Practice Problems EXAM 2 PHYS 103

1. An aluminum electric tea kettle has a 1500-W heating coil. How long will it take to heat up 1 kg of water from 18°C to 98°C in this kettle? (specific heat of water is 4186 J/kg·°C)

Ans. 4 minutes

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

C = 349 J/kg^{0}C

3. A 120 grams of ice at temperature 0^0C added to water was able to decrease the temperature of water from 26^0C to 11^0C. What was the mass of the water? (latent heat of fusion for water is 33500 J/kg; specific heat of water is 4186 J/kg^{0}C) .

Ans m = 0.73 kg

4. 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?

Ans. T = 13.7^{0}C

5. 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)

Ans. P = 52 W

6. 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? ($\sigma = 5.67 \times 10^{-8}$ W/m^2K^4)

Ans. P = 431 W

7. A rod, with sides insulated to prevent heat loss, has one end immersed in boiling water at 100°C and the other end in a water-ice mixture at 0°C. The rod has uniform cross-sectional area 7.05 cm^2 and length 87 cm. The heat conducted by the rod melts the ice at a rate of 1.0 g every 11 seconds. What is the thermal conductivity of the rod? Recall that the heat of fusion of water is 3.34×10^5 J/kg.

Ans k = 370 W/ms

8. Gas in a container expands at a constant pressure of 3 atm adiabatically. Find the change in the internal energy of the gas (in J) if the initial volume is 5 liters and the final volume is 10 liters. (1 atm = 1.013×10^5 Pa, 1L = 0.001 m^3)

Ans. U = -1500 J

9. A Carnot engine takes 2000 J from a hot reservoir at 500 K, does some work, and discards some heat to cold reservoir at 350 K. The work done by the engine is closest to

Ans. 600 J

10. 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?

Ans. Q = 3 x 10^4 J

11. One kilogram of chilled water at 10^o C is placed in a freezer which is kept at -12^o C. Approximately how much electric energy is needed to operate the compressor to cool this water to -12^oC if the room temperature is maintained at 20^o C? (L_{ice} = 3.33 x 10^5 J/kg; c_{ice} = 2090 J/kgC^o c_w = 4186 J/kgC^o

50000

12. A mass of 0.40 kg, hanging from a spring with a spring constant of 80 N/m, is set into an up-and-down simple harmonic motion. What is the speed of the mass when moving through the equilibrium point? The starting displacement from equilibrium is 0.10 m.

Ans. v = 1.4 m/s

13 A mass of 0.40 kg, hanging from a spring with a spring constant of 80 N/m, is set into an up-and-down simple harmonic motion. What is the speed of the mass when moving through a point at 0.05 m displacement? The starting displacement of the mass is 0.10 m from its equilibrium position.

Ans. V =1.2 m/s

14 A 0.3-kg block, attached to a spring, executes simple harmonic motion according to x = 0.08 cos (35 rad/s·t), where x is in meters and t is in seconds. Find the total energy of the spring-mass system.

Ans.E =1.18 J

15. A 1.5-kg cart attached to an ideal spring with a force constant (spring constant) of 20 N/m oscillates on a horizontal, frictionless track. At time t = 0.00 s, the cart is released from rest at position x = 10 cm from the equilibrium position. Find the position of the cart at t = 5.0 s

Ans. x=8.25 cm

16. A 12.0-m brass wire is pulled taut with a tension of 125 N. It takes 0.09 s for a wave to propagate along the wire. What is the linear mass of the wire?

Ans. 0.007 kg/m

17. A rope with a total mass of 25.0 kg is tied to a tree on one side of a 125-m wide ravine. You are pulling on the other end of the rope with a force of 415 N. If you pluck the rope at your end, how long will it take the pulse to travel across the ravine to the tree?

Ans. t = 2.74 s