School of Physics

The Pendulum

Solutions to preliminary questions

Question P1

$$\text{Since } F = mg \text{ and } F = \frac{GMm}{r^2}$$

$$mg = \frac{GMm}{r^2} \Rightarrow g = \frac{GM}{r^2}$$

Question P2

Gravitational field strength may vary in different locations around the world due to altitude (variations in r) or latitude (the Earth is not spherical; it is an *oblate spheroid* – wider at the equator than it is tall at the poles – so r is larger at the equator than at the poles). Local density of the surrounding environment may also affect the local strength of gravity (dense rocks would have stronger local gravity than somewhere in the in the middle of the ocean).

Question P3

$$T = 2\pi\sqrt{\frac{l}{g}}$$

square both sides…

$$T^2 = 4\pi^2\frac{l}{g}$$

Shuffle some terms around…

$$T^2 = \frac{4\pi^2}{g}l$$

$$Y = AX + B$$

Question P4

Horizontal axis – pendulum length, l

Vertical axis – period squared, T^2

Question P5

$$\text{gradient} = \frac{4\pi^2}{g}$$

$$\therefore g = \frac{4\pi^2}{\text{gradient}}$$