adamjee maths

A-LEVEL MATHS / EDEXCEL / FREE RESOURCES

Constant acceleration

Question paper

6 questions

Exam questions and marking instructions remain credited to their board.

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1. A car moves in a straight line along a horizontal road with constant acceleration $2\,\text{m s}^{-2}$

The car is moving with speed $15\,\text{m s}^{-1}$ in the direction of the acceleration when it passes a signpost on the road.

The car is modelled as a particle.

(a) Use the model to find the speed of the car 4 s after passing the signpost.

(2)

Figure 1 below shows the horizontal forces acting on the car.

Given that

- the car has mass 800 kg
- the driving force of the engine has magnitude D newtons
- the resistance to the motion of the car has magnitude 400 N
- the acceleration of the car is $2\,\text{m s}^{-2}$ in the direction of the driving force

(b) use the model to find the value of D.

(2)

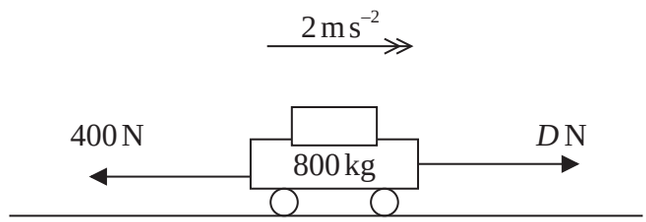


Figure 1

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Question 1 continued

(Total for Question 1 is 4 marks)

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3. [*In this question,* **i** *and* **j** *are horizontal unit vectors due east and due north respectively.*]

A particle P of mass 0.5 kg moves with constant acceleration $(2\mathbf{i} - 2.4\mathbf{j})\,\text{m s}^{-2}$ on a smooth horizontal plane under the action of a constant horizontal force **F** N.

(a) Find **F** in terms of **i** and **j**.

(1)

At time $t = 0$, P is moving with velocity $(-7\mathbf{i} + 7.8\mathbf{j})\,\text{m s}^{-1}$

(b) Find the velocity of P at time $t = 2$ seconds.

(2)

(c) Find the direction of motion of P at time $t = 2$ seconds, giving your answer as a bearing in degrees.

(3)

At time $t = 0$, P passes through the point O.

At time $t = 5$ seconds, P passes through the point A.

(d) Find $\overrightarrow{OA}$ in terms of **i** and **j**.

(2)

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Question 3 continued

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Question 3 continued

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Question 3 continued

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1. A car is initially at rest on a straight horizontal road.

The car then accelerates along the road with a constant acceleration of $3.2\,m\,s^{-2}$

Find

(a) the speed of the car after 5 s,

(1)

(b) the distance travelled by the car in the first 5 s.

(2)

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Question 1 continued

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4. [*In this question,* **i** *and* **j** *are horizontal unit vectors and position vectors are given relative to a fixed origin O*]

A particle P is moving on a smooth horizontal plane.

The particle has constant acceleration $(2.4\mathbf{i} + \mathbf{j})\,\text{m s}^{-2}$

At time $t = 0$, P passes through the point A.

At time $t = 5\,\text{s}$, P passes through the point B.

The velocity of P as it passes through A is $(-16\mathbf{i} - 3\mathbf{j})\,\text{m s}^{-1}$

(a) Find the speed of P as it passes through B.

(4)

The position vector of A is $(44\mathbf{i} - 10\mathbf{j})\,\text{m}$.

At time $t = T$ seconds, where $T > 5$, P passes through the point C.

The position vector of C is $(4\mathbf{i} + c\mathbf{j})\,\text{m}$.

(b) Find the value of T.

(3)

(c) Find the value of c.

(3)

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Question 4 continued

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Question 4 continued

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1. A particle P moves with constant acceleration $(2\mathbf{i} - 3\mathbf{j})\,\text{m s}^{-2}$

At time $t = 0$, P is moving with velocity $4\mathbf{i}\,\text{m s}^{-1}$

(a) Find the velocity of P at time $t = 2$ seconds.

(2)

At time $t = 0$, the position vector of P relative to a fixed origin O is $(\mathbf{i} + \mathbf{j})\,\text{m}$.

(b) Find the position vector of P relative to O at time $t = 3$ seconds.

(2)

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Question 1 continued

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8. [*In this question* **i** *and* **j** *are horizontal unit vectors due east and due north respectively and position vectors are given relative to the fixed point O.*]

A particle P moves with constant acceleration.
At time $t = 0$, the particle is at O and is moving with velocity $(2\mathbf{i} - 3\mathbf{j})\,\text{m s}^{-1}$
At time $t = 2$ seconds, P is at the point A with position vector $(7\mathbf{i} - 10\mathbf{j})\,\text{m}$.

(a) Show that the magnitude of the acceleration of P is $2.5\,\text{m s}^{-2}$

(4)

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

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)

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Question 8 continued

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Question 8 continued

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Question 8 continued

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