

**Physics 10 Final (250 PTS MAX) - #B**  
**5:35PM, Fall 2003**

1. A 50-gram chunk of  $80^{\circ}\text{C}$  iron is dropped into a cavity in a very large block of ice at  $0^{\circ}\text{C}$ . How many grams of ice will melt? (The specific heat capacity of iron is  $0.11\text{ cal/g}^{\circ}\text{C}$ .) (a) 50 gm (b) 5.0 gm (c) 5.5 gm (d) 10 gm
2. What is the ideal efficiency of an OTEC power plant where fuel is heated to 2700 K and the outdoor air is at 270 K? (a) 10% (b) 20% (c) 90% (d) 80%
3. Convert the temperature  $120^{\circ}\text{F}$  to the Celsius scale: (a)  $120^{\circ}\text{C}$  (b)  $45^{\circ}\text{C}$  (c)  $48.89^{\circ}\text{C}$  (d)  $15^{\circ}\text{C}$
4. In a weather forecast, it is reported that the high temperature for the next day is expected to be  $15^{\circ}\text{C}$ . How should you dress to go to class tomorrow? (What is the Fahrenheit temperature?) (a)  $15^{\circ}\text{F}$  (b)  $30^{\circ}\text{F}$  (c)  $59^{\circ}\text{F}$  (d)  $50^{\circ}\text{F}$
5. A child has a temperature of  $40^{\circ}\text{C}$ . Is this serious? Explain in terms of Fahrenheit temperature. (a)  $40^{\circ}\text{F}$  (b)  $60^{\circ}\text{F}$  (c)  $80^{\circ}\text{F}$  (d)  $104^{\circ}\text{F}$
6. A strict user of the SI tells you that the temperature that day is 288 K. What is the temperature on the Fahrenheit? (a)  $15^{\circ}\text{F}$  (b)  $59^{\circ}\text{F}$  (c)  $30^{\circ}\text{F}$  (d)  $30^{\circ}\text{C}$
7. In a thermodynamic process a quantity of gas expands, doing 100 J of work. If only 25 J of energy are added to the system in the process, what is the energy deficit, and where does this energy come from? (a) -75 J (b) -25 J (c) -100 J (d) 25 J
8. A heat engine does 125 J of work each cycle while receiving 375 J of heat per cycle. What is the engine's thermal efficiency? (a) 20% (b) 33% (c) 40% (d) 60%
9. Two pellets, each with a charge of 1 microcoulomb ( $10^{-6}\text{ C}$ ), are located 3 cm (0.03 m) apart. What is the electric force between them? What mass object would experience this same force in the Earth's gravitational field? (a) 6 N (b) 10 N (c) 3 N (d) 20 N
10. The wattage marked on a light bulb is not an inherent property of the bulb but depends on the voltage to which it is connected, usually 110 or 120 V. How many amperes flow through a 120-W bulb connected in a 120-V circuit? (a) 0.5 A (b) 2.0 A (c) 0.75 A (d) 1.0 A
11. Using the equation Power = current • voltage, find the current drawn by a 1200-W hair dryer connected to 120 V. Then using the method you used in the previous problem, find the resistance of the hair dryer. (a) 10 A,  $12\ \Omega$  (b) 12 A,  $10\ \Omega$  (c) 120 A,  $1200\ \Omega$  (d) 5 A,  $6\ \Omega$
12. A cello string 0.75 m long has a 220-Hz fundamental frequency. Find the wave speed along the vibrating string. (a) 660 m/sec (b) 330 m/sec (c) 330 m (d) 660 m
13. A bat flying in a cave emits a sound and receives its echo 0.1 s later. How far away is the cave wall? (a) 17 m (b) 34 m (c) 51 m (d) 102 m
14. How far does the light travel in one year? This distance is known as a light-year and is commonly used length in astronomy. (a)  $9.46 \times 10^8\text{ km}$  (b)  $9.46 \times 10^{12}\text{ km}$  (c)  $9.46 \times 10^{13}\text{ km}$  (d)  $2.592 \times 10^{10}\text{ km}$
15. Light in air is incident on a surface at an angle of  $60^{\circ}$ . What is its angle of refraction in glass? ( $n_{\text{G}} = 1.5$ ) (a)  $22^{\circ}$  (b)  $35.264^{\circ}$  (c)  $40^{\circ}$  (d)  $60^{\circ}$
16. Locate the image of an arrow placed 60 cm from a diverging lens with a focal length of 30 cm. (a) 20 cm (b) -20 cm (c) 60 cm (d) -60 cm
17. Over what range of positions can an object be located so that the image produced by a converging lens is real and smaller than the object? (a)  $d_o > 2f$  (b)  $d_o < 2f$  (c)  $d_o < f$  (d)  $d_o > f$
18. What is the speed of light in glass with an index of refraction of 1.6? (a)  $1.6 \times 10^8\text{ m/sec}$  (b)  $1.875 \times 10^8\text{ m/sec}$  (c)  $3.0 \times 10^8\text{ m/sec}$  (d)  $4.0 \times 10^8\text{ m/sec}$
19. If it takes light 5 ns to travel 1 m in an optical cable, what is the index of refraction in the cable? (a) 1.3333 (b) 1.5 (c) 2.0 (d) 3.0
20. A European visitor reads that the average temperature of two different places in the United States is  $59^{\circ}\text{F}$ . He asks you what these temperatures are in Celsius. Could you help him? (a)  $59^{\circ}\text{C}$  (b)  $15^{\circ}\text{C}$  (c)  $45^{\circ}\text{C}$  (d)  $77^{\circ}\text{C}$
21. What is the Kelvin temperature when the Fahrenheit and Celsius temperatures are equal? (a) 40K (b) -40C

