Physics 2A
Fall 2018

ave. = 7.2
σ = 2.3

Name Answer Key

Lab: early late (please circle one)

Quiz #7: Using Energy and Thermal Properties of Matter

Problem 1 (2 points)
The two ends of an iron rod are maintained at different temperatures. The amount of heat that flows through the rod by conduction during a given time interval does *not* depend upon

a) the length of the iron rod.
b) the thermal conductivity of iron.
c) the temperature difference between the ends of the rod.
d) the mass of the iron rod.
e) the duration of the time interval.

D

$P = Q/\Delta t = \frac{KA\Delta T}{L}$

$Q = \frac{KA\Delta T\Delta t}{L}$

Problem 2 (2 points)
A fixed amount of an ideal gas is initially at a temperature of 25 °C. What will the new temperature of the gas be if the pressure and volume are both doubled?

$pV = nRT \rightarrow T = \frac{pV}{nR}$ $T_i = 25°C = 298K$

⇒ if p + V are both doubled, the temperature increases by a factor of 4

$T_f = 4T_i = 4(298K) \rightarrow T_f = 1192K = 919°C$

Problem 3 (3 points)
A typical fast food meal contains about 1350 calories. Assuming a typical efficiency for energy use by the body, if a 55-kg person were to use all of this energy to climb a mountain, how high could she climb?

$E = 1350\,Cal\left(\frac{4186J}{1\,Cal}\right) = 5.65\times10^6 J$ → this is E_{in}

$\varepsilon = \frac{E_{out}}{E_{in}} = 0.25 \rightarrow E_{out} = (0.25)(5.65\times10^6 J) = 1.41\times10^6 J$

$E_{out} = mg\Delta y \rightarrow \Delta y = \frac{E_{out}}{mg}$

$\Delta y = \frac{1.41\times10^6 J}{(55Kg)(9.80m/s^2)} \rightarrow \Delta y = 2621J$

$\Delta y = 2.6\times10^3 J$

Problem 4 (3 points)

How much heat is required to turn a 1.50 kg block of ice initially at –10.0°C into water at 65.0°C?

Useful constants:

$c_{water} = 4186$ J/(kg C°)
$c_{ice} = 2.00 \times 10^3$ J/(kg C°)
$L_f = 3.33 \times 10^5$ J/kg
$L_v = 22.6 \times 10^5$ J/kg

ice melting — water changing temp from 0°C → 65.0°C

$$Q = m_{ice} c_{ice} \Delta T_{ice} + m_{ice} L_f + m_{water} c_{water} \Delta T_{water}$$

ice changing temp. from −10.0°C → 0°C

$$Q = (1.50\,\text{kg})(2.00\times10^3\,\text{J/kg}\cdot\text{C}^\circ)(10.0\,\text{C}^\circ) + (1.50\,\text{kg})(3.33\times10^5\,\text{J/kg}\cdot\text{C}^\circ) + (1.50\,\text{kg})(4186\,\text{J/kg}\cdot\text{C}^\circ)(65.0\,\text{C}^\circ)$$

$$Q = 3.00\times10^4\,\text{J} + 5.00\times10^5\,\text{J} + 4.08\times10^5\,\text{J}$$

$$\boxed{Q = 9.38\times10^5\,\text{J}}$$