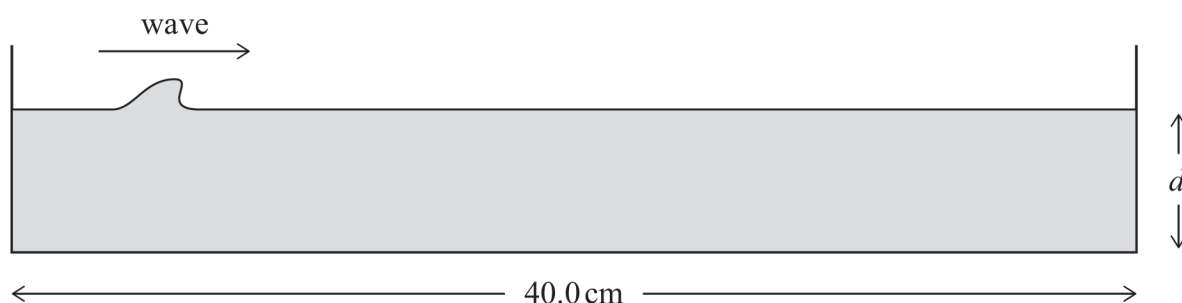3   A student investigated how the speed $v$ of waves in water is affected by the depth of the water.

She filled a 40.0 cm long plastic tray with water to a depth $d$.

She raised and released one end of the tray, creating a wave which travelled along the surface of the water, as shown.



The wave travelled to the far end of the tray and was reflected.

(a)  The student had a metre rule and a stopwatch.

Describe how the student could determine accurate values for $d$ and $v$.

(4)

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(b) The student was given a formula for the speed of water waves

$$v^2 = kd$$

where $k$ is a constant.

(i) Describe how the student could use a graph to determine a value of $k$.

(2)

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(ii) She determined the speed $v$ of the wave for three depths $d$ of water.

She calculated the value of $k$ for each depth.

| $d/\text{mm}$ | $v/\text{m s}^{-1}$ | $k/\text{m s}^{-2}$ |
|---|---|---|
| 7.5 | 0.265 | 9.36 |
| 11 | 0.331 | 9.9 |
| 15 | 0.385 | 9.88 |

Criticise the recording of these results.

(1)

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(iii) The student suggested that the value of $k$ should be equal to the gravitational field strength.

Discuss whether it is likely that $k$ is the gravitational field strength. Your answer should include calculations.

(3)

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**(Total for Question 3 = 10 marks)**