Work

Q1 (17/O/N/15/12):
In which situation is no work done?

A The air in a bicycle tyre is released because of a puncture.
B A ball is dropped and falls to the ground.
C A box moves at constant speed across a smooth horizontal surface.
D A crane lifts a steel girder at constant speed.

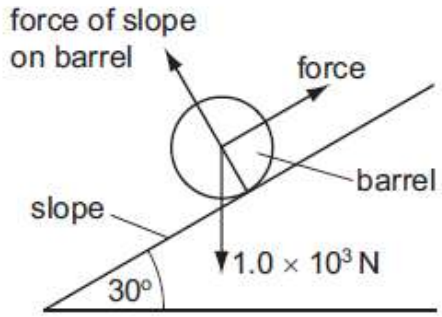
Q2 (16/M/J/15/11):

A team of nine dogs can pull a sledge with a combined force of 800 N at a speed of $1.5\,m\,s^{-1}$ for 360 minutes. What is the average work done by each dog during this time?

A 4.8×10^4 J **B** 4.3×10^5 J **C** 2.9×10^6 J **D** 2.6×10^7 J

Q3 (17/O/N/13/12):

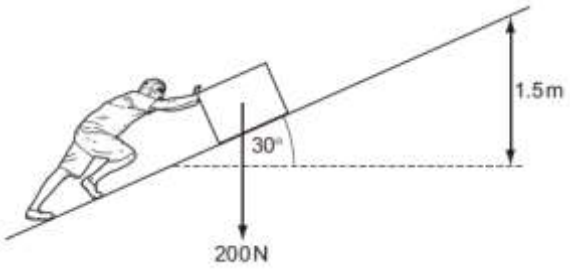
The diagram shows a barrel of weight 1.0×10^3 N on a frictionless slope inclined at 30^o to the horizontal.



A force is applied to the barrel to move it up the slope at constant speed. The force is parallel to the slope. What is the work done in moving the barrel a distance of 5.0 m up the slope?

A 2.5×10^3 J B 4.3×10^3 J C 5.0×10^3 J D 1.0×10^4 J

Q4 (14/O/N/10/12):
A box of weight 200 N is pushed so that it moves at a steady speed along a ramp, through a height of 1.5 m. The ramp makes an angle of 30° with the ground. The frictional force on the box is 150 N while the box is moving.

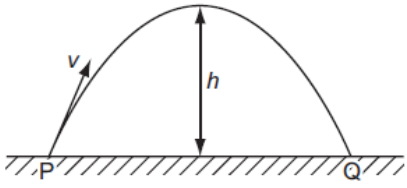


What is the work done by the person?

A 150 J B 300 J C 450 J D 750 J

Q5 (14/M/J/13/13):

A ball of mass m is thrown up to height h in air with an initial velocity v, as shown.



Air resistance is considered negligible. The acceleration of free fall is g.
What is the total work done by the gravitational force on the ball during its flight from P to Q?

A zero B $\frac{1}{2}mv^2$ C mgh D 2mgh

Work done by/on the gases

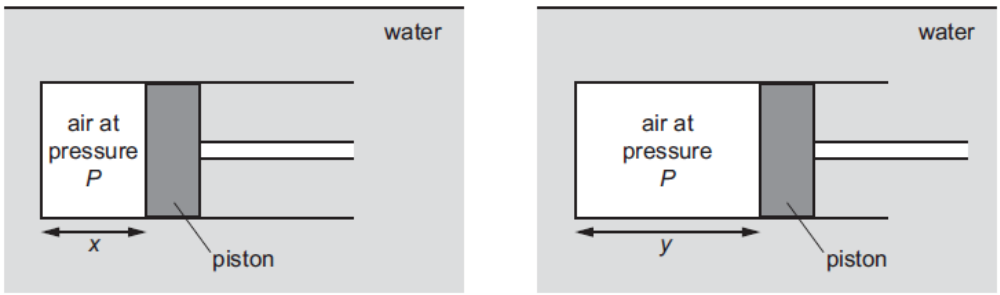
Q6 (17/O/N/17/11):

A piston in a gas supply pump has an area of 400 cm^2. The pump moves the gas against a fixed pressure of 3000 Pa. During part of its stroke, the piston moves a distance of 25 cm in one direction.
How much work is done by the piston during this movement?

A 30 J B 3.0×10^3 J C 3.0×10^5 J D 3.0×10^7 J

Q7 (17/O/N/17/13):

A horizontal cylinder of cross-sectional area A is fitted with a frictionless piston and contains air at pressure P. It is immersed in hot water and the length of the air column increases from x to y. The pressure P is constant.



Which equation represents the work done by the trapped air during this process?

A PAy B –PAy C PA(y – x) D –PA(y – x)

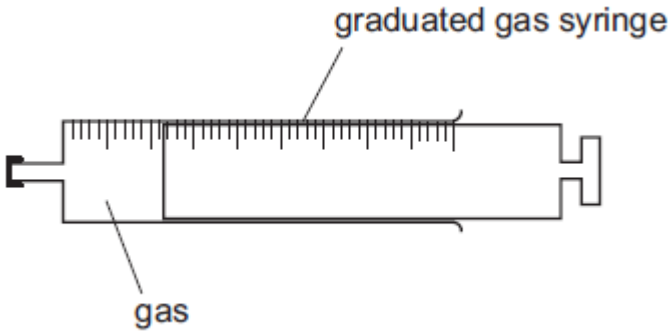
Q8 (19/O/N/12/11):

A piston in a gas supply pump has an area of 600 cm^2 and it moves a distance of 40 cm during one stroke. The pump moves the gas against a fixed pressure of 5000 Pa.
How much work is done by the piston during one stroke?

A 1.2×10^2 J B 1.2×10^4 J C 1.2×10^6 J D 1.2×10^8 J

Q9 (15/O/N/15/11):

A gas is contained inside a sealed syringe, as shown.



The volume of gas at room temperature is 2.0 cm^3.
Atmospheric pressure is 101 kPa.
What is the work done by the gas when it is heated and expands to a volume of 6.0 cm^3?

A 404 µJ B 404 mJ C 404 J D 404 kJ

Q10 (14/M/J/17/13):

The first column in the table gives four examples of work being done. The second column gives more detail of the action. Which row is not correct?

	Example	detail
A	a girl dives from a diving board into a swimming pool	work is done by the girl against the gravitational field as she falls
B	a man pushes a car along a level road	work is done by the man against friction
C	an electron is accelerated towards a positively charged plate	work is done on the electron by the electric field of the plate
D	a piston is pushed outwards as a gas expands	work is done on the atmosphere by the gas

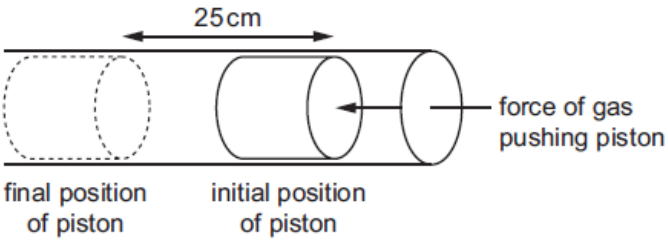
Q11 (19/O/N/12/13):

A piston in a gas supply pump has an area of 400 cm^2 and it moves a distance of 25 cm during one stroke. The pump moves the gas against a fixed pressure of 3000 Pa.
How much work is done by the piston during one stroke?

A 30 J B 3.0×10^3 J C 3.0×10^5 J D 3.0×10^7 J

Q12 (17/M/J/15/13):

The gas in an engine does work on a piston of cross-sectional area 80 cm^2. The pressure on the piston has a constant value of 4.6×10^5 Pa.

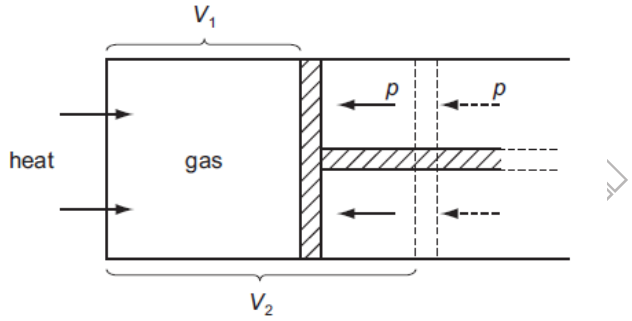


How much work is done by the gas on the piston when it moves through a distance of 25 cm?

A 9.2×10^2 J B 9.2×10^4 J C 9.2×10^6 J D 9.2×10^8 J

Q13 (18/M/J/13/12):

A gas is enclosed inside a cylinder which is fitted with a frictionless piston.

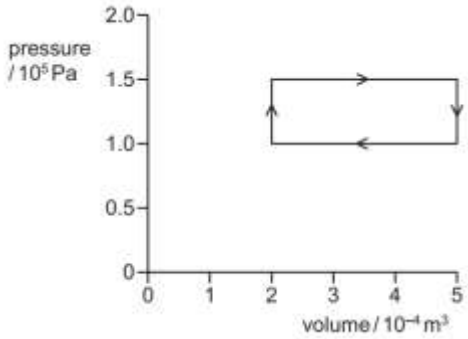


Initially, the gas has a volume V1 and is in equilibrium with an external pressure p. The gas is then heated slowly so that it expands, pushing the piston back until the volume of the gas has increased to V2. How much work is done by the gas during this expansion?

A $p(V_2-V_1)$ B $\frac{1}{2}p(V_2-V_1)$ C $p(V_2+V_1)$ D $\frac{1}{2}p(V_2+V_1)$

Q14(16/O/N/19/11)

A fixed amount of a gas undergoes a series of changes to its pressure and volume.In two of the changes, no work is done by or on the gas. In one change work is done by the gas on its surroundings. In another change work is done on the gas by its surroundings.



During the change when work is done on the gas by its surroundings, how much work is done on the gas?

