Heat Transfer Practice

1) When a 200.0 g, 100.0°C piece of metal was dropped into a cup containing 150.0 ml of 20.0°C water. The temperature of the water rose to 22.0°C. What is the specific heat of the metal? Evaluate using significant figures.

HOT	LESS HOT
metal	water
$m = 200.0g$	$m = 150.0g$
$c = ?$ ← we expect this to be small*	$c = 4.19 \frac{J}{g°C}$
$\Delta T = 22°C - 100°C$	$\Delta T = 22°C - 20°C$
$\Delta T = -78°C$	$= 2°C$
	$Q_{water} = mc\Delta T$
	$= (150.0g)(4.19 \frac{J}{g°C})(2°C)$
	$= 1257J$

metal water

$-Q = Q$

$(-200.0g)c(-78°C) = 1257J$

$c = \frac{1257J}{(200g)(78°C)}$

$c = 0.0806 \frac{J}{g°C}$

2) A hot poker is made of tin (0.228 J/g°C), it has a mass of 2.5 kg. In order to lose some heat it is placed in 1500 mL of water, which has a temperature of 15°C, the final temperature reaches 19°C. What was the initial temperature of the poker?

HOT	LESS HOT
poker	water
$m = 2500g$	$m = 1500g$
$c = 0.228 \frac{J}{g°C}$	$c = 4.19 \frac{J}{g°C}$
$\Delta T = ?$	$\Delta T = T_f - T_i$
* we expect the metal to have a high T_i *	$= 19°C - 15°C = 4°C$
	$Q_{water} = mc\Delta T$
	$= (1500g)(4.19 J/g°C)(4°C)$
	$= 25,140J$

poker water

$-Q = Q$

$-(2500g)(0.228 \frac{J}{g°C}) \Delta T = 25,140J$

$\Delta T = \frac{25,140J}{(-2500g)(0.228 \frac{J}{g°C})}$

$\Delta T = -44.105°C$

$T_f - T_i = -44.105°C$

$19°C - T_i = -44.105°C$

$T_i = 63.1°C$

3. A hot metal is placed in 100.0 mL, of 25.0°C water. The initial temperature of the metal is 95.0°C and it reaches a final temperature of 27°C. The specific heat of the metal is 0.454 J/g°C. What is the mass of the metal?

HOT	LESS HOT
metal	water
$m = ?$	$m = 100.0g$
$c = 0.454 \frac{J}{g°C}$	$c = 4.19 \frac{J}{g°C}$
$\Delta T = T_f - T_i$	$\Delta T = 2°C$
$= 27°C - 95°C$	$Q_{water} = mc\Delta T$
$= -68°C$	$= (100.0g)(4.19 \frac{J}{g°C})(2°C)$
	$= 838J$

metal water

$-Q = Q$

$-m(0.454 \frac{J}{g°C})(-68°C) = 838J$

$m = \frac{838J}{(0.454 \frac{J}{g°C})(68°C)}$

$m = 27.1g$

4. Platinum–gold alloys are often used in the production of fine jewellery. The alloys are 90% by mass platinum and 10% by mass gold (how to deal with this in problem: make up any numbers for mass that have the same ratio ex. 90 g for platinum and 10 g for gold). During the fabrication of the alloy, the two metals are heated separately to a temperature that exceeds their melting points by 100.0°C and are then mixed.

Consider the following information and assume that no heat is lost to the surroundings.

Property	**Platinum**	**Gold**
Melting point (°C)	1768	1064
Specific heat capacity (J/g•°C)	0.1300	0.1300

What is the final temperature of the mixture?

A) 1798°C

B) 1698°C

C) 1516°C

D) 1416°C

HOT	LESS HOT
Platinum	Gold
$m = 9g$	$m = 1g$
$C = 0.1300 \frac{J}{g°C}$	$C = 0.1300 \frac{J}{g°C}$
$\Delta T = ?$	$\Delta T = ?$
$T_i = 1868°C$	$T_i = 1164°C$

*We expect the final temp. to be closer to that of platinum because they have the same heat capacity and platinum has the larger mass in the alloy

Platinum Gold → Cancel specific heat same on both sides

$-Q = Q$

$(-9g)\left(0.1300 \frac{J}{g°C}\right)\Delta T = (1g)\left(0.1300 \frac{J}{g°C}\right)\Delta T$

$\frac{-9g\,\Delta T}{1g} = \frac{1g\,\Delta T}{1g}$

$-9\Delta T = \Delta T$

$-9(T_f - 1868°C) = T_f - 1164°C$

$-9T_f + 16812 = T_f - 1164°C$

$\frac{17976}{10} = \frac{10T_f}{10}$

$T_f = 1797.6°C$

(A)