Exam Math Review
Collection Grades III & IV
Answer Key

The Division of Water Quality makes no claim as the accuracy of any answers provided herein.

Certification Exam Review
Collections Grade III & IV

Math Problems - Conversions

1. 35 psi will push wastewater how high?

$1 \text{ psi} = 2.31 \text{ ft}$

$35 \text{ psi} \times \frac{2.31 \text{ ft}}{1 \text{ psi}} = 80.85 \text{ ft}$

2. 12,000 gallons of wastewater is how many cubic feet?

$1 \text{ ft}^3 = 7.48 \text{ gal}$

$12{,}000 \text{ gal} \times \frac{1 \text{ ft}^3}{7.48 \text{ gal}} = 1{,}604.28 \text{ ft}^3$

3. A 10 KW motor will run what horsepower pump?

$1 \text{ kW} = 1.34 \text{ hp}$

$10 \text{ kW} \times \frac{1.34 \text{ hp}}{1 \text{ kW}} = 13.4 \text{ hp}$

Math Problems - Areas

1. What is the cross sectional area in square feet, in a 18 inch diameter pipe?

$0.785 \times \left(\frac{18 \text{ in}}{12 \frac{\text{in}}{\text{ft}}}\right)^2 = 1.766 \text{ ft}^2$

2. How many square feet of asphalt much be removed, if a 12 foot diameter circle must be cut around a manhole?

$0.785 \times (12\ ft)^2 = 113.04\ ft^2$

3. After installing a main through a park, a strip that is 1,200 feet long and 6 feet wide that must be reseeded with grass. If one bag of grass seed covers 1,000 ft^2. How many bags of seed do you need to buy?

$1\ bag = 1{,}000\ ft^2$

$1{,}200\ ft \times 6\ ft = 7{,}200\ ft^2$

$7{,}200\ ft^2 \times \frac{1\ bag}{1{,}000\ ft^2} = 7.2\ bags\ (8\ bags)$

Math Problems - Volumes

1. How many gallons will a rectangular tank 50 feet long by 20 feet wide and 8 feet deep?

$1\ ft^3 = 7.48\ gal$

$50\ ft \times 20\ ft \times 8\ ft = 8{,}000\ ft^3$

$8{,}000\ ft^3 \times \frac{7.48\ gal}{1\ ft^3} = 59{,}840\ gal$

2. How deep is the wastewater in a manhole if there is 600 gallons in it? The manhole has a radius of 3 feet.

$1 ft^3 = 7.48\ gal$

$600\ gal \times \frac{1\ ft^3}{7.48\ gal} = 80.21\ ft^3$

$0.785 \times (6\ ft)^2 = 28.26\ ft^2$

$depth = \frac{80.21\ ft^3}{28.26\ ft^2} = 2.84\ ft$

3. How many gallons of wastewater will a 4,500 foot section of 18 inch pipe hold?

$1\ ft^3 = 7.48\ gal$

$0.785 \times \left(\frac{18\ in}{12\ \frac{in}{ft}}\right)^2 \times 4{,}500\ ft = 7{,}948.125\ ft^3$

$7{,}948.125\ ft^3 \times \frac{7.48\ gal}{1\ ft^3} = 59{,}451.98\ gal$

4. A wet well is 10 feet by 12 feet, the water is at an elevation 78 feet. If the top of the wet well at elevation of 90 feet. How many additional gallons can the wet well hold before it overflows?

$1\ ft^3 = 7.48\ gal$

$10\ ft \times 12\ ft \times (90\ ft - 78\ ft) = 1{,}440\ ft^3$

$1{,}440\ ft^3 \times \frac{7.48\ gal}{1\ ft^3} = 10{,}771.2\ gal$

Math Problems - Velocity

1. Wastewater is pumped into a 6 inch pressure line by a 300 gpm pump. If the pump is 85% efficient, what is the velocity of the wastewater in the pressure line?

$1\ ft^3 = 7.48\ gal$

$300\ \frac{gal}{min} \times \frac{1\ ft^3}{7.48\ gal} \times 85\% = 34.09\ \frac{ft^3}{min}$

$0.785 \times \left(\frac{6\ in}{12\ \frac{in}{ft}}\right)^2 = 0.196\ ft^2$

$\frac{34.09\ \frac{ft^3}{min}}{0.196\ ft^2} = 173.7\ \frac{ft}{min} \times \frac{1\ min}{60\ sec} = 2.895\ \frac{ft}{s}$

2. If it takes dye 3 minutes 42 seconds to go between two manholes, and the manholes are 400 feet apart. What is the velocity of the wastewater?