A 15 J **B** 25 J **C** 30 J **D** 45 J

Kinetic Energy

Q1 (18/O/N/13/13):

A body travelling with a speed of $20\,m\,s^{-1}$ has kinetic energy E_k.

If the speed of the body is increased to $80\,m\,s^{-1}$, what is its new kinetic energy?

A $4E_k$ B $8E_k$ C $12E_k$ D $16E_k$

Q2 (18/O/N/12/11):

The kinetic energy of a particle is increased by a factor of 4.
By what factor does its speed increase?

A 2 B 4 C 8 D 16

Q3 (17/M/J/11/11):

A body travelling with a speed of $10\,m\,s^{-1}$ has kinetic energy 1500 J.

If the speed of the body is increased to $40\,m\,s^{-1}$, what is its new kinetic energy?

A 4500 J B 6000 J C 24 000 J D 1 350 000 J

Q4 (15/O/N/7/1):

A car of mass 1000 kg first travels forwards at $25ms^{-1}$ and then backwards at $5ms^{-1}$.
What is the change in the kinetic energy of the car?

A 200kJ B 300kJ C 325kJ D 450kJ

Q5 (13/O/N/9/12):

A projectile is launched at 45° to the horizontal with initial kinetic energy E.
Assuming air resistance to be negligible, what will be the kinetic energy of the projectile when it reaches its highest point?

A 0.50E B 0.71 E C 0.87 E D E

Q6 (18/O/N/17/12):

Car X is travelling at half the speed of car Y. Car X has twice the mass of car Y.
Which statement is correct?

A Car X has half the kinetic energy of car Y.
B Car X has one quarter of the kinetic energy of car Y.
C Car X has twice the kinetic energy of car Y.
D The two cars have the same kinetic energy.

Q7 (15/O/N/10/12):

A raindrop of mass m is falling vertically through the air with a steady speed v. The raindrop experiences a retarding force kv due to the air, where k is a constant. The acceleration of free fall is g. Which expression gives the kinetic energy of the raindrop?

A $\frac{mg}{k}$ **B** $\frac{mg^2}{2k^2}$ **C** $\frac{m^3g^2}{k^2}$ **D** $\frac{m^3g^2}{2k^2}$

Work energy principle

Q1 (15/O/N/11/12):

When a horizontal force F is applied to a frictionless trolley over a distance s, the kinetic energy of the trolley changes from 4 J to 8 J.

If a force of 2F is applied to the trolley over a distance of 2s, what will the original kinetic energy of 4 J become?

A 16 J B 20 J C 32 J D 64 J

Q2 (20/O/N/12/12):

A railway engine accelerates a train of total mass 1200 tones (1 tone = 1000 kg) from rest to a speed of 75 m s^{-1}. How much useful work must be done on the train to reach this speed?

A 1.7×10^6 J B 3.4×10^6 J C 1.7×10^9 J D 3.4×10^9 J

Q3 (16/O/N/11/12):

The kinetic energy of a vehicle of mass 1000 kg is 4.5×10^5 J. It is braked with a total constant braking force of 6000 N.

What will be its stopping distance?

A 37 m B 75 m C 150 m D 300 m

Q4 (17/M/J/17/11):

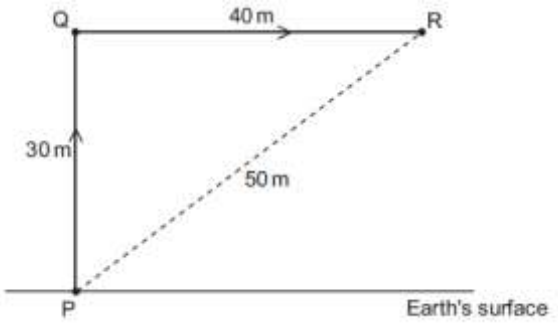
A railway engine accelerates a train of total mass 800 tonnes (1 tonne = 1000 kg) from rest to a speed of 50 m s^{-1}. How much useful work must be done on the train to reach this speed?

A 1.0×10^6 J B 2.0×10^6 J C 1.0×10^9 J D 2.0×10^9 J

Gravitational Potential Energy

Q1 (18/M/J/6/1):

A stone of weight 4.0 N in the Earth's gravitational field is moved from P to Q and then to R along the path shown.



How much potential energy does the stone gain?

A 120 J B 200 J C 280 J D 1200 J

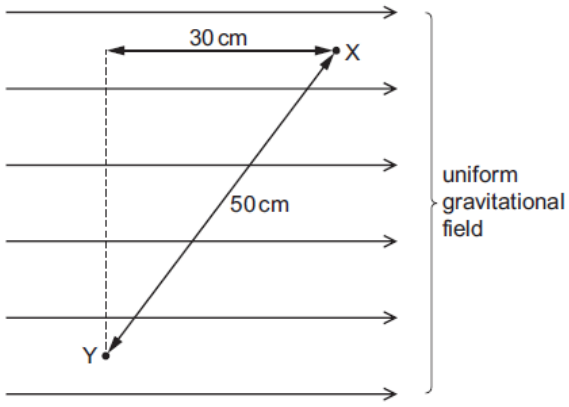
Q2 (16/O/N/6/1):

To get to his office from the entrance of the building, a man has to walk up six flights of stairs. The height of each flight is 2.5 m and the man has a mass of 80 kg.
What is the approximate gain in the man's gravitational potential energy during the climb?

A 1200 J B 2000 J C 4800 J D 12 000 J

Q3 (14/M/J/14/12):

A mass at point X inside a uniform gravitational field experiences a gravitational force of 0.200 N. It has 1.00 J of gravitational potential energy.



The mass is then moved to point Y.
What is its new gravitational potential energy?

A 0.90 J B 0.94 J C 1.06 J D 1.10 J

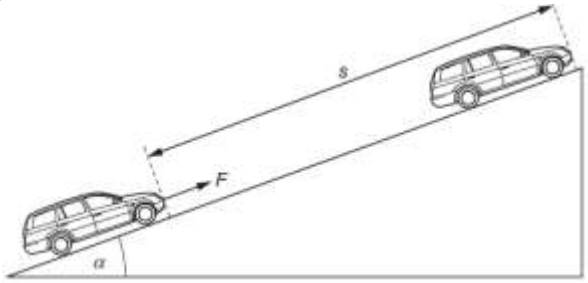
Q4 (16/M/J/12/11):

A concrete cube of side 0.60 m and uniform density 2.0×10^3 kg m^{-3} is lifted 5.0 m vertically by a crane. What is the change in potential energy of the cube?

A 2.2 kJ B 21 kJ C 59 kJ D 450 kJ

Q5 (17/O/N/17/12):

A constant force F, acting on a car of mass m, moves the car up a slope through a distance s at constant velocity v. The angle of the slope to the horizontal is α.



What is the ratio $\frac{gravitational\ potential\ energy\ gained\ by\ car}{work\ done\ by\ force\ F}$?

A $\frac{mgs\sin\alpha}{Fv}$ B $\frac{mv}{Fs}$ C $\frac{mv^2}{2Fs}$ D $\frac{mg\sin\alpha}{F}$

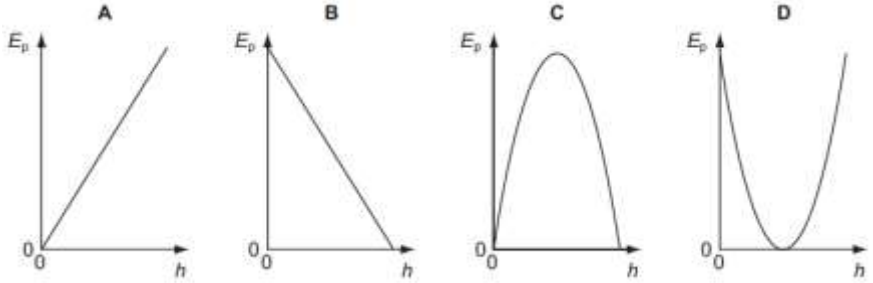
Q6 (15/M/J/17/12):

A cyclist is travelling at a constant speed up a hill. The frictional force resisting the cyclist's motion is 8.0 N. The cyclist uses 450 J of energy to travel a distance of 20 m.
What is the increase in the gravitational potential energy of the cyclist?

A 160 J **B** 290 J **C** 440 J **D** 610 J

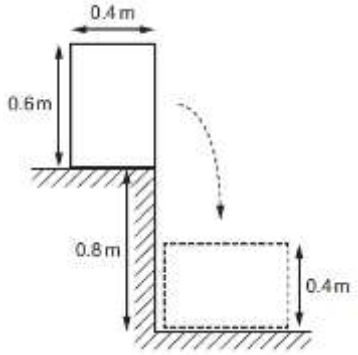
Q7 (16/O/N/8/1):

An object is thrown into the air. Which graph shows how the potential energy E_p of the object varies with height h above the ground?



Q8 (15/M/J/15/12):

A uniform solid block has weight 500 N, width 0.4 m and height 0.6 m. The block rests on the edge of a step of depth 0.8 m, as shown.



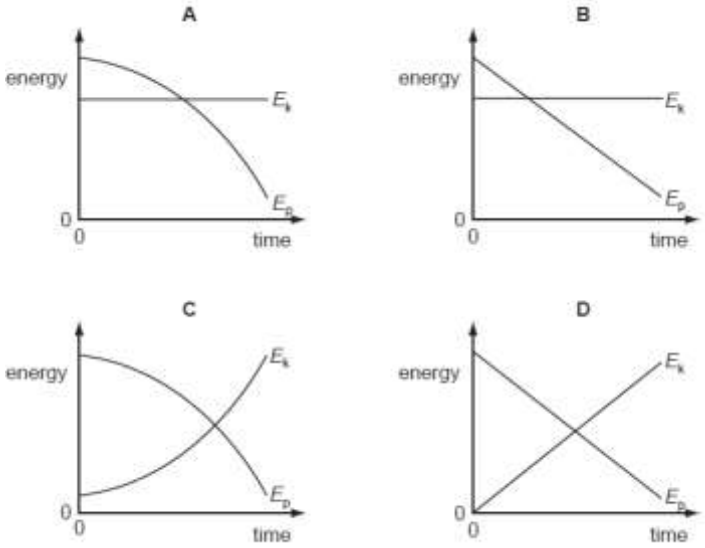
The block is knocked over the edge of the step and rotates through 90° before coming to rest with the 0.6 m edge horizontal.
What is the change in gravitational potential energy of the block?

