



**Test Papers
Hub.**

QCAA Physics Unit 3 Practice Paper 1

Internal Assessment 1: Data Test (Unit 3)

Perusal 5 minutes · Working time 60 minutes · Internal Assessment 1 (Unit 3) · 45 marks in all

How to use this booklet

- Perusal time – 5 minutes (reading only). Working time – 60 minutes. Write using black or blue pen.
- A QCAA-approved scientific or graphics calculator may be used. A formula and data sheet is provided at the back of the paper.
- Attempt ALL questions (1 – 8). Show all working for calculations.
- Worked solutions follow the paper: every question has step-by-step working and a key takeaway.

UNSEEN DATA TEST

45 marks · Attempt ALL questions (1 – 8) · Allow 60 minutes

Use the data in each question to respond. Show all working: marks are awarded for method as well as the final answer.

Question 1 (5 marks)

A 24 kg crate is pulled along a horizontal floor by a constant horizontal force of 140 N. The coefficient of kinetic friction between the crate and the floor is 0.30.

(a) What is the magnitude of the friction force on the crate? [3 marks]

(b) What is the acceleration of the crate? [2 marks]

Question 2 (7 marks)

A ball is kicked from level ground at 30 m s^{-1} at 40° above the horizontal. Ignore air resistance and take $g = 9.8 \text{ m s}^{-2}$.

(a) What is the ball's time of flight? [3 marks]

(b) What is the horizontal range of the ball? [2 marks]

(c) What is the maximum height reached? [2 marks]

Question 3 (5 marks)

A 1100 kg lander is on the surface of Mars (mass 6.42×10^{23} kg, radius 3.39×10^6 m).

(a) What is the escape speed from the surface? [3 marks]

(b) How much energy must be supplied to the lander to escape from the surface? [2 marks]

Question 4 (5 marks)

An electron is accelerated from rest through a potential difference of 6700 V in a vacuum. (Use $e = 1.602 \times 10^{-19}$ C; electron mass 9.109×10^{-31} kg, proton mass 1.673×10^{-27} kg, alpha particle mass 6.645×10^{-27} kg.)

(a) What is its final speed (non-relativistic)? [3 marks]

(b) What is its kinetic energy in electronvolts? [2 marks]

WORKED SOLUTIONS

Answers & worked solutions

UNSEEN DATA TEST

Question 1 (5 marks) [Forces and Newton's laws]

A 24 kg crate is pulled along a horizontal floor by a constant horizontal force of 140 N. The coefficient of kinetic friction between the crate and the floor is 0.30.

(a) What is the magnitude of the friction force on the crate?

(a) Answer: 70.6 N

- On a horizontal surface the normal force equals the weight: $N = mg = 24 \times 9.8 = 235 \text{ N}$.
- $f = \mu N = 0.30 \times 235 = 70.6 \text{ N}$

(b) What is the acceleration of the crate?

(b) Answer: 2.89 m s⁻²

- Net force = applied force – friction = $140 - 70.6 = 69.4 \text{ N}$.
- $a = F_{\text{net}} \div m = 69.4 \div 24 = 2.89 \text{ m s}^{-2}$

LOS: Forces and Newton's laws

KEY TAKEAWAY

Newton's second law: find the NET force (add forces in the direction of motion, subtract opposing ones), then $a = F_{\text{net}} \div m$.

Question 2 (7 marks) [Projectile motion]

A ball is kicked from level ground at 30 m s^{-1} at 40° above the horizontal. Ignore air resistance and take $g = 9.8 \text{ m s}^{-2}$.

(a) What is the ball's time of flight?

(a) Answer: 3.94 s

- Resolve the launch velocity: vertical component $v_y = 30 \times \sin 40^\circ = 19.3 \text{ m s}^{-1}$.
- It returns to the same height, so the vertical displacement is zero: $0 = v_y t - \frac{1}{2}gt^2$, giving $t = 2v_y/g$.
- $t = 2 \times 19.3 \div 9.8 = 3.94 \text{ s}$

(b) What is the horizontal range of the ball?

(b) Answer: 90.4 m

- Horizontal velocity is constant: $v_x = 30 \times \cos 40^\circ = 23.0 \text{ m s}^{-1}$.
- Range = $v_x \times t = 23.0 \times 3.94$
- Range = 90.4 m

(c) What is the maximum height reached?

(c) Answer: 19.0 m

- At the top $v_y = 0$. Use $v_y^2 = u_y^2 + 2as$ with $a = -9.8$: $0 = (19.3)^2 - 2 \times 9.8 \times h$.
- $h = (19.3)^2 \div (2 \times 9.8) = 19.0 \text{ m}$

LOS: Projectile motion