Math Field Day 2011 Short Course Event   Names _____ CALCS KEY _____

48 points total   School _____

Scores
  part one: number correct_____ x 4 = _____ minus number wrong _____ = _____ (A)

  part two: _____ (B)   Total score (A)+(B) _____

Part one Instructions: Work in teams of two. You should use the formulas, constants, and conversion factors provided and your notes. <u>Record your answers by circling the letter to the right</u>. Each correct answer worth 4 points; one point will be deducted for each wrong answer. (Maximum score on part 1 is 24 points.)

	In problems 1 through 6 you are to **choose the closest answer**.	Circle the letter of the correct answer
1.	Continuity: $Q = A_{12}V_{12} = A_3 V_3$ $\Rightarrow V_3 = \dfrac{A_{12}V_{12}}{A_3} = \dfrac{\pi/4\,(1.65)}{\pi/64} = 16(1.65) = 26.4\,^{ft}/_{sec}$ (a) 2.64 (b) 3.64 (c) 5. (d) 26.4 (e) 30.	a b c $<d>$ e
2.	Continuity: $500\,gpm \times \dfrac{1\,min}{60\,sec} \times \dfrac{1\,ft^3}{7.48\,gal} = 1.114\,cfs$ $\Rightarrow V_6 = \dfrac{A_{12}V_{12}}{A_6} = \dfrac{Q}{A_6} = \dfrac{1.114}{\pi/4\,(\frac{1}{2})^2} = 5.67\,^{ft}/_{sec}$ (a) 1.42 (b) 14.2 (c) 5.67 (d) 9.20 (e) 56.7	a b $<c>$ d e
3.	Darcy-Weisbach: $h_L = f\left(\dfrac{L}{d}\right)\left(\dfrac{V^2}{2g}\right) = .024\left(\dfrac{200}{\frac{1}{2}}\right)\left(\dfrac{2^2}{2(32.2)}\right) = 0.596\,ft$ (a) 0.25 ft (b) 0.596 ft (c) 0.921 ft (d) 1.25 ft (e) 4.93 ft	a $<b>$ c d e
4.	Darcy-Weisbach: $h_L = f\left(\dfrac{L}{d}\right)\left(\dfrac{V^2}{2g}\right) = f\left(\dfrac{L}{d}\right)\dfrac{(Q/A)^2}{2g} = .0155\left(\dfrac{1000}{d}\right)\left(\dfrac{(12/\pi d^2/4)^2}{2(32.2)}\right) = 4$ Solve for d or use solver $\Rightarrow d = 1.696\,ft \Rightarrow d = 20.3\,in$ (a) 12 in (b) 15 in (c) 18 in (d) 21 in (e) 24 in	a b c $<d>$ e
5.	Velocity head and static head: $h_s = \dfrac{V^2}{2g} \Rightarrow V = \sqrt{2gh_s}$ $\Rightarrow V = \sqrt{2(32.2)10} = 25.38\,^{ft}/_{sec}$ (a) 12.2 (b) 17.9 (c) 25.4 (d) 29.2 (e) 35.8	a b $<c>$ d e
6.	Velocity head and static head: $h_s = \dfrac{V^2}{2g} = \dfrac{10^2}{2(32.2)} = 1.5528\,ft$ (a) 1.55 (b) 1.75 (c) 2.05 (d) 2.25 (e) 2.50	$<a>$ b c d e

(over)

part two: number correct_____ x 4 = _____ minus number wrong _____ = _____ (B)

Part two Instructions: Work in teams of two. You should use the formulas, constants, and conversion factors provided and your notes. <u>Record your answers by circling the letter to the right</u>. Each correct answer worth 4 points; one point will be deducted for each wrong answer. (Maximum score on part 2 is 24 points.)

	In problems 7 through 12 you are to **choose the closest answer**.	Circle the letter of the correct answer
7.	Energy equation: (Velocity heads are equal and so cancel) $$\frac{p_A}{w} + z_A - h_L = \frac{p_B}{w} + z_B$$ $$\Rightarrow h_L = \frac{p_A}{w} + z_A - \frac{p_B}{w} - z_B \Rightarrow \frac{30(144)}{62.4} + 150 - \frac{35(144)}{62.4} - 130 = 8.46$$ (a) 3.5 (b) 5.0 (c) 8.5 (d) 15.0 (e) 17.5	a b <c> d e
8.	Manning formula: $$Q = A\frac{1.486}{n}R^{2/3}S^{1/2} = 10\left(\frac{1.486}{.015}\right)\left(\frac{10}{9}\right)^{2/3}(.0004)^{1/2} = 21.26$$ (a) 2.13 (b) 3.15 (c) 15.9 (d) 21.3 (e) 31.5	a b c <d> e
9.	Manning formula: $Q = A\dfrac{1.486}{n}R^{2/3}S^{1/2}$ $$14.5 = 10\left(\frac{1.486}{n}\right)\left(\frac{10}{9}\right)^{2/3}(.0004)^{1/2} \quad \text{solve for } n \text{ or use solver}$$ $$\Rightarrow n = .02199$$ (a) .010 (b) .015 (c) .019 (d) .022 (e) .025	a b c <d> e
10.	Manning formula: $Q = A\dfrac{1.486}{n}R^{2/3}S^{1/2}$ $$6.00 = \frac{\pi}{2}\left(\frac{1.486}{.013}\right)\left(\frac{1}{2}\right)^{2/3}S^{1/2} \quad \text{solve for } S \text{ or use solver}$$ $$\Rightarrow S = .00281$$ (a) .0004 (b) .0008 (c) .0009 (d) .0012 (e) .0028	a b c d <e>
11.	Manning formula: $Q = A\dfrac{1.486}{n}R^{2/3}S^{1/2}$ $$500 = 6w\left(\frac{1.486}{.010}\right)\left(\frac{6w}{w+12}\right)^{2/3}(.0004)^{1/2} \quad \text{use solver} \Rightarrow w = 13.1\,ft$$ (a) 6.2 ft (b) 10.1 ft (c) 13.1 ft (d) 15.6 ft (e) 19.2 ft	a b <c> d e
12.	Hydraulic Radius: $R = \dfrac{A}{wp} = \dfrac{circle - (sec\,tor - triangle)}{Arc}$ $$R = \frac{A}{wp} = \frac{\pi d^2/4 - (.2318d^2 - .12d^2)}{2.214d} = .304d$$ (a) 0.291d (b) 0.304d (c) 0.632d (d) 0.98d (e) 1.50d	a <b> c d e