A 300 J B 400 J C 450 J D 550 J

Q9 (18/M/J/8/1):

A steel ball is falling at constant speed in oil.

Which graph shows the variation with time of the gravitational potential energy E_p and the kinetic energy E_k of the ball?



Q10 (17/M/J/12/12):

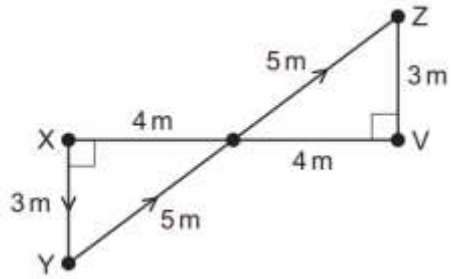
Initially, four identical uniform blocks, each of mass m and thickness h, are spread on a table.

How much work is done on the blocks in stacking them on top of one another?

A 3 mgh B 6 mgh C 8 mgh D 10 mgh

Q11 (17/F/M/20/12):

An object is moved in a vertical plane from X to Y, and then from Y to Z, as shown in the diagram.



The distances between various points are indicated on the diagram.

Lines XY and VZ are vertical. The object weighs 20 N.

How much gravitational potential energy does the object gain by moving from X to Z?

A 60 J **B** 120 J **C** 140 J **D** 260 J

Q12 (14/M/J/14/13):

A uniform solid cuboid of concrete of dimensions 0.50 m x 1.20m x 0.40m and weight 4000 N rests on a flat surface with the 1.20 m edge vertical as shown in diagram 1.

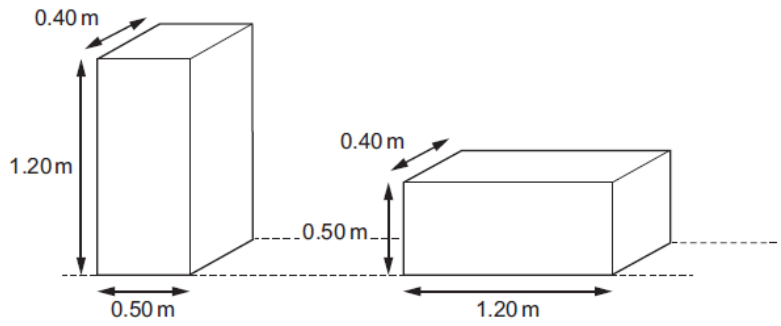


diagram 1 diagram 2

What is the minimum energy required to roll the cuboid through 90° to the position shown in diagram 2 with the 0.50 m edge vertical?

A 200 J B 400 J C 1400 J D 2600 J

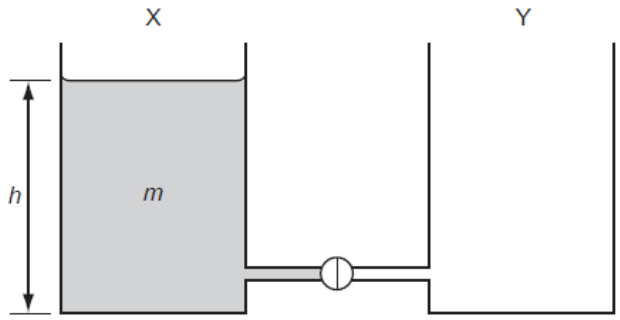
Q13 (17/M/J/15/12):

A fisherman lifts a fish of mass 250 g from rest through a vertical height of 1.8 m. The fish gains a speed of 1.1 m s^{-1}. What is the energy gained by the fish?

A 0.15 J B 4.3 J C 4.4 J D 4.6 J

Q14 (15/O/N/9/1):

The diagram shows two identical vessels X and Y connected by a short pipe with a tap.

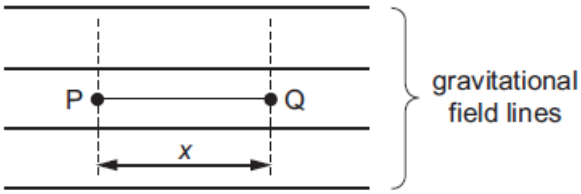


Initially, X is filled with water of mass m to a depth h, and Y is empty.
When the tap is opened, water flows from X to Y until the depths of water in both vessels are equal. How much potential energy is lost by the water during this process? (g = acceleration of free fall)

A 0 **B** $\frac{mgh}{4}$ **C** $\frac{mgh}{2}$ **D** mgh

Q15 (14/O/N/14/12):

A mass m is situated in a uniform gravitational field.

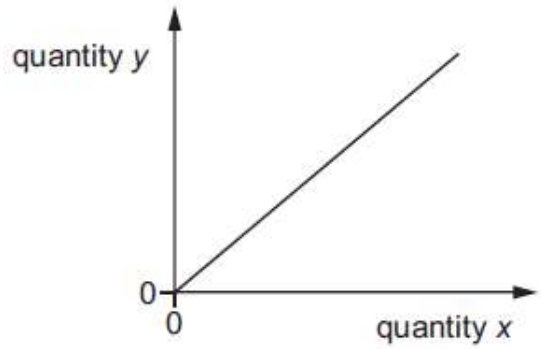


When the mass moves through a displacement x, from P to Q, it loses an amount of potential energy E. Which row correctly specifies the magnitude and the direction of the acceleration due to gravity in this field?

	magnitude	direction
A	$\frac{E}{mx}$	→
B	$\frac{E}{mx}$	←
C	$\frac{E}{x}$	→
D	$\frac{E}{x}$	←

Q16 (8/M/J/17/13):

The graph shows the variation of a quantity y with a quantity x for a body that is falling in air at constant (terminal) velocity in a uniform gravitational field.

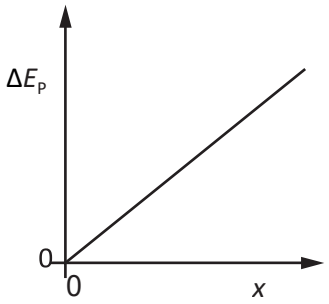


Which quantities could x and y represent?

	x	y
A	air resistance	acceleration
B	loss of height	gain in kinetic energy
C	loss of potential energy	work done against air resistance
D	time	velocity

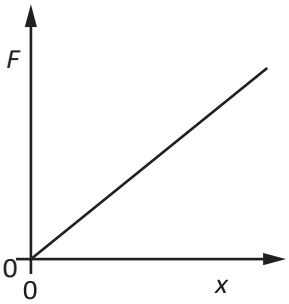
Q17 (17/M/J/24/13):

An object is in a uniform gravitational field. The graph shows how the change in gravitational potential energy ΔE_P of the object varies with the vertical distance x moved by the object from a fixed point.

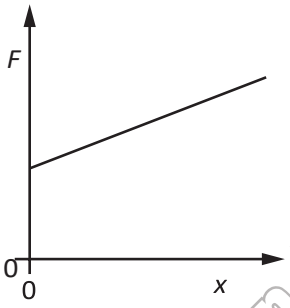


Which graph shows how the gravitational force F acting on the object varies with distance x?

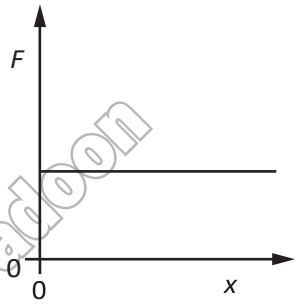
A



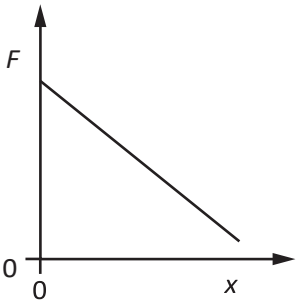
B



C



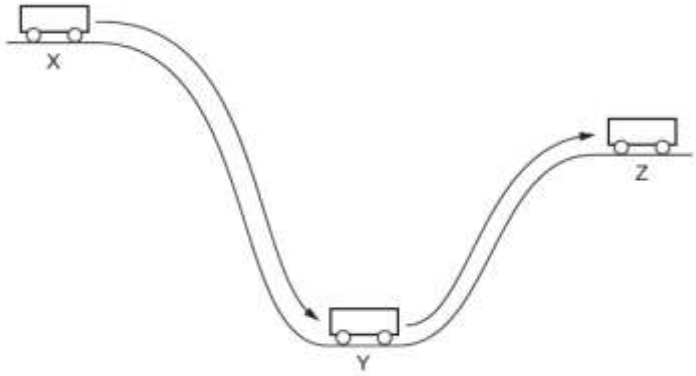
D



Energy transfer and law of conservation of energy.

Q1 (16/O/N/15/13):

A trolley starts from rest at X. It rolls down to Y and eventually comes to rest at Z.



Which row is a possible summary of the energy changes during this process?

	X to Y	Y to Z
A	p.e. → k.e.	k.e. → p.e.
B	p.e. → k.e.	k.e. → p.e. + heat
C	p.e. → k.e. + heat	k.e. → p.e.
D	p.e. → k.e. + heat	k.e. → p.e. + heat

p.e. potential energy k.e. kinetic energy

Q2 (15/M/J/17/11):

A man climbs slowly at a steady speed to the top of a ladder.
What is the main energy transfer taking place for the man as he climbs?

