Area 4: Energy of Motion

Multiple Choice Questions 1 → 10

1. A 4·5 kg box is lifted onto a shelf that is 3·4 m above the ground, in a time of 5·0 s. Calculate the potential energy gained by the box.

   A 1·32 J
   B 15·3 J
   C 76·5 J
   D 150 J
   E 750 J

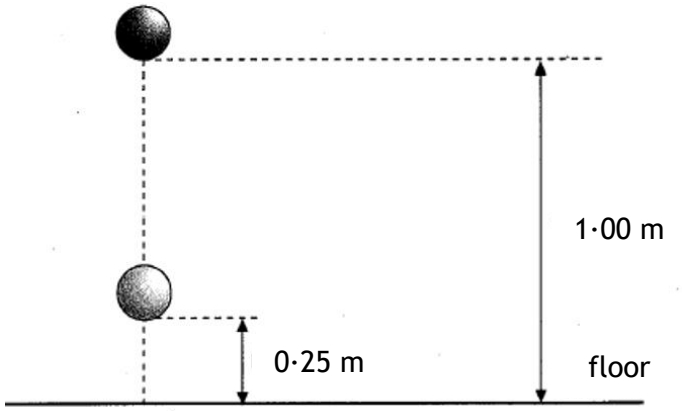
2. An electrical motor raises a crate of mass 500 kg through a height of 12 m in a time of 4 s. Calculate the minimum power rating of the motor.

   A 1·25 kW
   B 1·5 kW
   C 15 kW
   D 60 kW
   E 240 kW

3. Determine which of the following units could be the unit of kinetic energy.

   A $N\ m^2$
   B $N\ ms^{-1}$
   C $kg\ ms^{-1}$
   D $N\ kg^{-1}$
   E $kg\ m^2s^{-2}$

4. A ball of mass 0·50 kg is released from a height of 1·00 m.



   Determine the gravitational potential energy and the kinetic energy of the ball when it is at a height of 0·25 m above the ground.

	gravitational potential energy (J)	kinetic energy (J)
A	0·125	0·125
B	1·23	1·23
C	1·23	3·67
D	3·67	1·23
E	4·90	1·23

5. A man of mass 80 kg dives from a diving board which is 10 m above the water. Neglecting air friction, calculate the kinetic energy of the diver immediately before he hits the water.

A	80 J
B	784 J
C	980 J
D	3920 J
E	7840 J

6. An engine applies a force of 2000 N to move a lorry at a constant velocity.
The lorry travels a distance of 100 m in a time of 16 s.
Calculate the power developed by the engine during this time.

A	0·8 W
B	12·5 W
C	320 W
D	12500 W
E	3200000 W

7. A crate of mass 200 kg is pushed a distance of 20 m across a level floor.
The crate is pushed with a force of 150 N.
The force of friction acting on the crate is 50 N.
Calculate the work done in pushing the crate across the floor.

A	1000 J
B	2000 J
C	3000 J
D	4000 J
E	20000 J

8. A car of mass 750 kg is travelling at a constant velocity of 3·5 ms^{-1}. The car brakes and comes to rest.
Calculate the maximum heat energy release by the brakes.

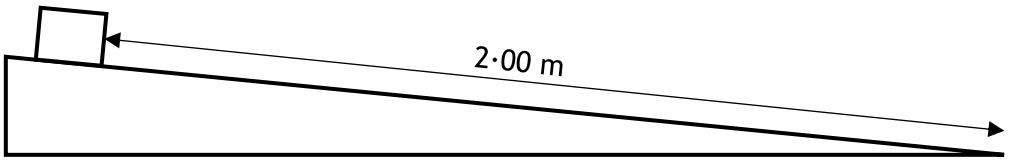
A	214 J
B	2625 J
C	1313 J
D	4594 J
E	9188 J

9. An arrow is fired from a bow as shown.

An archer pulls the string back a distance of 0·50 m. The string exerts an average force of 300 N on the arrow as it is fired. The mass of the arrow is 0·15 kg.
Calculate the maximum kinetic energy gained by the arrow.

