1. Motion, forces and energy

1.7 Energy, work and power

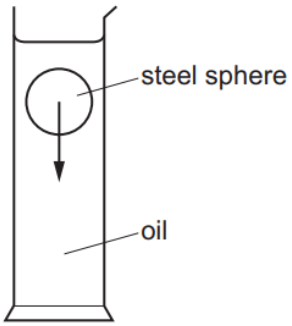
Paper 1 and 2

Question Paper

Paper 1

Questions are applicable for both core and extended candidates

1 The diagram shows a steel sphere falling through a cylinder of oil.



Which row indicates what happens to the steel sphere and what happens to the oil as the steel sphere falls?

	the steel sphere becomes warmer	the oil becomes warmer
A	yes	yes
B	yes	no
C	no	yes
D	no	no

2 A moving object is brought to rest by a frictional force of 30 N over a distance of 5.0 m.

The diagram shows the energy transferred between stores.

How much energy is transferred by this force and how is the energy transferred?

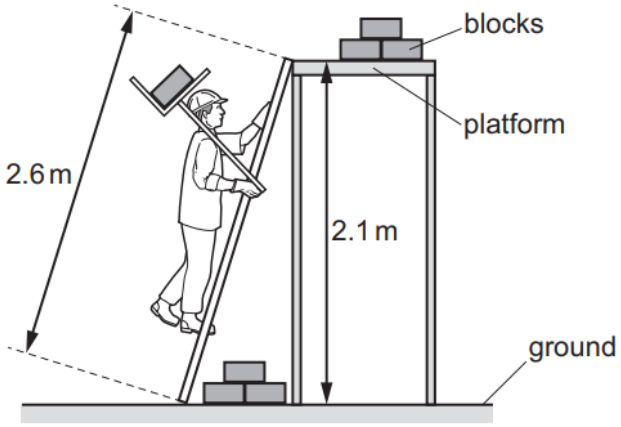
	energy transferred / J	how the energy is transferred
A	6.0	by electrical working
B	6.0	by mechanical working
C	150	by electrical working
D	150	by mechanical working

3 A motor transfers 24 J of energy in 60 seconds.

What is the power output of the motor?

A 0.40 W **B** 2.5 W **C** 24 W **D** 1400 W

4 A builder lifts one concrete block from the ground onto a platform.



The weight of one block is 170 N.

What is the useful work done against gravity on one block?

A 360 J **B** 440 J **C** 360 W **D** 440 W

5 Students are asked for examples of water being used to store energy.

Three examples are listed.

1 energy stored in water waves

2 energy stored in tides

3 energy stored in water behind dams

Which examples describe water being used to store energy?

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

6 Which statement about power is correct?

A Power is measured in joules.

B Power = energy × time.

C Power is the rate of energy transfer.

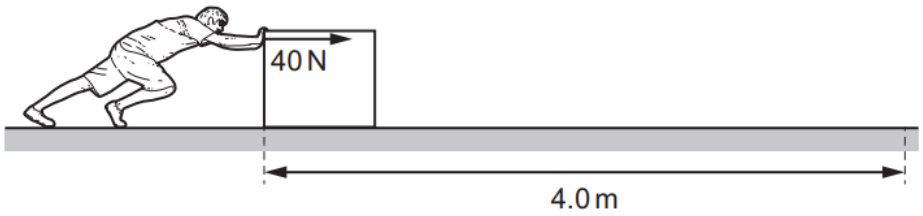
D Greater power always gives higher efficiency.

7 A cyclist stops his bicycle using the brakes.

Which row about energy stores is correct?

	decreases	increases
A	kinetic energy store of bicycle	chemical energy store of brakes
B	kinetic energy store of bicycle	thermal energy store of brakes
C	thermal energy store of brakes	kinetic energy store of bicycle
D	thermal energy store of brakes	chemical energy store of bicycle

8 A man applies a force of 40 N to push a box along the floor.



How much power is required to push the box 4.0 m in 3.0 seconds?

A 3.3 W **B** 30 W **C** 53 W **D** 480 W

9 A cyclist travels down a hill from rest at point X without pedalling.

The cyclist applies his brakes and the cycle stops at point Y.

Which energy transfers have taken place between X and Y?

A gravitational potential → kinetic → internal (thermal)

B gravitational potential → internal (thermal) → kinetic

C kinetic → gravitational potential → internal (thermal)

D kinetic → internal (thermal) → gravitational potential

10 Which energy resource is non-renewable?

A geothermal

B natural gas

C solar

D wind

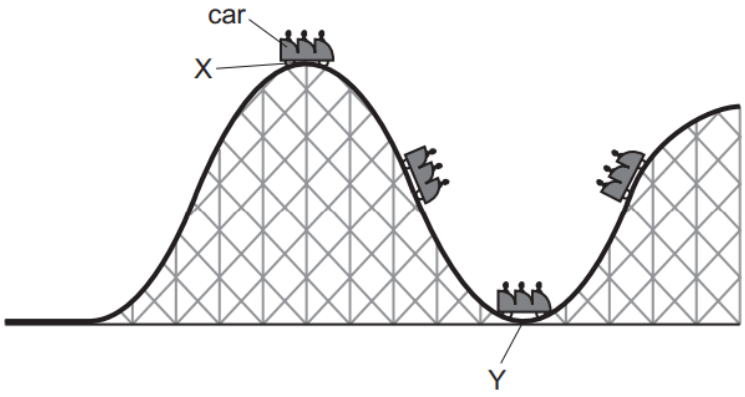
11 A pump does 460 000 J of work to raise water to fill a tank. It takes 7 minutes to fill the tank.

