InkPhysics

ANSWER BOOK

Scalars and vectors

Mechanics · Year 12

AQA 3.4.1.1 · CIE 1.4 · OCR A 2.3.1

11 questions · 38 marks

NAVY EDITION

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SECTION A · Warm-up

A1 Scalars: distance, energy, temperature, speed. Vectors: velocity, momentum, force, displacement. (One mark per two correct rows.) [4]

A2 A scalar has magnitude only; a vector has magnitude and direction. Example scalar: speed (or energy, distance). Example vector: velocity (or force). [2]

A3 5.0 N to the right. Along one line, vectors add with sign. [2]

SECTION B · Standard

B1 $R = \sqrt{(3.0^2 + 4.0^2)} = 5.0$ N. $\tan\theta = 4.0/3.0$, so $\theta = 53°$ from the 3.0 N force. [4]

B2 Horizontal: $12.0 \cos 30° = 10.4$ N. Vertical: $12.0 \sin 30° = 6.0$ N. [3]

B3 Horizontal: $60 \cos 25° = 54.4$ m s^{-1}. Vertical: $60 \sin 25° = 25.4$ m s^{-1}. [3]

B4 (a) 7.0 km. (b) $\sqrt{(3.0^2 + 4.0^2)} = 5.0$ km. (c) $\tan\theta = 3.0/4.0$ east of north, bearing 37°. [4]

B5 Parallel: $20 \sin 35° = 11.5$ N. Perpendicular: $20 \cos 35° = 16.4$ N. Check: $\sqrt{(11.5^2 + 16.4^2)} = 20$ N. [4]

SECTION C · Stretch

C1 The third force balances the resultant, so its magnitude is $\sqrt{(6.0^2 + 8.0^2)} = 10$ N, directed opposite: bearing 217°. [4]

C2 Along the 8.0 N direction: $8.0 + 5.0 \cos 60° = 10.5$ N; perpendicular: $5.0 \sin 60° = 4.33$ N. $R = \sqrt{(10.5^2 + 4.33^2)} = 11.4$ N at 22° to the 8.0 N force. [4]

C3 Drawn head to tail the three forces close a triangle, so their vector sum is zero and equilibrium is possible. Since $5^2 + 12^2 = 13^2$, the triangle is right-angled: the angle between the 5.0 N and 12 N forces is 90°. [3]