Event supervisor notes:

→ Teams need a ruler!

→ I didn't specify point values for calculations & Part 2 — I thought you might want to decide after seeing whether teams could do them.

→ I've included my calculations. I did them all twice, but no other eyes have checked them! If many teams get identical slightly off answers, you might want to check if it's just a difference of clearing calculator vs. "chaining" calculations.

→ Part 2 - also not checked by anyone else

① GW flow direction you'll have to measure w/ protractor. I get it 77° off line A-C. With reasonable care they should easily be w/in 5°!

② You can't give much leeway in gradient calc, — I gave $\pm 0.0001 \frac{m}{m}$ — Small differences in measurement

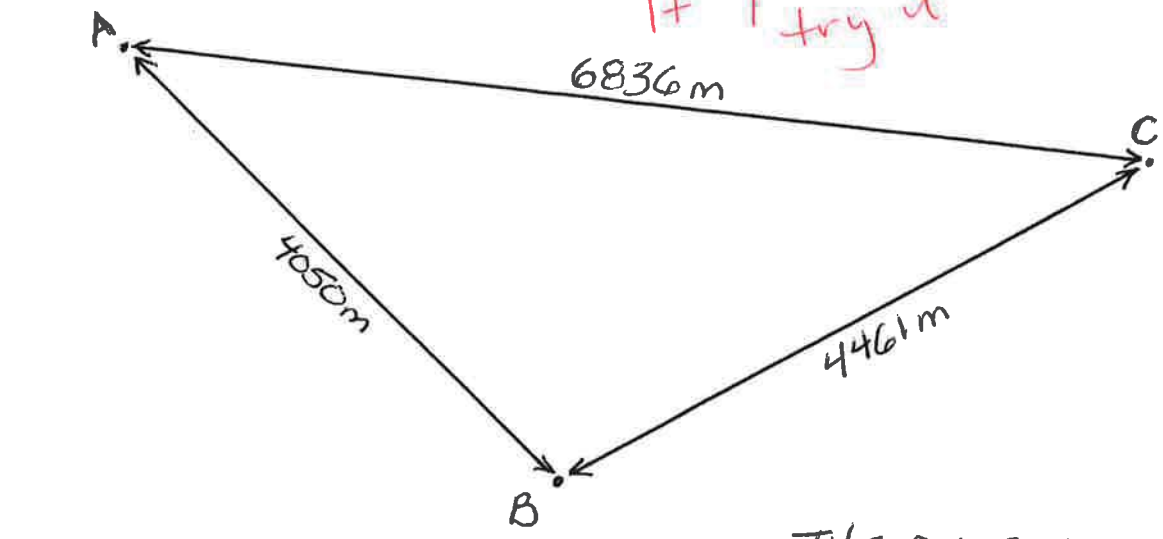
→

(denominator) have little effect.
Answers $0.00081 \frac{m}{m}$ or $0.00079 \frac{m}{m}$ are the (totally incorrect!) results of calculating gradient along lines $A \rightarrow C$ or $A \rightarrow B$, which are not parallel to flow.

I've included a blank Part 2 sheet if you want to try it.

PART 2

If you wish to try it



THIS DIAGRAM IS TO SCALE

1 cm = 500m

Follow directions in test booklet.

Graded :- Groundwater flow direction arrow on map above

- Average water table gradient

= _____

KEY

Part 1 Section 3: Calculations
Use the space below for your work, and put your answer on your answer sheet.

Questions 1&2 are based on the following situation: A confined, unconsolidated aquifer has a hydraulic conductivity of 29.0 m/day. The aquifer has an average thickness of 182m, and an average width of 1.35 km. Piezometer A has a water level of 842m. Piezometer B is directly downgradient and 2414m away from A, and has a water level of 817m. Effective porosity is 0.25

1. Use Darcy's Law to calculate the daily discharge of the aquifer.

$$Q = KA\frac{dh}{dl}$$

$$= \left(29.0\frac{m}{day}\right)(182m \times 1350m)\left(\frac{842m - 817m}{2414m}\right)$$

