PRACTICE PROBLEMS FOR EXAM 2

Chapter 14 Sec. 1-8, Chapter 15 Sec. 1-2,5-6, Chapter 11 sect.1-8,12

1. An electric tea kettle has a 500-W heating coil. How long will it take to heat up 1 kg of water from 18^oC to 98^oC in this kettle? The specific heat of water is 4186 J/kg·^oC (negect the kettle)

A) 2 minutes

$P*t = mc\Delta T \quad t =[1kg*4186*(98-18)]/500\ W = 670s=11min$

B) 7 minutes

C) 11 minutes

D) 22 minutes

E) 29 minutes

2. A 320-g piece of metal alloy at 130^0 is dropped into the light calorimeter containing 178 g of water at 15^{0}C. The final temperature of the system is 30^{0}C. What is the specific heat of the metal? C_w = 4186 J/kg·^oC

A) 349 J/kg·K

B) 830 J/kg·K

C) 1450 J/kg·K

$0.32kg*c_{metal}*(130^0C-30^0C) = 0.178\ kg*4186*(30^0C-15^0C)$ solve for c_{metal}

D) 2370 J/kg·K

E) 2910 J/kg·K

3. A 120 grams of ice at temperature 0^{0}C added to water was able to decrease the temperature of water from 26^{0}C to 11^{0}C. What was the mass of the water? (latent heat of fusion for water is 335000 J/kg; specific heat of water is 4186 J/kg^{0}C) .

A) 128 g

B) 236 g

$0.12kg*3.35x10^5J/kg+ 0.12\ kg*4186*(11^0C-0^0C) =m*4186*(26^0C-11^0C)$

C) 349 g

solve for m

D) 728 g

E) 891 g

4. A 450 ml of water at 12^0 C is added to light calorimeter that contains 450 ml of water at 85^{0}C Find the final temperature (in degree of Celsius) of the water. (c_{water} = 4186 J/kg·^{0}C)

A) 48.5

B) 12.0

C) 85.0

$0.45\ kg*4186(T-12) = 0.45\ kg*4186*(85-T)$

D) 125.0

E) 22.5

$T-12 =85 - T \quad 2T = 97 \quad T=48.5^0C$

5. How much heat must be added to 0.05 kg of copper at 25^0C to melt it completely? C_{cu} = 387 J/kg·^{0}C L_f = 20.7x10^4 J/kg, melting point T = 1083 ^{0}C

A) 5 kJ $Q = 0.05kg*387*(1083^0C - 25^0C) + 0.05kg*20.7x10^4 J/kg$
B) 12 kJ
C) 25 kJ
D) 0.5 kJ
E) 31 kJ

6. What is the outside temperature if 22.0 x10^6 J of heat is lost through a 4.0 m^2 pane of 3.5 mm thick glass (k = 0.84 W/m^{0}C) in one hour from a house kept at 20^0C?
A) 0^0C
B) 4^0C $Q = [\kappa A(T_2-T_1)/L]*t = (0.84*4m^2*(T-20)*3600)/0.0035$ solve for T
C) 26^0C
D) 12^0C
E) 17^0C

7. A thermopane window consists of two glass panes, each 0.6 cm thick, with a 1-cm-thick sealed layer of air in between. If inside the room temperature is 23 ^{0}C and the outside temperature is 0^0 C, determine the rate of energy transfer through 1m^2 of the window. (k=0.84 J/smK k_{air} = 0.0234 J/smK)

A) 62 W
B) 58 W $R_1=R_3=l/\kappa = 0.006/0.84 = 0.0071$ $R_2 = 0.01/0.0234 = 0.427$
C) 55 W $P = [A(T_2-T_1)]/(R_1+R_2+R_3)]$
D) 65 W
E) 52 W

8. A radiator has an emissivity of 0.7 and its exposed area is 1.2 m^2. The temperature of the radiator is 85^0C and the surrounding temperature is 20^0C. What is the net heat flow rate from the radiator? (σ = 5.67x10^{-8} W/m^2K^4) $P = \varepsilon\sigma A(T_1^4 - T_2^4)$
A) 855 W $P = 0.7*5.67x10^{-8} *1.2*(358^4 - 293^4)$
B) 628 W
C) 431 W
D) 325W
E) 100 W

9. If the absolute temperature of an object is tripled, the thermal power radiated by this object (assuming that its emissivity and size are not affected by the temperature change) will
A) increase by a factor of 3.
B) increase by a factor of 9.
C) increase by a factor of 18.
D) increase by a factor of 27.
E) increase by a factor of 81.

Which of the following happens when a material undergoes a phase change?

a. The temperature changes
b. The chemical composition changes.
c. **Heat flows into or out of the material.**
d. The molecules break apart into atom
e. None of the above

Radiation is emitted

a. Only by glowing object such as the Sun
b. Only by objects whose temperature is greater than the temperature of the surroundings
c. **By any object not at 0 K**
d. Only by objects that have a large specific heat
e. None of the above

10. Gas in a container expands at a constant pressure of 3 atm. Find the work done (in J) by the gas if the initial volume is 5 liters and the final volume is 10 liters. ($1\ atm = 1.013x10^5\ Pa$, $1L = 0.001\ m^3$)

A) 0
B) 150 $W = p\Delta V = 3x1.013x10^5*(0.01m^3 – 0.005m^3)$
C) 15
D) 1 500
E) 1.5

11. A Carnot engine takes 2000 J from a hot reservoir at 227^0C K, does some work, and discards some heat to cold reservoir at 77^0C. The work done by the engine is closest to

A) 3600 J
B) 3000 J $e=W/Q_H$ $e = (T_H-T_C)/T_H = (227-77)/(227+273) = 0.3$
C) 2400 J
D) 1200 J $W = e*Q_H = 0.5*2000J$
E) 600 J

12. An ideal Carnot engine operates between a warm reservoir at 233 K and a colder reservoir. During each cycle, this engine extracts 15.0 J of heat from the warm reservoir and does 4.0 J of work. What is the temperature of the colder reservoir?