A chemical potential to gravitational potential **B** chemical potential to kinetic

C kinetic to gravitational potential **D** thermal (heat) to kinetic

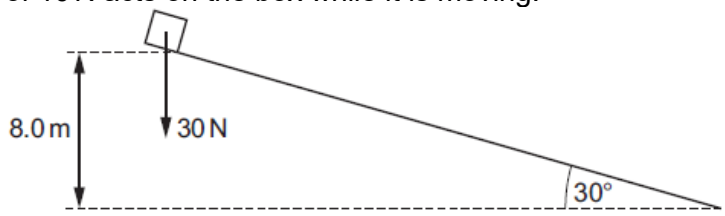
Q3 (16/M/J/16/12):

A parachutist is falling at constant (terminal) velocity.
Which statement is not correct?

A Gravitational potential energy is converted into kinetic energy of the air.
B Gravitational potential energy is converted into kinetic energy of the parachutist.
C Gravitational potential energy is converted into thermal energy of the air.
D Gravitational potential energy is converted into thermal energy of the parachutist.

Q4 (17/O/N/14/13):

A box of weight 30 N is released from rest on a ramp that is at an angle of 30° to the horizontal. The box slides down the ramp so that it falls through a vertical distance of 8.0 m. A constant frictional force of 10 N acts on the box while it is moving.

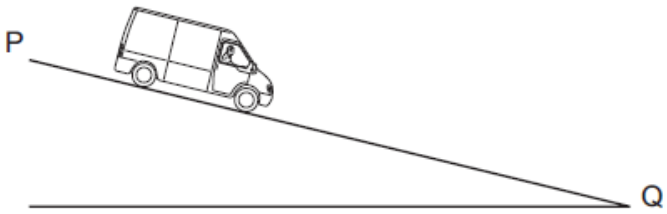


What is the kinetic energy of the box after falling through this distance?

A 80 J B 160 J C 240 J D 400 J

Q5 (19/O/N/14/13):

A van driver adjusts the force on a van's brakes so that the van travels at constant speed down a hill from P to Q.



The magnitude of the change in the van's kinetic energy is ΔE_k. The magnitude of the change in its gravitational potential energy is ΔE_p.
Which statement is correct?

A $\Delta E_k > \Delta E_p$ B $\Delta E_k = \Delta E_p$

C $\Delta E_p > \Delta E_k > 0$ D $\Delta E_k = 0$

Q6 (17/M/J/16/12):

A boy on a bicycle starts from rest and rolls down a hill inclined at 30° to the horizontal.
The boy and bicycle have a combined mass of 25 kg.
There is a frictional force of 30 N, which is independent of the velocity of the bicycle.
What is the kinetic energy of the boy and the bicycle after rolling 20 m down the slope?

A 1850 J B 2450 J C 3050 J D 3640 J

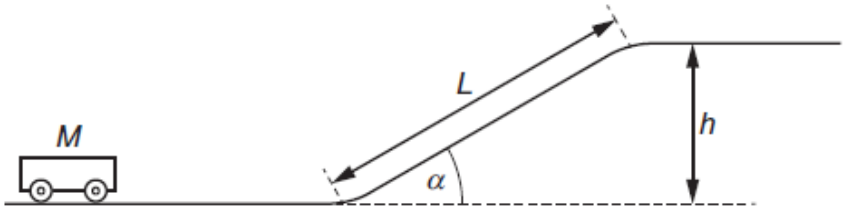
Q7 (15/O/N/17/13):

A ball is thrown vertically upwards. Air resistance is negligible.
Which statement is correct?

A By the principle of conservation of energy, the total energy of the ball is constant throughout its motion.
B By the principle of conservation of momentum, the momentum of the ball is constant throughout its motion.
C The kinetic energy of the ball is greatest at the greatest height attained.
D The potential energy of the ball increases at a constant rate during its ascent.

Q8 (18/O/N/17/13):

A trolley rolls along a horizontal surface and then travels up a slope before reaching a second horizontal surface. The slope is of length L. The trolley has mass M. The slope is at an angle α to the horizontal surface. The second horizontal surface is at height h above the first surface.

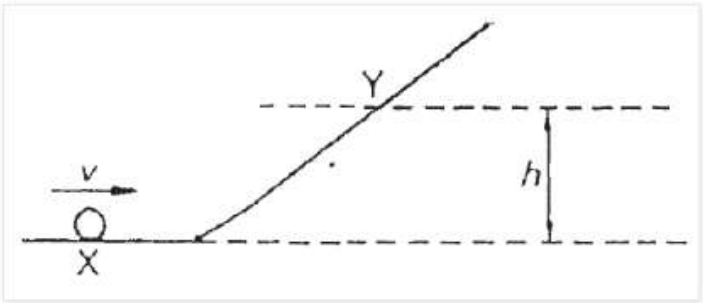


Assume negligible frictional forces. The acceleration of free fall is known.
In order to determine the minimum initial velocity of the trolley for it to reach the top of the slope, which additional values are needed?

A h and M B M, L and h C α, L, M D h only

Q9 (5/M/J/87/1):

An object of mass m passes a point X with a velocity v and slides up a frictionless incline to stop at point Y which is at a height h above X.



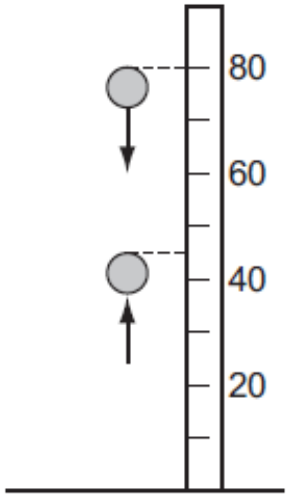
A second object of mass ½ m passes X with a velocity of ½ v. To what height will it rise?

A ¼ h B ½ h C (1/√2) h D h

Q10 (17/M/J/16/13):
An object of mass 0.30 kg is thrown vertically upwards from the ground with an initial velocity of 8.0 m s^{-1}. The object reaches a maximum height of 1.9 m.
How much work is done against air resistance as the object rises to its maximum height?

A 4.0 J B 5.6 J C 9.6 J D 15 J

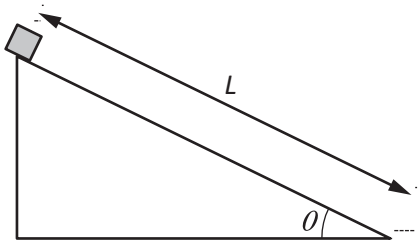
Q11 (17/M/J/13/11):
A solid rubber ball has a diameter of 8.0 cm. It is released from rest with the top of the ball 80 cm above a horizontal surface. It falls vertically and then bounces back up so that the maximum height reached by the top of the ball is 45 cm, as shown.



If the kinetic energy of the ball is 0.75 J just before it strikes the surface, what is its kinetic energy just after it leaves the surface?

A 0.36 J B 0.39 J C 0.40 J D 0.42 J

Q12 (15/F/M/25/12):
A block is released from rest at the top of a slope inclined at an angle to the horizontal. The slope has length *L* as shown in the diagram.

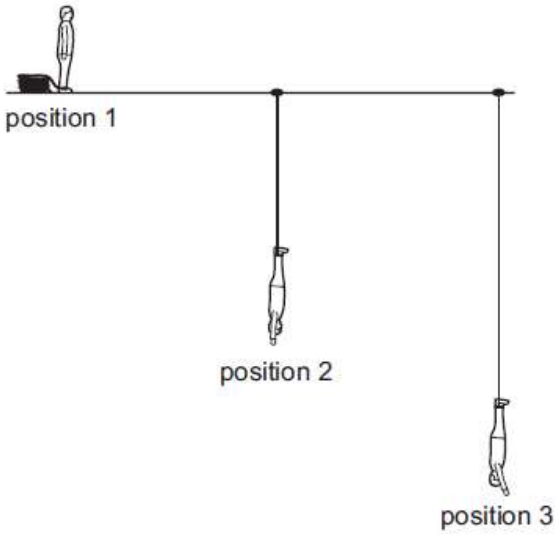


There are no resistive forces acting on the block.

What is the speed of the block at the bottom of the slope?

A $4.43\sqrt{L\cos\theta}$ **B** $4.43\sqrt{L\sin\theta}$ **C** $19.6L\cos\theta$ **D** $19.6L\sin\theta$

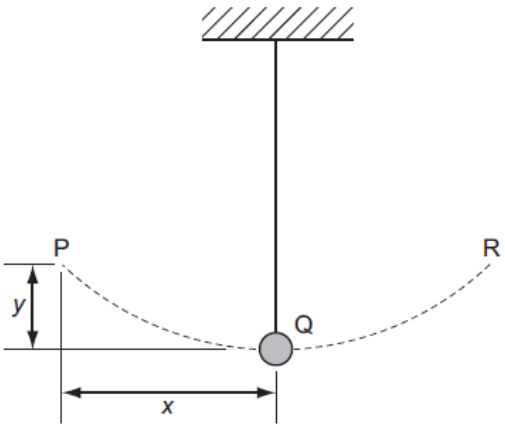
Q13 (16/O/N/7/1):
When bungee jumping, a student starts with maximum gravitational potential energy (position 1), then falls freely until the rope fully unwinds (position 2), after which the rope starts to stretch until the lowest point of the jump is reached (position 3).



What are the kinetic and elastic potential energies at position 3?

	Kinetic energy	Elastic potential energy
A	Maximum	Maximum
B	Maximum	Minimum
C	Minimum	Maximum
D	Minimum	minimum

Q14 (17/O/N/8/1):
A pendulum bob oscillates between P and R.



