Mass and weight

Universal physics measuring instrument

Object of the experiment

1. Investigation of relationship between weight and mass

Setup

- Attach the force sensor to the stand rod
- Calibrate the zero point for the sensor using button $\rightarrow 0 \leftarrow$ on the universal measuring instrument.
- By pressing the RANGE button a few times, set a measuring range of 0.00 N.

Apparatus

1 Force sensor, 0...±50 N 524 042
1 Universal physics measuring instrument 531 835
1 Slotted weight hanger, 50 g, large 315 450
1 Slotted weight, 50 g 315 454
1 Stand base, V-shaped, small........................... 300 02
1 Stand rod, 25 cm, 12 mm diam........................ 300 41
1 Leybold multiclamp.. 301 01

Procedure

- Suspend the hanger for slotted weights (*m* = 0.050 kg) from the force sensor.
- Read off the weight (the force due to gravity) *G* from the measuring instrument and enter it into the table.
- Add extra slotted weights (*m* = 0.050 kg) to the hanger one by one and repeat the force measurement.
- Calculate the quotients $\frac{G}{m}$ and enter them into the table.

Measurement results

Mass *m* in kg	Weight (force due to gravity) *G* in N*	Quotient $\frac{G}{m}$ in $\frac{\text{m}}{\text{s}^2}$
0.050	0.49	9.80
0.100	0.98	9.80
0.150	1.47	9.80
0.200	1.96	9.80
0.250	2.46	9.84
0.300	2.95	9.83

* $1\ \text{N} = \text{kg} \cdot \frac{\text{m}}{\text{s}^2}$

Evaluation

The weight of a body is dependent on its mass. The higher a body's mass, the greater its weight will be. The following is true: $G \sim m$ or $\frac{G}{m} = \text{constant}$. The constant $\frac{G}{m}$ is called the acceleration due to gravity *g*: $\frac{G}{m} = g$.

In this example, the acceleration due to gravity is approximately $9.80\ \frac{\text{m}}{\text{s}^2}$.

Since the acceleration due to gravity is dependent on location, unlike mass, weight varies depending on where it is measured.

Remark:

Acceleration due to gravity at various places on earth:

Location	Acceleration due to gravity *g* in $\frac{\text{m}}{\text{s}^2}$
Standard location*	9.80
Equator	9.78
Poles	9.83

*45° northerly latitude at sea level

Generally a rounded average of $g = 9.81 \frac{m}{s^2}$ is used.

Acceleration due to gravity on various celestial bodies:

Body	Acceleration due to gravity *g* in $\frac{\text{m}}{\text{s}^2}$
Earth	9.81
Moon	1.63
Sun	273

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