What is the power of the pump?

A 1.1 kW **B** 66 kW **C** 3200 kW **D** 190 000 kW

12 The diagram shows part of a rollercoaster ride with the car at different positions.

The car runs freely down from position X to position Y and up the hill on the other side.



What happens to the energy in the kinetic store and the gravitational potential store of the car as it moves from position X to position Y?

	energy in kinetic store	energy in gravitational potential store
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

13 In a small power station, biofuel is used to generate electricity.

Which energy store is reduced by this process?

A chemical

B kinetic

C nuclear

D thermal

14 An electric car is charged overnight. In 8.0 hours, 180 MJ of energy is transferred.

What is the power of the charger?

A 6.3 kW **B** 380 kW **C** 23 MW **D** 1400 MW

15 Which row about the change of energy in the energy store must be correct?

	process	energy store	change of energy in store
A	water pumped up to a high-altitude dam	gravitational potential energy of water	increases
B	water pumped up to a high-altitude dam	kinetic energy of water	decreases
C	air passes through a wind turbine	gravitational potential energy of air	increases
D	air passes through a wind turbine	kinetic energy of air	increases

16 A rock of weight 50 N falls a vertical distance of 7.0 m from rest.

What is the change in the gravitational potential energy store of the rock?

A decrease of 7.1 J

B decrease of 350 J

C increase of 7.1 J

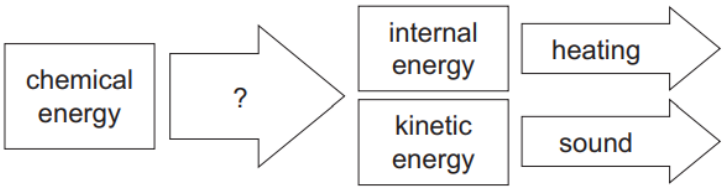
D increase of 350 J

17 A child runs up a set of stairs four times. The time taken for each run is recorded.

Which time is measured when the child's useful power is greatest?

A 10 s **B** 20 s **C** 30 s **D** 40 s

18 The diagram shows the energy stores for a mobile (cell) phone and how the energy is transferred between stores.



What describes how the chemical energy is transferred?

A electrical work done

B mechanical work done

C electromagnetic waves

D sound waves

19 A moving object is brought to rest by a resistive force of 50 N over a distance of 5.0 m.

What is the work done by the force?

A 0.10 J **B** 10 J **C** 55 J **D** 250 J

20 Which two physical quantities must be used to calculate the power developed by a student running up a flight of steps?

A force exerted and the vertical height of the steps only

B force exerted and the time taken only

C work done and the vertical height of the steps only

D work done and the time taken only

21 Brakes are used to slow down a moving car.

Into which form of energy is most of the kinetic energy converted as the car slows down?

A chemical

B elastic

C thermal

D sound

22 What is a disadvantage of nuclear fission as a source of energy?

A Nuclear power stations are expensive to build.

B Nuclear power stations are unreliable.

C Nuclear power stations can only provide small quantities of energy.

D Nuclear power stations release large quantities of carbon dioxide into the atmosphere.

23 The statements describe what happens when the power of a machine is increased.

1 The work done in a given time decreases.

2 The work done in a given time increases.

3 The time taken to do a given quantity of work decreases.

4 The time taken to do a given quantity of work increases.

Which statements are correct?

A 1 and 3 **B** 1 and 4 **C** 2 and 3 **D** 2 and 4

24 An object falls towards the Earth's surface.

What happens to the gravitational potential energy and to the kinetic energy of the object?

	gravitational potential energy	kinetic energy
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

25 Which source of energy is **not** currently used to generate electrical energy?

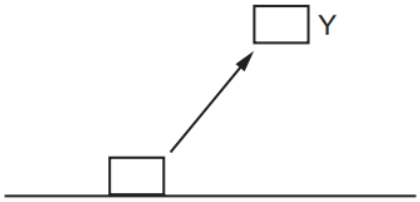
A nuclear fusion

B solar

C tidal

D waves

26 A mass is lifted from rest on the ground to Y. There is no air resistance.



P is the increase in gravitational energy of the mass.

Q is the kinetic energy of the mass at Y.

Which expression is equal to the mechanical work done on the mass?

A $P + Q$ **B** $P - Q$ **C** $Q - P$ **D** $P \times Q$

27 Which piece of equipment is designed to produce a type of electromagnetic wave?

A electric fire

B electric generator

C electric motor

D electromagnet

28 A mass hangs vertically from a spring.

The mass is raised to a point P and is then released.

The mass oscillates repeatedly between point P and a lower point Q.

Which energies alternately increase and decrease throughout the oscillations?

A gravitational potential energy, kinetic energy and elastic energy

B gravitational potential energy and kinetic energy only

C gravitational potential energy, kinetic energy and internal energy

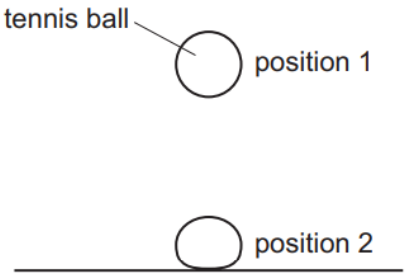
D internal energy and elastic energy

29 A force F acts on an object and the object moves a distance d in the direction of the force.

What is the work done on the object?

