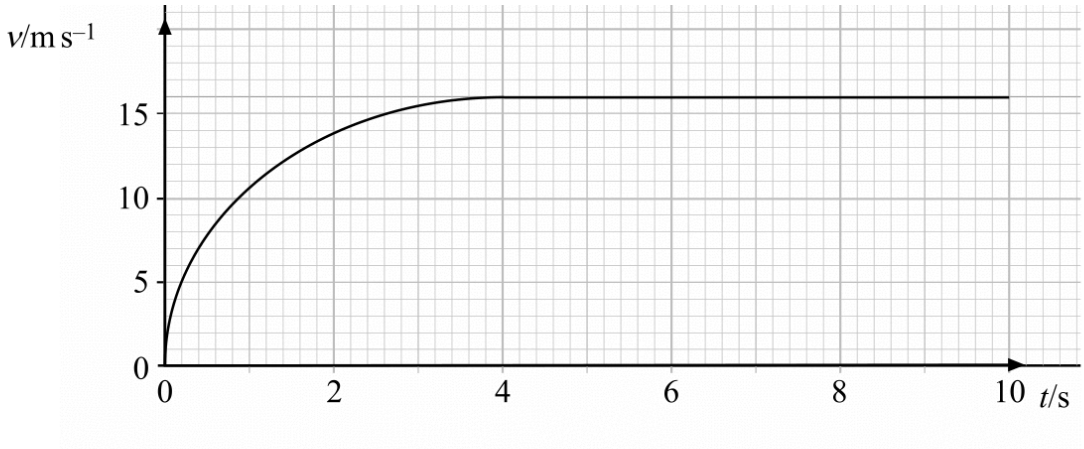
Work Done & Power Past Paper Questions

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 $30\,\text{m}\,\text{s}^{-1}$, 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)

5 A car accelerates at a steady rate of $2.5\,\text{m s}^{-2}$ along a straight, level road. The mass of the car is $1.3 \times 10^3\,\text{kg}$.

Q5 Jun 2002

(a) Calculate the magnitude of the resultant force acting on the car.

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(2 marks)

(b) When the accelerating car reaches a speed of $2.2\,\text{m s}^{-1}$, the total force opposing the motion of the car is 410 N.

Calculate

(i) the driving force provided by the wheels,

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(ii) the power delivered to the wheels of the car.

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(3 marks)

(c) Explain how the total force opposing the motion of the car is affected when it is travelling up a hill.

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(1 mark)

Q7 Jan 2003

7 In an experiment to measure the power output of a motor, the motor is used to lift a metal block vertically at constant speed.

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

(a) Describe an experiment to check whether the speed of the rising mass is constant.

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(2 marks)

(b) Explain how the output power of the motor is calculated, stating what measurements need to be made.

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(2 marks)

4 A skydiver of mass 70 kg, jumps from a stationary balloon and reaches a speed of 45 m s^{-1} after falling a distance of 150 m.

Q4 Jun 2004

(a) Calculate the skydiver's

(i) loss of gravitational potential energy,

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(ii) gain in kinetic energy.

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(4 marks)

(b) The difference between the loss of gravitational potential energy and the gain in kinetic energy is equal to the work done against air resistance. Use this fact to calculate

(i) the work done against air resistance,

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(ii) the average force due to air resistance acting on the skydiver.

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(3 marks)

3 A packing case is being lifted vertically at a constant speed by a cable attached to a crane. The packing case has a mass of 640 kg.

(a) With reference to one of Newton's laws of motion, explain why the tension, *T*, in the cable must be equal to the weight of the packing case.

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

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(3 marks)

(b) The packing case is lifted through a vertical height of 8.0 m in 4.5 s.

Calculate

(i) the work done on the packing case,

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(ii) the power output of the crane in this situation.