A	23 J
B	150 J
C	600 J
D	2000 J
E	6750 J

10. A box slides down an inclined plane (slope) with a constant frictional force acting.

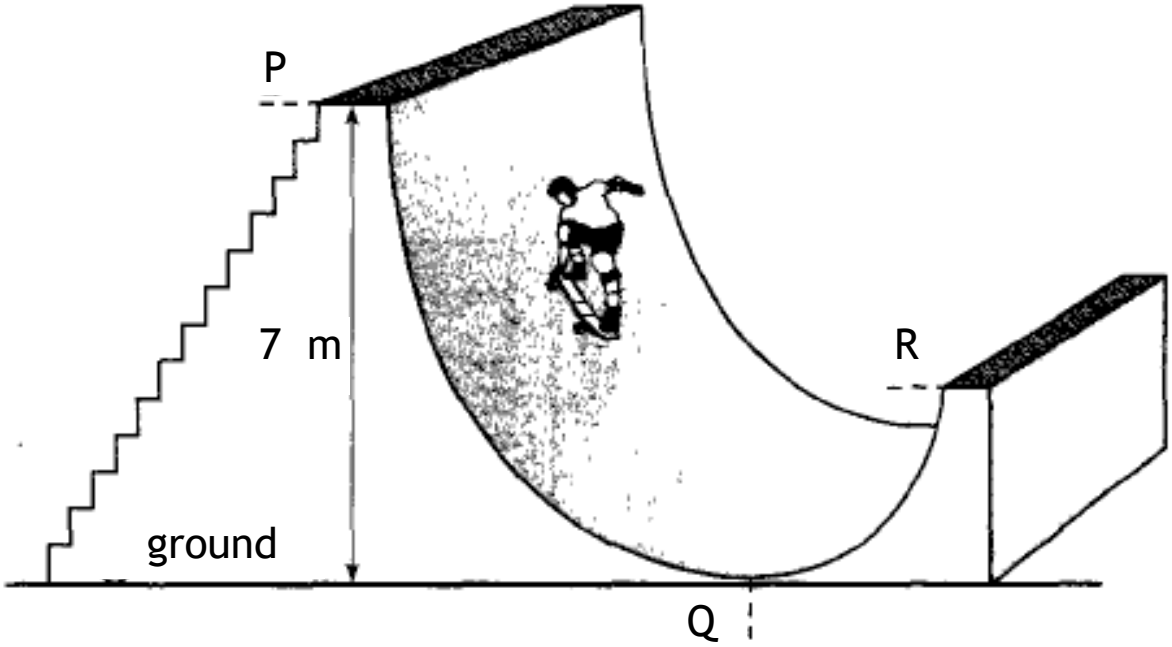


The box is measured to have 2·55 J of potential energy at the top of the inclined plane. The box is measured to have 1·55 J of kinetic energy at the bottom of the inclined plane.
Calculate the force of friction acting down the slope.

A	1·28 N
B	0·50 N
C	0·78 N
D	1·00 N
E	1·28 N

Full Response Questions 11→ 14

11. A skateboarder is practising on a ramp.
The total mass of the skateboarder and the board is 60 kg.



(a) Calculate the increase in potential energy of the skateboarder and board in moving from the ground to position P.

(b) The skateboarder moves along the ramp from P to R, and rises into the air above R.

(i) State which point P, Q or R on the ramp that the kinetic energy of the skateboarder is the greatest.

The vertical speed of the skateboarder at R is 6 ms^{-1}.

(ii) Calculate the height that the skateboarder rises to, above R.

(iii) Explain why the skateboarder does not rise to the same height as P.

12. A railway train travels uphill between two stations.

Information about the train and its journey is given below.

Average speed of train	5 ms^{-1}
Time for journey	150 s
Power of train	120 kW
Mass of train plus passengers	20 000 kg

(a) Calculate the energy used by the train during the journey.

(b) Calculate the height gained by the train during the journey.

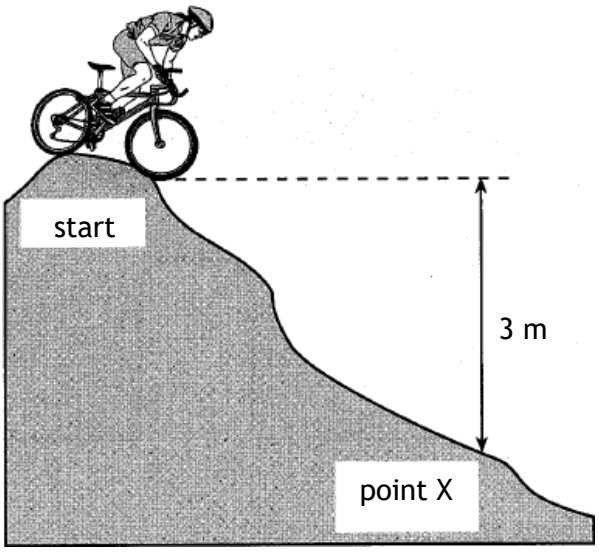
(c) Suggest why the actual height gained by the train is less than the value calculated in part (*b*).