A $\frac{F}{d}$ **B** $\frac{d}{F}$ **C** $F \times d$ **D** $\frac{1}{(F \times d)}$

30 A tennis ball is dropped from position 1. It falls vertically onto a hard surface at position 2.



Which energy changes have taken place between position 1 and position 2?

A gravitational potential → kinetic → chemical

B gravitational potential → kinetic → elastic (strain)

C kinetic → gravitational potential → chemical

D kinetic → gravitational potential → elastic (strain)

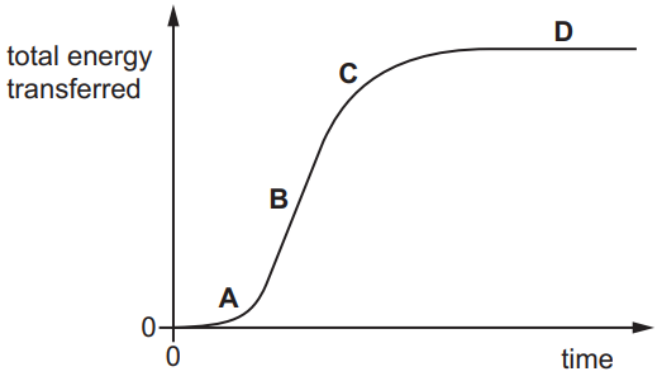
31 A force does work moving an object in the direction of the force.

Which change in the force and distance **always** increases the work done?

	force	distance
A	greater	same
B	greater	smaller
C	same	smaller
D	smaller	smaller

32 The graph shows the total energy transferred by an electric motor over a period of time.

In which region of the graph is the greatest power being developed by the motor?



33 Electrical energy may be obtained from nuclear fission.

In which order is the energy transferred in this process?

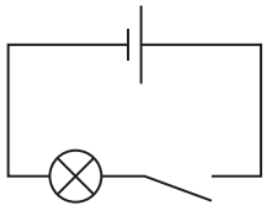
A nuclear fuel → generator → reactor and boiler → turbines

B nuclear fuel → generator → turbines → reactor and boiler

C nuclear fuel → reactor and boiler → generator → turbines

D nuclear fuel → reactor and boiler → turbines → generator

34 The diagram shows an electric circuit. When the switch is closed, the lamp is lit.



Which row states the type of energy stored in the cell and how this energy is usefully transferred to the lamp?

	type of energy stored in the cell	how this energy is usefully transferred to the lamp
A	chemical	by electric current
B	chemical	by light
C	electrical	by electric current
D	electrical	by light

35 A scientist uses an electric motor to lift a load through a vertical distance of 2.0 m.

He then increases the input power to the motor and repeats the experiment. The efficiency of the motor does not change.

Which row correctly describes the effect that this has on the useful work done lifting the load and the time taken to lift it?

	work done	time taken
A	decreases	decreases
B	stays the same	decreases
C	decreases	stays the same
D	stays the same	stays the same

36 A stone falls.

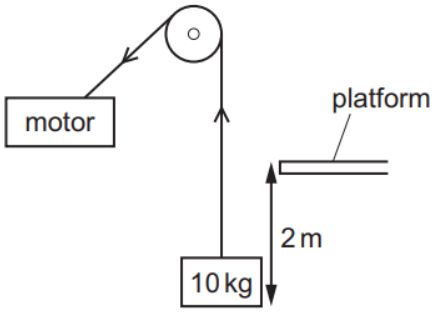
Which row gives the energy changes?

	gravitational potential energy	kinetic energy
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

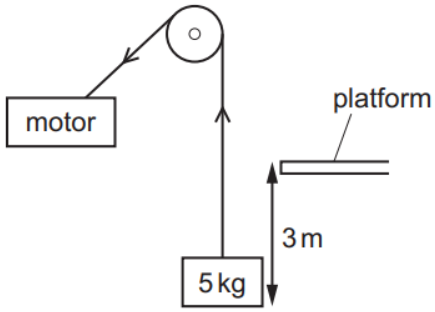
37 A rope, connected to a pulley system and motor, is used to lift different objects through different distances. The time taken to lift each object is the same. The diagrams are not to scale.

Which motor requires the greatest power?

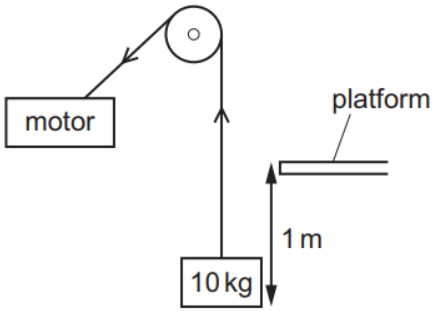
A



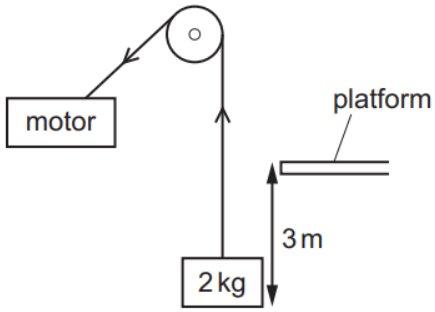
B



C



D



38 Which situation involves no work being done and no energy being transferred?

A a car skidding to a stop on a road

B a crane lifting a load

C a heavy load hanging from a strong bar

D a student dragging a big box over a rough floor

39 A student suggests that there are several ways of transferring energy to a small, stationary block of iron on a smooth table. He makes the following suggestions.

