

November 9, 2009

$$N_A = 6.02 \times 10^{23}$$

- (a) 720
(b) 1080
(c) 24
(d) 12,000
(e) none of these

4. What is the shortest length (in cm) of a hollow tube, open at each end, that will resonate at a frequency of 100 Hz? The speed of sound is 340 m/s.
- (a) 340
 - (b) 170
 - (c) 85
 - (d) 680
 - (e) none of these
5. The speed of waves on a stretched string is 8 m/s. The length of the string is 1.2 m. What frequency of vibration (in Hz) of one end of the string will set up standing waves with five antinodes?
- (a) 4.3
 - (b) 16.7
 - (c) 8.6
 - (d) 17.2
 - (e) none of these
6. The density of a certain metal is 4500 kg/m^3 . What would have to be the height (in cm) of a solid cylinder of this metal, having a radius $r = 0.06 \text{ m}$, and mass $m = 900 \text{ g}$?
- (a) 3.54
 - (b) 14.36
 - (c) 1.77
 - (d) 4.53
 - (e) none of these
7. The area of the smaller piston of a hydraulic lift system is 12 cm^2 , while the lift piston has an area of 300 cm^2 . What weight in N may be lifted by the lift piston if a 90 N force is applied to the push piston?
- (a) 25
 - (b) 30
 - (c) 200
 - (d) 2250
 - (e) none of these
8. The temperature drop of a 400 gram block of this metal is 21.3 C° when 800 cal of thermal energy are removed. What is the specific heat capacity of this metal, in cal/g-C?
- (a) 0.094
 - (b) 0.087
 - (c) 0.033
 - (d) 1.234
 - (e) none of these

9. An object having a mass of 900 kg and a density of 450 kg/m^3 is held under water. What is the buoyant force on the object, in N?

- (a) 900
- (b) 8820
- (c) 1800
- (d) 19,600
- (e) none of these

10. How many atoms are in 28 grams of carbon dioxide ($\text{C}_2\text{H}_5\text{OH}$)?

- (a) 1.87×10^{24}
- (b) 1.56×10^{22}
- (c) 7.56×10^{23}
- (d) 3.30×10^{24}
- (e) none of these

11. How many liters of ethane (C_2H_6) at standard temperature and pressure will contain 4×10^{24} atoms of hydrogen?

- (a) 17.43
- (b) 74.42
- (c) 49.54
- (d) 24.81
- (e) none of these

12. A stretched wire 0.60 meters long is vibrating in standing wave mode at 40 Hz, with six “loops,” i.e., six antinodes. What is the speed of the waves on this wire, in m/s?

- (a) 24
- (b) 6
- (c) 18
- (d) 8
- (e) none of these

13. A metal plate at 20°C is 2.000 m long and 1.300 m wide; the metal has a coefficient of thermal expansion of 8×10^{-6} per $^\circ\text{C}$. What would be the new area in m^2 if the temperature is lowered to -300°C ?

- (a) 2.5692
- (b) 2.5987
- (c) 2.5867
- (d) 2.5994
- (e) none of these

14. What is the fourth-lowest frequency of sound (in Hz) that will resonate in a hollow tube, 70 cm long, open at one end, closed at the other end? The speed of sound is 340 m/s.

- (a) 850
- (b) 425
- (c) 607
- (d) 529
- (e) none of these

15. A sound source emits sound at a frequency of 2000 Hz. The source speeds away from a stationary listener, who hears sound 1910 Hz. Roughly what is the speed of the sound source, in m/s?

- (a) 8.4
- (b) 15.3
- (c) 21.9
- (d) 16.0
- (e) none of these

16. 4000 calories of thermal energy are added to 40 grams of ice at 0 °C, converting all of it to water, and then raising the melted water's temperature. What is the final temperature of the water, in °C?

- (a) 12
- (b) 30
- (c) 20
- (d) 40
- (e) none of these

17. An object is losing thermal energy by emitting electromagnetic radiation. If the rate at which energy is being lost is 1000 W, what would be the rate of loss from an object made of the same substance, but with one-fourth the surface area, and at a Kelvin temperature four times as great?

- (a) 500
- (b) 1000
- (c) 3200
- (d) 6400
- (e) none of these

18. A 40 gram metal block at 70 °C, and having a specific heat capacity of 0.09 cal/g-C, is placed in 200 g of water at 20 °C. What will the equilibrium temperature of the mixture, in degrees Celsius?

- (a) 20.9
- (b) 23.8
- (c) 28.6
- (d) 30.1
- (e) none of these

19. What would have to be the minimum radius (in cm) of a circular “suction cup” attached to a wall at sea level if it is to withstand an 800 N pull perpendicular to the wall?

- (a) 9.8
- (b) 5.0
- (c) 2.4
- (d) 4.6
- (e) none of these

20. The rate (in J/s, or W) at which thermal energy is conducted down a bar of length L , cross sectional area A , is given by $R = kA \Delta T/L$, where ΔT is the temperature difference between the ends of the bar in Celsius degrees, and k is the “thermal conductivity.” A is measured in m^2 , and L is measured in meters.

The cross section of a metallic bar is a rectangle 4.0 cm wide and 7.0 cm tall. Its length is 1.2 m. The thermal conductivity is 80.2 W/m-C. If one end of the bar is at 30 °C, and the other end is at 100 °C, how many joules of thermal energy will be transported down the bar in one hour?

- (a) 23,500
- (b) 47,200
- (c) 15,600
- (d) 9,700
- (e) none of these