is lost, that the specific heat capacity of water may be used, and that the solutions have a density of  $1.00\,\mathrm{g\,cm^{-3}}$  at  $19.10\,\mathrm{^{\circ}C}$ , find the enthalpy change of the reaction per mole of water produced by neutralisation.

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### Essential Pre-Uni Chemistry F1.8



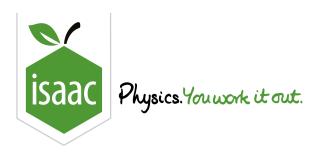
Specific heat capacity of water  $=4.18\,\mathrm{J\,g^{-1}\,K^{-1}}$ 

 $30.0\,\mathrm{cm^3}$  of ethanoic acid at  $1.60\,\mathrm{mol\,dm^{-3}}$  and  $18.65\,^\circ\mathrm{C}$  is placed in an insulated polystyrene cup. When  $40.0\,\mathrm{cm^3}$  of sodium hydroxide at  $1.00\,\mathrm{mol\,dm^{-3}}$  and  $18.65\,^\circ\mathrm{C}$  is added, the temperature rises to  $25.80\,^\circ\mathrm{C}$ .

Assuming that no heat is lost, that the specific heat capacity of water may be used, and that the solutions have a density of  $1.00\,\mathrm{g\,cm^{-3}}$  at  $18.65\,^\circ\mathrm{C}$ , find the enthalpy change of the reaction per mole of water produced by neutralisation.

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### Essential Pre-Uni Chemistry F1.9



Specific heat capacity of water  $=4.18\,\mathrm{J\,g^{-1}\,K^{-1}}$ .

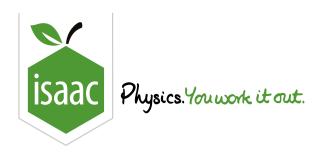
When  $5.0\,\mathrm{g}$  of ammonium nitrate dissolves in  $100\,\mathrm{g}$  of water, the temperature of the water drops from  $18\,^{\circ}\mathrm{C}$  to

# $14\,^{\circ}\mathrm{C}$ . Calculate the enthalpy of solution of ammonium nitrate in $\mathrm{kJ\,mol^{-1}}$ using the following scheme. **Empirical formula** Part A Write fown the formula of ammonium nitrate. Formula mass Part B Calculate the formula mass of ammonium nitrate. Give your answer to 3 significant figures. Number of moles Part C Calculate the number of moles of ammonium nitrate in $5.0\,\mathrm{g}$ .

#### Heat loss of water Part D

Calculate the heat lost from the  $100\,\mathrm{g}$  of water. Give your answer to 2 significant figures.

Part E Molar heat loss of ammonium nitrate				
Calculate the heat lost per mole of ammonium nitrate.				
Part F Enthalpy of ammonium nitrate				
Give the enthalpy of solution of ammonium nitrate.				
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Home Gameboard

Chemistry

Physical Energetic

**Energetics** Essential Pre-Uni Chemistry F1.10

## Essential Pre-Uni Chemistry F1.10



The enthalpies of combustion of three fuels are shown below:

Fuel	$\Delta H_{ m c}$ / ${ m kJ}{ m mol}^{-1}$
$\mathrm{CH}_4$	-890.3
$\mathrm{C_{3}H_{8}}$	-2219.2
$\mathrm{C_4H_{10}}$	-2876.5

#### Part A (a)

Which gives out most heat per gram?

#### Part B (b)

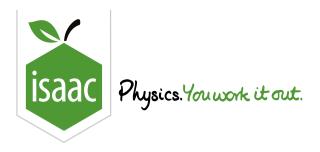
Which gives out most heat per mole?

#### Part C (c)

Which gives out most heat per cubic foot?

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Home Gameboard Chemistry Physical Energetics Average Bond Enthalpy

### **Average Bond Enthalpy**



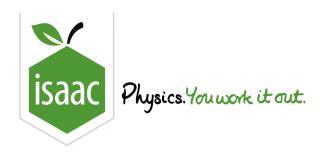
The average bond enthalpy of the C-F bond in tetrafluoromethane is given by the standard enthalpy change for one of the following reactions. Which one is it?

- $\bigcirc \quad \operatorname{CF}_4(\operatorname{s}) \longrightarrow \operatorname{CF}_4(\operatorname{g})$
- $igg( 2 \operatorname{F}_2(\operatorname{g}) + \operatorname{C}(\operatorname{s}) \longrightarrow \operatorname{CF}_4(\operatorname{g})$
- $\bigcirc \quad \operatorname{CF}_{4}(\operatorname{g}) \longrightarrow \operatorname{CF}_{3}(\operatorname{g}) + \operatorname{F}(\operatorname{g})$
- $\bigcirc \quad \frac{1}{4}\operatorname{CF}_4(g) \longrightarrow \frac{1}{4}\operatorname{C}(g) + \operatorname{F}(g)$
- $\mathrm{CF_4(g)} \longrightarrow \mathrm{CF_3}^+(\mathrm{g}) + \mathrm{F}^-(\mathrm{g})$

Adapted with permission from UCLES, OCSEB A Level Chemistry, June 1995, Paper 1, Question 10

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### Essential Pre-Uni Chemistry F2.3



Use some of the following bond enthalpies in  $kcal \, mol^{-1}$  to calculate the enthalpy changes for the reactions (in the gas phase):

C=C	146	$\mathrm{C}\equiv\mathrm{O}$	258
O=O	119	$_{ m H-O}$	111
$\mathrm{C-H}$	99	$\mathbf{H}\mathbf{-H}$	104
C=O	178		

#### Part A (a)

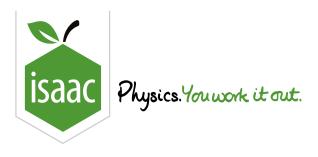
 $C_2H_4+O_2\longrightarrow 2\,CH_2O.$  Give your answer to 2 significant figures.

#### Part B (b)

 ${
m CO} + {
m H_2O} \longrightarrow {
m CO_2} + {
m H_2}.$  Give your answer to 2 significant figures.

### Part C (c)

 ${
m CH_2O} \longrightarrow {
m CO} + {
m H_2}.$  Give your answer to 2 significant figures.



### Essential Pre-Uni Chemistry F2.4



Given that the bond energy of H-H is  $4.53\,\mathrm{eV}$ , D-D is  $4.59\,\mathrm{eV}$ , and the energy change on reaction  $H_2+D_2\longrightarrow 2\,\mathrm{HD}$  is  $+0.02\,\mathrm{eV}$ , find the bond energy of H-D. Give your answer to 3 significant figures.