

Name _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

- 1) A mass of 50. kg is suspended from a steel wire of diameter 1.0 mm and length 11.2 m. How much will the wire stretch? (The Young's modulus for steel is 20×10^{10} N/m².) 34.9mm 1) _____
- 2) A wire of diameter 1.0 mm and length 3.5 m stretches 3.5 mm when 8.0 kg is hung from it. (a) What is the Young's modulus for the wire? 1×10^{11} (b) What is the effective spring constant for the stretching wire? 2.2×10^4 2) _____
- 3) Consider diving 20.0 m below the surface of the ocean (density 1.03 grams/cc). (a) what is the gauge pressure at that depth, in atmospheres? 1.99atm (b) what is the absolute pressure at that depth, in atmospheres? 2.99atm (c) If you were in a submarine at that depth, what would be the total force on a 100. cm² window? 2.02×10^3 3) _____
- 4) A cylindrical rod of length 12. cm and diameter 2.0 cm will just barely float in water. What is its mass? 37.7g 4) _____
- 5) A long telephone pole (wood density 0.80 kg/m³) is vertically lowered into a slightly larger vertical pipe which is filled with salt water of density 1.04 kg/m³. The pole ends up floating with what percent of the pole above the water? 23% 5) _____
- 6) An ideal fluid in a pipe of diameter 14. cm is moving at 6.0 m/s. (a) If the incompressible fluid density is 1.05 grams/cc, what is the flow rate in kg/s? 97kg/s (b) What is the speed of flow if the pipe narrows to 4.0 cm radius? 18m/s 6) _____
- 7) An incompressible fluid flows at 0.252 m/s through a 44. mm diameter (circular cross section) pipe. The pipe widens to a square cross sectional area 5.5 cm on a side. Assuming steady flow: (a) what is the speed through the "square" section? .13m/s (b) what is the flow rate in liters/minute? 23liters/minute 7) _____

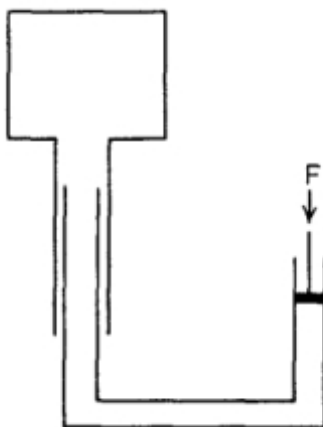
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

8) A plastic block of dimensions $2.0\text{ cm} \times 3.0\text{ cm} \times 4.0\text{ cm}$ has a mass of 30. grams. What is its density? 8) _____

- A) 1.2 g/cm^3
- B) 1.6 g/cm^3
- C) 2.3 g/cm^3
- D) 1.3 g/cm^3 XXX
- E) 0.80 g/cm^3

9) Instead of cables, a hydraulic lift raises an elevator weighing 2.5 kiloNewtons. The input piston has a 2.0 cm diameter and the lift piston has a 28. cm diameter (See Figure 9-3). 9) _____

Figure 9-3



What minimum force must be applied to the input piston?

- A) 13. NXXX B) 35. kN C) 0.49 MN D) 0.18 kN E) 2.5 kN

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

10) At what temperature are the numerical readings on the Fahrenheit and Celsius scales the same? -40 10) _____

11) The thermal coefficient of linear expansion of Copper is $1.7 \times 10^{-5}\text{ }^\circ\text{C}^{-1}$. What is the thermal volume expansion coefficient? 5.1×10^{-5} 11) _____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

12) Express your body temperature (98.6° F) in Celsius degrees.

12) _____

- A) 37.0° CXXX
- B) 66.6° C
- C) 72.6° C
- D) 45.5° C
- E) 29.5° C

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

13) A steel cable spanning a river is 200.000 m long when the temperature is 20.° C. What will be its length when the temperature drops to 0° C? (The coefficient of thermal expansion of steel is $12. \times 10^{-6} \text{ K}^{-1}$.)

13) _____

199.952m

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

14) "Absolute Zero" is what temperature on the Celsius and Fahrenheit scales respectively?

14) _____

- A) -212° C, -273° F
- B) 0° C, 459° F
- C) -273° C, -459° FXXX
- D) -273° C, -212° F
- E) -459° C, -273° F

15) A bolt hole in a brass plate has a diameter of 1.2 cm at 20.° C. What is the diameter of the hole when the plate is heated to 220.° C? (The coefficient of linear thermal expansion for brass is 19×10^{-6} per degree C.)