1 Heat it.

2 Shine light on it.

3 Pass a current through it.

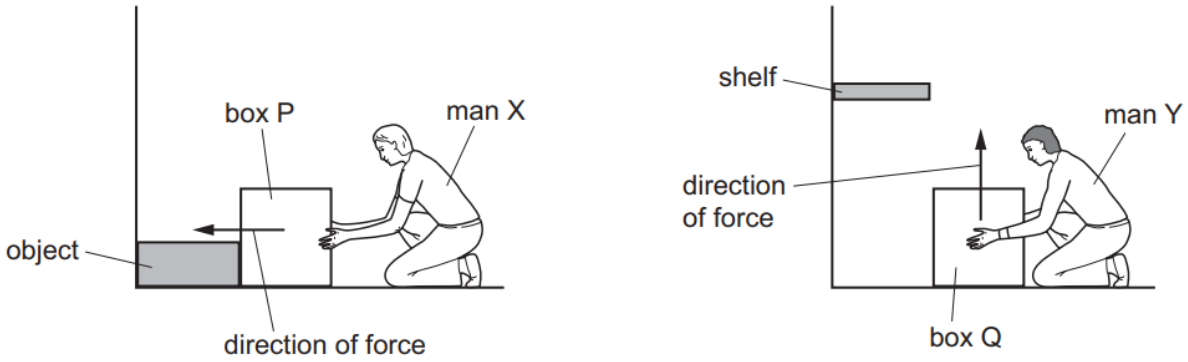
Which suggestions are correct?

A 1 and 2 only **B** 1 and 3 only **C** 2 and 3 only **D** 1, 2 and 3

40 Two men, X and Y, try to move identical heavy boxes, P and Q.

Man X tries to push box P along the floor. The box does not move because an object is in the way.

Man Y lifts box Q from the floor onto a shelf.



Which man does the most work on their box, and which box gains the most energy?

	man doing most work	box gaining most energy
A	X	P
B	X	Q
C	Y	P
D	Y	Q

41 An object is falling through a vacuum.

Which energy transfer is taking place?

A gravitational potential to kinetic

B gravitational potential to thermal

C kinetic to gravitational potential

D kinetic to thermal

42 This question is about four methods used to produce electrical energy.

Which method has a correct description?

	method	energy source is renewable	emits carbon dioxide
A	a hydroelectric power station	yes	no
B	a coal-fired power station	no	no
C	a wind turbine	no	yes
D	a nuclear power station	yes	yes

43 The arrows show an outline of the processes in an oil-fired power station.

oil is burnt → turns turbine → turns generator → output transformer

What are the processes for the transfer of energy between the turbine and the generator and between the generator and the output transformer?

	turbine to generator	generator to output transformer
A	electrical working	electrical working
B	mechanical working	electrical working
C	mechanical working	transfer of thermal energy
D	transfer of thermal energy	mechanical working

44 Work is done.

Which physical quantity is transferred?

A distance

B energy

C force

D temperature

45 To calculate the power produced by a force, the size of the force must be known.

What else needs to be known to calculate the power?

	the distance that the force moves the object	the time for which the force acts on the object
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

key
✓ = needed
✗ = not needed

46 Two wind farms supply electrical energy to consumers in different ways.

Wind farm 1 supplies energy directly to consumers and for every 1000 J of energy extracted from the wind, 360 J is transferred to consumers as electrical energy.

Wind farm 2 stores electrical energy in batteries and then supplies energy from the batteries to the consumer. For every 1000 J of energy extracted from the wind, 270 J is transferred to consumers as electrical energy.

Which statement about the two wind farms is correct?

A Wind farm 1 is less reliable and less efficient than wind farm 2.

B Wind farm 1 is less reliable but more efficient than wind farm 2.

C Wind farm 1 is more reliable but less efficient than wind farm 2.

D Wind farm 1 is more reliable and more efficient than wind farm 2.

47 Student P uses a force of 35 N to push a box 3.0 m across the floor.

Student Q uses a force of 22 N to push another box 1.8 m across the floor.

Which statement gives a full explanation why student P uses more energy than student Q?

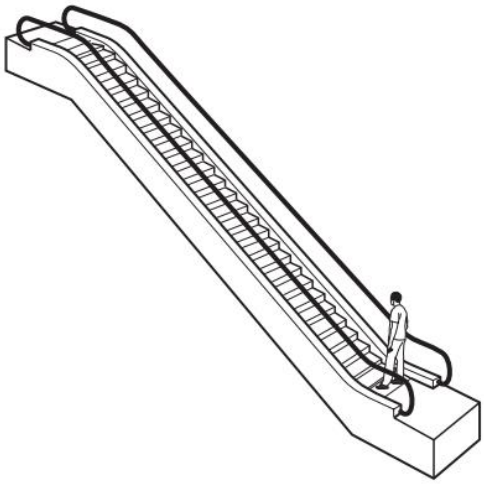
A Student P pushes his box a greater distance than student Q.

B Student P pushes his box a greater distance and uses a bigger force than student Q.

