

※ 考生請注意：本試題不可使用計算機

1. Please describe the relationships of the viscosities of liquid and gas with temperature, respectively, and explain the reasons. (15%)
2. An open, 60 cm-diameter tank contains water to a depth of 90 cm when at rest. If the tank is rotated about its vertical axis with an angular velocity of 160 rpm, what is the minimum height of the tank walls to prevent water from spilling over the sides? (15%)
3. The pressure in domestic water pipe is typically  $4 \text{ kg/cm}^2$  above atmosphere. If viscous effects are neglected, please determine the height reached by a jet of water through a tiny hole in the top of the pipe. (15%)
4. A hot-air balloon structural weight, including the passengers, is 275 kg, the ambient temperature is 290K, and the air density is  $1.22 \text{ kg/m}^3$ . The balloon is then inflated with hot air and its volume can be a sphere of diameter  $D = 15 \text{ m}$ . What is the internal temperature while the liftoff begins? (15%)
5. Please describe the boundary layer concept. (10%)
6. A nozzle is attached to an 80-mm inside-diameter flexible hose. The nozzle area is  $500 \text{ mm}^2$ . If the delivery pressure of water at the nozzle inlet is 700 kPa, what is the horizontal component (axial direction along the hose) of the anchoring force? Do you think a normal fireman can hold the hose and nozzle in this condition firmly? (15%)
7. Please plot a figure to show the relationship of the drag coefficient,  $C_D$ , and the Reynolds number,  $Re$ , and explain their physical meanings. (15%)