2009

19 An object of mass 5kg falls from rest and hits the ground at a speed of 20m/s. Air resistance is negligible.

From what height has the object fallen?

Take g to be 10m/s^2

A 10m

B 20m

C 50m

D 100m

E 200m

F 1000m

2010

23 In an ornamental fountain, water is squirted vertically upwards through a nozzle by a pump. 5kg of water pass through the nozzle each second, and the water reaches a height of 5m after leaving the nozzle.

What is the power of the pump (assuming 100% efficiency), and at what speed does the water leave the nozzle?

(Take g to be 10N/kg)

	power of pump / W	speed of water / m/s
A	5	5
B	5	50
C	25	10
D	25	100
E	50	5
F	50	50
G	250	10
H	250	100

27 A car of mass 800kg moves up an incline of 1 in 20 (1 in 20 means for every 20m along the road the car gains 1m in height) at a constant speed of 20m/s. The frictional force opposing motion is 500N.

How much work has been done by the engine after the car has moved 50m?

A 20kJ

B 25kJ

C 27kJ

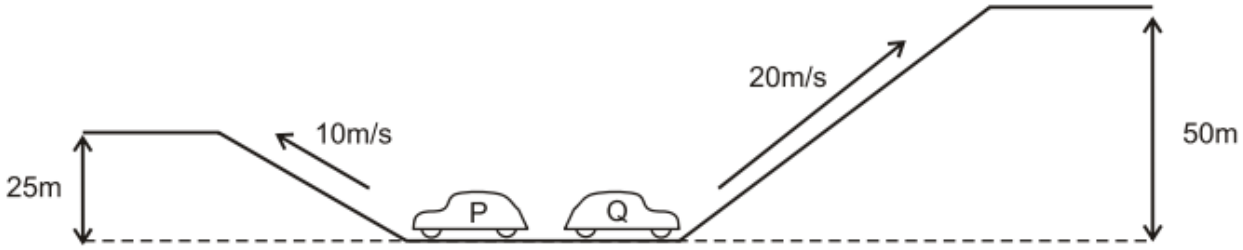
D 45kJ

E 65kJ

F 160kJ

2011

3 Two identical cars, P and Q, start at the same level. Car P moves at a constant speed of 10m/s up a hill to a height of 25m in a time of 20s. In the same time car Q moves at a constant speed of 20m/s up a hill to a height of 50m.

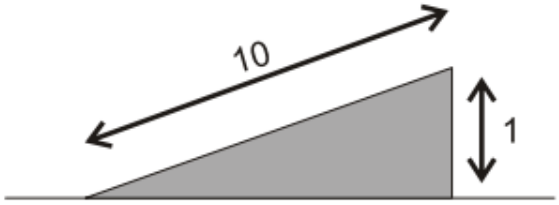


What are the kinetic energies of the cars while they are travelling up the hills, and what are their gravitational potential energies once they have reached the top?

	kinetic energy	**gravitational potential energy**
A	car Q has twice as much as car P	car Q has twice as much as car P
B	car Q has twice as much as car P	car Q has four times as much as car P
C	car Q has four times as much as car P	car Q has twice as much as car P
D	car Q has four times as much as car P	car Q has four times as much as car P

2012

23 A cyclist and a bike have a combined mass of 100kg. The cyclist free-wheels (rolls without pedalling) at a constant speed of 0.8m/s down a 1 in 10 slope (this means that the cyclist descends 1.0m for each 10m travelled along the road, as shown in the diagram.)



Calculate the loss in gravitational potential energy as he loses 100m in vertical height and hence calculate the total resistive force on the cyclist.
[g = 10N/kg]

	Loss in gravitational potential energy (J)	Resistive force (N)
A	3200	3.2
B	3200	$32/\sqrt{99}$
C	3200	$32/\sqrt{100}$
D	100 000	100
E	100 000	$1000/\sqrt{99}$
F	100 000	$1000/\sqrt{101}$

2013

27 A resultant force of 20 N has accelerated a body of mass 4.0 kg from rest, until the present moment, at which time its kinetic energy is 1800 J.

If this force continues to act unchanged, how much extra kinetic energy will the body gain during the next 2 seconds?