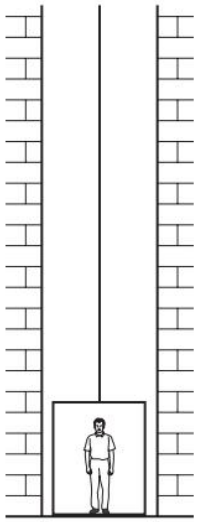
C Student P uses a bigger force than student Q.

D Student P pushes a heavier box than student Q.

48 A man can either take an escalator or a lift to travel up between two floors in a hotel.



escalator



lift

The escalator takes 20 seconds to carry the man between the two floors. The useful work done against gravity is *W*. The useful power developed is *P*.

The lift takes 30 seconds to carry the same man between the same two floors.

How much useful work against gravity is done by the lift, and how much useful power is developed by the lift?

	useful work done against gravity by lift	useful power developed by lift
A	more than *W*	less than *P*
B	more than *W*	*P*
C	*W*	less than *P*
D	*W*	*P*

49 Which energy resource is **not** renewable?

A geothermal

B nuclear fission

C solar

D wind

50 Two motors X and Y lift loads of the same weight through the same vertical distance.

Motor X is more efficient than motor Y.

Which statement about the motors is correct?

A The useful energy output of motor X is larger than that of motor Y.

B The useful energy output of motor X is smaller than that of motor Y.

C The energy input of motor X is larger than that of motor Y.

D The energy input of motor X is smaller than that of motor Y.

51 Which does **not** transfer useful energy?

A emitting a sound wave

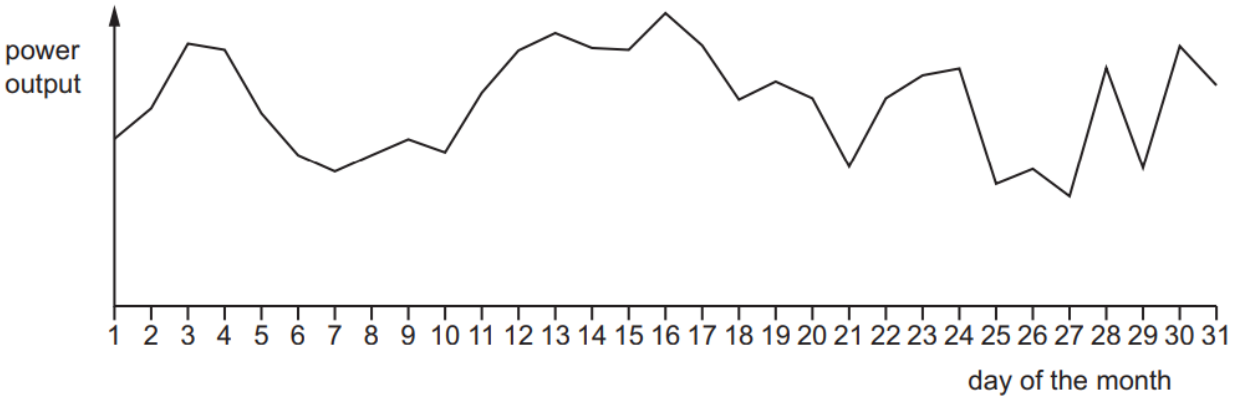
B measuring a temperature

C passing an electric current

D pushing a box along the floor

52 The power output from solar panels is recorded every day for a month.

The graph shows the output recorded.



Which conclusion can be drawn from this graph?

A The power output from the solar panels changes from day to day.

B The power output from the solar panels is cheap to produce.

C Solar panels create no pollution.

D Solar energy is renewable.

53 What is the unit of thermal energy?

A °C **B** N **C** J **D** W

54 Which source of energy is non-renewable?

A oil

B solar

C tidal

D wind

55 A machine is very efficient.

What does this mean?

A It produces a large amount of power.

B It uses very little energy.

C It wastes very little energy.

D It works very quickly.

56 An object is lifted vertically by a motor.

In which example is the power produced the greatest?

A lifting it a shorter distance in a longer time

B lifting it the same distance in a longer time

C lifting it a shorter distance in the same time

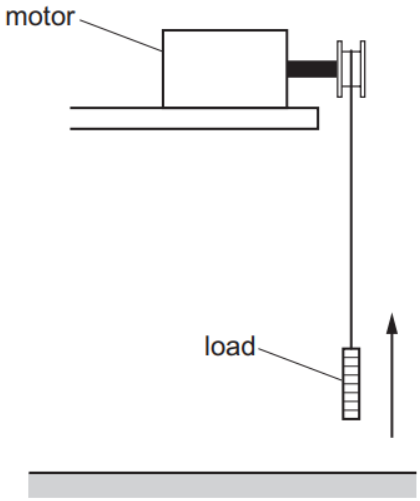
D lifting it the same distance in a shorter time

57 An object falls under gravity.

What happens to the gravitational potential energy and to the kinetic energy of the object?

	gravitational potential energy	kinetic energy
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

58 A student is testing four different electric motors. He measures the time it takes for a motor to lift either a heavy load or a light load through a height of 1 metre.



He makes a similar measurement for the other three motors.

The table shows his results.

Which motor produces the most power?

	load	time taken / s
A	heavy	12
B	heavy	16
C	light	12
D	light	16

59 Which device is designed to convert chemical energy into kinetic energy?

A an a.c. generator

B a battery-powered torch

C a car engine

D a wind-up mechanical clock

60 A man climbs a ladder.

Which two quantities can be used to calculate the useful power of the man?

