Work, Energy & Power
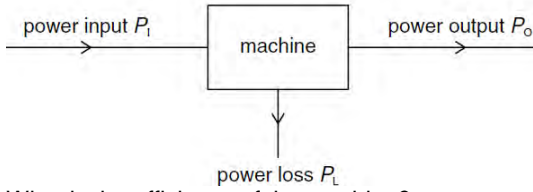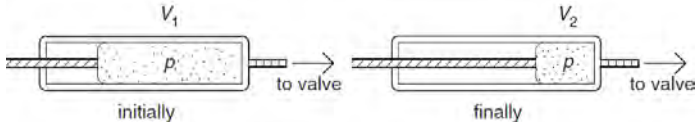
May 02

1. Power is transferred through a machine as shown.

What is the efficiency of the machine?

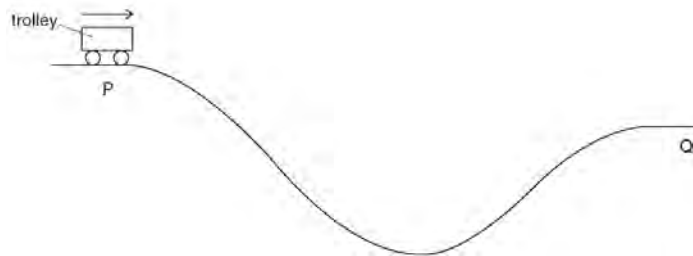A $\dfrac{P_I}{P_o + P_L}$ B $\dfrac{P_L}{P_I}$ C $\dfrac{P_L}{P_o}$ D $\dfrac{P_o}{P_I}$

2. Air in a bicycle pump is forced through a valve at a constant pressure p. In one stroke of the pump
the volume of air in the pump chamber is reduced from V_1 to V_2.

What is the work done on this air in one stroke of the pump?

A $\dfrac{p(V_1 + V_2)}{2}$ C $p(V_1 - V_2)$

B $p(V_1 + V_2)$ D pV_1

3. 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

4. To travel at a constant speed, a car engine provides 24 kW of useful power. The driving force on the car is 600N. At what speed does it travel?
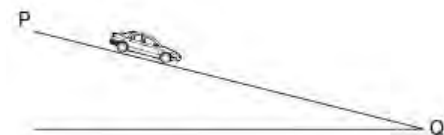A $2.5ms^{-1}$ B $4.0ms^{-1}$ C $25ms^{-1}$ D $40ms^{-1}$

Nov 02
5. Which of the following is an expression for power?
A energy x time   B force x displacement
C force x velocity   D mass x velocity

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

The magnitude of the change in the car's kinetic energy is ΔEk.
The magnitude of the change in its gravitational potential energy is ΔEp.Which statement is correct?
A ΔEk > ΔEp B ΔEk = ΔEp C ΔEp > ΔEk > 0 D ΔEk = 0

7. An area of land is an average of 2.0m below sea level. To prevent flooding, pumps are used to lift rainwater up to sea level.
What is the minimum pump output power required to deal with 1.3×10^9 kg of rain per day?
A 15 kW   B 30 kW   C 150 kW   D 300 kW

8. A twig from a tree drops from a 200m high cliff on to a beach below. During its fall, 40% of the twig's energy is converted into thermal energy.
What is the speed with which the twig hits the beach?
A $35ms^{-1}$ B $40ms^{-1}$ C $49ms^{-1}$ D $63ms^{-1}$

June 03

9. 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.
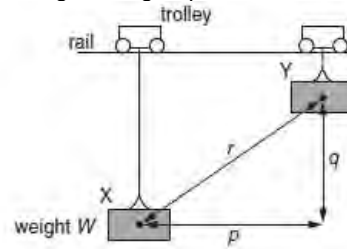
As a result, the weight moves through a distance r from X to Y. It starts and finishes at rest.
How much work is done on the weight during this process?
A Wp   B W(p + q)   C Wq   D Wr

10. A motorist travelling at $10ms^{-1}$ can bring his car to rest in a distance of 10 m.
If he had been travelling at $30ms^{-1}$, in what distance could he bring the car to rest using the same braking force?
A 17 m   B 30 m   C 52 m   D 90m

Nov 03.

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

A $(E_p - E_k)t$ C $\dfrac{E_p - E_k}{t}$

B $(E_p + E_k)t$ D $\dfrac{E_p + E_k}{t}$

12. A boat moving at constant speed v through still water experiences a total frictional drag F.
What is the power developed by the boat?
A ½ Fv   B Fv   C ½ Fv^2 D Fv^2

June 04

13. What is the expression used to define power?

A $\dfrac{\text{energy output}}{\text{energy input}}$

B energy x time taken

C force x velocity

D $\dfrac{\text{work done}}{\text{time taken}}$

14. A ball is thrown vertically upwards.
Neglecting air resistance, which statement is correct?
A The kinetic energy of the ball is greatest at the greatest height attained.
B By the principle of conservation of energy, the total energy of the ball is constant throughout
its motion.
C By the principle of conservation of momentum, the momentum of the ball is constant
throughout its motion.
D The potential energy of the ball increases uniformly with time during the ascent.

