1. A harmonic wave on a string travels at 4 m/s and has a wavelength of 2 m. What is its frequency?
   (A) 2 Hz  (B) 8 Hz  (C) ½ Hz  (D) 0.5 s

2. If the period of a wave is 1/3 sec, what is its frequency?
   (A) 1/3 Hz  (B) 9 Hz  (C) 3 Hz  (D) 1 Hz

3. A heat engine operating in a cycle absorbs 10,000 J of heat from a high temperature reservoir and discards 4000 J to a low temperature reservoir. What is the % efficiency of this engine?
   (A) 0.6%  (B) 6%  (C) 14%  (D) 60%

4. To double the period of a pendulum you should
   (A) double its length
   (B) quadruple its length
   (C) halve its length
   (D) double the mass
   (E) halve the mass

5. Which statement is FALSE concerning the electrical charging process?
   (A) both conductors and nonconductors can be changed
   (B) when plastic is rubbed with fur it gets a negative charge
   (C) conductors have free electrons that can carry the flow of current
   (D) when glass is rubbed with silk, the glass gets positively charged because protons are transferred to it

6. You observe that a pendulum takes 2 s to swing from one side to the other side. What is the period of this pendulum?
   (A) 1 s  (B) 2s  (C) 4 s  (D) ½ s  (E) 8 s

7. The phenomenon that caused the failure of the Tacoma narrows bridge was
   (A) harmonic oscillation  (B) resonance  (C) wind  (D) poor engineering

8. Object A has a charge of –10 C and object B has a charge of –20 C. If –5 C of charge is transferred from object A to object B what is the final charge on A and B?

   A         B
   (A)  –15C  –15C
   (B)  –5C  –25C
   (C)  +5C  +25C
   (D)  –10C  –25C

9. The law of electric force between two charges is named after
   (A) Ampere  (B)Faraday  (C)Coulomb  (D) Oersted
10. Currents produce magnetic fields. This is known as the law of
   (A) Ampere    (B) Faraday    (C) Coulomb    (D) Hertz    (E) Oersted

11. A 60 W light bulb is connected to a 120 V outlet. How much current flows through the bulb and what is the resistance of the bulb?

   Current (amps)          Resistance (ohms)
   (A) 2                   2
   (B) ½                   240
   (C) 7200                ½
   (D) ½                   60

12. How much will it cost to run a 1000 W hair dryer for 5 minutes if the cost of electricity is 6 cents per kilowatt-hour (KWH)?
   (A) 10 cents    (B) 5 cents    (C) 1 cent    (D) ½ cent

13. You are given 2, 1.5 volt batteries. Which of the diagrams below illustrates the correct way to connect them to produce 3 volts?

   (A)                       (B)                        (C)                     (D)
   ![Diagram A]              ![Diagram B]             ![Diagram C]             ![Diagram D]

14. Which statement is TRUE concerning the magnetic field lines of a bar magnet?
   (A) they form circles that go around the axis of the magnet
   (B) they go from the north pole to the south pole
   (C) they go from the south pole to the north pole

15. A resistor with R = 4 Ω is connected to a 12 volt battery. How much current flows through the resistor and how much heat energy is produced in it each second?

   Current (A)    Power (W)
   (A) 3           0
   (B) 3           48
   (C) 1/3         4
   (D) 3           36

16. When bar magnet is thrust into a loop of wire, a current is induced in the loop. This was discovered by
   (A) Oersted      (B) Ampere     (C) Maxwell     (D) Faraday     (E) Hertz
17. What is the wavelength of the electromagnetic wave used in a 3 GHz (1 GHz = 10^9 Hz) microwave oven?
   (A) 1 mm  (B) 1 cm  (C) 10 cm  (D) 1 m

18. Which statement below is FALSE concerning electromagnetic waves?
   (A) They were discovered theoretically by Maxwell
   (B) They propagate at the speed of light
   (C) They consist of propagating constant electric and magnetic fields
   (D) Their frequency and wavelength are related by the golden rule

19. We always observe that ice melts when placed in water. This is due to
   (A) The first law of thermodynamics
   (B) The second law of thermodynamics
   (C) both
   (D) neither

20. Which statements are consistent with the second law of thermodynamics?
   (A) Heat flows spontaneously from a hot object to a cold object
   (B) Heat engines cannot be 100% efficient
   (C) molecules are never found all on one side of a box
   (D) spontaneous process always proceed to a more disordered state
   (E) all of the above

21. Standing waves are the result of
   (A) wave propagation  (B) interference  (C) the golden rule

22. A pendulum is released from rest from point A and then swings back and forth. Ignore the effects of friction and air resistance. Which statement is TRUE.
   A) The pendulum has kinetic energy at A
   B) The pendulum has maximum kinetic energy at B
   C) The pendulum has its least kinetic energy at B
   D) The potential energy decreases as it goes from B to C

23. A mass of 2 kg is hung from a vertical spring having a spring constant k = 100 N/m. How much does the spring stretch?
   A) 0.02 m  B) 50 m  C) 50 cm  D) 0.2 m

24. Which of these statements concerning the simple pendulum is FALSE?
   A) the period of the pendulum changes with the length
   B) the period of the pendulum does not depend on the mass
   C) the period of the pendulum does not depend on the amplitude
   D) the period of a pendulum is the same on earth and on the moon
   E) the period of the pendulum doubles if the length is increased by a factor of 4
25. Which statement is FALSE concerning sound waves?
   A) they are compressional waves in a gas or liquid
   B) they travel faster in water than in air, and faster in solids than in liquids
   C) they cannot propagate in a vacuum
   D) they are longitudinal waves
   E) they are transverse waves

ANSWERS

| 1 | A | 14 | B |
| 2 | C | 15 | D |
| 3 | D | 16 | D |
| 4 | B | 17 | C |
| 5 | D | 18 | C |
| 6 | C | 19 | B |
| 7 | B | 20 | E |
| 8 | B | 21 | B |
| 9 | C | 22 | B |
| 10| A | 23| D |
|11| B | 24| D |
|12| D | 25| E |
|13| B |   |   |