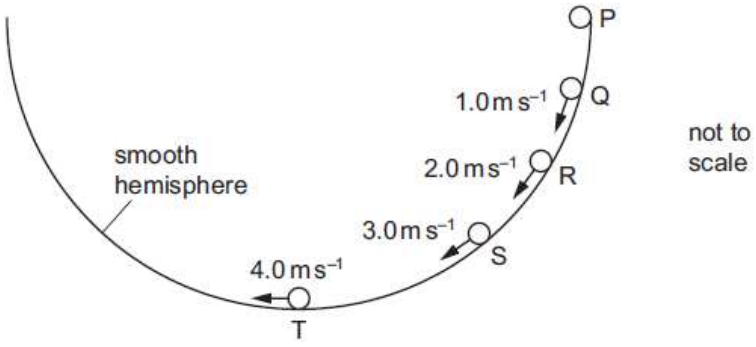
Assuming the gravitational potential energy lost in moving from P to Q is converted into kinetic energy, what is the speed of the bob at Q?

A $\sqrt{2gh}$ B $2gx$ C $\sqrt{2gy}$ D $2gy$

Q15 (15/M/J/14/12):

A small mass is placed at point P on the inside surface of a smooth hemisphere. It is then released from rest. When it reaches the lowest point T, its speed is $4.0\,m\,s^{-1}$.

The diagram (not to scale) shows the speed of the mass at others points Q, R and S as it slides down. Air resistance is negligible.



The mass loses potential energy E in falling from P to T.

At which point has the mass lost potential energy $\frac{E}{4}$?

A Q B R

C S D none of these

Q16 (14/M/J/11/11):

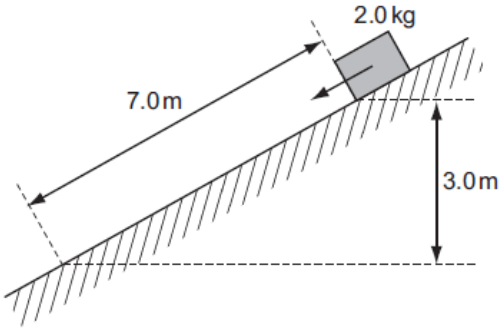
A steel sphere is dropped vertically onto a horizontal metal plate. The sphere hits the plate with a speed u, leaves it at a speed v, and rebounds vertically to half of its original height.

Which expression gives the value of $\frac{v}{u}$?

A $\frac{1}{2^2}$ B $\frac{1}{2}$ C $\frac{1}{\sqrt{2}}$ D $1-\frac{1}{\sqrt{2}}$

Q17 (15/M/J/11/11):

A block of mass 2.0 kg is released from rest on a slope. It travels 7.0 m down the slope and falls a vertical distance of 3.0 m. The block experiences a frictional force parallel to the slope of 5.0 N.

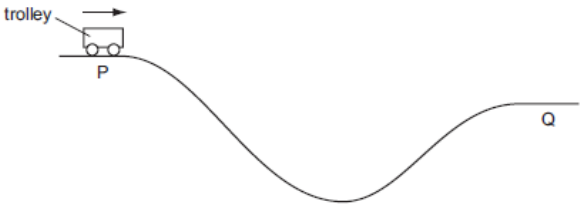


What is the speed of the block after falling this distance?

A $4.9\,m\,s^{-1}$ B $6.6\,m\,s^{-1}$ C $8.6\,m\,s^{-1}$ D $10.1\,m\,s^{-1}$

Q18 (18/O/N/11/11):

A trolley runs from P to Q along a track. At Q its potential energy is 50 kJ less than at P.



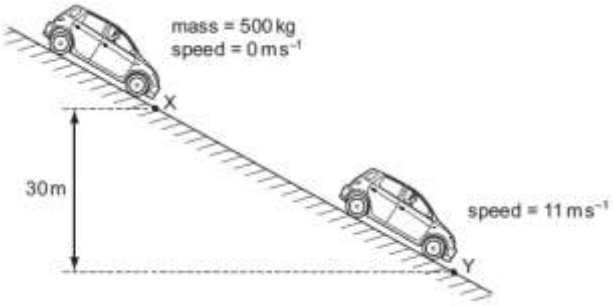
At P, the kinetic energy of the trolley is 5 kJ. Between P and Q, the work the trolley does against friction is 10 kJ.

What is the kinetic energy of the trolley at Q?

A 35 kJ B 45 kJ C 55 kJ D 65 kJ

Q19 (16/O/N/15/12):

A car of mass 500 kg is at rest at point X on a slope, as shown. The car's brakes are released and the car rolls down the slope with its engine switched off. At point Y the car has moved through a vertical height of 30 m and has a speed of 11 m s^{-1}.

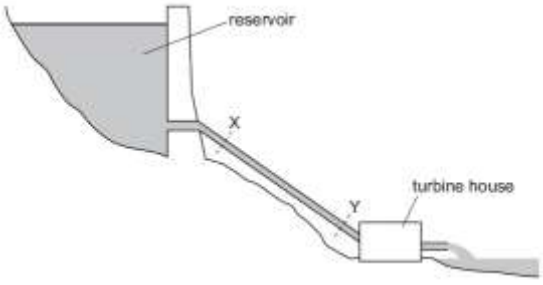


What is the energy dissipated by frictional forces when the car moves from X to Y?

A 3.0 x 10^4 J B 1.2 x 10^5 J C 1.5 x 10^5 J D 1.8 x 10^5 J

Q20 (16/M/J/15/12):

The diagram shows a hydroelectric power station. The reservoir is linked to the turbines by a pipe of uniform cross-sectional area.



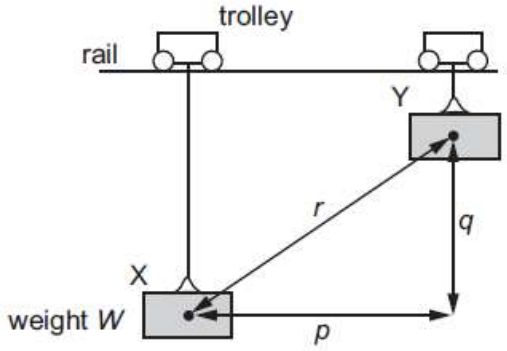
Water flows from X to Y at constant speed. Which statement about the change of energy of the water as it moves from X to Y is correct?

A It gains both gravitational potential energy and kinetic energy.
B It loses both elastic potential energy and kinetic energy.
C It loses both elastic potential energy and gravitational potential energy.
D It loses gravitational potential energy and gains elastic potential energy.

Q21 (19/M/J/16/11):
A hammer with 10 J of kinetic energy hits a nail and pushes it 5.0 mm into a plank.
Both the hammer and nail come to rest after the collision.
What is the approximate average force that acts on the nail while it moves through 5.0 mm?

A 0.050 N B 2.0 N C 50 N D 2000 N

Q22 (15/M/J/14/11):
A weight W hangs from a trolley that runs along a rail. The trolley moves horizontally through a distance p and simultaneously raises the weight through a height q.



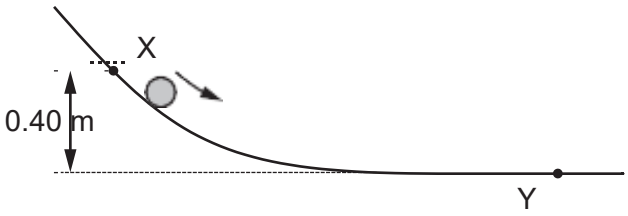
As a result, the weight moves through a distance r from X to Y. It starts and finishes at rest. How much work is done on the weight during this process?

A Wp B W (p + q) C Wq D Wr

Q23 (18/O/N/12/13):
A car travelling with speed 28 m s^{-1} leaves a motorway on an exit road. The end of the exit road is 22 m higher than the motorway.
If only the force of gravity is considered, what will be the speed of the car at the end of the exit road?

A 7.3 m s^{-1} B 19 m s^{-1} C 21 m s^{-1} D 24 m s^{-1}

Q24 (18/M/J/20/13)
A ball slides down a curved track, as shown.



Point X is at a height of 0.40 m above point Y. The speed of the ball at point X is 2.5 m s^{-1}. Frictional forces are negligible. What is the speed of the ball at point Y?

A 2.8 m s^{-1} **B** 3.2 m s^{-1} **C** 3.8 m s^{-1} **D** 14 m s^{-1}

Power

Q1 (15/M/J/7/1):
Which expression defines power?

A force × distance moved in the direction of the force
B force × velocity
C work done ÷ time taken
D work done × time taken

Q2 (18/O/N/11/12):
What is the unit of power in SI base units?

A $kg\,m\,s^{-2}$ B $kg\,m\,s^{-3}$ C $kg\,m^2\,s^{-2}$ D $kg\,m^2\,s^{-3}$

Q3 (17/O/N/10/12):
What are units of work, energy and power?

	work	energy	power
A	J	N m	J
B	$J\,s^{-1}$	J	$J\,s^{-1}$
C	N m	N m	W
D	N m	W	W

Q4 (14/M/J/14/11):
What is the average power output of a laser that can deliver 0.20 J of energy in 10 ns?

A 2 nW B 20 mW C 200 kW D 20 MW

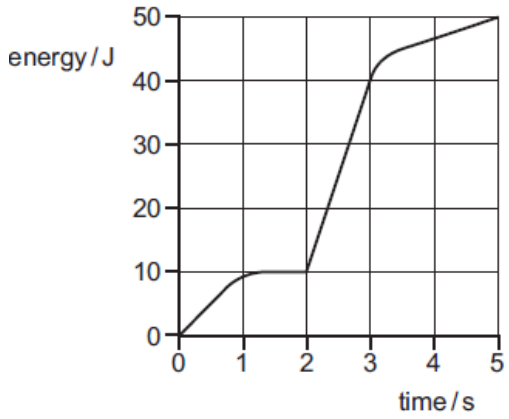
Q5 (16/M/J/14/11):
The engine of a car exerts a force of 600 N in moving the car 1.0 km in 150 seconds.
What is the average output power of the engine?

A 4.0 W B 4.0 kW C 90 kW D 90 MW

Q6 (3/O/N/17/11):
An ion is accelerated in a vacuum by a series of electrodes. A graph of the power supplied to the ion is plotted against time. What is represented by the area under the graph between two times?