(c) -40F (d) 233K

22. On a very hot day the temperature gets up to 100° F. A strict SI buff has his Kelvin thermometer along. What does it read? (a) 100K (b) 37.78K (c) 310.78K (d) 137.78K
23. A system receives 25 kcal of heat energy. If 5.0 kcal go into internal energy, how many joules of energy of mechanical work are done by the system? (Hint: 1 kcal = 4.2 kj.) (a) 20KJ (b) 84 KJ (c) 25 KJ (d) 5.0 KJ
24. The period of an SHM oscillation a) is equal to 1/f b) increase with amplitude c) has units of hertz d) is always in phase
25. If the motions of two oscillators were opposite, we say they are a) out of phase b) in SHM c) in phase d) both (a) and (c)
26. If the combined waveforms of two identical interfering waves is smaller than that of either wave, the interference is said to be a) constructive b) destructive c) standing d) both (b) and (c)
27. Standing waves a) have no motion at all b) are always out of phase c) have zero amplitude at the nodal positions d) can have only one characteristic frequency
28. When driven at resonance, a rope vibrates a) out of phase b) at only one possible frequency c) at only the 2<sup>nd</sup> harmonic or 2<sup>nd</sup> overtone d) at maximum amplitude
29. The speed of sound is a) independent of temperature b) on the order of 34m/s in air c) generally greater in liquids than in solids d) none of these
30. If a sound source and an observer both move with the same constant velocity, the frequency heard by the observer relative to the source frequency would be a) the same b) lower c) higher
31. The bel unit is a comparative measure of sound a) frequency b) quality c) intensity level d) none of these
32. A pleasant musical sound is said to be a) in octave b) consonant c) loud d) dissonant
33. For the Doppler effect to occur, there must be a) a moving listener b) a moving source of sound c) relative motion between a source of sound and listener d) all of these
34. Heat is a) a form of energy b) energy transferred because of a temperature difference c) internal energy in transit d) all of the preceding
35. The degree Fahrenheit is equal to the unit interval on a) the Celsius scale b) the Kelvin scale c) both (a) and (b) d) none of the preceding
36. Which of the following units could be used for specific heat? a) Cal/g°C b) kcal/kg-K c) Btu/lb-degree F d) all of the preceding
37. The smallest temperature unit is a) degree Celsius b) degree Fahrenheit c) the Kelvin d) all are the same
38. The human temperature sense is associated with a) touch b) sight c) hearing d) smell
39. The catastrophe of the ultraviolet catastrophe a) a shift or change in color with temperature b) a violation of the conservation of energy c) the emission of thermal radiation d) none of these
40. For a photon to cause the emission of an electron, it must have a frequency a) equal to Planck's constant b) in the visible region c) greater than the threshold frequency d) none of the preceding
41. The quantum hypothesis was introduced by a) Planck b) Einstein c) Bohr d) DeBroglie
42. When a hydrogen electron is excited to a higher energy level, a) it must be in the ground state b) a photon must be emitted c) energy is absorbed d) a photon of any frequency may be absorbed
43. Light amplification in a laser is due to a) spontaneous emission b) stimulated emission c) the photoelectric effect d) the ultraviolet catastrophe
44. If you wish to warm 100 kg of water by 30° C for your bath, how much heat is required? (Give your answer in calories and joules.) (a) 1000 Kcal (b) 2000 Kcal (c) 3000 Kcal (d) 4000 Kcal
45. What will be the final temperature of 100 g of 20° C water when 100 g of 40° iron nails are submerged in it? (The specific heat of iron is 0.12 cal/g C°. Here you should equate the heat gained by the water to the heat lost by the nails.) (a) 31.4°C (b) 22.1°C (c) 22.1°F (d) 22.1°K
46. Will burns a 0.6-g peanut beneath 50 g of water, which increases in temperature from 22° C to 50° C. Assuming 40% efficiency, what is the food value in calories of the peanut? (a) 1000 Cal (b) 1500 Cal (c) 2500 Cal (d) 3500 Cal