15. 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.

16. A barrel of mass 50 kg is loaded onto the back of a lorry 1.6 m high by pushing it up a smooth plank 3.4 m long.
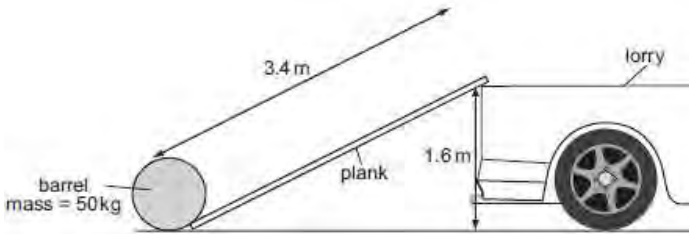
What is the minimum work done?
A 80 J   B 170 J   C 780 J   D 1700 J

June 04
17. 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

18. A horizontal force of 90 N is used to push a box across a horizontal floor. The frictional force on the box is 50 N.
What is the gain in kinetic energy of the box when it is moved through a distance of 6.0 m?
A 240 J   B 300 J   C 540 J   D 840 J

19. A cyclist is capable of generating an average power of 3.0 kW during a 4.0 km speed trial. His aerodynamic suit and position on the cycle reduce resistive forces to 180 N.
What is the approximate time achieved in the speed trial?
A 140 s   B 240 s   C 1300 s   D 2200 s

20. A constant force of 9.0 kN, parallel to an inclined plane, moves a body of weight 20 kN through a distance of 40 m along the plane at constant speed. The body gains 12 m in height, as shown.
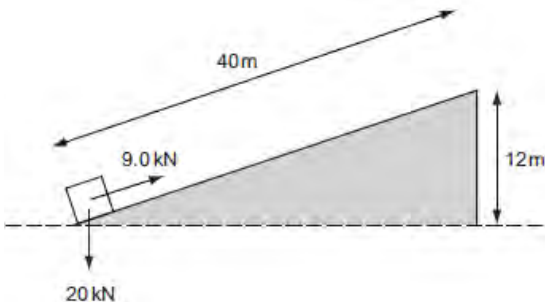

How much of the work done is dissipated as heat?
A 120 kJ   B 240 kJ   C 360 kJ   D 600 kJ

June 05
21. 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?
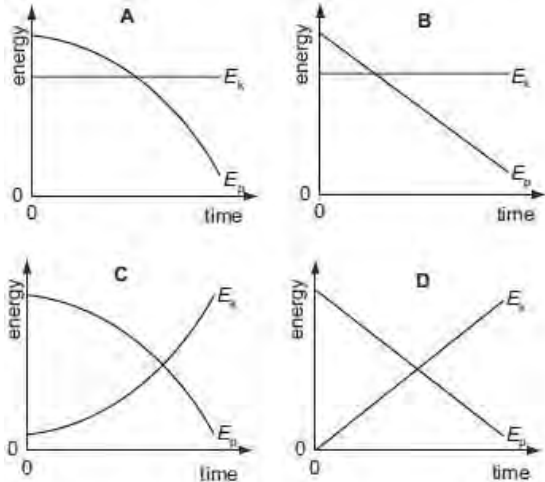
22. An electrical generator is started at time zero. The total electrical energy generated during the first 5 seconds is shown in the graph.
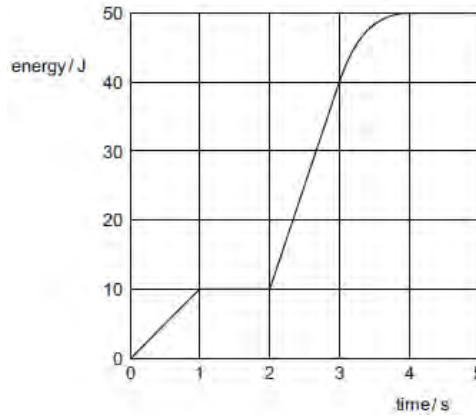

What is the maximum electrical power generated at any instant during these first 5 seconds?
A 10 W   B 13 W   C 30 W   D 50 W

23. A concrete cube of side 0.50 m and uniform density 2.0×10^3kg m^{-3} is lifted 3.0 m vertically by a crane.
What is the change in potential energy of the cube?
A 0.75 kJ   B 7.4 kJ   C 29 kJ   D 470 kJ