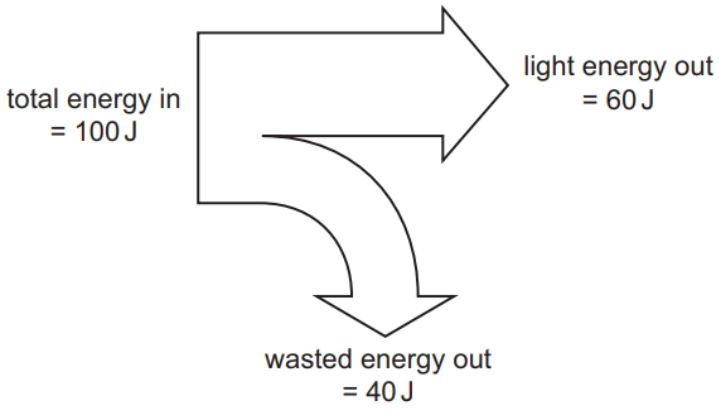
A the weight of the man and the time taken only

B the weight of the man and the vertical distance moved only

C the work done by the man and the time taken only

D the work done by the man and the vertical distance moved only

61 The diagram shows the energy transferred in a lamp in one second.



Which type of wasted energy is produced by the lamp?

A chemical potential energy

B electrical energy

C gravitational potential energy

D thermal energy

62 Which energy resource is **not** renewable?

A fossil fuel

B sunlight

C tides

D wind

63 A student does work by pulling a box across a horizontal floor.

She now pulls a second box along the same floor.

Which row indicates that the student is now doing twice as much work?

	force used to pull box	distance the box is pulled
A	is doubled	is doubled
B	is doubled	is halved
C	stays the same	is doubled
D	stays the same	is halved

64 Which source of energy is renewable?

A coal

B natural gas

C oil

D wind

Paper 2

Questions are applicable for both core and extended candidates unless indicated in the question

65 Which statement about the use of nuclear fuel as an energy resource is correct?

A It obtains its energy from the Sun.

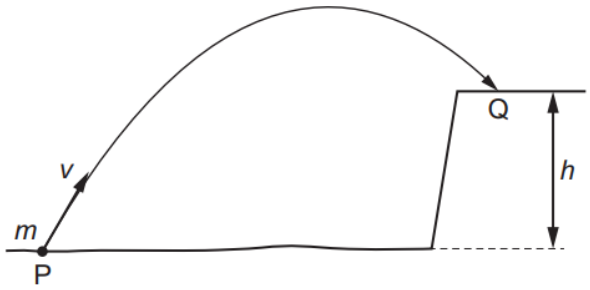
B It has **no** environmental impact.

C Nuclear power stations do **not** need turbines.

D The energy is released by nuclear fission.

66 The diagram shows an object of mass m being projected with speed v from a point P to a point Q on top of a cliff height h. **(extended only)**

The object does work W against air resistance as it travels from P to Q.



What is the kinetic energy of the object when it reaches point Q?

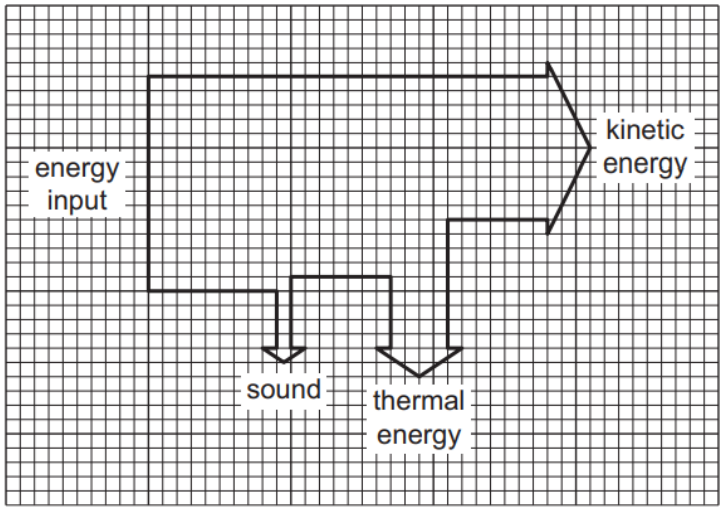
A $\frac{1}{2}mv^2 + mgh + W$

B $\frac{1}{2}mv^2 + mgh - W$

C $\frac{1}{2}mv^2 - mgh + W$

D $\frac{1}{2}mv^2 - mgh - W$

67 The diagram shows a Sankey diagram for an electric drill. **(extended only)**



scale: distance between two lines = 40 J

What is the total wasted energy shown by the diagram?

A 120 J **B** 200 J **C** 360 J **D** 560 J

68 Which row shows the process by which energy in the Sun is released, the process by which it is transferred to the Earth and a way in which it is stored once it reaches the Earth? **(extended only)**

	process by which energy is released in the Sun	process by which the energy is transferred from the Sun to the Earth	a method by which the energy is stored on the Earth
A	fission	convection	biofuel
B	fusion	radiation	nuclear fuel
C	fusion	convection	nuclear fuel
D	fusion	radiation	biofuel

