



QUESTION WORKBOOK

Mass and weight

Mechanics · Year 12

AQA 3.4.1.1 · CIE 3.1.1, 3.1.6 · OCR A 3.2.1(c)

18 questions · 53 marks

NAVY SCREEN EDITION

SECTION A · Warm-up

A1 Distinguish between the mass and the weight of an object, including the unit of each. [2]

A2 Calculate the weight of a 5.0 kg object on Earth, where $g = 9.81 \text{ m s}^{-2}$. [2]

A3 State what a chemical balance and a newton meter (spring balance) each measure. [2]

SECTION B · Standard

B1 The same 5.0 kg object is taken to the Moon, where $g = 1.62 \text{ N kg}^{-1}$. State its mass there and calculate its weight. [3]

- B2** An astronaut has a mass of 80 kg. Calculate their weight (a) on Earth ($g = 9.81 \text{ m s}^{-2}$) and (b) on Mars ($g = 3.70 \text{ m s}^{-2}$). [4]

- B3** A person of mass 60 kg stands on a set of scales in a lift. Taking $g = 9.81 \text{ m s}^{-2}$, calculate the reading (the normal force) when the lift accelerates downwards at 3.0 m s^{-2} , and state how the reading compares with the person's weight. [4]

SECTION C · Stretch

- C1** A planet has mass $6.0 \times 10^{24} \text{ kg}$ and radius $6.4 \times 10^6 \text{ m}$. Using $g = GM/r^2$ with $G = 6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$, calculate the gravitational field strength at its surface. [4]

- C2** In the absence of air resistance, a hammer and a feather dropped together on the Moon land at the same time. Explain why, referring to mass and weight. [3]

- C3** A student says 'the object weighs 5 kg'. Explain what is wrong with this statement and give the correct way to express it. [3]

SECTION A · Warm-up

- A4** The gravitational field strength g may be quoted as 9.81 N kg^{-1} or as 9.81 m s^{-2} . Show that these two units are equivalent. [2]

- A5** A parcel has a weight of 34.3 N on Earth, where $g = 9.81 \text{ N kg}^{-1}$. Calculate its mass. [2]

- A6** State the direction in which an object's weight acts. [1]

SECTION B · Standard

- B4** The value of g varies slightly over the Earth's surface: it is 9.78 N kg^{-1} at the equator and 9.83 N kg^{-1} at the poles. A scientist of mass 70.0 kg travels from the equator to the South Pole. State what happens to her mass, and calculate the change in her weight. [3]

- B5** An airline limits cabin baggage to a mass of 7.0 kg . A passenger's bag has a mass of 1.9 kg and contains a laptop of mass 1.6 kg , a camera of mass 850 g and books of mass 2.3 kg . Deduce whether the baggage is within the limit, and calculate its total weight. $g = 9.81 \text{ N kg}^{-1}$. [3]

- B6** A stone hangs from a newton meter on Earth, where $g = 9.81 \text{ N kg}^{-1}$; the meter reads 12.0 N . The same stone and meter are taken to Europa, where $g = 1.31 \text{ N kg}^{-1}$. Calculate the reading on Europa. [3]

SECTION C · Stretch

- C4** A probe lands on the surface of a planet and hangs a 6.00 kg calibration mass from a newton meter, which reads 53.2 N. Use the data below to deduce which planet the probe has landed on.

Surface gravitational field strength in N kg^{-1} : Mercury 3.70; Mars 3.71; Venus 8.87; Earth 9.81.

[3]

- C5** A student stands on a set of bathroom scales on the floor of a drop-tower ride. During the ride the cabin falls freely. Explain why the scales read zero during the fall, and state whether the student's weight has changed.

[4]

- C6** A geologist checks a rock sample of mass 3.0 kg with two instruments: a beam balance and a newton meter. Both instruments are then taken to the Moon, where $g = 1.62 \text{ N kg}^{-1}$ (on Earth $g = 9.81 \text{ N kg}^{-1}$). Describe and explain the reading each instrument gives on the Moon. [5]