15) _____

- A) 1.190 cm
- B) 1.210 cm
- C) 1.205 cmXXX
- D) 1.200 cm
- E) 1.195 cm

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16) The water flowing over Niagara Falls drops a distance of 50. m. Assuming that all the gravitational energy is converted to thermal energy, by what temperature does the water rise?.

16) _____

12C

17) At what rate is the human body radiating energy when it is at 33°C? Take the body surface area to be 1.4 m², and approximate the body as a black body..

17) _____

7KW

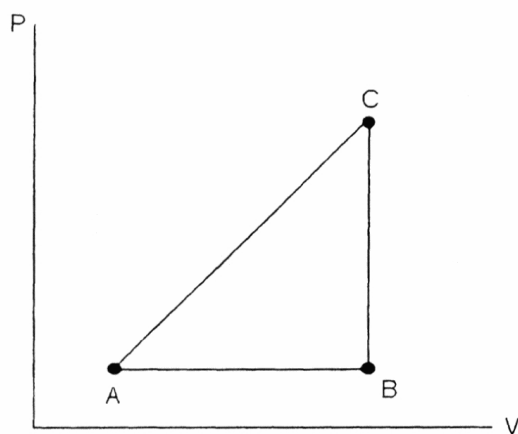
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

- 18) A 0.10 kg piece of copper, initially at 95°C , is dropped into 0.20 kg of water contained in a 0.28-kg aluminum can; the water and aluminum are initially at 15°C . What is the final temperature of the system? 18) _____
 A) 17.8°C CXXX B) 19.2°C C) 18.3°C D) 23.7°C
- 19) What temperature exists inside a solar collector (effective collection area of 15 m^2) on a bright sunny day when the outside temperature is $+20^{\circ}\text{C}$? Assume that the collector is thermally insulated, that the sun irradiates the collector with a power per unit area of 600 W/m^2 , and that the collector acts as a perfect black body. 19) _____
 A) 154°C B) 73°C C) 93°C CXXX D) 107°C E) 33°C
- 20) A lamp radiates 75 J/s when the room is set on 27°C but it radiates 90 J/s when the room temperature drops to 10°C . What is the temperature of the lamp? 20) _____
 A) 97°C B) 97 K C) 110°C D) 86°C CXXX E) 86 K

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- 21) Referring to Figure 12-9, a substance carried from point A to B absorbs 50 J and finds its internal energy has increased by 20 J . Going from B to C the internal energy decreases by 5 Joules . 21) _____

Figure 12-9



- (a) How much work was done from A to B? 30 J
 (b) How much heat was absorbed from B to C? -5 J
 (c) How much work was done going from B to C? Zero
- 22) A piece of metal at 80°C is placed in 1.2 L of water at 72°C . The system is thermally isolated and reaches a final temperature of 75°C . Estimate the approximate change in entropy for this process. 2 cal/K 22) _____

- 23) What is the change of entropy of water ($L_f = 0.333 \text{ MJ/kg}$, $L_v = 2.26 \text{ MJ/kg}$) when 450. grams of water: 23) _____
- (a) changes from liquid to steam? 2.73 kJ/K
(b) changes from ice to liquid? 549 J/K

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

- 24) How much heat must be removed from steam to change it to liquid? 24) _____
- A) 1.8 kcal/g B) 600 cal/g C) 1 kcal/g D) 540 cal/g XXX
- 25) How much heat is needed to raise the temperature of 200 g of lead ($c = 0.11 \text{ kcal/kg} \cdot ^\circ\text{C}$) by 10°C ? 25) _____
- A) 2000 cal B) 330 cal XXX C) 20 kcal D) 33.0 cal

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

- 26) An engine on each cycle takes in 40. Joules, does 10. Joules of work, and expels 30. J of heat. What is its efficiency? $=25\%$ 26) _____
- 27) A heat engine absorbs 64 kcal of heat each cycle and exhausts 42 kcal. 27) _____
- (a) Calculate the efficiency each cycle. $=34\%$
(b) Calculate the work done each cycle. $=22 \text{ Kcal}$
- 28) A refrigerator has a COP of 2.5. If it removes 7.7 MJ of heat in 25. minutes, 28) _____
- (a) what is the minimum power motor to operate the refrigerator? 2.1 KW
(b) what is its efficiency if it were a reversible engine? 29%
- 29) If the efficiency of a reversible engine is 28% , 29) _____
- (a) what is its COP operated as a refrigerator? 2.6
(b) what is its COP operated as a heat pump? 3.6

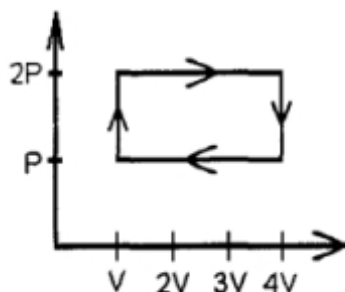
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

- 30) An athlete doing push-ups performs 650 kJ of work and loses 425 kJ of heat. What is the change in the internal energy of the athlete? 30) _____
- A) 276 kJ
B) -225 kJ
C) -1075 kJ XXX
D) 225 kJ
E) 1075 kJ

31) A gas is taken through the cycle illustrated here in Figure 12-10.

