InkPhysics

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

PRINT EDITION

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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 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 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 ($g = 9.81$ m s^{-2}) and (b) on Mars ($g = 3.70$ m s^{-2}). [4]

B3 A person of mass 60 kg stands on a set of scales in a lift. Taking $g = 9.81$ 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 6.0×10^{24} kg and radius 6.4×10^{6} m. Using $g = GM/r^2$ with $G = 6.67 \times 10^{-11}$ N m^2 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 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 N kg^{-1}. [3]

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