

Question One:

What is the maximum depth of an underground water storage reservoir in order to be able to operate a lift type suction pump when the atmospheric pressure is 759 mm Mercury, specific gravity = 13.6.

$$\frac{(13.6 \text{ kg})(1000)}{\text{m}^3 \text{ m}^2} \cdot \frac{9.81 \text{ m}}{\text{sec}^2} \cdot .759 \text{ meters} = \frac{1000 \cdot 9.81}{h}$$

$$\therefore h = (13.6 \times .759) = 10.3 \text{ meters}$$

Question Two:

What is the relative (%) change in pressure if we double the absolute temperature of an ideal gas keeping mass and volume constant?

$$\frac{P_1}{P_2} = \frac{T_1}{2T_1} = P_1 \times 2 = P_2 \quad 100\%$$

Question Three:

A five meter long vertical tube of cross sectional area = 200 cm² is placed in a water fountain. It is filled with water at temperature = 15 °C. The bottom of the tube is closed and the top it is open to the atmosphere where P₀ = 100 kPa. How much water is in the tube in kilograms?

$$\text{Volume} = (5 \text{ m})(.02 \text{ m}^2) = 0.10 \text{ m}^3$$

$$\rho = 1000 \text{ kg/m}^3$$

$$\therefore \text{mass} = \frac{0.10}{.001001}$$

$$100.0 \text{ kg}$$

Question Four:

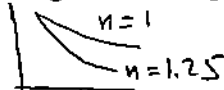
When a 12-volt car battery is charged with 6 amperes for three hours, how much energy in kilo joules is delivered?

$$(12 \text{ volts})(6 \text{ amp}) = .072 \text{ kW}$$

$$72 \frac{\text{kJ}}{\text{sec}} \times \frac{(3 \times 3600)}{1000} = 777.600 \text{ kJ}$$

Question Five:

An ideal gas goes through an expansion process whereby volume doubles. Which process will lead to a larger work output, an isothermal process or a polytropic process with n = 1.25?



pressure drops faster when n = 1.25

isothermal

Question Six:

A system of two kilograms of water at 120°C and a quality of 25% has its temperature raised 20°C in a constant volume process. What are the new quality and specific internal energy of the system?

$$v_1 = v_2 = v_f + (x_1)(v_{fg}) = .001060 + (.25)(.89080) = .22376$$

state 2 140°C

$$u_f = 588.72$$

$$u_{fg} = 1961.3$$

$$.22376 = v_f + (x_2)(v_{fg})_{140} \therefore$$

$$x_2 = .4385$$

$$u_2 = 1448.2 \frac{\text{kJ}}{\text{kg}}$$

Question Seven:

Air at 500 K, 500 kPa is expanded to 100 kPa in two steady state flow cases.

Case 1: is a throttle and Case 2: is a turbine. Which has the highest exit temperature and why?

Case 1

throttle has the higher temp because Temp = constant