

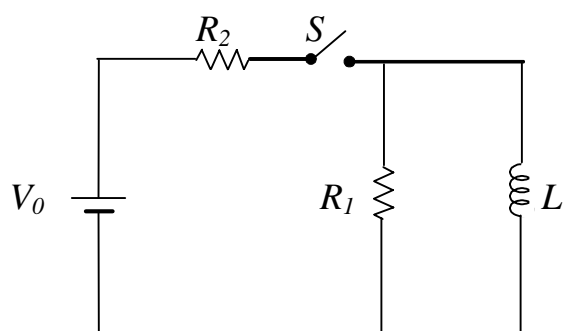
# 國立嘉義大學九十三年學年度轉學生招生考試試題

科目：普通物理

(請將答案寫在答案卷上)

## 一、選擇題(40% , 每題 4%)

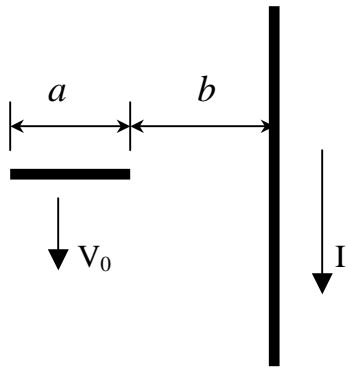
1. A glass plate ( $n=1.61$ ) is covered with a thin uniform layer of oil ( $n=1.2$ ). A monochromatic light beam in air is incident normally on oil surface. Observation of the reflected beam shows destructive interference at 500 nm and constructive interference at 750 nm, with no intervening maxima or minima. What is thickness of the film?  
(A) 313 nm (B) 362 nm (C) 390 nm (D) none of the above
2. The de Broglie wavelength of a thermal neutron with mass  $M$  at a temperature of  $27^\circ\text{C}$  is  
(A)  $\frac{h}{\sqrt{300MK}}$  (B)  $\frac{\sqrt{900MK}}{h}$  (C)  $\frac{\sqrt{27MK}}{h}$  (D) none of the above
3. A transverse sinusoidal wave equation  $y(x,t)=0.3\cos[3\pi t-2\pi x+\pi/3]$  in SI units. What specific characteristics will we have by the given equation? (A) the wave propagates along  $-x$  axis (B) wave speed  $v=1.5\text{m/s}$  (C) period  $T=1.5\text{s}$  (D) phase of the wave is  $\pi/3$
4. A hollow material cubic of inner and outer length 8 and 9cm correspondingly, floats just half-submerged in a liquid of density  $800\text{kg/m}^3$ . What is the density of the material for which the cubic was made?  
(A) 0.4 (B) 1.0 (C) 1.3 (D) 1.7
5. A uniformly charged insulating sphere of radius  $R$  and total charge  $q$ . Calculate the magnitude of the electric potential at a point inside the sphere ( $a < R$ ).  
(A)  $\frac{q(3R^2 - a^2)}{4\pi\epsilon_0 R^2}$  (B)  $\frac{q(2R^3 - a^3)}{8\pi\epsilon_0 R^3}$  (C)  $\frac{q(2R^3 - a^3)}{4\pi\epsilon_0 R^3}$  (D)  $\frac{q(3R^2 - a^2)}{8\pi\epsilon_0 R^2}$
6. A single conservative force  $F(x)$  acts on a 1kg particle that moves along an  $x$  axis. The potential energy  $U(x)$  associated with  $F(x)$  is given by  $U(x) = -4xe^{-x/4}$  J, where  $x$  is in meters. Determine the  $F(x)$  for this system with  $e^{-1}=0.37$ . (A)  $F(0)=0$  (B)  $F(-1)=F(1)$  (C)  $F(4)=F_{\text{max}}$  (D)  $F(x<0)>0$
7. At  $t=0$ , the switch  $S$  in the figure is closed. How much time does taken when the current in the inductor reaches  $\frac{V_0}{4R_2}$   
(A)  $\frac{L}{R_2} \ln 4$  (B)  $\frac{L(R_1 + R_2)}{R_1 R_2} \ln 4$  (C)  $L(R_1 + R_2) \ln 4$  (D)  $\frac{LR_1 R_2}{R_1 + R_2} \ln 4$



8. A pellet gun fires ten 0.2g pellets per second with a speed of 100m/s. A rigid wall reflected each pellet back in 2 milli-second with same speed. What's the average force on the wall?  
(A) 200N (B) 1000N (C) 2000N (D) Undermined.
9. A short section of wire of length  $a$ , is moving with a constant velocity  $V_0$  parallel to a very long wire carrying a current  $I$  as shown in figure. What is the induced emf between the ends of the short section?

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- (A)  $\frac{\mu_0 IV_0}{2\pi} \ln \frac{a+b}{b}$  (B)  $\frac{\mu_0 IV_0}{2\pi} \ln \frac{a+b}{a}$  (C)  $\frac{\mu_0 IV_0}{2\pi} \ln \frac{a}{b}$  (D)  $\frac{\mu_0 IV_0}{2\pi} \ln \frac{b}{a}$



10. A block moves with uniform circular motion because a cord tied to the block is anchored at the center of a circle. Is the power due to the force on the block from the cord be  
 (A) Positive (B) Negative (C) Zero (D) Undetermined.

## 二、計算題 (每題 15%)

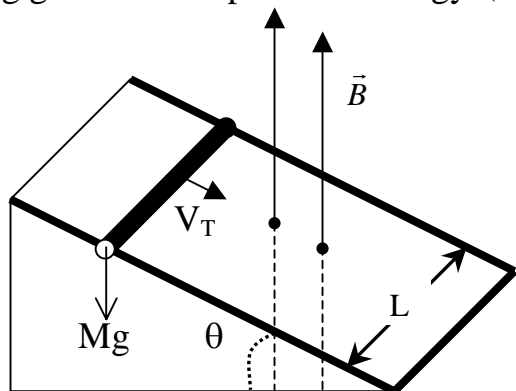
1. Pressure  $p$ , volume  $V$  and temperature  $T$  for a certain material are related by  $p = \frac{AT - BT^2}{V}$  where  $A$  and  $B$  are constants. Find an expression for the work done by the material if temperature changes from  $T_1$  to  $T_2$  in isobaric process.

2. Write down the solution  $x(t)$  for damped harmonic motion equation  $m \frac{d^2 x(t)}{dt^2} + b \frac{dx(t)}{dt} + kx(t) = 0$  with  $x(0) = X_{\max}$  and  $\dot{x}(0) = 0$ .

3. A rod of length  $L$ , mass  $M$ , and resistance  $R$  slides without friction down a pair of parallel conducting rails of negligible resistance, as shown in figure below. The rails are connected together at the bottom as shown, forming a conducting loop with the rod as the top member. The plane of the rails makes an angle  $\theta$  with the horizontal and a uniform vertical magnetic field  $\vec{B}$  exists throughout the region.

- (a) Show that the rod acquires a steady state terminal speed whose magnitude is  $V_T = \frac{MgR \sin \theta}{B^2 L^2 \cos^2 \theta}$ . (8%)

- (b) Show that the rate at which thermal energy is being generated in the rod is equal to the rate at which the rod is losing gravitational potential energy. (7%)



4. X-rays of wavelength 0.2 nm are scattered from a carbon target. If the scattered radiation is detected at  $60^\circ$  to the incident beam, find

- (a) the Compton shift  $\Delta\lambda$  (7%)

- (b) the kinetic energy imparted to the recoiling electron. (8%)