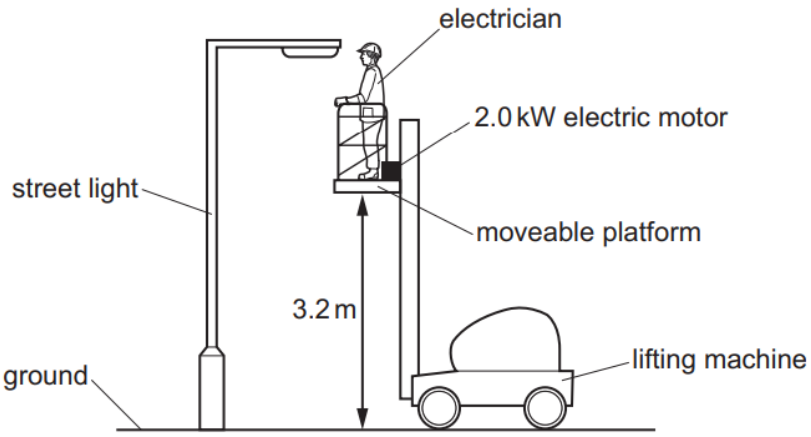
69 An object has a mass of 20 kg. **(extended only)**

It is taken up stairs through a height of 4.0 m.

What is the increase in the store of gravitational potential energy?

A 5.0 J **B** 49 J **C** 80 J **D** 780 J

70 An electrician uses a lifting machine, as shown. The lifting machine takes 4.5 s to lift the electrician a vertical height of 3.2 m. **(extended only)**



The mass of the electrician is 72 kg.

The energy for the lifting machine is supplied by a 2.0 kW electric motor.

What is the efficiency of the lifting machine?

A 0.026 **B** 0.25 **C** 0.50 **D** 0.75

71 A coal-fired power station generates electricity. Coal is burned and the energy released is used to boil water. The steam from the water makes the generator move and this produces electricity.

Which row gives the name of the energy store in the coal and the energy store of the moving generator?

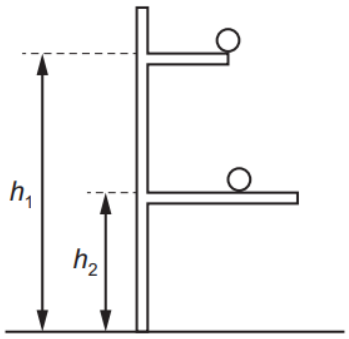
	coal	generator
A	chemical	hydroelectric
B	chemical	kinetic
C	geothermal	hydroelectric
D	geothermal	kinetic

72 The table gives four energy resources and states whether the main source of energy for the resource is the Sun. **(extended only)**

Which row is correct?

	energy resource	main source of energy is the Sun
A	geothermal	yes
B	oil	no
C	water held behind a dam	yes
D	wind	no

73 An object of mass m falls from a higher shelf to a lower shelf. **(extended only)**



How much gravitational potential energy does the object lose?

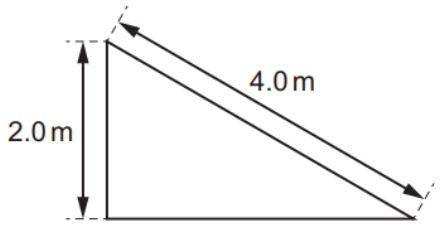
A mgh_2 **B** $\left(\frac{m}{g}\right)h_2$ **C** $\left(\frac{m}{g}\right)(h_1 - h_2)$ **D** $mg(h_1 - h_2)$

74 A box is initially at rest at the top of a rough slope. **(extended only)**

The box slides down the slope.

The weight of the box is 20 N.

The slope is 4.0 m long and 2.0 m high.



The box does 10 J of work against friction as it slides down the slope.

What is the speed of the box as it reaches the bottom of the slope?

A 5.4 m/s **B** 6.3 m/s **C** 7.1 m/s **D** 9.5 m/s

75 A woman of mass 50 kg has 81 J of kinetic energy. **(extended only)**

What is her speed?

A 1.3 m/s **B** 1.6 m/s **C** 1.8 m/s **D** 3.2 m/s

76 A wind turbine is 30% efficient and has an output of 2.5 MW of electrical power.

What is the power input to the turbine? **(extended only)**

A 0.75 MW **B** 8.3 MW **C** 75 MW **D** 83 MW

77 An object has kinetic energy of 200 J.

A constant resultant force of 190 N is applied in the direction of its motion through a distance of 10 m.

What is the final kinetic energy of the object?

A 390 J **B** 1700 J **C** 2000 J **D** 2100 J

78 The statements describe what happens when the power of a machine is increased.

1 The work done in a given time decreases.

2 The work done in a given time increases.

3 The time taken to do a given quantity of work decreases.

4 The time taken to do a given quantity of work increases.

Which statements are correct?

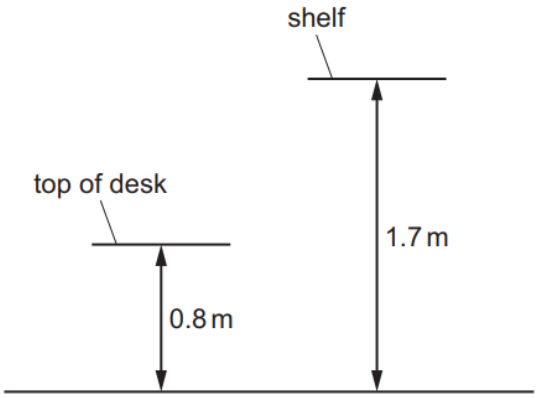
A 1 and 3 **B** 1 and 4 **C** 2 and 3 **D** 2 and 4

79 An object falls towards the Earth's surface.

What happens to the gravitational potential energy and to the kinetic energy of the object?

	gravitational potential energy	kinetic energy
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

80 A boy takes 0.60 s to lift a book of mass 0.60 kg from the top of a desk and place it on a shelf. The top of the desk is 0.80 m above the floor, and the shelf is 1.7 m above the floor. The gravitational field strength is 10 N / kg. **(extended only)**



Which power does the boy develop?

