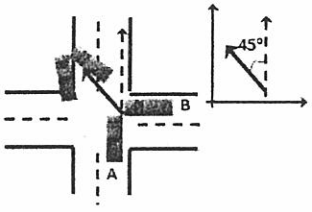
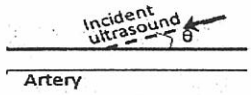
1、(10%)The vehicle (Car A) with mass of 25kg was traveling north and hit the westbound vehicle (Car B) with mass of 15kg. Immediately afterward the traffic accident, two vehicles were entangling together and were sliding on the road in a direction of 45° relative to the initial direction of Car A. The driver of Car B claimed that he had stopped at the stop sign and was then driving through the intersection at a speed of less than 30 km/h while the Car A moving at a speed of at least 60 km/h. It is noted that Car A had the right of the way (道路優先權) because Car B had a stop sign and must made a full stop before proceeding. Can the description by the driver of Car B be correct?



2、(20%) (a)Design a physical pendulum to measure the free-fall acceleration g at a particular location on Earth's surface, taking the pendulum to be a uniform rod of length L and mass m. Make prediction, with detailed deduction, of the theoretical g in function of the period of oscillation T and L. (b)If the distance from the pivot point to the center of mass is d. What is the relation between T and d ? (The rotational inertia of this pendulum about a perpendicular axis through its center of mass is $(1/12)mL^2$) (c) Is the physical pendulum complete equivalent to a simple pendulum if the rod swings about a pivot point at one end?

3、(10%)Doppler ultrasonography is used to measure the speed of the blood in the body, by taking the acoustic source from the ultrasound generator which is stationary. (a) What is the frequency of the ultrasound sent into the body comparing with the frequency of the ultrasound reflected back by the blood, suppose incident ultrasound at angle θ to the blood's travel line. (b) If θ were greater, would the reflected frequency be greater or less?



4、(20%) (a)What is the theoretical maximum efficiency of an electric power plant, which produce stream with temperature as high as 600 °C and exhaust the waste heat into the environment at a temperature of 20 °C? (b)Suppose we have 250g of water at 0°C. We want to freeze this water by putting it into a refrigerator which operating in an environment of 27 °C. The temperature inside the refrigerator is maintained at -23 °C. What is the minimum amount of electrical energy that must be supplied to the refrigerator to freeze the water? (c) How much does the entropy change for the water completely frozen to the ice at temperature 0 °C? Is the entropy change positive or negative? Dose the result consist with the second law of thermodynamics. (The latent heat of fusion of water (ice) is 334 kJ/kg. Unit: 273K= 0°C.)

5、(20%)A coaxial cable with the diameter of center conductor a and inner diameter of cable shield b. The space in between is filled with a medium of dielectric constant ε.(a) Calculate the inductance L per unit length. (b) What is the capacitive reactance per unit length of the coaxial cable carrying a current $I = I_{max} \sin \omega t$? (c) Make a low-pass filter based on ac voltage divider circuit utilizing a resistor connected with a capacitor or inductor. What is the ratio of output voltage to input voltage in response to the frequency?

6、(20%) (a) What is physical meaning for the experiment, in 1927, Davisson and Germer scattered electrons from aluminium foil and observed diffraction pattern similar to x-rays, which confirmed de Broglie's hypothesis. (b) Make physical interpretation of the Schrödinger equation, being viewed as quantum operator form of the conservation of classical mechanic energy (potential + kinetic) applied to the particles. **(c)** A particle of mass m is confined in an one-dimensional infinite square well with $U(x) = 0$ in $0 < x < L$ and $U(x) = \infty$, for $x < 0$ and $x > L$. Complete the solution for the wave functions and the energies for the particle.

試題隨卷繳回