Question 1
A child of mass 15 kg climbs to the top of a slide that is 1.7 m above a horizontal run that extends for 0.50 m at the base of the slide. After sliding down, the child comes to rest just before reaching the very end of the horizontal portion of the slide. (a) How much internal energy was generated during this process? (b) Where did the generated energy go? (To the slide, to the child, to the air, or to all three?)

A) (a) 200 J; (b) to the slide
(B) (a) 250 J; (b) all three
C) (a) 250 J; (b) to the air
D) (a) 200 J; (b) all three
E) (a) 220 J; (b) to the slide

a) $U = mg\Delta y = (15)(9.8)(1.7) = \boxed{250\,J}$

b) all three

Question 2
Convert 1.00 kcal to kilowatt-hours (kWh).

A) 1.35 × 10-3 kWh
B) 1.48 × 10-3 kWh
(C) 1.16 × 10-3 kWh
D) 1.72 × 10-3 kWh

$1\ kcal = 1000\ Cal = 4186\ J$

$1\ kwh = \left(1000\ \frac{J}{s}\right)(3600\,s) = 3.6 \times 10^6\ J$

Thus $\frac{4186}{3.6 \times 10^6} = \boxed{1.16 \times 10^{-3}}\ kcal/kwh$

Question 3
What is the heat capacity of a gold ring that has a mass of 5.00 g?

A) 0.132 cal/K
(B) 0.153 cal/K
C) 0.148 cal/K
D) 0.158 cal/K

Heat capacity $= \frac{Q}{\Delta T}$ Specific heat capacity $= c = \frac{Q}{m\Delta T}$

$\hookrightarrow = cm_{Gold} = (0.128 \times 4.186)(5) = \boxed{0.153}\ Cal/K$

Question 4
How long will it take a 500-W heater to raise the temperature of 400 g of water from 15.0° C to 98.0° C.

A) 66 s
(B) 278 s
C) 435 s
D) 16 s

$Q = mc\Delta T = (400)(4.186)(98-15) = 1.39 \times 10^5\ J$

$P = \frac{Q}{t} \rightarrow t = \frac{Q}{P} = \frac{1.39 \times 10^5\ J}{500\ J/s} = 277.9\,s \simeq \boxed{278\,s}$

Question 5
How many calories are required to heat each of the following from 15° C to 65° C? (a) 3.0 g of aluminum, (b) 5.0 g of Pyrex glass, (c) 20 g of platinum. The specific heats, in cal/g·° C, for aluminum, Pyrex, and platinum are 0.21, 0.20, and 0.032, respectively.

A) (a) 41 cal, (b) 65 cal, (c) 42 cal
B) (a) 50 cal, (b) 80 cal, (c) 51 cal
(C) (a) 32 cal, (b) 50 cal, (c) 32 cal
D) (a) 3.2 cal, (b) 5 cal, (c) 3.2 cal

$Q = mc\Delta T$ for each Case.

Question 6

A 55-g copper calorimeter (c=0.093calcal/g·° C) contains 250 g of water at 18.0° C. When 75 g of an alloy at 100° C is dropped into the calorimeter, the resulting temperature is 20.4° C. What is the specific heat of the alloy?

(A) 0.10 cal/g·° C
B) 0.002 cal/g·° C
C) 0.093 cal/g·° C
D) 0.082 cal/g·° C

$Q_{given} = Q_{alloy}$; $Q_{absorbed} = Q_{calorimeter} + Q_{water}$

$75 C_{alloy}(100 - 20.4) = (55 \times 0.093)(20.4 - 18) + (250)(1)(20.4 - 18)$

$\Rightarrow C_{alloy} = 0.10$ cal/g.°C

Question 7

How much heat is required to change 10 g of ice at exactly 0° C to steam at 100° C?

A) 6.4 kcal
B) 6.2 kcal
(C) 7.2 kcal
D) 5.4 kcal

$Q = (10)(80) + (10)(1)(100 - 10) + (10)(540)$

$= 800 + 900 + 5400 = 7100$ cal $= 7.1$ kcal

Question 8

Ten kilograms of steam at 100° C is condensed in 500kg of water at 40.0° C. What is the resulting temperature?

(A) 51.8° C
B) 52.8° C
C) 41.2° C
D) 53.8° C

$Q_{absorbed} = Q_{given}$

$(500{,}000)(1)(T_f - 40) = (10{,}000)(540) + (10{,}000)(1)(100 - T_f)$

$\Rightarrow T_f = 51.8^{\circ}C$

Question 9

A single-thickness glass window on a house actually has layers of stagnant air on its two surfaces. But if it did not, how much heat would flow out of an 80 cm x 40 cm x 3.0 mm window each hour on a day when the outside temperature was precisely 0° C and the inside temperature was 18° C? For glass kT=0.84 W/K·m.

(A) 1.4 x 10^3 kcal/h
B) 5.8 x 10^3 kcal/h
C) 385 cal/h
D) 4.2 kcal/h

$P = kA\frac{\Delta T}{d} = (0.8)(0.4 \times 0.8)\frac{18 - 0}{3 \times 10^{-3}}$

$P = 1612.8$ J/s $= \frac{1612.8}{4.186} \times \frac{3600}{1000} = 1387$ kCal/s

Question 10

An incandescent lamp filament has area of 50 mm2 and operates at a temperature of 2127° C. Assume that all the energy furnished to the bulb is radiated from it. If the filament's emissivity is 0.83, how much power must be furnished to the bulb when it is operating?

A) 48 W
B) 5.65 x 10^{-9} W
(C) 78 W
D) 94 W

$P = e\sigma AT^4$

$\begin{cases} e = 0.83 \\ \sigma = 5.67 \times 10^{-8}\ W/m^2 \cdot K^4 \\ A = 50 \times 10^{-6}\ m^2 \\ T = 2127 + 273 = 2400\ K \end{cases} \Rightarrow P = 78\ W$