計算題：每題 10 分

1. A human body consists mainly of water. One mole of water has a mass of 18 g. Assuming the molecules of water in your body are closed packed together; make a rough estimate of the size of a single water molecule (liner size). (Use a 60 Kg man with the dimension of 1.75m x 0.4m x0.3m)
2. A ball is thrown straight up with a speed of 10.0 m/sec from a third floor window that is located 15.0 m above the ground. Calculate the maximum height of the ball, the ball's velocity when it hits the ground, and the total time it takes to reach the ground.
3. A female professor with a light eraser in her hand leans against a blackboard. Her arm makes an angle of 30^0 with the horizontal, and the force $\mathbf{F}_{prof}$ exert by her arm on the eraser has magnitude $\mathbf{F}_{prof} = 50N$. The coefficient of the static friction between the eraser and the blackboard is $\mu_s = 0.15$. Does the eraser slip? Her mass is 55 Kg, and the coefficient of static friction between her and the floor is μ_l. What is the minimum value ofμ_l for which she will not slip on the floor?

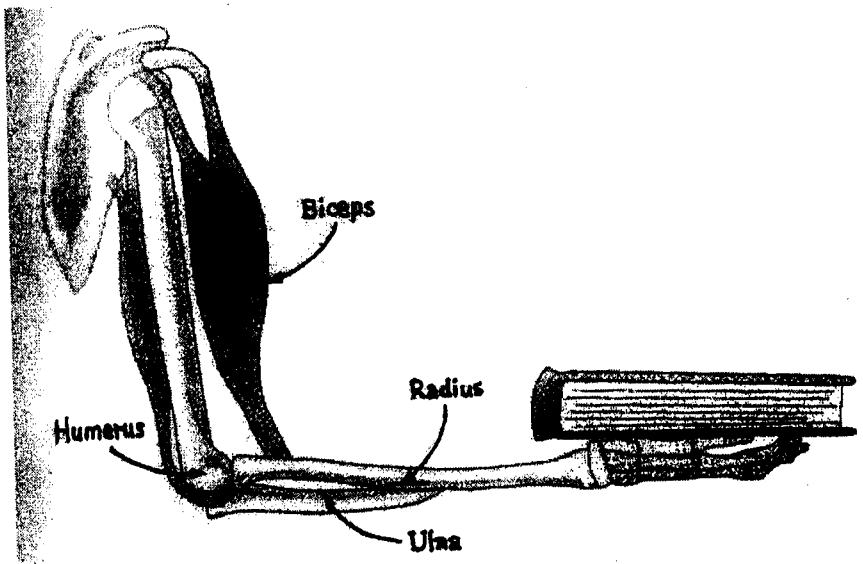
(a)

4. The engine of a train pulls 5 cars, each of mass m = 30,000 Kg. During a period of acceleration, the force between the engine and the first car is 45,000 N. (a) What is the acceleration of the train? (b) Sketch the forces acting on the first car (c) How larger if the tension (force) in the hook between the first and second cars? (d) If the size of hook is 10 cm by 10 cm iron, what is the stress in this iron hook

(背面仍有題目,請繼續作答)

between the second and third cars?

5. A cannonball is fired horizontally with an initial speed of 125m/s from the top of a cliff that is 68 m above the see. What is the speed of cannonball when it hits the water? How is that changed if the cannon is inclined at a 32^0 angle with the horizontal without any change initial speed? Ignore all the effects of air resistance.
6. A mass m attached to a spring of spring constant k is stretched a length X from its equilibrium position and released with no initial motion. (a) What is the maximum speed attained by the mass in the subsequent motion? (b) At what time is this speed first attained? (Hint: frequency $\omega = (k/m)^{-1/2}$)
7. The biceps muscle is responsible for bending your arm. It acts through a kind of lever system, as in next Fig. Some typical values for a, the elbow-hand distance, and x, the distance from the biceps attachment point to the elbow, are a = 30 cm and x = 4 cm. If a mass 5 Kg is held in your hand with your forearm horizontal and your upper arm vertical, what upper force does the biceps have to exert on the forearm bone? The cross sectional area for biceps is about 4 cm^2 and the biceps is stretched about 2% elastically from measurement. Estimate what is the Young's Modulus for biceps? Ignore the weight of the forearm bone itself and assume the hand-forearm forms a single system.



(a)

8. A giraffe needs a strong heart because of its long neck. Suppose that the difference between aortic valve (the place where arterial blood comes out of the heart) and the head of a giraffe is 2.5 m, and that the artery leading from near the aortic valve to the head has constant cross section. What is the minimum pressure at the aorta valve? Blood is an incompressible fluid with density $\rho = 1.0\ g/cm^3$)

9. A block of iron (mass 100 g) is heated in an oven to 500^0K and then plunged into a closed, thermally insulated container of 0.5 kg of water at 292^0K. The block and the water come to an equilibrium temperature of 297^0K. What is the specific heat of iron? Assume that the specific heats of water and iron do not vary significantly over the temperature ranges in equation.

10. Two parallel metal plates have area A = 225 cm^2 and are separated by ℓ = 0.50 cm. They have a potential difference of 0.25 V. Find the numerical value of the electric field. What are the charge density and total charge on each plate. Draw the equipotential surfaces at 0,10 V and 0.2 V. (Hint: $E = \sigma / \varepsilon_0$ where E: electric field, σ: charge per unit area, ε_0: permittivity $8.85 \times 10^{-12}\ C^2/N \cdot m^2$)