A the average force on the ion
B the change in kinetic energy of the ion
C the change in momentum of the ion
D the change in velocity of the ion

Q7 (19/O/N/13/13):
An electrical generator is started at time zero. The total electrical energy generated during the first 5 seconds is shown in the graph.



What is the maximum electrical power generated at any instant during these first 5 seconds?

A 10 W B 13 W C 30 W D 50 W

Q8 (18/M/J/16/11):
Which amount of energy is not 2400 J?

A the decrease in gravitational potential energy of a body of mass 60 kg when it moves vertically downwards through 40 m near the Earth's surface
B the energy transferred in 15 s by a machine of power 160 W
C the kinetic energy of a body of mass 12 kg moving at a speed of 20 m s^{-1}
D the work done by a gas expanding against a constant external pressure of 120 kPa when its volume increases by 0.020 m^3

Q9 (15/M/J/10/11):
A force of 1000 N is needed to lift the hook of a crane at a steady velocity. The crane is then used to lift a load of mass 1000 kg at a velocity of 0.50 m s^{-1}.
How much of the power developed by the motor of the crane is used in lifting the hook and the load? Assume that the acceleration of free fall g is equal to 10 m s^{-2}.

A 5.0 kW B 5.5 kW C 20 kW D 22 kW

Q10 (18/M/J/17/12):
What is a correct derivation of the equation relating power, force and velocity?

A power $= \frac{work\ done}{time\ taken}$ and work done = force x displacement

So power $= \frac{force \times displacement}{time\ taken}$

Power = force x velocity

B power $= \frac{work\ done}{time\ taken}$ and work done = force x distance

So power $= \frac{force \times distance}{time\ taken}$

Power = force x velocity

C power $= \frac{work\ done}{time\ taken}$ and work done = $\frac{force}{displacement}$

So power $= \frac{force}{displacement} \times time\ taken$

Power = $\frac{force}{velocity}$

D power $= \frac{work\ done}{time\ taken}$ and work done = $\frac{force}{distance}$

So power $= \frac{force}{distance} \times time\ taken$

Power = $\frac{force}{velocity}$

Q11 (18/O/N/13/12):
A car travelling on a level road at a steady
20 m s^{-1} against a constant resistive force develops a power of 40 kW.
What is the magnitude of the resistive force?

A 200 N B 800 N C 2000 N D 4000 N

Q12 (18/M/J/16/13):

A racing car has an output power of 300 kW when travelling at a constant speed of 60 m s^{-1}.
What is the total resistive force acting on the car?

A 5 kN B 10 kN C 50 kN D 100 kN

Q13 (19/M/J/12/12):
A car engine exerts an average force of 500 N in moving the car 1.0 km in 200 s.
What is the average power developed by the engine?

A 2.5 W B 2.5 kW C 100 kW D 100 MW

Q14 (18/M/J/16/12):

An escalator in an underground station has 250 people standing on it and is moving with a velocity of 4.3 m s^{-1}. The average mass of a person is 78 kg and the angle of the escalator to the horizontal is 40°. What is the minimum power required to lift these people?

A 54 kW B 64 kW C 530 kW D 630 kW

Q15 (16/O/N/17/13):

A car of total mass 1560 kg is travelling with a constant speed of 32 m s^{-1}. The driving force provided by the car is 680 N. The kinetic energy of the car is 800 kJ and its momentum is 50 000 N s.

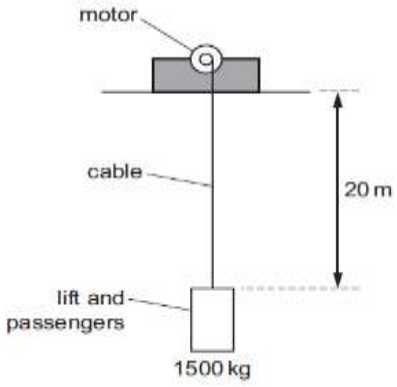
Which two items of data could be used to calculate the useful power output of the car?

A driving force and momentum B kinetic energy and mass

C mass and momentum D speed and driving force

Q16 (19/M/J/16/12):

An electric motor operating a lift has an output power of 20 kW.



The lift and passengers have a combined mass of 1500 kg. The motor raises the lift through a distance of 20 m.

How long does it take?

A 6 s B 15 s C 30 s D 60 s

Q17 (17/M/J/17/13):

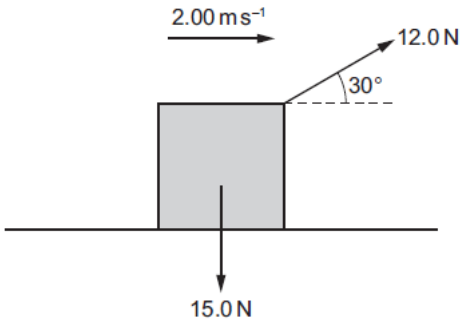
A man has a mass of 80 kg. He ties himself to one end of a rope which passes over a single fixed pulley. He pulls on the other end of the rope to lift himself up at an average speed of 50 cm s^{-1}.

What is the average useful power at which he is working?

A 40 W B 0.39 kW C 4.0 kW D 39 kW

Q18 (17/O/N/15/13):

An object of weight 15.0 N is pulled along a horizontal surface at a constant velocity of 2.00 m s^{-1}. The force pulling the object is 12.0 N at 30° to the horizontal, as shown.



What is the power used to move the object?

A 12.0 W B 20.8 W C 24.0 W D 30.0 W

Q19 (17/M/J/12/11):

The force resisting the motion of a car is taken as being proportional to the square of the car's speed. The magnitude of the force at a speed of 20 m s^{-1} is 800 N.

What effective power is required from the car's engine to maintain a steady speed of 40 m s^{-1}?

A 32 kW B 64 kW C 128 kW D 512 kW

Q20 (18/O/N/8/1):

Which operation involves the greatest mean power?

A a car moving against a resistive force of 0.4 kN at a constant speed of 20 m s^{-1}

B a crane lifting a weight of 3 kN at a speed of 2 m s^{-1}

C a crane lifting a weight of 5 kN at a speed of 1 m s^{-1}

D a weight being pulled across a horizontal surface at a speed of 6 m s^{-1} against a frictional force of 1.5 kN

Q21 (14/O/N/9/1):

The forward motion of a motor-boat is opposed by forces F which vary with the boat's speed v in accordance with the relation F = k v^2, where k is a constant.

The effective power of the propellers required to maintain the speed v is P.

Which expression relates k, P and v?

A $k = \frac{P}{v}$ B $k = \frac{P}{v^2}$ C $k = \frac{P}{v^3}$ D $k = \frac{P}{v^4}$

22 (17/M/J/16/11):

The power P required to move an object through a medium at constant speed depends on the speed v and the resistive force F acting on the object.
The resistive force F also depends on the speed v.
Which row shows a possible relationship between speed v, resistive force F and power P?

	resistive force F	power P
A	proportional to v	Constant
B	proportional to v	proportional to v
C	proportional to v^2	proportional to v^2
D	proportional to v^2	proportional to v^3

Q23 (18/M/J/15/13):

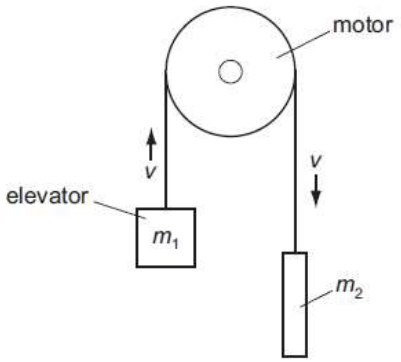
A loaded aeroplane has a total mass of 1.2×10^5 kg while climbing after take-off. It climbs at an angle of 23° to the horizontal with a speed of $50\,m\,s^{-1}$. What is the rate at which it is gaining potential energy at this time?

A $2.3 \times 10^6\,J\,s^{-1}$ B $2.5 \times 10^6\,J\,s^{-1}$

C $2.3 \times 10^7\,J\,s^{-1}$ D $2.5 \times 10^7\,J\,s^{-1}$

Q24 (18/O/N/10/11):

The diagram shows a lift system in which the elevator (mass m_1) is partly counterbalanced by a heavy weight (mass m_2).



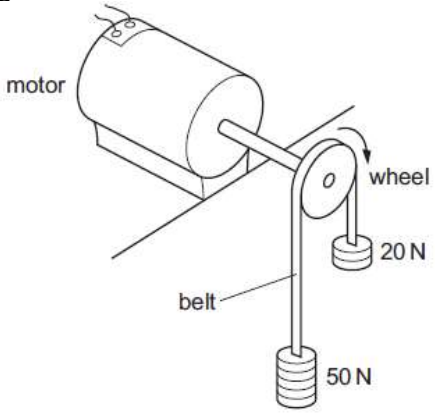
At what rate does the motor provide energy to the system when the elevator is rising at a steady speed v? (g = acceleration of free fall)

A $\frac{1}{2}m_1v^2$ B $\frac{1}{2}(m_1 - m_2)v^2$

C m_1gv D $(m_1 - m_2)gv$

Q25 (19/O/N/17/13):

The diagram shows an arrangement used to find the output power of an electric motor.
The wheel attached to the motor's axle has a circumference of 0.5 m and the belt which passes over it is stationary when the weights have the values shown.

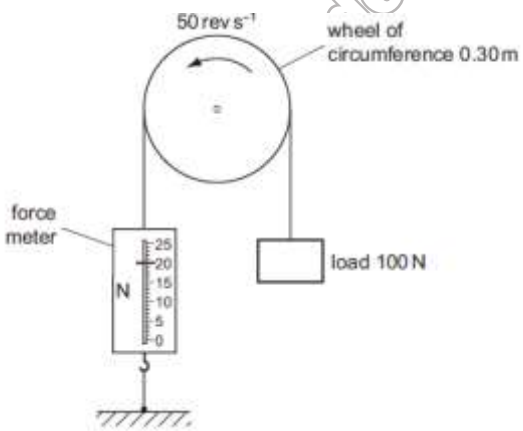


When the wheel is making 20 revolutions per second, what is the output power of the motor?