$3\ min\ 42\ sec = 222\ sec$

$\frac{400\ ft}{222\ sec} = 1.802\ \frac{ft}{s}$

3. If it is assumed that the average velocity of the wastewater in the collection system is 2.5 feet per second. How long does it take the wastewater to reach the treatment plant, if the maximum distance from the treatment plant to the farthest lateral is 12 miles?

$$12 \text{ miles} \times 5{,}280 \frac{\text{ft}}{\text{mile}} = 63{,}360 \text{ ft}$$

$$\frac{63{,}360 \text{ ft}}{2.5 \frac{\text{ft}}{\text{s}}} = 25{,}344 \text{ sec} \quad (7 \text{ hours}, 2 \text{ min}, 24 \text{ sec})$$

Math Problems - Efficiency

1. What is the efficiency of the 10 hp pump, if a 10 KW motor is needed?

$$1 \text{ KW} = 1.34 \text{ hp}$$

$$10 \text{ kW} \times \frac{1.34 \text{ hp}}{1 \text{ kW}} = 13.4 \text{ hp}$$

$$\frac{10 \text{ hp}}{13.4 \text{ hp}} \times 100\% = 74.6\%$$

2. If a wet well has two 100 gpm pumps in it. How many gallons of wastewater can be pumped a day if one of the pumps is 85% efficient and the other is 75% efficient?

$$100 \text{ gpm} \times 85\% + 100 \text{ gpm} \times 75\% = 160 \text{ gpm}$$

$$160 \frac{\text{gal}}{\text{min}} \times 60 \frac{\text{min}}{\text{hr}} \times 24 \frac{\text{hr}}{\text{day}} = 230{,}400 \text{ gpd}$$

Math Problems - Chlorine Equation

1. What is the chlorine feed rate per day for a flow of 1.5 MGD with a dose rate of 15 mg/L.

$$8.34 \frac{\text{lbs}}{\text{gal}} \times 1.5 \text{ MGD} \times 15 \frac{\text{mg}}{\text{L}} = 187.65 \frac{\text{lbs}}{\text{day}}$$

Math Problems - Pressure

1. If a pump must lift wastewater 28 feet, and the pressure sewer line is 2,250 feet. Head loss in the sewer line is 4 feet per 1,000 feet of line. How many pound of pressure must the pump deliver for the wastewater to flow?

$1\ psi = 2.31\ ft$

$28\ ft + (2{,}250\ ft \times \frac{4\ ft}{1{,}000\ ft}) = 37\ ft$

$37\ ft \times \frac{1\ psi}{2.31\ ft} = 16.02\ psi$

2. If a 125 gpm pump is driven by a 3 horsepower motor. The efficiency of the pump is 80% and the motor is 50%. What is the maximum head that the system deliver?

$hp = \frac{gpm \times head}{3960}$

$3\ hp \times 50\% = \frac{125\ gpm \times 80\% \times head}{3960}$

$1.5\ hp = \frac{100\ gpm \times head}{3960}$

$head = 59.4\ ft$

Math Problem - Times

1. If it takes 2 people 10 hours to do a job, how many hours will it take 5 people to do the same job?

$2\ person \times 10\ hours = 20\ person\text{-}hr$

$\frac{20\ person\text{-}hr}{5\ persons} = 4\ hr.$

2. A positive displacement pump has a volume of 0.134 ft^3. The pump operates at 30 cycles/minutes. How long will it take to pump a wet well that is 5 foot by 6 foot and the wastewater is 5 feet deep?

$1\ ft^3 = 7.48\ gal$

$0.134\ ft^3 \times \frac{7.48\ gal}{1\ ft^3} = 1\ gal \times 30 = 30\ gpm$

$5\ ft \times 6\ ft \times 5\ ft = 150\ ft^3$

$150\ ft^3 \times \frac{7.48\ gal}{1\ ft^3} = 1{,}122\ gal$

$\frac{1{,}122\ gal}{30\ gpm} = 37.4\ min$

2. Chlorine is used in the system for "freshening". If the chlorine demand is 9 mg/L and the desired residual is 0 mg/L. The flow through the system is 3.6 MGD. How many pound of chlorine are used a day?

$$8.34 \frac{lbs}{gal} \times 3.6\ MGD \times \left(9 \frac{mg}{L} + 0 \frac{mg}{L}\right) = 270.21 \frac{lbs}{day}$$

3. Industrial wastewater from a food processor has a BOD concentration of 3,000 mg/L and the industry produces 40 pounds of BOD per day. How many gallons of wastewater are produced a day?

$$40 \frac{lbs}{day} = 8.34 \frac{lbs}{gal} \times MGD \times 3{,}000 \frac{mg}{L}$$

$$MGD = \frac{40}{25{,}020} \times 1{,}000{,}000 \frac{gal}{MG} = 1{,}598.7\ gpd$$

4. A jet rodder cleans 311,000 ft. of sewer line per month. If the operating costs of the rodder are $0.30/100 ft. What is the monthly cost to use the rodder?

$$100\ ft = 0.30\ \$$$

$$311{,}000\ ft \times \frac{0.30\ \$}{100\ ft} = 933.00\ \$$$

5. A vactor truck holds 5,000 gallons of concentrated grit. If the grit mixture has a TSS concentration of 25,000 mg/L. How many pounds of TSS are on the truck?

$$8.34 \frac{lbs}{gal} \times \frac{5{,}000\ gal}{1{,}000{,}000 \frac{gal}{MG}} \times 25{,}000 \frac{mg}{L} = 1{,}042.5\ lbs$$