31) _____

Figure 12-10



During one cycle, how much work is done by an engine operating on this cycle?

- A) pV B) $4pV$ C) $5pV$ D) $2pV$ E) $3pV$ XXX

32) A certain engine extracts 1300 J of heat from a hot temperature reservoir and discharges 700 J of heat to a cold temperature reservoir. What is the efficiency of this engine?

32) _____

- A) 54% B) 86% C) 46%XXX D) 13% E) 27%

33) If the theoretical efficiency of a Carnot engine is to be 100%, the heat sink must be

33) _____

- A) at 0°C .
B) at absolute zero.XXX
C) a perfect radiator.
D) infinitely hot.
E) at 100°C .

34) What is the theoretical efficiency of a Carnot engine that operates between 600 K and 300 K?

34) _____

- A) 100% B) 75% C) 25% D) 50%XXX E) 0%

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

35) What is the spring constant of a spring that stretches 2.0 cm when a mass of 0.60 kg is suspended from it? .29KN/m

35) _____

36) A spring-driven dart gun propels a 10. g dart. It is cocked by exerting a force of 20. N over a distance of 5.0 cm. With what speed will the dart leave the gun, assuming the spring has negligible mass? 10m/s

36) _____

37) A 0.30 kg mass is suspended on a string. In equilibrium the mass stretches the spring 2.0 cm downward. The mass is then pulled an additional distance of 1.0 cm down and released from rest.

37) _____

- (a) Calculate the period of oscillation. =0 .28s
(b) Calculate the total energy of the system. 0.0074J

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

- 38) An air conditioner with a coefficient of performance of 3.5 uses 30 kW of power. How much power is it discharging to the outdoors? 38) _____
- A) 75 kW
B) 210 kW
C) 105 kW
D) 30 kW
E) 135 kWXXX
- 39) What is the change of entropy associated with 3.0 kg of water freezing to ice at 0.°C? 39) _____
- A) -0.88 kcal/KXXX B) +0.88 kcal/K
C) 1.0 kcal/K D) -1.1 kcal/K
- 40) 1500 J of work is equivalent to how much heat? 40) _____
- A) 6,279,000 cal B) 358 calXXX C) 6.279 kcal D) 358 kcal

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

- 41) 0.45 kg of a metal at 90.° C is added to 0.40 kg of water at 20.0° C. 41) _____
- (a) If the final temperature of the mixture is 26.° C, what is the specific heat of the metal?
(b) If the water container has a significant heat capacity, will this increase or decrease the metal specific heat determined in part "a"given the same data?
- 42) A pendulum makes 12 complete swings in 8.0 s. 42) _____
- (a) What is its frequency?1.5Hz(b) What is its period?o.67sec
- 43) An object oscillates such that its displacement is $x = (0.222 \text{ m}) \sin(314. t)$ where t is in seconds. 43) _____
- (a) In one period, the object moves what distance?.888m
(b) What is the frequency?50Hz
(c) What is the position at $t = 1.00 \text{ s}$?-0.0352m
- 44) Suppose you want to set up a simple pendulum with a period of 0.250 s. 44) _____
- (a) What length is required if $g = 9.80 \text{ m/s}^2$ on Earth?0.0155m
(b) What length would be required on the moon assuming g is 6 (assume exact) times LESS than on Earth?0.259cm

- 45) A string of length 2.5 m is fixed at both ends. When the string vibrates at a frequency of 85 Hz, a standing wave with five loops is formed. 45) _____
- (a) Determine the distance between two adjacent nodes. 0.5m (b) Determine the wavelength of the waves that travel on the string. 1.0m
- (c) Determine the velocity of waves. 85m/s
- (d) Determine the fundamental frequency of this string. 17Hz
- 46) "Absolute Zero" is how many Fahrenheit degrees below freezing (water)? 491 below freezing 46) _____