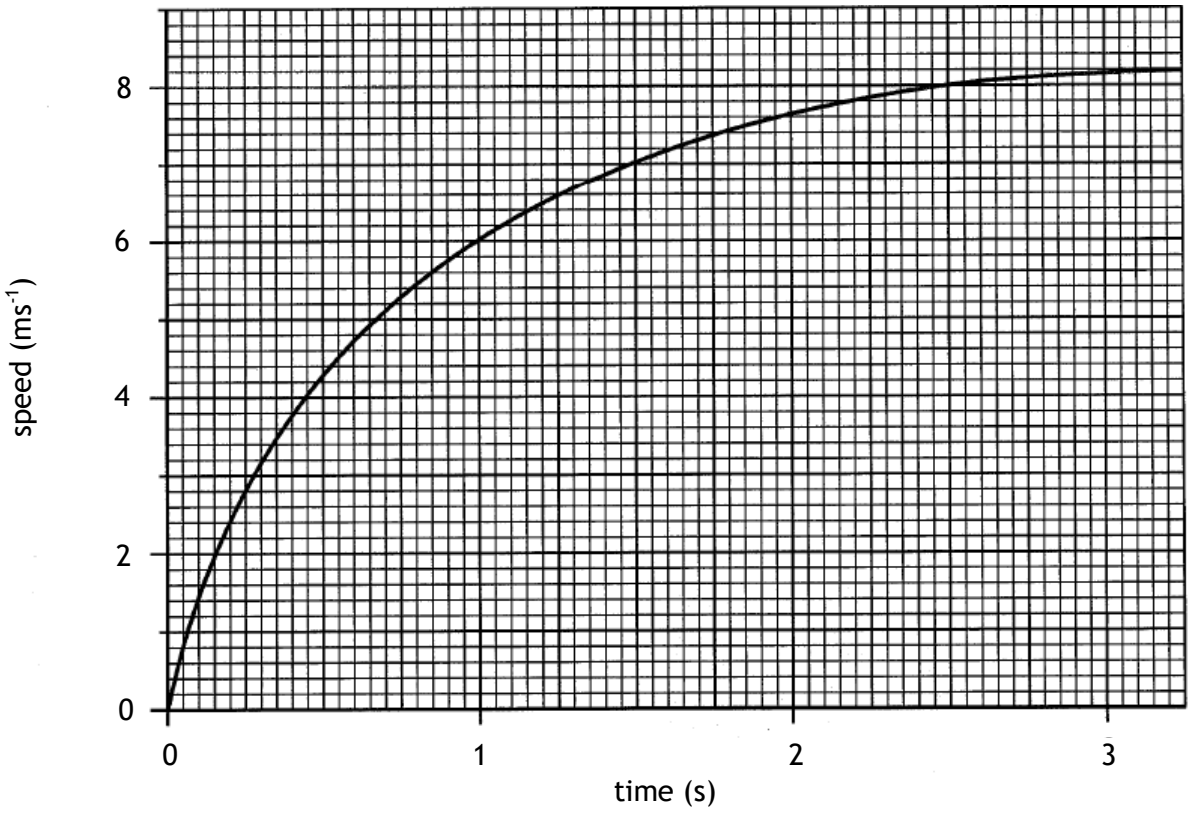
13. A chairlift at a ski resort carries skiers through a vertical distance of 400 m.

(a) The chairlift carries 3000 skiers of average mass 90.0 kg each hour.
Calculate the total gravitational potential energy gained by the skiers in one hour.

(b) Calculate the power of the motor required to move the skiers.

14. In a mountain bike competition, a competitor starts from rest at the top of a hill. He pedals downhill and after 2.5 seconds he passes point X which is 3 m lower than the start. The total mass of the bike and the competitor is 90 kg. A speed time graph for this part of the competitors journey is shown below:





(a) Calculate the decrease in gravitational potential energy of the competitor and the bike from the start of the race to point X.

(b) Calculate the kinetic energy of the competitor and the bike at point X.

(c) Explain the difference between your answers to part (a) and (b).