InkMaths

ANSWER BOOK

Work, energy and power

Further Mechanics 1 · Year FM

6 questions · 20 marks

NAVY EDITION

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SECTION A · Warm-up

A1 Work = Fd cos θ, where θ is the angle between the force and the displacement. The normal reaction acts at right angles to the surface and so at right angles to the motion along it, making cos θ = 0 and the work done zero. [2]

A2 Work = 40 × 12 × cos25° = 480 × 0.9063 = 435 J to three significant figures. Ignoring the angle would give 480 J, an overestimate of about 10%. [3]

SECTION B · Standard

B1 Work by gravity = 60(9.8)(10)sin20° = 2011 J. Normal reaction = 60(9.8)cos20° = 553 N, so friction is 166 N and the work against it is 1658 J. Kinetic energy gained = 2011 - 1658 = 353 J, so ½(60)v² = 353.5 and v = 3.43 m/s. [4]

B2 Driving force = 12000/20 = 600 N. Resultant = 600 - 400 = 200 N, so a = 200/900 = 0.222 m/s². At maximum speed the acceleration is zero, so 12000/v = 400 and v = 30 m/s. [4]

B3 With P fixed, the driving force P/v falls as v rises. The resistance meanwhile grows, so the resultant force shrinks from both ends and the acceleration falls with it. At the speed where the driving force has dropped to equal the resistance, the acceleration reaches zero and the car can go no faster. [3]

SECTION C · Stretch

C1 A slope of 1 in 20 means the component of weight along the slope is 80(9.8)/20 = 39.2 N. At steady speed the driving force balances that plus the resistance: 39.2 + 25 = 64.2 N. Power = Fv = 64.2 × 6 = 385 W to three significant figures. [4]