(1) 單選題每題 5% 請依序作答，答錯不扣分。

1. An electric heater is constructed by applying a potential difference of 100 V across a wire with a resistance of 5 Ω. What is the power rating of the heater?
   A. 2000  B. 500  C. 2500  D. 20  E. 0.05  W

2. The nucleus of a hydrogen atom, a proton, sets up an electric field. The charge on the proton is 1.6x10^-19 C. The distance between the proton and electron is about 5x10^-11 m. What is the magnitude of the electric field at this distance from the proton? \( K_e = 9 \times 10^9 \text{ Nm}^2/\text{C}^2 \) A. 5.5x10^10 B. 5.5x10^10 C. 5.5x10^11 D. 5.5x10^12 E. 28.8 N/C

3. A fountain sends water to a height of 10 m. What must be the pressure at the top of the water system? (1 ATM = 10^5 N/m^2)
   A. 10  B. 100  C. 1000  D. 10^4  E. 10^5  N/m^2.

4. A 0.01-kg bullet is fired into a 0.1-kg block of wood at rest on a horizontal surface. The speed of the bullet before impact is 100 m/s. What is the velocity of the block after impact?
   A. 0.01  B. 0.1  C. 1  D. 10  E. 100 m/s.

5. Stars originate from large bodies of slowly rotating gas. Because of gravity, these clumps of gas slowly decrease in size. The angular velocity of a star increases as it shrinks because of A. conservation of energy  B. conservation of angular momentum  C. conservation of angular momentum  D. conservation of mass  E. the law of universal gravitation.

6. A pendulum is constructed using a thin rope (m=0.01 kg, l=1 m) and a small sphere (m=1 kg). The period for small oscillations is approximately A. 1  B. 2  C. 3  D. 4  E. 5 seconds.

7. A long straight wire (diameter = 2 mm) carries a current of 20 A. What is the magnitude of the magnetic field 4 mm from the axis of the wire? \( k_m = \frac{B}{r} = 10^{-7} \text{T/mA} \)
   A. 20  B. 10  C. 2  D. 1  E. 0.5 x10^{-3} Tesla.
8. A parallel plate capacitor (電容器) consists of two conducting plates of area $A$ separated by an air space of thickness $d$, and is connected to a battery. If a plastic slab of dielectric constant $\varepsilon > 1$ is placed between the plates:  
A. the electric field between the plates increase.  
B. the electric field between the plates decreases.  
C. the potential difference between the plates decreases.  
D. the capacitance of the capacitor increases.  
E. the charge density on the plate decreases.

9. Which of the following is NOT electromagnetic wave?  
A. gamma-ray  
B. blue light  
C. radio wave  
D. microwave  
E. All are electromagnetic wave.

10. Which of the following utilizes nuclear fusion (核融合)?  
A. the nuclear power plant  
B. the nuclear submarine  
C. the hydrogen bomb  
D. the atomic bomb  
E. the solar battery.

(2) Draw a diagram for a transformer (變壓器) and explain how it works. (15%)  

(3) From the zeroth to the third, state the four laws of thermodynamics (熱力學第零到第三定律). Briefly explain them if necessary. (20%)  

(4) Plot the temperature dependence of the resistance for a metal, a semiconductor and a superconductor (超導體), respectively. (15%)