Theoretical Exam - October 27, 2017

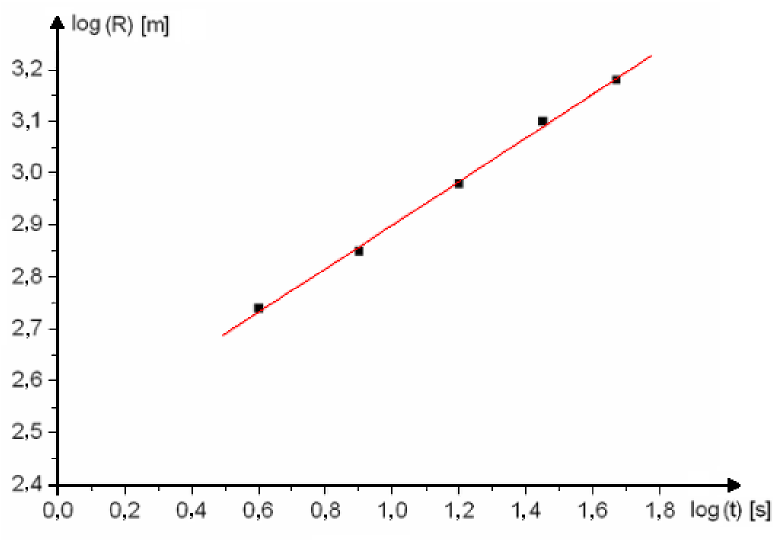
Marking scheme

Any other solution that leads to correct results will be duly marked

No. item	*Theoretical Problem No. 2 – Part A Sir Geoffrey I. Taylor*		Points
a.	For:		**0.5p**
	$R \sim t^{\alpha} \cdot E^{\beta} \cdot \rho^{\gamma}$	0.1p	
	$L = T^{\alpha} \cdot \left(M \cdot L^{2} \cdot T^{-2}\right)^{\beta} \cdot \left(M \cdot L^{-3}\right)^{\gamma}$	0.1p	
	$\begin{cases} \alpha - 2\beta = 0 \\ 2\beta - 3\gamma = 1 \\ \beta + \gamma = 0 \end{cases}$	0.1p	
	$\alpha = \frac{2}{5} \qquad \beta = \frac{1}{5} \qquad \gamma = -\frac{1}{5}$	0.1p	
	$R \sim t^{\frac{2}{5}} \cdot \left(\frac{E}{\rho}\right)^{\frac{1}{5}}$	0.1p	
b.	For:		**1.5p**
	$C \cong 1 \qquad R = t^{\frac{2}{5}} \cdot \left(\frac{E}{\rho}\right)^{\frac{1}{5}}$	0.1p	
	$\log R = \frac{2}{5} \cdot \log t + \frac{1}{5} \cdot \log \frac{E}{\rho}$	0.3p	
	$y = A \cdot x + B$, where $\begin{cases} y = \log R \\ x = \log t \\ A = \frac{2}{5} \\ B = \frac{1}{5} \log \frac{E}{\rho} \end{cases}$	0.2p	

Table 1

$t(s)$	$R(m)$	$\log t$	$\log R$
4	550	0.60	2.74
8	700	0.90	2.85
16	950	1.20	2.98
28	1250	1.45	3.10
46	1500	1.67	3.18



Note: Graf plot of $\log R = f(\log t)$ *is optional*

0.5p

The line fitting for the datasets in Table 1 has the following values of the slope and interception.

$$\begin{cases} A = 0.42 \\ B = 2.48 \end{cases}$$

0.2p

estimation of the amount of energy released at the atomic bomb explosion for which the images in Figure 1

$E \approx 3 \cdot 10^{12}\ J$

0.2p

TOTAL SCORE: Theoretical Problem No. 2 – Part A **2.0p**

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