1

(*a*) A cyclist's average power output when climbing a mountain is 280 W. He completes the climb in 18 minutes. How much energy does he use?

2

(*e*) Calculate the energy from the Sun falling on a football pitch of dimensions 106 m × 68 m in 90 minutes.

(speed of sound in air = 340 m s^{-1}; solar constant = 1.36 kW m^{-2})

3

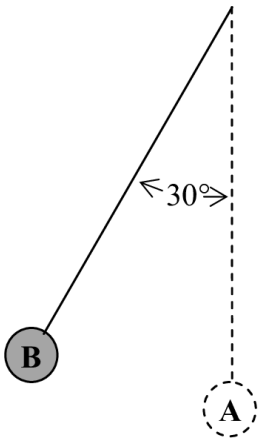
(*a*) State the law of conservation of energy. (4)

The pendulum in the diagram is 8 m long with a small bob of mass 6 kg at its end. It is displaced through an angle of 30° from the vertical (position **A**) and is then held in position **B**, as shown. Calculate the height through which the bob has been raised and the potential energy that it has gained. (9)

The bob is then released and allowed to swing freely. What is the maximum velocity it attains? (9)

When the moving bob is at position **A**, a force is applied which brings the bob to a stop in a distance of 5 mm. Calculate the force applied. (6)

(acceleration due to gravity, g = 9.8 m s^{-2})



4

(*a*) State the principle of conservation of energy. (4)

In a pole-vaulting competition an athlete, whose centre of gravity is 1.1 m above the ground, sprints from rest and reaches a maximum velocity of 9.2 m s^{-1} after 3.0 seconds. He maintains this velocity for 2.0 seconds before jumping.

Draw a velocity-time graph to illustrate the athlete's horizontal motion.
Use your graph to calculate the distance travelled by the athlete before jumping. (12)

What is the maximum height above the ground that the athlete can raise his centre of gravity? (12)

(acceleration due to gravity = 9.8 m s^{-2})

5

(a) State the principle of conservation of energy. (6)

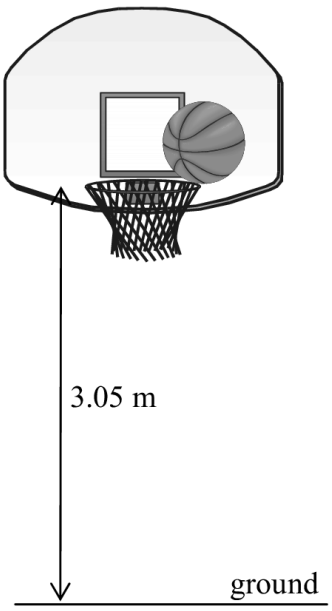
A basketball of mass 600 g which was resting on a hoop falls to the ground 3.05 m below.

What is the maximum kinetic energy of the ball as it falls? (9)

On bouncing from the ground the ball loses 6 joules of energy. What happens to the energy lost by the ball? (4)

Calculate the height of the first bounce of the ball. (9)

(acceleration due to gravity = 9.8 m s^{-2})



6

(c) The average value for the solar constant in Ireland is 1.2×10^2 W m^{-2}. What is the average energy falling normally on an area of 5 m^2 of ground in Ireland in 1 minute? (7)