A-Level Starter Activity

Jethwa Maths

Topic: Converting Units and Assumptions

Chapter Reference: Mechanics 1, Chapter 8

6 minutes

1. Covert to SI units,

a. 2.5 km per minute **(2)**

b. 0.6kg cm^{-2} **(2)**

c. 1.2×10^3 gcm^{-3} **(2)**

2. A man throws a bowling ball in a bowling alley.

a. Make a list of assumptions you might make to create a simple model of the motion of the bowling bowl. **(2)**

b. Taking the direction that the ball travels in as the positive direction, state with a reason, whether each of the following are likely to be positive or negative,

i. The velocity **(1)**

ii. The acceleration **(1)**

Solutions

1a.

$\frac{2.5 \times 1000}{60}$	**M1**
$= 41.7$ m s^{-1}	**M1**

1b.

$\frac{0.6}{1 \div (100 \times 100)}$	**M1**
$= 6000$ kg m^{-2}	**M1**

1c.

$\frac{1.2 \times 10^3 \times (100 \times 100 \times 100)}{1000}$	**M1**
$= 1.2 \times 10^6$ kg m^{-3}	**M1**

2a.

Model the ball as a particle	**M1**
Assume the floor is smooth	**M1**

2bi.

The velocity will be positive as the positive direction is defined as such.	**M1**

2bii.

In real life the acceleration would be negative, as the ball always slows down. However, if we assume there is no friction, then the ball would move at constant velocity.	**M1**

A-Level Starter Activity

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Topic: Modelling with Vectors Chapter Reference: Mechanics 1, Chapter 8	6 minutes

1. The velocity of a toy car is given by $v = 3.5\mathbf{i} - 2.5\mathbf{j}$ ms^{-1}. Find,

a. The speed of the toy car **(2)**

b. The angle the direction of motion of the tour car makes with the unit vector **j**. **(4)**

Solutions

1a.

$\|v\| = \sqrt{3.5^2 + 2.5^2}$ $\|v\| = \sqrt{4.30}$	**M1**
$\|v\| = 4.30$ (to 3 s.f) Therefore, the speed of the toy car is 4.30 ms^{-1}	**M1**

1b.

Let the acute angle made with **j** be θ, then	**M1**
$\tan\theta = \frac{3.5}{2.5} = 1.4$	**M1**
$\theta = 54.5^{\circ}$	**M1**
Angle required = 180 - θ = 180 – 54.5 = 126°	**M1**

A-Level Starter Activity

Jethwa Maths

Topic: Horizontal Motion with Vectors Chapter Reference: Statistics 2, Chapter	8 minutes

1. A particle P moves with constant acceleration. At time $t = 0$, the particle is at O and is moving with velocity $(2\mathbf{i} - 3\mathbf{j})$ ms^{-1}. At time $t = 2$ seconds, P is at the point A with position vector $(7\mathbf{i} - 10\mathbf{j})$ m.
a. Show that the magnitude of the acceleration of P is 2.5 ms^{-2}. **(4)**

At the instant when P leaves the point A, the acceleration of P changes so that P now moves with constant acceleration $(4\mathbf{i} + 8.8\mathbf{j})$ ms^{-2}.

At the instant when P reaches the point B, the direction of motion of P is north east.
b. Find the time it takes for P to travel from A to B. **(4)**

Solutions

1a.

$s = 7\mathbf{i} - 10\mathbf{j}$ $u = 2\mathbf{i} - 3\mathbf{j}$ $a = ?$ $t = 2$	**M1**
$\begin{pmatrix} 7 \\ -10 \end{pmatrix} = \begin{pmatrix} 2 \\ 3 \end{pmatrix}(2) + \frac{1}{2}a(2)^2$ $\begin{pmatrix} 7 \\ -10 \end{pmatrix} = \begin{pmatrix} 4 \\ -6 \end{pmatrix} + 2a$	**M1**
$a = \begin{pmatrix} 1.5 \\ -2 \end{pmatrix}$	**M1**
$a = \sqrt{1.5^2 + (-2)^2}$ $a = 2.5 \text{ ms}^{-2}$	**M1**

1b.

$v = u + at$ $v = \begin{pmatrix} 2 \\ 3 \end{pmatrix} + \frac{1}{2}\begin{pmatrix} 3 \\ 4 \end{pmatrix}(2)$ $v = \begin{pmatrix} 5 \\ -7 \end{pmatrix}$	**M1**
$\begin{pmatrix} a \\ a \end{pmatrix} = \begin{pmatrix} 5 \\ -7 \end{pmatrix} + \begin{pmatrix} 4 \\ 8.8 \end{pmatrix}T$	**M1**
Equating components: $-7 + 8.8T = 5 + 4T$ $4.8T = 12$	**M1**
$T = 2.5$ seconds.	**M1**