Nov 05
24. A car with a total mass of 1400 kg is travelling at 30 m s^{-1}.
What is the kinetic energy of the car?
A 21 kJ   B 42 kJ   C 630 kJ   D 1260 kJ

25. An object is thrown into the air. Which graph shows how the potential energy Ep of the object varies with height h above the ground?
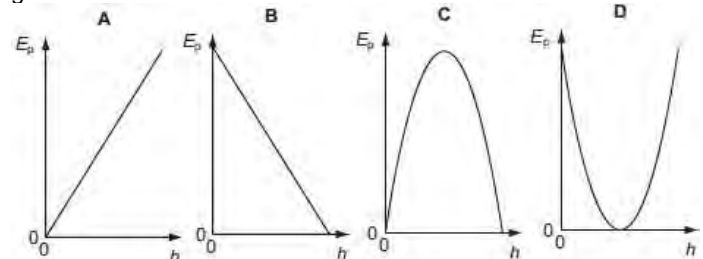
26 The diagram shows a barrel of weight 1.0×10^3 N on a frictionless slope inclined at $30°$ to the horizontal.
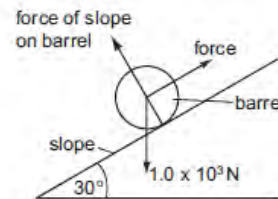
A force is applied to the barrel to move it up the slope at constant speed. The force is parallel to the slope.
What is the work done in moving the barrel a distance of 5.0 m up the slope?
A 1.0×10^4J   B 2.5×10^3J
C 4.3×10^3J   D 5.0×10^3J

June 06
27. 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.
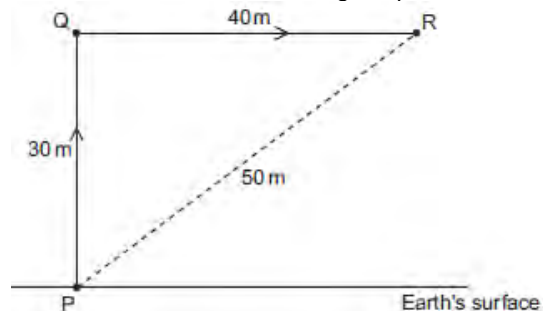
How much potential energy does the stone gain?
A 120 J   B 200 J   C 280 J   D 1200 J

PhysicsAndMathsTutor.com

Nov 06

28. 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

29. 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 %

June 07

30. 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

Nov. 07

31. A car of mass 1000 kg first travels forwards at 25 m s^{-1} and then backwards at 5 m s^{-1}.
What is the change in the kinetic energy of the car?
A 200 kJ   B 300 kJ   C 325 kJ   D 450 kJ

32. 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).


position 1

position 2
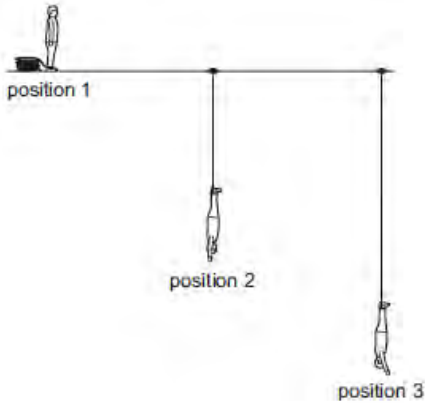
position 3

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

June 08

33. A positive charge experiences a force F when placed at point X in a uniform electric field.
The charge is then moved from point X to point Y.
Distances r and s are shown on the diagram.
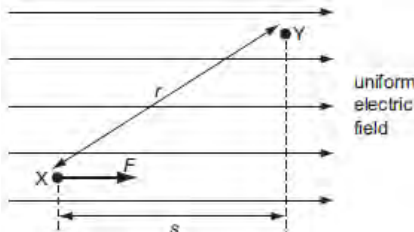
What is the change in the potential energy of the charge?
A decreases by Fs   B increases by Fs
C decreases by Fr   D increases by Fr

34. A steel ball is falling at constant speed in oil.
Which graph shows the variation with time of the gravitational potential energy Ep and the kinetic energy Ek of the ball?
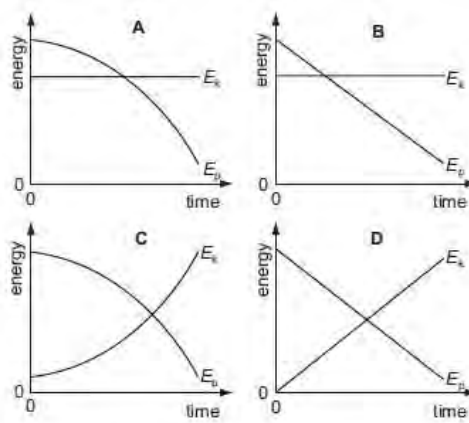
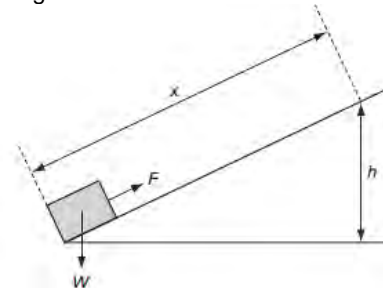35. The total energy input Ein in a process is partly transferred to useful energy output U, and partly to energy that is wasted W.
What is the efficiency of the process?