A 200 J

B 650 J

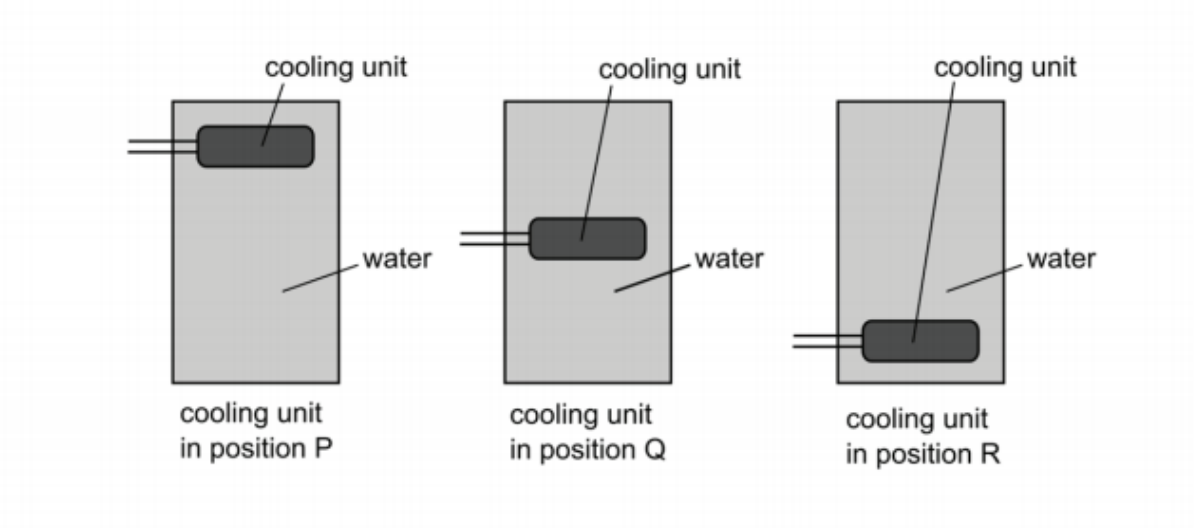
C 1000 J

D 1300 J

E 1400 J

2014

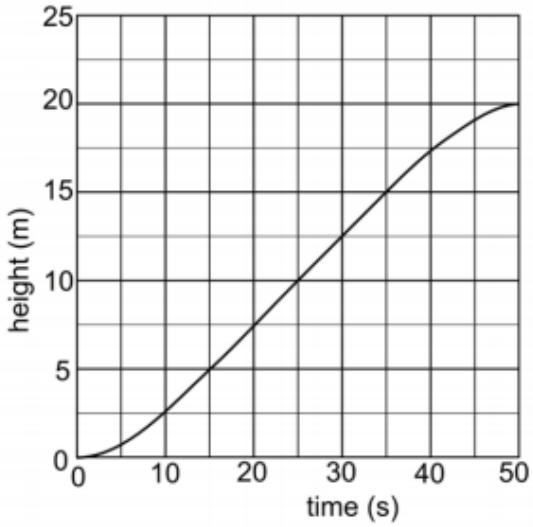
15 A container is filled with water at 20 °C and placed in a room that is also at 20 °C. The container can be fitted with an internal electric cooling unit, in one of the three labelled positions P, Q or R. The outside of the container can either be painted dull black, or be covered in shiny aluminium foil.



In order to cool all the water as quickly as possible to 5 °C, in which position should the cooling unit be fitted, and should the outside of the container be dull black or shiny?

	Position of cooling unit	*Outside of container*
A	P	black
B	P	shiny
C	Q	black
D	Q	shiny
E	R	black
F	R	shiny

27 The graph shows the variation with time of the height through which a crane lifts a mass of 20 kg.



Assume the gravitational field strength g is 10 N / kg, and that the effects of air resistance and friction are negligible.

What is the power output of the crane when the mass is at a height of 10 m?

A 0.1 W

B 10 W

C 40 W

D 100 W

E 400 W

F 4000 W

2016

23 An object that has a weight of 15 N on Earth is taken to a planet where it has a weight of 3.0 N. The planet has no atmosphere.

Which line in the table correctly shows the mass of the object on the planet, and the kinetic energy it gains after falling from rest near the surface of the planet through a vertical distance of 10 m?

(Take the gravitational field strength *g* on Earth to be 10 N / kg.)

	mass of object on planet (kg)	*kinetic energy after falling 10 m on planet (J)*
A	0.30	0.60
B	0.30	6.0
C	0.30	30
D	1.5	15
E	1.5	30
F	1.5	150

2017

27 A graph of kinetic energy, in joules (y-axis) against the square of the speed in $(\text{m/s})^2$ (x-axis) is plotted for an object of mass 2.5 kg travelling along the surface of the Earth. The result is a straight line.

What is the numerical value of the gradient of this line?

A 0.40

B 0.80

C 1.25

D 2.50

E 5.00

F 6.25