

5-9 一个开口的柱形水池,水深 H ,在水池

一侧水面下 h 处开一小孔(如图).

(1) 从小孔射出的水流到地面后距池壁的距离 R 是多少?

(2) 在池壁上多高处开一个小孔,使射出的水流与(1)有相同的射程?

(3) 在什么地方开孔,可以使水流有最大的射程? 最大射程是多少?

$$(1) H-h = \frac{1}{2}gt^2 \Rightarrow t = \sqrt{\frac{2(H-h)}{g}}, \quad v = \sqrt{2gh}$$

$$R = vt = 2\sqrt{(H-h)h}$$

$$(2) \text{ 设水面下处高为 } h', \text{ 则: } 2\sqrt{(H-h)h} = 2\sqrt{(H-h')h'}, \quad h' = H - h$$

$$(3) R = 2\sqrt{(H-h)h}, \text{ 当 } H-h=h \text{ 时有最大射程, } h = \frac{H}{2}, \quad R_{\max} = H.$$

5-14 水管的横截面积在粗处为 40 cm^2 , 细处为

10 cm^2 (如图), 流量为 $3000 \text{ cm}^3/\text{s}$, 求:

(1) 粗处和细处水的流速;

(2) 粗处和细处的压强差;

(3) U 形管中水银柱高度差.

$$(1) Q = S_1 v_1 = S_2 v_2 = 3000 \text{ cm}^3/\text{s}$$

$$\therefore v_1 = \frac{Q}{S_1} = \frac{3000}{40} = 75 \text{ cm/s} = 0.75 \text{ m/s}$$

$$\therefore v_2 = \frac{Q}{S_2} = \frac{3000}{10} = 300 \text{ cm/s} = 3 \text{ m/s}$$

$$(2) P_1 + \frac{1}{2} \rho v_1^2 = P_2 + \frac{1}{2} \rho v_2^2 \Rightarrow P_1 - P_2 = \frac{1}{2} \times 10^3 \times (3^2 - 0.75^2) = 4.22 \times 10^3 \text{ Pa}$$

$$(3) P_1 + \rho gh = P_2 + \rho' gh \Rightarrow h = \frac{P_1 - P_2}{(\rho' - \rho)g} = \frac{4.22 \times 10^3}{(13.6 - 1) \times 10^3 \times 9.8} = 3.42 \text{ cm}$$

习题5-6: 弹簧秤D下挂有物块A，A浸没于烧杯B的液体C中。
 已知： $G_B = 7.3N$ 、 $G_C = 11.0N$ 、 $F_D = 18.3N$ 、 $F_E = 54.8N$ 、
 $V_A = 2.83 \times 10^{-3} m^3$ 。求(1)液体密度 ρ_C ；(2)将A拉到液体外，弹簧秤的读数 G'_A 。

$$(1) \text{ 对物块 } A: \quad F_D = G_A - F_{\text{浮}}$$

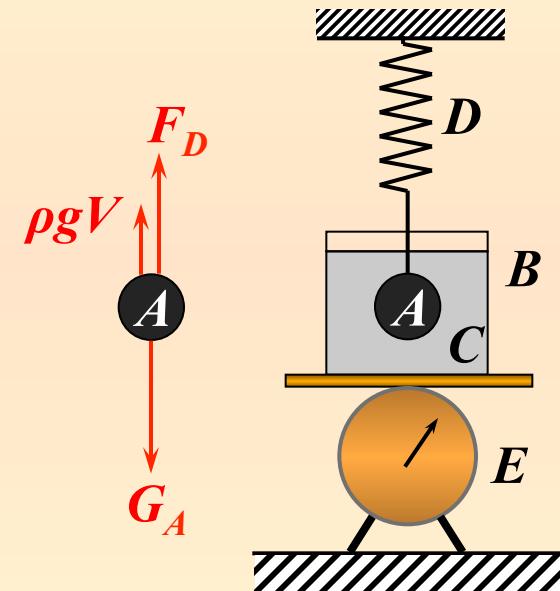
$$\text{对 } A, B, C: \quad F_E + F_D = G_A + G_B + G_C$$

$$\begin{aligned} \therefore F_{\text{浮}} &= G_A - F_D = F_E + F_D - G_B - G_C - F_D \\ &= F_E - G_B - G_C = 36.5N \end{aligned}$$

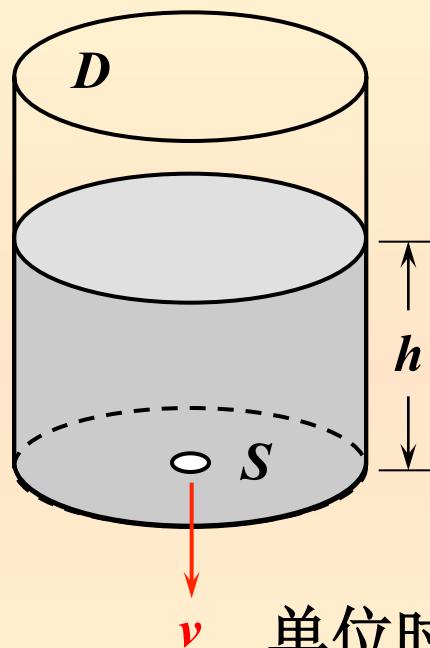
$$\text{又: } F_{\text{浮}} = \rho_C g V_A$$

$$\therefore \rho_C = \frac{F_{\text{浮}}}{g V_A} = 1.316 \times 10^3 \text{ kg/m}^3$$

$$(2) \quad G'_A = F_D + F_{\text{浮}} = 54.8 N$$



习题5-11: 直径为 $0.10m$, 高为 $0.20m$ 的圆筒形容器底部有 $1cm^2$ 的小孔。水流入容器内的流量为 $1.4 \times 10^{-4} m^3/s$ 。求: (1)容器内水面能上升多高? (2)达最高水位后停止注水, 水流完需时多少?



(1)由伯努利方程: $v = \sqrt{2gh}$

当水面升至最高时: $Q_V = vS = S\sqrt{2gh_m}$

$$\therefore h_m = \frac{Q_V^2}{2gS^2} = 0.10m$$

(2)容器内水的总体积: $V = \frac{1}{4}\pi D^2 \times h$

单位时间内, 容器内水的减少等于从小孔流出的流量:

$$\frac{dV}{dt} = \frac{1}{4}\pi D^2 \times \frac{dh}{dt} = -S\sqrt{2gh} \quad \text{积分得: } t = \frac{\pi D^2}{2S} \sqrt{\frac{h_m}{2g}} = 11.2 s$$