A $\dfrac{U}{W} \times 100\%$ C $\dfrac{U}{E_{in}} \times 100\%$

B $\dfrac{W}{E_{in}} \times 100\%$ D $\dfrac{U+W}{E_{in}} \times 100\%$

Nov. 08

36. A block of weight W is pulled up a rough slope by a force F. When the block has moved a distance x along the slope, it has risen height h.

Which expressions give the amount of work done on the block and the amount of gravitational potential energy gained by the block?

	work done	gravitational potential energy
A	Fx	Wh
B	Fh	Wx
C	Wx	Fh
D	Wh	Fx

37. 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?
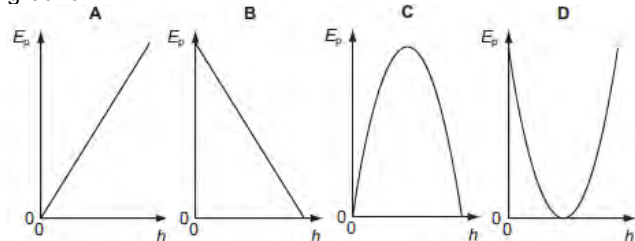
38. A pendulum bob oscillates between P and R.
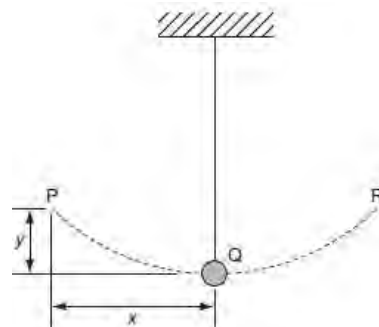
Assuming the gravitational potential energy lost in moving from P to Q is converted into kinetic energy, what is the speed of the bob at Q?
A $\sqrt{2gx}$ B $2gx$ C $\sqrt{2gy}$ D $2gy$

39. 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

June 09

40. 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 $k = \dfrac{P}{v}$ B $k = \dfrac{P}{v^2}$ C $k = \dfrac{P}{v^3}$ D $k = \dfrac{P}{v^4}$

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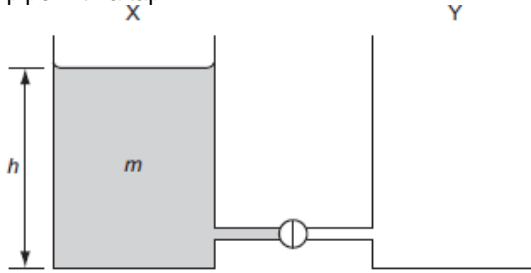
Initially, X is filled with water of mass m to a depth h, and Y is empty.
When the tap is opened, water flows from X to Y until the depths of water in both vessels are equal.
How much potential energy is lost by the water during this process? (g = acceleration of free fall)

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

Nov 09

42. 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 0.50 E   B 0.71 E   C 0.87 E   D E

43. 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

June 10

44. An ion is accelerated by a series of electrodes in a vacuum. 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 change in kinetic energy of the ion
B the average force on the ion
C the change in momentum of the ion
D the change in velocity of the ion

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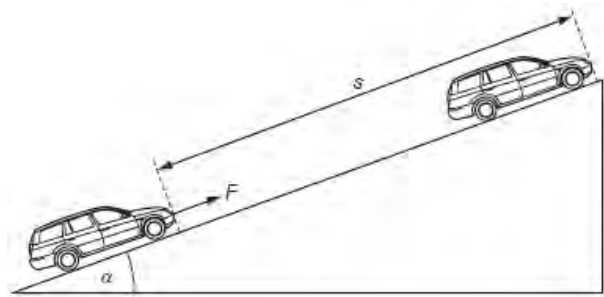
Which expression gives the efficiency of the process?

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

46.

Answers

1	d	13	d	25	a	37	a
2	c	14	b	26	b	38	c
3	b	15	a	27	a	39	d
4	d	16	c	28	d	40	c
5	c	17	a	29	a	41	b
6	d	18	a	30	c	42	a
7	d	19	b	31	b	43	c
8	c	20	a	32	c	44	a
9	c	21	b	33	a	45	d
10	d	22	c	34	b		
11	d	23	b	35	c		
12	b	24	c	36	a		