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ANSWER BOOK

Forces and Newton's laws

Mechanics · Year 12-13

6 questions · 20 marks

NAVY EDITION

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SECTION A · Warm-up

A1 A body keeps a constant velocity unless a resultant force acts. Steady speed in a straight line means zero resultant: the driving force exactly balances the resistances, however fast the car happens to be going. [2]

A2 F = ma applies to the resultant: D - 500 = 1000 × 2, so D = 2500 N. The engine must both cause the acceleration and pay off the resistance; forgetting the second job gives 2000 N and loses the mark. [3]

SECTION B · Standard

B1 Along the motion: resultant 42 - 12 = 30 N, so a = 30/6 = 5 m s^{-2}. Vertically nothing moves, so R = mg = 58.8 N. The two directions are treated separately, and the vertical equation is an equilibrium even while the crate accelerates horizontally. [4]

B2 Upwards positive: R - mg = ma gives R = 70 × 11.3 = 791 N, heavier than the true weight of 686 N. Accelerating down: R = 70 × 8.3 = 581 N, lighter. The scales read the reaction, not the weight, and the reaction is whatever F = ma demands. [4]

B3 The partner is the push of the book on the table: same type of force, same size, opposite direction, on the other body. The weight's partner is the book's gravitational pull on the Earth. Reaction and weight act on the same body and can differ (in a lift they do), so they fail both tests for a pair. [3]

SECTION C · Stretch

C1 Kinematics first: $v^2 = u^2 + 2as$ gives 0 = 400 + 100a, so a = -4 m s^{-2}. Then F = ma = 900 × 4 = 3600 N opposing the motion. Two lessons in one chain: suvat finds the acceleration, Newton's second law prices it in force. [4]

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