$$Q = 73{,}800\frac{m^3}{day}$$

2. Calculate the average linear flow velocity for water in the aquifer.

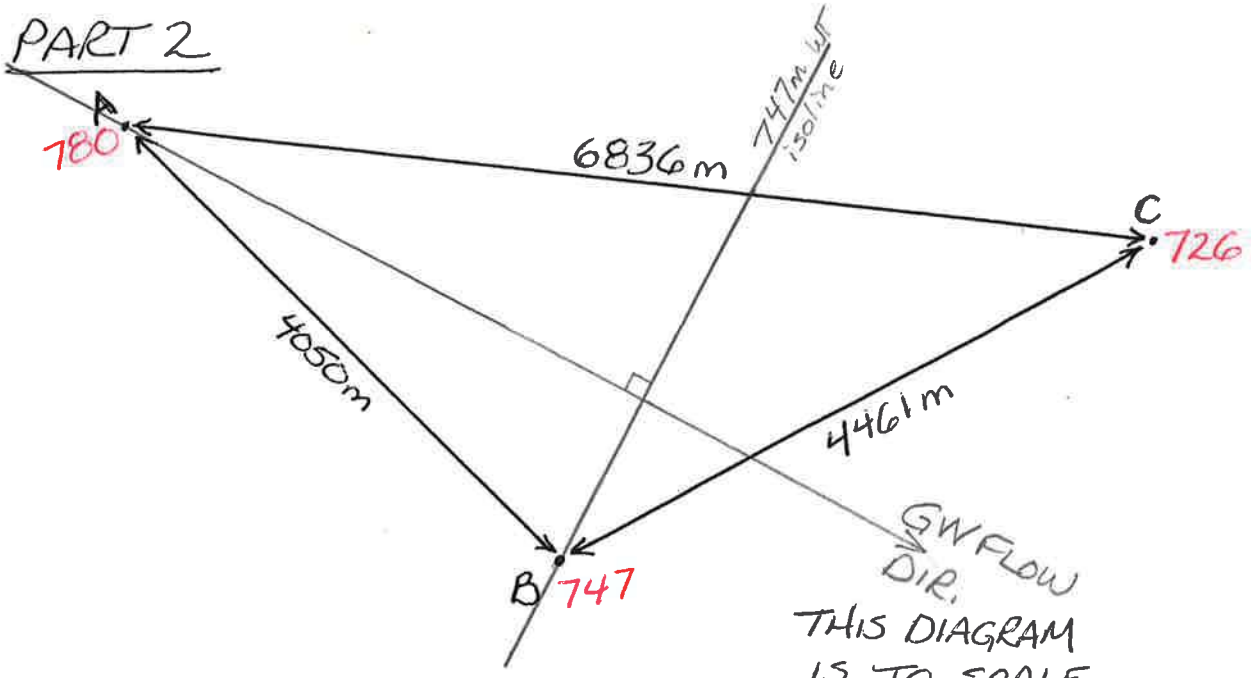
$$\text{Darcy velocity, } v = \frac{Q}{A} = \frac{73{,}800\frac{m^3}{day}}{182m \times 1350m}$$

$$v = 0.300\frac{m}{day}$$

$$\text{Avg. linear flow velocity} = \frac{v}{n_e} = \frac{0.300\frac{m}{day}}{0.29}$$

$$\text{avg. linear flow velocity} = 1.2\frac{m}{day}$$

PART 2



THIS DIAGRAM IS TO SCALE

1 cm = 500m

Well	Land surface elev. (m)	Depth to static water level (m)	Static water level (m)
A	828	48	780
B	784	37	747
C	758	32	726

Dist. A → point on line A-C where water table elev. = 747m:

$6836m\left(\frac{780m-747m}{780m-726m}\right) = 4178m$

Map dist. $= \frac{4178m}{500\frac{m}{cm}} = 8.36cm$

Follow directions in test booklet.

Graded: → Groundwater flow direction arrow on map above must be ±5°

→ Average water table gradient

$= 0.0085\frac{m}{m} \pm 0.0001\frac{m}{m}$

Gradient calculation:

Dist. A → 747m isoline along gw flow = 7.78cm (map)

= 3890m (real)

$$\text{Gradient} = \frac{780m-747m}{3890m} = 0.0085\frac{m}{m}$$

FMHS SO Invitational 2016-2017
Hydrogeology Answer Sheet

Team Name: KEY

Team #: _____

Part 1 Section 1: Multiple Choice

1. B
2. E
3. D
4. D
5. B
6. D
7. D
8. B
9. C
10. B
11. C
12. C
13. D
14. C

Part 1 Section 3: Calculations 3

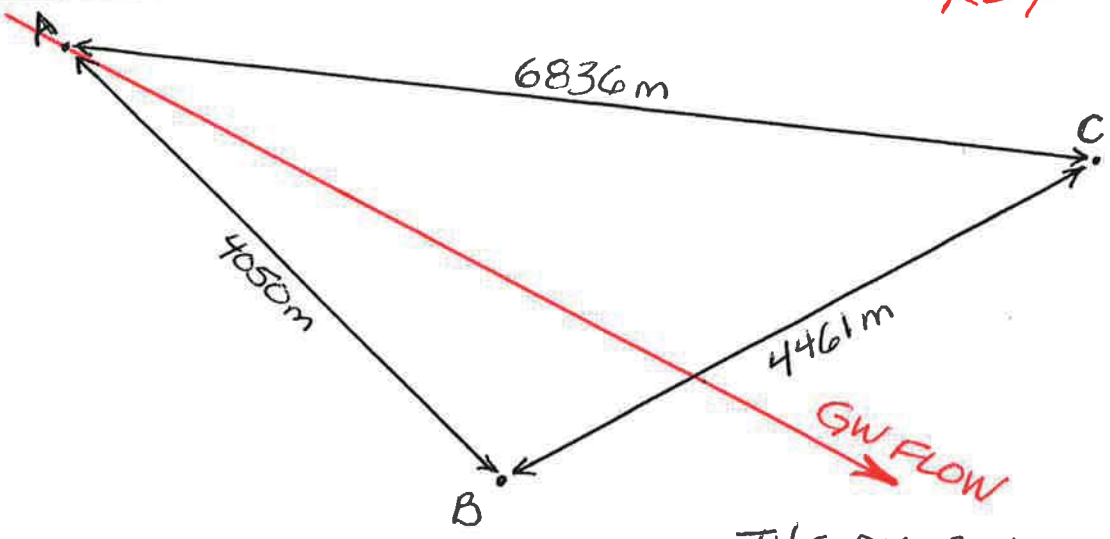
1. 73,800 $\frac{m}{day}$
2. 1.2 $\frac{m}{day}$

Part 1 Section 2: Matching

1. isotropic
2. pressure head
3. baseflow
4. aquiclude
5. dispersion
6. heterogeneous
7. specific retention
8. sustainable yield
9. transmissivity
10. specific capacity

PART 2

KEY



THIS DIAGRAM IS TO SCALE

1 cm = 500m

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Follow directions in test booklet.

Graded: → Groundwater flow direction arrow on map above

→ Average water table gradient

= $0.0085 \frac{m}{m} \pm 0.0001 \frac{m}{m}$