1. Block 1 (mass m_1 = 8.00 kg) is moving on a frictionless 30.0° incline. This block is connected to block 2 (mass m_2 = 22.0 kg) by a massless cord that passes over a massless and frictionless pulley (see Figure 1). Find the acceleration of each block and the tension in the cord.
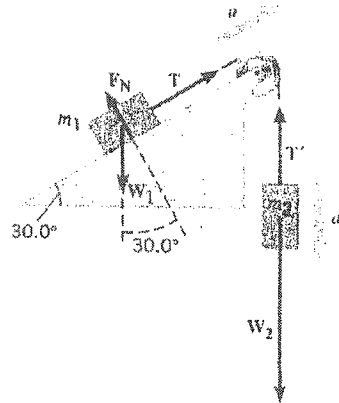

Figure 1

2. Cold water at a temperature of 15 °C enters a heater, and the resulting hot water has a temperature of 61°C. A person uses 120 kg of hot water in talking a shower. Find the energy needed to heat the water.

3. Two positive charges, q_1 = +16 μC and q_2 = +4.0 μC, are separated in a vacuum by a distance of 3.0 m, as Figure 2 illustrates. Find the spot on the line between the charges where the net electric field is zero.
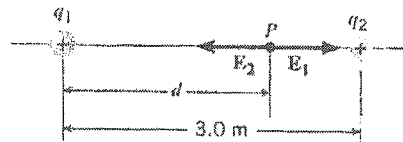

Figure 2

4. As shown in Figure 3, using a zero reference potential at infinity, determine the amount by which a point charge of 4.0×10^{-8} C alters the electric potential at a spot 1.2 m away when the charge is positive.
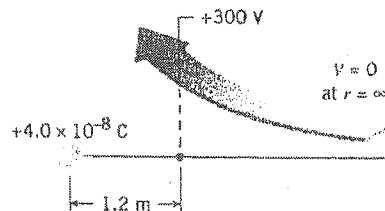

Figure 3

注意：背面有試題

5. Figure 4 shows a circuit that contains two batteries and two resistors. Determine the current I in the current.
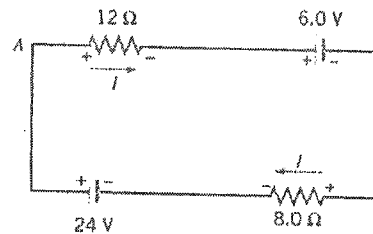

Figure 4

6. Suppose the rod in Figure 5 is moving at a speed of 5.0 m/s in a direction perpendicular to a 0.80-T magnetic field. The rod has a length of 1.6 m and a negligible electrical resistance. The rails also have negligible resistance. The light bulb, however, has a resistance of 96 Ω. Find (*a*) the current induced in the circuit, (*b*) the energy used by the bulb in 60.0 s.
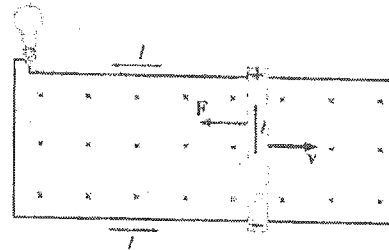
參考用

Figure 5

7. The Bohr model does not apply to multiple-electron atoms, but it can be used to make estimates. Use the Bohr model to estimate the minimum energy that an incoming electron must have to knock a K-shell electron entirely out of an atom in a platinum ($Z = 78$) target in an X-ray tube.

8. As shown in Figure 6, red light ($\lambda = 664$ nm in vacuum) is used in Young's experiment with the slits separated by a distance $d = 1.20 \times 10^{-4}$ m. The screen is located at a distance of $L = 2.75$ m from the slits. Find the distance y on the screen between the central bright fringe and the third-order bright fringe.
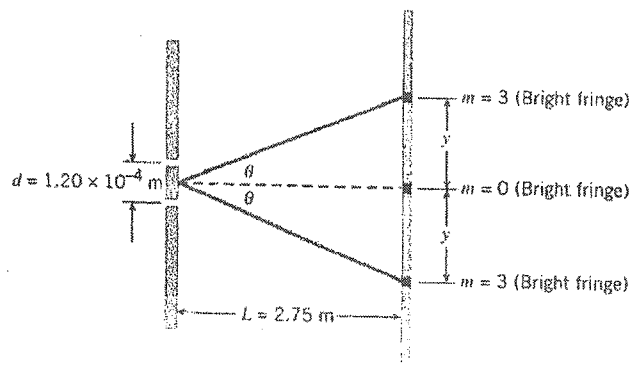

Figure 6

注意：背面有試題

9. Blood in the arteries is flowing, but as a first approximation, the effects of this flow can be ignored and the blood can be treated as a static fluid. Estimate the amount by which the blood pressure P_2 in the anterior tibial artery at the foot exceeds the blood pressure P_1 in the aorta at the heart when a person is (a) reclining horizontally as in Figure 7a and (b) standing as in Figure 7b.
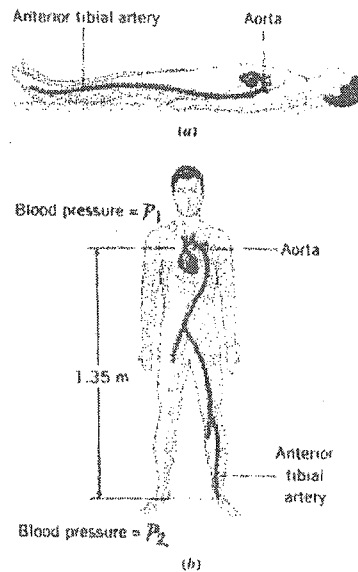

Figure 7

10. A 0.20-kg rocket in a fireworks display is launched from rest and follows an erratic flight path to reach the point P, as Figure 8 shows. Point P is 29 m above the starting point. In the process, 425 J of work is done on the rocket by the nonconservative force generated by the burning propellant. Ignoring air resistance and the mass lost due to the burning propellant, find the speed v_f of the rocket at the point P.
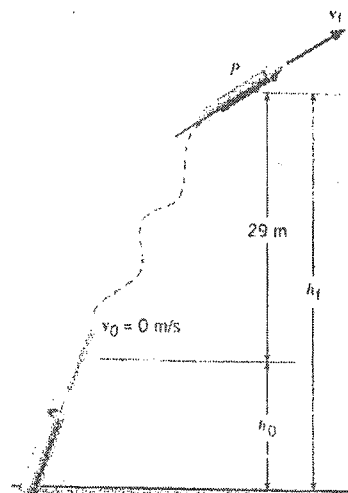

Figure 8

NOTE: 10 points for each question and some useful constants:
  a. Coulomb constant: $k = 8.99 \times 10^9 \, N \cdot m^2/C^2$
  b. Mass density of blood $\rho = 1060 \, kg/m^3$
  c. Specific heat capacity of water: $c = 4186 \, J/(kg \cdot °C)$