Science 3101
Test II

Multiple Choice (3 points each, place answer on the answer sheet)

1. A satellite in an elliptical orbit travels at constant
   a. velocity     b. speed
   c. acceleration     d. none of these

2. A rocket fired vertically at 11.2 km/s will escape the Earth. If it is instead fired horizontally at this
   speed, free from obstructions, will it still escape the Earth?
   a. yes     b. no     c. there’s no way to tell     d. am I in the right room?

3. Pumice is a volcanic rock that floats. Its density is
   a. less than the density of water.     b. equal to the density of water.
   c. more than the density of water.

4. The volume of water displaced by a floating 20-ton boat is
   a. 20 cubic meters
   b. the volume of 20 tons of water.
   c. the volume of the boat
   d. depends on the shape of the boat’s hull.

5. Buoyant force is greatest on a submerged
   a. 1 cubic centimeter block of lead.
   b. 1 cubic centimeter block of aluminum.
   c. is the same on each.

6. A bubble of air released from the bottom of a lake
   a. rises to the top at constant volume
   b. becomes smaller as it rises.
   c. becomes larger as it rises.
   d. alternately expands and contracts as it rises.

7. Airplane flight is best illustrated by
   a. Archimedes’ principle
   b. Bernoulli’s principle
   c. Boyle’s law

8. When you touch a cold piece of ice with your finger, energy flows
   a. from your finger to the ice.
   b. from the ice to your finger
   c. both ways

9. The SI unit for heat energy is
   a. joules
   b. calories
   c. BTU (British Thermal Unit)
   d. kilocalories

10. We are warmed by condensation because water molecules in the air that strike our bodies
    a. transfer some of their kinetic energies to us.
    b. gain kinetic energy as they change state.
    c. form an insulating layer on our bodies.
11. A substance can absorb heat energy by the process of
   a. conduction
   b. convection
   c. radiation
   d. all of these

12. If an object radiates more energy than it absorbs, its
   a. thermal energy decreases.
   b. temperature decreases.
   c. both of these.
   d. neither of these.

13. The planet Earth loses heat mainly by
   a. conduction
   b. convection
   c. radiation
   d. all of these

14. The greater the difference in temperature between the input reservoir and the output reservoir for a heat engine, the
   a. greater the efficiency.
   b. less the efficiency.
   c. neither, efficiency doesn’t depend on temperature difference.

15. The ideal efficiency for a heat engine operating between temperatures of 2700°K and 300°K is
   a. 10%
   b. 24%
   c. 80%
   d. 89%

16. When the distance between two charges is halved, the electrical force between the charges
   a. quadruples
   b. doubles
   c. halves
   d. is reduced by one-quarter

17. An ohm is a unit of electrical
   a. pressure
   b. current
   c. resistance
   d. potential

18. A 10 ohm resistor has 5 A current in it. What is the voltage across the resistor?
   a. 0.2 V
   b. 5 V
   c. 50 V
   d. none of these

19. When two lamps are connected in series to a battery, the resistance that the battery senses is
   a. more than the resistance of either lamp.
   b. less than the resistance of either lamp.
   c. the same as the resistance in a single lamp.

20. A 6 ohm resistor is connected in parallel with a 20 ohm resistor. This combination produces an equivalent resistance of
   a. 26 ohm
   b. 0.039 ohm
   c. 4.6 ohm
   d. none of these

21. Voltage can be induced in a wire by
   a. moving the wire near a magnet.
   b. moving a magnet near the wire.
   c. changing the current in a nearby wire.
   d. all of these

22. A device that transforms electrical energy to mechanical energy is a
   a. generator
   b. motor
   c. transformer
   d. magnet
23. A step-up transformer increases
   a. power
   b. energy
   c. voltage
   d. amperage

24. When there is a change in the magnetic field in a closed loop of wire,
   a. a voltage is induced in the wire.
   b. current is made to flow in the loop of wire.
   c. electromagnetic induction occurs.
   d. all of these

25. Compared to the amount of electric current that flows in a filament of a lamp, the amount of current
    that flows in the connecting wire is
   a. definitely less
   b. often less
   c. actually more
   d. the same

Problems (SHOW ALL WORK ON THE ANSWER SHEET):

1. (5 points) What is the ideal efficiency of an automobile engine in which gasoline is heated to 1500K
   and the outdoor air is 275K?

   \[
   \frac{1500K - 275K}{1500K} = 0.817
   \]

   or

   \[
   \left( \frac{1500K - 275K}{1500K} \right) \times 100 = 81.7\%
   \]

2. (5 points) How much current flows through a lamp that has a resistance to 60 ohms when 12 V is
   passed through it?

   \[
   \text{current} = \frac{\text{voltage}}{\text{resistance}} = \frac{12\text{volts}}{60\text{ohms}} = 0.20\text{amps}
   \]

3. (5 points) How much electrical power is supplied by a system running at 120V and 15 amps?

   \[
   \text{power} = \text{voltage} \times \text{current} = 120V \times 15A = 1800\text{watts}
   \]
4. (5 points) An ideal transformer has 150 turns in its primary and 250 turns in its secondary. For 12 V AC connected to its primary, what is the voltage supplied by the secondary?

\[
\frac{V_{\text{primary}}}{\text{Turns}_{\text{primary}}} = \frac{V_{\text{secondary}}}{\text{Turns}_{\text{secondary}}}
\]

\[
\frac{12V}{150} = \frac{x}{250}
\]

\[x = 20V\]

5. (5 points) How much energy is absorbed when 25.0g of water is warmed from 25.0°C to 40.0°C? (the specific heat of water is 1.0 cal/g°C)

\[
\text{specific heat} = \frac{\text{calories}}{\text{mass} \cdot (t_{\text{final}} - t_{\text{initial}})}
\]

\[
1.0\text{cal/g°C} = \frac{x}{25.0g \cdot (40.0°C - 25.0°C)}
\]

\[x = 375\text{cal}\]