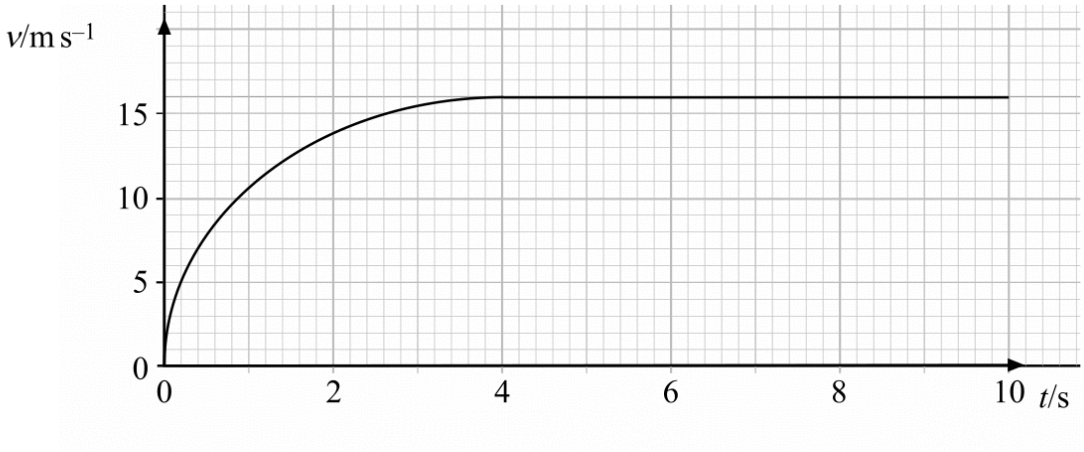
Terminal Velocity Past Paper Questions

Jan 2002 to Jan 2009

5 The graph represents the motion of a car of mass 1.4×10^3 kg, travelling in a straight line.



Q5 Jan 2002

(a) Describe, without calculation, how the *resultant* force acting on the car varies over this 10 second interval.

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(2 marks)

(b) Calculate the maximum kinetic energy of the car.

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(2 marks)

(c) At some time later, when the car is travelling at a steady speed of $30\,\text{m s}^{-1}$, the useful power developed by the engine is 20 kW. Calculate the driving force required to maintain this speed.

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(2 marks)

7 A ball bearing is released into a tall cylinder of clear oil. The ball bearing initially accelerates but soon reaches terminal velocity.

Q7 Jan 2002

(a) By considering the forces acting on the ball bearing, explain its motion.

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(3 marks)

(b) How would you demonstrate that the ball bearing had reached terminal velocity?

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(2 marks)

6 (a) A man jumps from a plane that is travelling horizontally at a speed of $70\,m\,s^{-1}$. If air resistance can be ignored, determine

Q6 Jan 2003

(i) his horizontal velocity 2.0 s after jumping,

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(ii) his vertical velocity 2.0 s after jumping,

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(iii) the magnitude and direction of his resultant velocity 2.0 s after jumping.

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(5 marks)

(b) After 2.0 s the man opens his parachute. Air resistance is no longer negligible. Explain in terms of Newton's laws of motion, why

(i) his velocity initially decreases,

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(ii) a terminal velocity is reached.

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(4 marks)

3 An apple and a leaf fall from a tree at the same instant. Both apple and leaf start at the same height above the ground but the apple hits the ground first.

You may be awarded marks for the quality of written communication in your answer.

Use Newton's laws of motion to explain why **Q3 Jun 2003**

(i) the leaf accelerates at first then reaches a terminal velocity,

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(ii) the apple hits the ground first.

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(5 marks)

3 (a) Explain why a raindrop falling vertically through still air reaches a constant velocity.

You may be awarded marks for the quality of written communication in your answer.

Q3 Jun 2005

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(4 marks)

(b) A raindrop falls at a constant vertical velocity of $1.8\,\text{m}\,\text{s}^{-1}$ in still air. The mass of the raindrop is 7.2×10^{-9}kg.

Calculate

(i) the kinetic energy of the raindrop,

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(ii) the work done on the raindrop as it falls through a vertical distance of 4.5 m.

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(4 marks)

(c) The raindrop in part (b) now falls through air in which a horizontal wind is blowing. If the velocity of the wind is $1.4\,\text{m}\,\text{s}^{-1}$, use a scale diagram or calculation to determine the magnitude and direction of the resultant velocity of the raindrop.

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(3 marks)