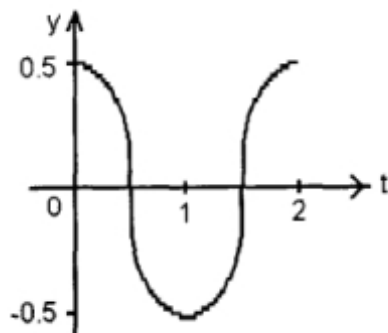
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

- 47) The mass of a mass-and-spring system is displaced 10 cm from its equilibrium position and released. A frequency of 4 Hz is observed. What frequency would be observed if the mass had been displaced only 5 cm and then released? 47) _____
- A) 2 Hz B) 4 Hz XXX C) 8 Hz D) 6 Hz
- 48) A mass attached to the free end of an ideal spring executes SHM according to the equation $x = 0.5 \sin(20t)$ where x is in meters and t is in seconds. What is the magnitude of the maximum acceleration for this mass? 48) _____
- A) 20 m/s^2
- B) 100 m/s^2
- C) 10 m/s^2
- D) $(20/\pi) \text{ m/s}^2$
- E) 200 m/s^2 XXX
- 49) Grandfather clocks often are built so that each one-way swing of the pendulum is a second. How long is the length of a simple pendulum for a 2.00 second period? 49) _____
- A) 24.8 cm
- B) 0.993 m XXX
- C) 101.cm
- D) 500. cm
- E) 0.500 m

50) The equation of motion of the wave shown in Figure 13-6 is

50) _____

Figure 13-6



- A) $y = 0.5 \sin(40t)$.
- B) $y = 0.5 \cos(40t)$.
- C) $y = 1.0 \cos(2\pi t)$.
- D) $y = 1.0 \sin(\pi t)$.
- E) $y = 0.5 \cos(\pi t)$.

51) What is the wavelength (in meters) of a wave whose displacement is given by $y = 0.5 \sin(0.20x + 120t)$, where x and y are in meters and t in seconds?

51) _____

- A) 10. m
- B) 19. m
- C) 0.20 m
- D) 5.0 m
- E) 31. mXXX

52) What is the frequency (in Hz) of a wave whose displacement is given $y = 50. \sin(0.20x + 120t)$, where x and y are in cm and t in seconds?

52) _____

- A) 19. HzXXX
- B) $120\sqrt{2\pi}$ Hz
- C) 10 Hz
- D) 0.5 Hz
- E) 0.120 kHz

53) What mass should be attached to a vertical spring ($k = 39.5$ N/m) so that the natural vibration frequency of the system will be 1.00 Hz?

53) _____

- A) 1.56 kg
- B) 2.00 kg
- C) 1.00 kgXXX
- D) 39.5 kg
- E) 6.29 kg

- 54) A 25.0-g string is stretched with a tension of 43.0 N between two fixed points 12.0 m apart. What is the frequency of the second harmonic? 54) _____
- A) 12.0 HzXXX
 B) 18.0 Hz
 C) 36.0 Hz
 D) 24.0 Hz
 E) 6.00 Hz
- 55) Find the first three harmonics of a string of linear mass density 2.00 g/m and length 0.600 m when it is subjected to tension of 50.0 N. 55) _____
- A) 66 Hz, 132 Hz, 198 Hz
 B) 132 Hz, 264 Hz, 396 HzXXX
 C) 264 Hz, 528 Hz, 792 Hz
 D) none of the above
- 56) The velocity of propagation of a transverse wave on a 2.0 m long string fixed at both ends is 200. m/s. Which one of the following is not a resonant frequency of this string? 56) _____
- A) 25 HzXXX
 B) 100 Hz
 C) 200 Hz
 D) 50 Hz
- 57) A 2.0 kg mass is attached to the end of a horizontal spring ($k = 50. \text{ N/m}$) and set into simple harmonic motion with an amplitude of 10. cm. What is the total mechanical energy of this system? 57) _____
- A) 0.25 JXXX
 B) 1.00 J
 C) 25 J
 D) 2.5 J
 E) 0.02 J
- 58) Water flows through a horizontal pipe of cross-sectional area $10. \text{ cm}^2$ at a pressure of 0.25 atm. The flow rate is 1.0 L/s. At a valve, the effective cross-sectional area of the pipe is reduced to 5.0 cm^2 . What is the pressure at the valve? 58) _____
- A) 0.112 atm
 B) $7.7 \times 10^3 \text{ Pa}$
 C) 0.157 atm
 D) 0.235 atmXXX
 E) 0.200 atm