

## Janssen effect

### Part A. Hydrostatics (0.5 points)

**A.1** (0.2pt)

$$p_1 =$$

**A.2** (0.3pt)

$$p(z) =$$

### Part B. Janssen effect in a cylindrical vessel with vertical walls (2.9 points)

**B.1** (0.5pt)

Equation:

**B.2** (1.2pt)

$$A =$$

$$B =$$

$$\lambda =$$

**B.3** (1.2pt)

$$\rho =$$

$$K =$$

### Part C. Conical vessel (2.3 points)

**C.1** (0.1pt)

$$r(z) =$$

**C.2** (0.6pt)

Equation:

**C.3** (0.8pt)

$$A =$$

$$\gamma =$$

$$\beta =$$

**C.4** (0.8pt)

Graph:

$$\frac{P_{\max}}{\rho g z_{\max}} =$$

**Part D. What if the vessel is lifted? (1.5 points)**

**D.1** (0.4pt)

Equation:

**D.2** (0.3pt)

$$A =$$

$$B =$$

$$\lambda =$$

**D.3** (0.8pt)

$$H =$$

**Part E. Fluid outflow through the wall (1.8 points)**

**E.1** (0.2pt)

Equation:

**E.2** (0.1pt)

$$W_1 =$$

**E.3** (0.3pt)

$$A =$$

**E.4** (0.3pt)

$$p_2 =$$

**E.5** (0.3pt)

$$v(h) =$$

**E.6** (0.6pt)

$$\tau =$$

**Part F. "Flow" of granules through a wall (1 point)**

**F.1** (0.2pt)

$$\theta_r =$$

**F.2** (0.8pt)

$$q =$$

$$n =$$