I. Multiple Choice Item

Carefully read each multiple-choice item and select one correct answer from the corresponding choices. **21pt**

(1.5pt each)

1. Choose the wrong statement(s) among the following regarding phase transition
   A. Temperature remains constant.
   B. Heat is either released or absorbed.
   C. Temperature can change.
   D. Latent heat of fusion causes a substance to change from liquid to gas.
   E. C and D.
2. Which of the following heat transfer mechanisms takes place through the mass flow of fluid?
   A. Convection
   B. Conduction
   C. Radiation
   D. None of them
3. Heat is the flow of energy between systems in thermal contact due to difference in
   A. internal energy.
   B. temperature.
   C. thermal expansion.
   D. heat capacity.
4. In an adiabatic process, an increase in internal energy of a system is equal to the
   A. heat absorbed by the system.
   B. work done by the system.
   C. heat released from the system.
   D. work done on the system.
5. A simple pendulum with a length of 4 m oscillates on the surface of unknown planet. What is the surface gravity on the planet if the period of oscillations is 4 s?
   A. $3.14\ m/s^2$
   B. $6.28\ m/s^2$
   C. $9.42\ m/s^2$
   D. $9.86\ m/s^2$

6. If the amplitude of a simple harmonic motion is tripled, what will be the maximum velocity of the oscillation if no other changes made to the motion?
   A. Doubled
   B. Tripled
   C. Quadrupled
   D. None of the above
7. According to the Doppler effect, if a sound source and an observer are moving away from each other with velocities v_s and v_o, respectively, then the observed frequency f_o and the source frequency f_s are related as (denoting the speed of sound by v):
   A. $f_o = \frac{v+v_o}{v-v_s} f_s$
   B. $f_o = \frac{v+v_o}{v+v_s} f_s$
   C. $f_o = \frac{v-v_o}{v-v_s} f_s$
   D. $f_o = \frac{v-v_o}{v+v_s} f_s$
8. The magnetic flux through a loop of wire is maximum when the magnetic field lines are
   A. parallel to the loop's plane.
   B. at 45° with respect to the loop's plane.
   C. perpendicular to the loop's plane.
   D. None of the above.
9. If an inflated balloon contains a net charge of -0.016 nC, then the number of excess electrons on it will be
   A. 1.0×10^9
   B. 0.50×10^8
   C. 1.0×10^8
   D. 1.0×10^7
10. What is the function of a diode?
   A. Acts as a current amplifier.
   B. Acts as a switch.
   C. Stores electric charge.
   D. Allows the flow of current in both directions.

11. Which of the following statement is correct about N-type semiconductors?
    A. The majority charge carriers are electrons.
    B. The impurity added is a trivalent atom.
    C. The majority charge carriers are holes.
    D. B and C.
12. One of the following materials are known to have the highest energy gap between the valence and conduction bands of their atoms:
    A. Insulators
    B. Conductors
    C. Semiconductors
    D. None of the above
13. Among the three sections of transistors which one is heavily doped?
    A. Base
    B. Emitter
    C. Collector
    D. All of the above
14. Which one of the following logic gates give(s) the output as high only if all the inputs signals are high?
    A. NOT gate
    B. AND gate
    C. NAND gate
    D. NOR gate

II. Black Space and Short Answer Items

Fill Blank Spaces with correct answers and clearly state short answers (do not show calculations). **14pt**

15. A gas is compressed at a constant pressure of 0.80 Pa from 0.09 m^3 to 0.02 m^3. In the process, 400 J of energy leaves from the gas in the form of heat. Then **(2pt each)**
    A. work done on the gas is _____.
    B. change in internal energy of the gas is _____.
16. _____ is the amount of energy required to convert a unit mass of a solid into a liquid without any change in the temperature.
17. If a simple harmonic oscillator takes 12.0 s to undergo five complete cycles, then the frequency of the oscillation is _____.
18. The maximum displacement from its equilibrium position of a sinusoidal wave is known as _____.
19. Diodes have a low resistance when they are _____ biased and a very high resistance when they are _____ biased.
20. _____ is the process of adding impurity to a pure semiconductor crystal to improve its conductivity.
21. Sketch the symbol of the NPN transistor:

III. **Workout Items**

Solve each of the following items by showing all the necessary steps. **15pt**

22. Find the amount of heat required to convert 500 g of ice at $-10\ °C$ into water at 20 °C? (Use $L_f = 334\ \text{kJ / kg}$, $c_{ice} = 2260\ \text{J/kg °C}$ and $c_{water} = 4186\ \text{J/kg °C}$.) (4pt)

23. An object oscillates with simple harmonic motion along the x-axis. Its displacement as a function of time is $x(t) = 2.0\cos(0.75\pi t - 0.25\pi)$ m where t is in seconds and the angles are in radians. Find (2pt)

a) the amplitude, period and frequency of the motion (3pt)

b) the displacement, velocity and acceleration of the object at $t = 2.0$ s

24. A rectangular coil of dimension 5.4 cm × 8.5 cm is placed in a magnetic field of magnitude 0.35 T. What is the magnetic flux on the rectangular loop when

a) the field is perpendicular to the plane of the loop. (1.5pt)

b) the angle between the field and the normal of the loop is 30°. (1.5pt)