A 300 W B 500 W C 600 W D 700 W

Q26 (19/M/J/13/11):

The diagram shows a wheel of circumference 0.30 m. A rope is fastened at one end to a force meter. The rope passes over the wheel and supports a freely hanging load of 100 N. The wheel is driven by an electric motor at a constant rate of 50 revolutions per second.
When the wheel is turning at this rate, the force meter reads 20 N.



What is the output power of the motor?

A 0.3 kW B 1.2 kW C 1.8 kW D 3.8 kW

Q27 (18/M/J/17/11):

A mass is raised vertically. In time t, the increase in its gravitational potential energy is E_p and the increase in its kinetic energy is E_k. What is the average power input to the mass?

A $(E_p - E_k)t$ B $(E_p + E_k)t$ C $\frac{(E_p - E_k)}{t}$ D $\frac{(E_p + E_k)}{t}$

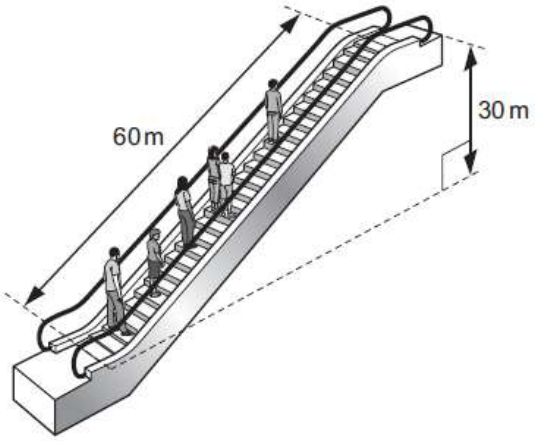
Q28 (19/M/J/15/11):

A conveyor belt is driven at velocity v by a motor. Sand drops vertically on to the belt at a rate of $mkgs^{-1}$. What is the additional power needed to keep the conveyor belt moving at a steady speed when the sand starts to fall on it?

A $\frac{1}{2}mv$ B mv C $\frac{1}{2}mv^2$ D mv^2

Q29 (16/M/J/14/12):

An escalator is 60 m long and lifts passengers through a vertical height of 30 m, as shown.



To drive the escalator against the forces of friction when there are no passengers requires a power of 2.0 kW.

The escalator is used by passengers of average mass 60 kg and the power to overcome friction remains constant.

How much power is required to drive the escalator when it is carrying 20 passengers and is travelling at 0.75 m s^{-1}?

A 4.4 kW B 6.4 kW C 8.8 kW D 10.8 kW

Q30 (17/O/N/19/13)

The maximum useful output power of a car travelling on a horizontal road is P. The total resistive force acting on the car is kv^2, where v is the speed of the car and k is a constant.

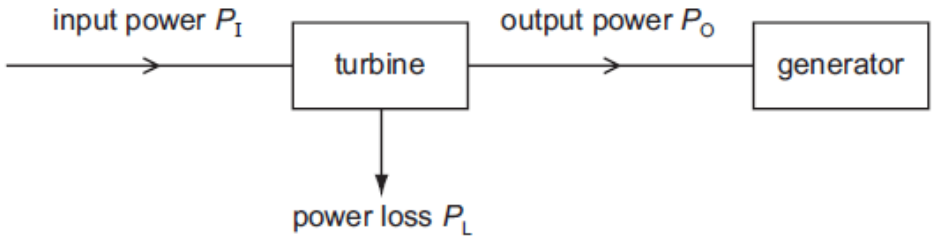
Which equation is correct when the car is travelling at maximum speed?

A $v^3 = \frac{P}{k}$ **B** $v^2 = \frac{P}{k}$ **C** $v = \left(\frac{P}{k}\right)^2$ **D** $v = \left(\frac{P}{k}\right)^3$

Efficiency

Q1 (15/M/J/17/13):

A steam turbine is used to drive a generator. The input power to the turbine is P_I and the output power P_O. The power loss in the turbine is P_L, as shown below.

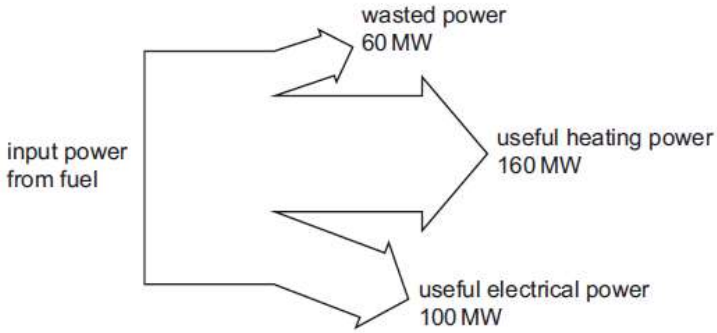


What is the efficiency of the turbine?

A $\frac{P_L}{P_0}$ B $\frac{P_I}{P_0}$ C $\frac{P_L}{P_I}$ D $\frac{P_0}{P_I}$

Q2 (16/O/N/15/11):

A combined heat and power (CHP) station generates electrical power and useful heat. The diagram shows the input and output for a CHP station.



What is the efficiency of the CHP station for producing useful power?

A 31% B 38% C 50% D 81%

Q3 (16/M/J/17/11):

During an interval of time, fuel supplies energy X to a car.
Some of this energy is converted into kinetic energy as the car accelerates.
The rest of the energy Y is lost as thermal energy.
What is the efficiency of the car?

A $\frac{X}{X-Y}$ B $\frac{Y}{X-Y}$ C $\frac{X-Y}{X}$ D $\frac{X \mp Y}{Y}$

Q4 (19/M/J/8/1):

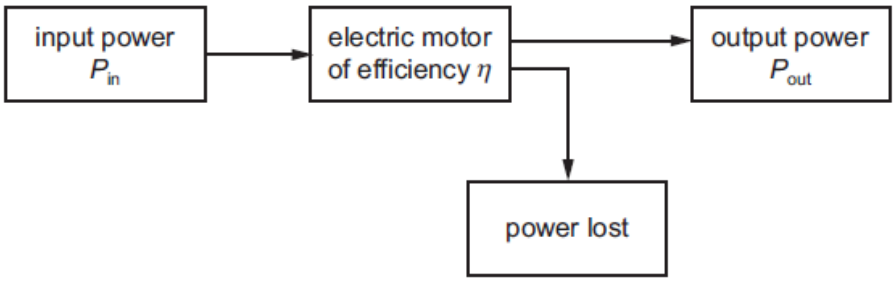
The total energy input E_{in} in a process is partly transferred to useful energy output U, and partly to energy that is wasted W.
What is the efficiency of the process?

A $\frac{U}{W}$ x 100% B $\frac{W}{E_{in}}$ x 100%

C $\frac{U}{E_{in}}$ x 100% D $\frac{U+W}{E_{in}}$ x 100%

Q5 (16/M/J/14/13):

An electric motor has an input power P_{in}, useful output power P_{out} and efficiency η.

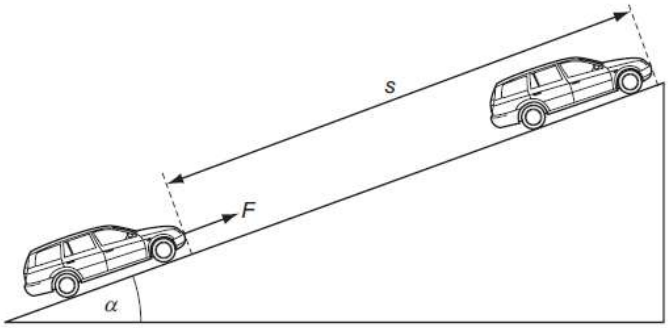


How much power is lost by the motor?

A ηP_{in} B $(\frac{1}{\eta}-1)P_{in}$ C ηP_{out} D $(\frac{1}{\eta}-1)P_{out}$

Q6 (15/O/N/14/13):

A constant force F, acting on a car of mass m, moves the car up a slope through a distance s at constant velocity v. The angle of the slope to the horizontal is α.



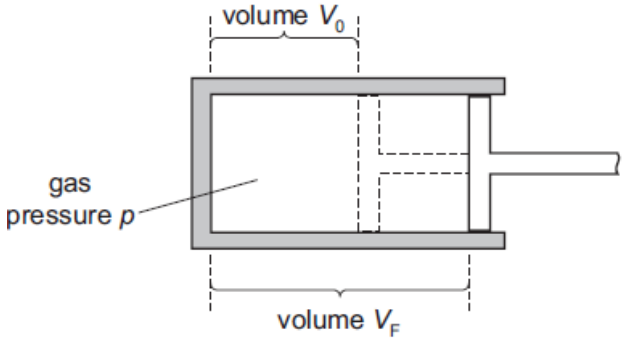
Which expression gives the efficiency of the process?

A $\frac{mgs\sin\alpha}{Fv}$ B $\frac{mv}{Fs}$ C $\frac{mv^2}{2Fs}$ D $\frac{mg\sin\alpha}{F}$

Q7 (16/M/J/16/11):

Some gas in a cylinder is supplied with thermal energy q.

The gas does useful work in expanding at constant pressure p from volume V_0 to volume V_F, as shown.



Which expression gives the efficiency of this change?

A $\frac{pV_0}{q}$ B $\frac{V_F}{V_0 q}$ C $\frac{p(V_F-V_0)}{q}$ D $\frac{(V_F-V_0)}{V_0 q}$

Q8 (17/O/N/13/13):

The pump of a water pumping system uses 2.0 kW of electrical power when raising water. The pumping system lifts 16 kg of water per second through a vertical height of 7.0 m.
What is the efficiency of the pumping system?

