

(d) The students now decide to use their value for  $g$  to estimate the mass of the Earth.

- (i) Using Newton's universal law of gravitation,  $F = \frac{GMm}{r^2}$ , and  $F = ma$ , show that:

$$M_E = \frac{gR^2}{G} \quad [1]$$

Where  $M_E$  = mass of the Earth

$R$  = Radius of the Earth ( $6.38 \times 10^6 \text{ m} \pm 2\%$ )

$G$  = Gravitational constant ( $6.6743 \pm 0.0007 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$ )

.....

.....

.....

.....

.....

- (ii) Use the above equation, and your value for  $g$  to estimate the mass of the Earth,  $M_E$ . [1]

.....

.....

.....

.....

- (iii) Calculate the total **percentage** uncertainty in your answer to (d)(ii). [3]

.....

.....

.....

.....

.....

- (iv) Hence determine the absolute uncertainty in the mass of the Earth. [2]

.....

.....

.....

.....

.....

**END OF QUESTION PAPER**