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Waves Homework 3

# Problem 1 – DD 4.1

## Part a)

## Part b)

## Part c)

Values below calculated using MATLAB code in APPENDIX

# Problem 2 – DD 4.3

Beginning, the distance between wave rays is defined by:

If two wave rays are chosen at the edges of the flume at station A, then . Since the wave rays will hug the flume wall, the distance between rays at station B will give the slope of the walls. Starting with wave energy conservation, can be determined by

Rearranging and using APPENDIX to solve for ,

To find the slope, we first must find the change in Y of the wall defined by

The final answer can be solved with

# Problem 3 – DD 4.4

In elliptical particle trajectory, the semi-major and semi-minor axes of the ellipse are defined respectively as

If we take the semi-minor axis of the particle trajectory at the middle of the water column and assume shallow water, the definition reduces to

Rearranging to solve for yields

If the same simplifications are made for the semi-major axis, its definition reduces to

Rearranging and substituting allows the equation to transform and yield the wavelength

The shallow-water approximation also gives an easy definition for as a rearrangement of

# Problem 4 – DD 4.8

The number of waves passing through the wave group, can be defined as a frequency of waves through space. Therefore, the time a wave takes to travel through the wave group can be defined as the period of the group’s period or

In deep water, a wave will encounter a wave group that is travelling at half of its celerity. The distance the wave group travels in the time it takes the wave passes through it can be expressed as

# Problem 5 – DD 4.9

Dynamic pressure underneath a wave is defined by

For simplicity, is assumed to be 0 so the equation is reduced to

However, this equation has multiple unknown variables that must be solved for and cannot be otherwise, so it is unclear how to proceed from here

# Problem 6 – DD 4.12

## Part a)

Using the wave parameters code in APPENDIX, and at are determined as

## Part b)

The water depth at which a wave breaks can be determined by

# Problem 7 – DD 4.13

If a shallow water approximation is used, , , the horizontal velocity at the seabed can be determined by

Rearranging yields an equation for and a maximum depth where the sand depths can be moved

Using the shallow water approximation definition and using APPENDIX to determine the wavelength , the wave is known to be in shallow water and therefore the approximation is appropriate.

# Problem 8 – DD 4.17

There are two reasons the pressure beneath a standing wave’s node is purely hydrostatic. First, the standing wave does not propagate, therefore there is no dynamic pressure; second, the surface at the node does not move vertically or horizontally – meaning it is not a function of time and remains constantly hydrostatic.