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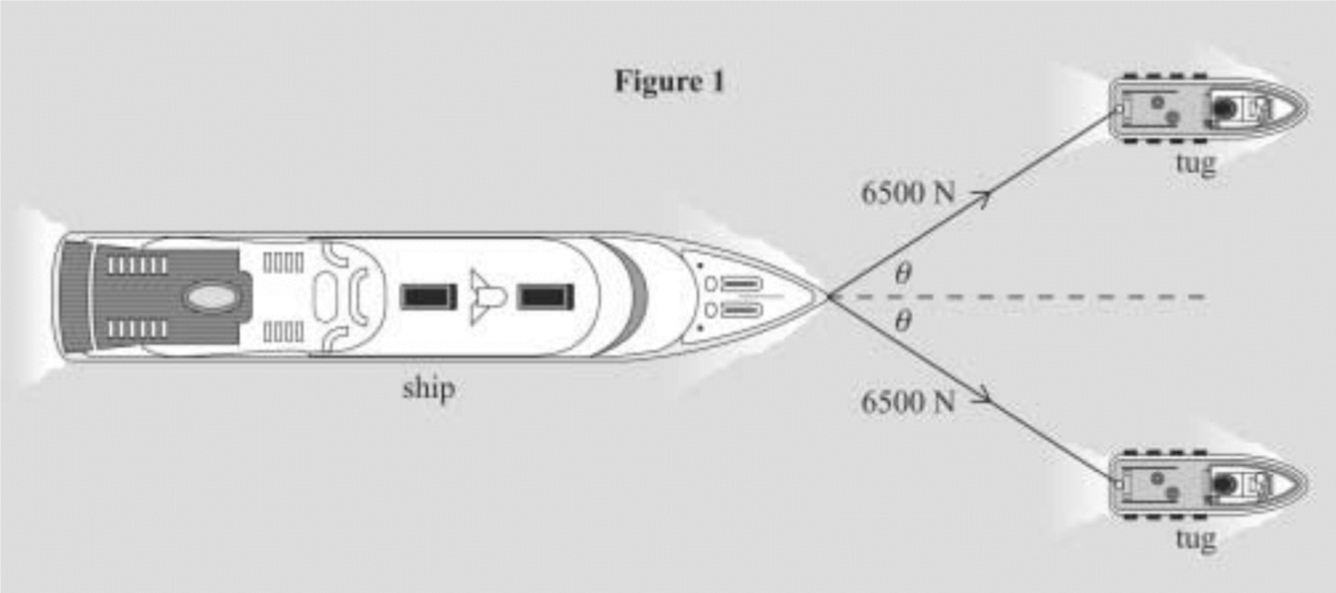
(3 marks)

3 **Figure 1** shows a ship being pulled along by cables attached to two tugs.

Q3 Jan 2007

Figure 1



(a) The tension in each cable is 6500 N and the ship is moving at a constant speed of $1.5\,m\,s^{-1}$. When θ is equal to 35°, calculate

(i) the resultant force exerted on the ship by the cables,

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(ii) the work done by the tension in the cables in one minute.

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(4 marks)

(b) Explain why the work done on the ship does not result in a gain in its kinetic energy.

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(2 marks)

Continued....

(c) State and explain the initial effect on the ship if the angle θ is reduced while the tension in the cables remains constant.

You may be awarded additional marks to those shown in brackets for the quality of written communication in your answer.

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(3 marks)

5 An athlete performs an experiment to measure the power developed as he runs up a flight of stairs. The athlete makes the assumption that the work done in climbing the stairs is equal to the gain in potential energy.

Q5 Jun 2007

(i) State the measurements that would be needed to find the power developed by the athlete.

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(ii) Show how the measurements would be used to calculate the power developed as the athlete runs up the stairs.

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(iii) Explain why the power calculated by the athlete is likely to be less than the power actually developed.

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(8 marks)

Q2 Jan 2009

2 (a) (i) State the difference between a scalar quantity and a vector quantity.

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(1 mark)

2 (a) (ii) State **two** examples of a scalar quantity and **two** examples of a vector quantity.

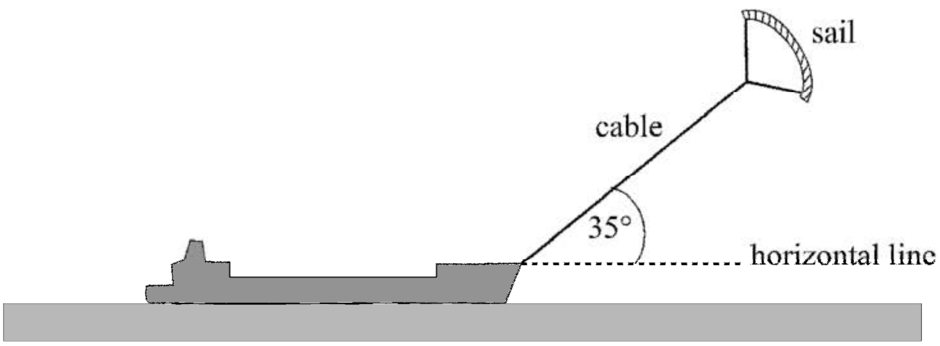
scalar quantities ....

vector quantities ....

(3 marks)

2 (b) **Figure 1** shows a ship fitted with a sail attached to a cable. The force of the wind on the sail assists the driving force of the ship's propellors.

Figure 1



The cable exerts a steady force of 2.8 kN on the ship at an angle of 35° above a horizontal line.

2 (b) (i) Calculate the horizontal and vertical components of this force.

horizontal component of force .... kN

vertical component of force .... kN

(2 marks)

2 (b) (ii) The ship is moving at a constant velocity of $8.3\,\text{m}\,\text{s}^{-1}$ and the horizontal component of the force of the cable on the ship acts in the direction in which the ship is moving.
Calculate the power provided by the wind to this ship, stating an appropriate unit.

Answer ....
(3 marks)

2 (c) The cable has a diameter of 0.014 m. Calculate the tensile stress in the cable when it exerts a force of 2.8 kN on the ship, stating an appropriate unit.
Assume the weight of the cable is negligible.

Answer ....
(5 marks)