A 1.8% B 5.6% C 22% D 55%

Q9 (18/M/J/15/12):

Water from a reservoir is fed to the turbine of a hydroelectric system at a rate of 500 kg s^{-1}. The reservoir is 300 m above the level of the turbine.
The electrical output from the generator driven by the turbine is 200 A at a potential difference of 6000 V.
What is the efficiency of the system?

A 8.0% B 8.2% C 80% D 82%

Q10 (18/M/J/12/11):

The data below are taken from a test of a petrol engine for a motor car.

power output	150 kW
fuel consumption	20 litres per hour
energy content of fuel	40 MJ per litre

Which expression will evaluate the efficiency of the engine?

A $\frac{150\times10^{3}}{40\times10^{6}\times20\times60\times60}$ B $\frac{150\times10^{3}\times60\times60}{20\times40\times10^{6}}$

C $\frac{150\times10^{3}\times40\times10^{6}\times20}{60\times60}$ D $\frac{150\times10^{3}\times20}{40\times10^{3}\times60\times60}$

Q11 (19/O/N/11/11):

An electric motor is required to produce 120 W of mechanical output power. The efficiency of the motor is 80 %.Which row is correct?

	electrical power input to motor / W	waste heat output from motor / W
A	120	24
B	120	96
C	150	30
D	150	120

Q12 (18/M/J/11/12):

An electric motor produces 120 W of useful mechanical output power. The efficiency of the motor is 60 %. Which row is correct?

	electrical power input / W	waste heat power output / W
A	72	48
B	192	72
C	200	72
D	200	80

Q13 (22/O/N/12/12):

Trains supply coal to a power station. The table below gives quantities describing the operation of the power station.

	symbol	unit
power station output	P	W
number of trains per day	N	
mass of coal on a train	M	
energy from 1 kg of coal	J	kg
number of seconds in one day	S	J

Which expression gives the efficiency of the power station?

A $\frac{PS}{NMJ}$ B $\frac{PSN}{MJ}$ C $\frac{NMJ}{PS}$ D $\frac{NM}{PSJ}$

Q14 (17/O/N/11/12):

In many old-style filament lamps, as much as 92 J of energy is emitted as thermal energy for every 8 J of energy emitted as light. What is the efficiency of the lamp, as the percentage of electrical energy converted to light energy?

A 8 % B 9 % C 91 % D 92 %

Q15 (17/O/N/6/1):

In many old-style filament lamps, as much as 93 J of energy is emitted as thermal energy for every 7 J of energy emitted as light. What is the efficiency of the lamp, as the percentage of electrical energy converted to light energy?

A 7 % B 8 % C 92 % D 93 %

Q16 (16/M/J/13/12):

A bow of mass 400 g shoots an arrow of mass 120 g vertically upwards. The potential energy stored in the bow just before release is 80 J. The system has an efficiency of 28%.
What is the height reached by the arrow when air resistance is neglected?

A 4 m B 19 m C 187 m D 243 m

Q17 (17/M/J/15/11):

Which statement is correct?

A A ball lands on the ground and bounces. The kinetic energy changes sign, because the ball changes direction.

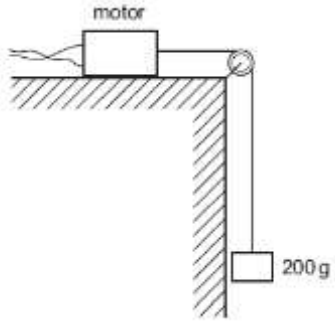
B A car drives up a slope at a steady speed. The power gene;ljkhjrated by the engine equals the potential energy gained per unit time.

C An electric heater can be 100% efficient.

D It is impossible for momentum to be conserved in a collision.

Q18 (15/O/N/14/12):

A small electric motor is mounted on a bench, as shown. The motor is connected to a 6.0 V supply and the current in the motor is 0.50 A. The motor is 50% efficient.

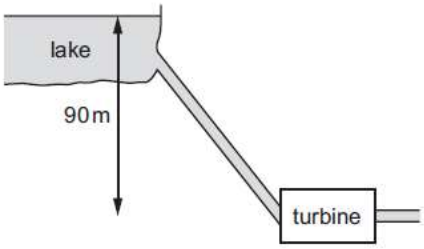


What is the time taken to lift a mass of 200 g up through a height of 90 cm?

A 0.59 s B 0.85 s C 1.2 s D 2.7 s

Q19 (19/M/J/17/11):

Water flows from a lake into a turbine that is a vertical distance of 90 m below the lake, as shown.



The mass flow rate of the water is 2400 kg min^{-1}. The turbine has an efficiency of 75%. What is the output power of the turbine?

A 26 kW B 35 kW C 1.6 MW D 2.1 MW

Q20 (17/M/J/13/12):

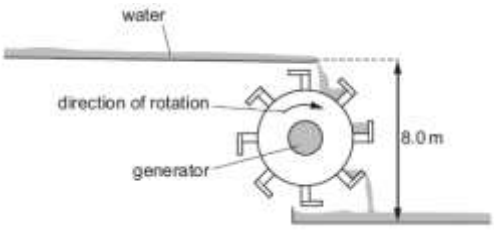
A train on a mountain railway is carrying 200 people of average mass 70 kg up a slope at an angle of 30° to the horizontal and at a speed of 6.0 m s^{-1}. The train itself has a mass of 80 000 kg. The percentage of the power from the engine which is used to raise the passengers and the train is 40 %.

What is the power of the engine?

A 1.1 MW B 2.8 MW C 6.9 MW D 14 MW

Q21 (19/M/J/16/13):

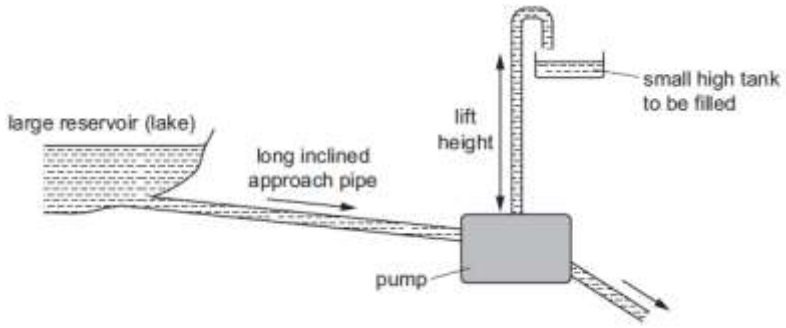
The diagram shows the design of a water wheel which drives a generator to produce electrical power. The flow rate of the water is 200 kg s^{-1}. The generator supplies a current of 32 A at a voltage of 230 V.



Ignoring any changes in kinetic energy of the water, what is the efficiency of the system?

A 14% B 16% C 22% D 47%

Q22 (18/M/J/15/11):
The diagram shows a pump called a hydraulic ram.



In one such pump the long approach pipe holds 500 kg of water. A valve shuts when the speed of this water reaches 2.0 m s^{-1} and the kinetic energy of this water is used to lift a small quantity of water by a height of 15 m. The efficiency of the pump is 10%. Which mass of water could be lifted 15 m?

A 0.15 kg B 0.68 kg C 1.5 kg D 6.8 kg

Q23 (18/O/N/15/12):
An electric railway locomotive has a maximum mechanical output power of 4.0 MW. Electrical power is delivered at 25 kV from overhead wires. The overall efficiency of the locomotive in converting electrical power to mechanical power is 80 %. What is the current from the overhead wires when the locomotive is operating at its maximum power?

A 130 A B 160 A C 200 A D 250 A

Q24 (19/O/N/17/11):
A turbine at a hydroelectric power station is situated 30 m below the level of the surface of a large lake. The water passes through the turbine at a rate of 340 m^3 per minute.
The overall efficiency of the turbine and generator system is 90%.
What is the output power of the power station? (The density of water is 1000 kg m^{-3}.)

A 0.15 MW B 1.5 MW C 1.7 MW D 90 MW

Q25 (19/O/N/13/12):
A turbine at a hydroelectric power station is situated 30 m below the level of the surface of a large lake. The water passes through the turbine at a rate of 340 m^3 per minute.
The overall efficiency of the turbine and generator system is 90%.
What is the output power of the power station? (The density of water is 1000 kg m^{-3}.)

A 0.15 MW B 1.5 MW C 1.7 MW D 90 MW

Q26 (18/M/J/13/11):
A wind turbine has blades that sweep an area of 2000 m^2. It converts the power available in the wind to electrical power with an efficiency of 50%.
What is the electrical power generated if the wind speed is 10 m s^{-1}? (The density of air is 1.3 kg m^{-3}.)

A 130 kW B 650 kW C 1300 kW D 2600 kW

Work

1	C	8	A
2	C	9	B
3	B	10	A
4	D	11	A
5	A	12	A
6	A	13	A
7	C	14	C

Kinetic Energy

1	D	5	A
2	A	6	A
3	C	7	D
4	B	8	

Work Energy principle

1	B	4	C
2	D	5	C
3	B	6	

Gravitational Potential Energy

1	A	9	B	17	C
2	D	10	B		
3	C	11	A		
4	B	12	C		
5	D	13	D		
6	B	14	B		
7	A	15	A		
8	C	16	C		

Law of Conservation of Energy

1	D	13	C
2	A	14	C
3	B	15	B
4	A	16	C
5	D	17	A
6	A	18	B
7	A	19	B
8	D	20	B
9	A	21	D
10	A	22	C
11	B	23	B
12	B	24	C

Power

1	C	11	A	21	
2	D	12	A	22	D
3	C	13	A	23	C
4	D	14	C	24	D
5	B	15	D	25	A
6	B	16	D	26	B
7	C	17	B	27	D
8	A	18	B	28	D
9	B	19	C	29	B
10	A	20	D	30	A

Efficiency

1	D	11	C	21	D
2	D	12	D	22	B
3	C	13	A	23	C
4	C	14	A	24	B
5	D	15	A	25	B
6	D	16	B	26	B
7	C	17	C		
8	D	18	C		
9	D	19	A		
10	B	20	C		