Mark Scheme Scalar/Vector Past Paper Questions

Jan 2002 to Jan 2009

3(a) displacement is a vector ✓
ball travels in opposite directions ✓

(b) velocity is rate of change of displacement
average speed is rate of change of distance
velocity is a vector [or speed is a scalar]
velocity changes direction

Q3 Jan 2003

any two ✓ ✓ (2)

(c)(i) \( a = \frac{(-6.0 - 8.0)}{0.10} \) ✓
\[ = (-140) \text{m s}^{-1} \] ✓ (allow C.E. for incorrect values of \( \Delta v \))

(c)(ii) \( F = 0.45 \times (-140) = (-)63 \text{ N} \) ✓ (allow C.E for value of \( a \))

(c)(iii) away from wall ✓
at right angles to wall ✓
[or back to girl ✓ ✓]
[or opposite to direction of velocity at impact ✓ ✓] (5)

(b)i

\[
\begin{align*}
9.5 \\
\sqrt{5} \\
\theta
\end{align*}
\]

scale ✓
5 N and 9.5 N ✓
correct answer (8.1 N ± 0.2 N) ✓

[or \( 9.5^2 = 5.0^2 + F^2 \) ✓
\( F^2 = 90.3 - 25 \) ✓
\( F = 8.1 \text{ N} \) ✓ (8.07 N)]

(b)ii

\( \cos \theta = \frac{5.0}{9.5} \)
gives \( \theta = 58^\circ \) ✓ (± 2° if taken from scale diagram) (4)

Q1 Jan 2004

(a)(i) a quantity that has magnitude only
[or has no direction] ✓

(ii) any two: e.g. energy ✓
temperature ✓ (3)

(8)
Question 2

(a) vector quantities have direction (as well as magnitude) and scalar quantities do not ✓ (1)

(b) vector: e.g. velocity, acceleration, momentum ✓
scalar: e.g. mass, temperature, energy ✓ (2)

(c)(i) addition of forces \((12 + 8)\) ✓

(use of \(F = ma\) gives) \(a = \frac{(12 + 8)}{6.5} = 3.1 \text{ m s}^{-2} \) ✓ \(3.08 \text{ m s}^{-2}\) (3)

(ii) subtraction of forces \((12 - 8)\) ✓

\(a = \frac{(12 - 8)}{6.5} = 0.62 \text{ m s}^{-2} \) ✓ \(0.615 \text{ m s}^{-2}\) (4)

<table>
<thead>
<tr>
<th>Question 2</th>
<th>Q2 Jan 2009</th>
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<tbody>
<tr>
<td>(a) (i)</td>
<td>vector has direction and a scalar does not ✓</td>
</tr>
<tr>
<td>(a) (ii)</td>
<td>scalar examples; any two e.g. speed, mass, energy, time, power</td>
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<tr>
<td></td>
<td>vector examples; any two e.g. displacement, velocity, acceleration, force or weight</td>
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<tr>
<td></td>
<td>✓ ✓ ✓ for 4 correct, ✓ ✓ for 3 correct, ✓ for 2 correct</td>
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</tbody>
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(b) (i) horizontal component \((= 2.8 \cos 35) = 2.3 \text{ (kN)} (2293.6) ✓

vertical component \((= 2.8 \sin 35) = 1.6 \text{ (kN)} (1606.0) ✓

(ii) power \(= \text{force} \times \text{velocity} \text{ or } 2.3 \text{ kN} \times 8.3 \text{ m s}^{-1} \) ✓ (ecf from 2 (b)(i))

\(= 1.9 \times 10^7 \text{ (19037 or 19100)} ✓ \text{ ecf W (or J s}^{-1}) ✓ \text{ or 19W (or kJ s}^{-1})) \) (5)

(c) (area of cross-section of cable \(= \pi \times \left(\frac{1}{2} \times 0.014\right)^2 \) ✓ \(= 1.5(4) \times 10^{-4} \text{ (m}^2\) ✓

stress \((= \frac{F}{A}) = \frac{2800\text{ N}}{1.54 \times 10^{-4} \text{ m}^2} \) (allow ecf here if attempt to calculate area) ✓

\(= 1.8(2) \times 10^7 ✓ \text{ ecf Pa (or N m}^{-2}) ✓ \) (5)

Total 14
1(a)(i) rate of change of velocity

\[ a = \frac{\Delta v}{t} \] ✓

(ii) (acceleration) has (magnitude and) direction ✓ (2)

(b)(i) (acceleration) is the gradient (or slope) of the graph ✓

(ii) (displacement) is the area (under the graph) ✓ (2)

(c) velocity

graph to show:

(linear) increase to \( t = 2.0 \pm 0.2 \) s ✓

uniform velocity between 2.0 s and 6.0 s ✓

(linear) decrease from 6.0 ± 0.2 s to 8.0 s ✓

zero velocity after \( t = 8.0 \) s ✓

(4)

(8)