A) 171 K $e=W/Q_H =4J/15J = 0.267$ $e = (T_H-T_C)/T_H$ $eT_H = T_H-T_C$
B) 62 K
C) 47 K $T_C = T_H-eT_H = (1-e)T_H = (1-0.267)*233K = 171K$
D) 67 K
E) 287 K

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13. A refrigerator has a coefficient of performance of 4.0. When removing 2.4×10^4 J from inside the refrigerator, how much energy is sent into the environment?

A) 9.6×10^4 J
B) 3.0×10^4 J
C) 1.8×10^4 J
D) 0.60×10^4 J
E) 0.20×10^3 J

COP= Q_L/W $Q_H = W+Q_L$ $W=Q_L/COP = 2.4x10^{-4}J/4= 0.6x10^4L$

$Q_H = 0.6x10^4 + 2.4x10^4J = 3.0x10^4$ J

14. One kilogram of chilled water at 32°F (0°C) is placed in a freezer which is kept at 0°F (–18°C). Approximately how much electric energy is needed to operate the compressor to cool this water to 0°F if the room temperature is maintained at 75°F (24°C)? ($L_{ice} = 3.33 \times 10^5$ J/kg; $c_{ice} = 2.09 \times 10^3$ J/kg·°C)

A) 13 kJ
B) 1.5 kJ
C) 57 kJ
D) 16 kJ
E) 33 kJ

COP = $T_C/(T_H-T_C)$ = 273/(24-(-18) = 6.5   COP= Q_L/W

COP ={ mL_F + mc_{ice} [0-(-18)]}/W

W = { 1kg3.33x10 + 1kg*2090 [0-(-18)]}/6.5 = 57 kW

1. In an isobaric compression of an ideal gas,
(*a*) no heat flows into the gas.
(*b*) the internal energy of the gas remains constant.
(*c*) no work is done on the gas.
(*d*) work is done on the gas.
(*e*) work is done by the gas.

(d)

4. An ideal gas undergoes an isothermal expansion from state A to state B. In this process (use sign conventions, page 413),
(*a*) $Q = 0,\ \Delta U = 0,\ W > 0.$
(*b*) $Q > 0,\ \Delta U = 0,\ W < 0.$
(*c*) $Q = 0,\ \Delta U > 0,\ W > 0.$
(*d*) $Q > 0,\ \Delta U = 0,\ W > 0.$
(*e*) $Q = 0,\ \Delta U < 0,\ W < 0.$

(d)

15. A 0.3-kg block, attached to a spring, executes simple harmonic motion according to x = 0.8 cos (35 rad/s·t), where x is in meters and t is in seconds. Find the spring constant of the spring.

A) 22 N/m
B) 1500 N/m
C) 368 N/m
D) 160 N/m
E) 2.8 N/ m

ω^2 m=k   k = 35^2*0.3kg = 368 N/m

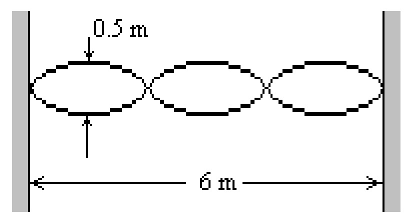
16. 200 g block attached to a spring oscillates with frequency of 12 Hz. If the amplitude of oscillations is 2.5 cm, what is the total energy of the spring-mass system?

A) **0.35 J** $E = ½kA^2$ $\omega 2$ m=k $(2\pi f)^2 m = k$ $k = (2\pi * 12Hz)^2 * 0.2$ kg = 5679 N/m
B) 0.65 J
C) 0.85 J $E = ½5679N/m*(0.025m)^2=0.35J$
D) 1.25 J
E) 1.75 J

17. A string of linear mass of 0.0015 kg/m is under a tension of 40 N. What should its length be if the frequency of the second harmonic is 440 Hz?

A) 0.26 m $v = (F/\mu)^{0.5} = (40N/0.0015kg/m^2)^{0.5}$ =163 m/s
B) 0.37 m
C) 0.41 m f = (v/2L)n solve for L
D) 0.85 m
E) 1.5 m

18. A standing wave is set up on a 180 g string, 6 m long as shown. What is the frequency of the wave if the string is under tension of 120 N?



n=3

A) 2 Hz
B) 8 Hz $\lambda = 2L/n = 12m/3 = 4$ m
C) 10 Hz $\mu = m/L = 0.18kg/6m = 0.03$ kg/m
D) 16 Hz
E) 22 Hz v= (F/μ) 0.5 = (120N/0.03)0.5= 63.2 m/s $v=\lambda f$ $f=v/\lambda = 15.8$ Hz

1) Mass on a spring: A mass *M* is attached to an ideal massless spring. When this system is set in motion with amplitude *A*, it has a period *T*. What is the period if the amplitude of the motion is increased to 2*A*?
A) 2*T*
B) *T*/2
C) $\sqrt{2}T$
D) 4*T*
E) *T*
Answer: E

If we double only the amplitude of a vibrating ideal mass-and-spring system, the mechanical energy of the system
A) increases by a factor of $\sqrt{2}$.
B) increases by a factor of 2.
C) increases by a factor of 3.
D) increases by a factor of 4.
E) does not change.
Answer: D