A 0.9 W **B** 1.7 W **C** 9.0 W **D** 17 W

81 A car has 620 kJ of kinetic energy. The car brakes and stops in a distance of 91 m.

What is the average braking force acting on the car?

A 0.15 N **B** 6.8 N **C** 6800 N **D** 56 000 N

82 A boy holds onto a bar and pulls himself up until his chin is level with the bar.

He raises himself through 40 cm in 0.5 s.

The weight of the boy is 500 N.

What is the average power he produces as he raises himself?

A 40 W **B** 400 W **C** 4000 W **D** 40 000 W

83 A motor of power P exerts a force F on an object. The object moves a distance d during the time t that the force acts.

Which equation is used to calculate the time t?

A $t = \frac{F}{Pd}$ **B** $t = \frac{Fd}{P}$ **C** $t = \frac{Pd}{F}$ **D** $t = \frac{P}{Fd}$

84 A scientist uses an electric motor to lift a load through a vertical distance of 2.0 m.

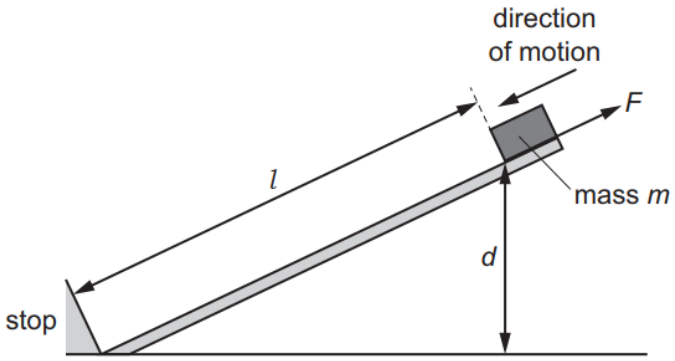
He then increases the input power to the motor and repeats the experiment. The efficiency of the motor does not change.

Which row correctly describes the effect that this has on the useful work done lifting the load and the time taken to lift it?

	work done	time taken
A	decreases	decreases
B	stays the same	decreases
C	decreases	stays the same
D	stays the same	stays the same

85 A box of mass *m* slides down a slope of length *l* against a frictional force *F*. It descends a vertical height *d*.

(extended only)



As the box slides down the slope, it loses gravitational potential energy and it does work against the friction.

Which row gives the loss in gravitational potential energy and the work done against friction?

	loss in gravitational potential energy	work done against friction
A	*mgd*	*Fl*
B	*mgd*	*Fd*
C	*mgl*	*Fl*
D	*mgl*	*Fd*

86 An engine produces 240 kJ of energy in 2.0 minutes.

What is the power output of the engine?

A 2.0 kW **B** 120 kW **C** 480 kW **D** 28 800 kW

87 This question is about four methods used to produce electrical energy.

Which method has a correct description?

	method	energy source is renewable	emits carbon dioxide
A	a hydroelectric power station	yes	no
B	a coal-fired power station	no	no
C	a wind turbine	no	yes
D	a nuclear power station	yes	yes

88 The power input to an electric motor is 400 W. The efficiency of the motor is 85%.

How much power is wasted? **(extended only)**

A 60 W **B** 85 W **C** 340 W **D** 470 W

89 An electric motor uses 1000 J of electrical energy. It provides 450 J of useful output energy.

What is the efficiency of the motor? **(extended only)**

A 4.5% **B** 5.5% **C** 45% **D** 55%

90 What is the source of the Sun's energy? **(extended only)**

A chemical reactions in the Sun's core

B γ-emissions in the Sun's core

C nuclear fission in the Sun's core

D nuclear fusion in the Sun's core

91 Which energy resource does **not** have the Sun as the original source? **(extended only)**

A coal

B geothermal

C hydroelectric

D wind

92 A car of mass 500 kg is moving at 10 m/s. The engine does work on the car and the speed increases to 16 m/s. **(extended only)**

How much work is done by the engine to increase the speed of the car?

A 3000 J **B** 9000 J **C** 39 000 J **D** 78 000 J

93 A man carries 20 tiles from the ground to the roof of a house. Each tile has a mass of 1.2 kg. The roof of the house is 15 m above the ground. **(extended only)**

How much work does the man do against gravity on the tiles in carrying them to the roof?

A 36 J **B** 180 J **C** 360 J **D** 3600 J

94 A car is moving along a straight horizontal road. The car has 1.6 MJ of kinetic energy. The car accelerates for 20 s until the kinetic energy of the car increases to 2.5 MJ.

What is the minimum average power developed by the car engine for this acceleration?

A 45 W **B** 205 W **C** 45 kW **D** 205 kW

95 A box of mass 8.0 kg is lifted from the ground and placed on a shelf. The box gains 100 J of potential energy.

(extended only)

The box falls off the shelf. Air resistance can be ignored.

At what speed does the box hit the ground?

A 3.5 m/s **B** 5.0 m/s **C** 25 m/s **D** 28 m/s

96 An object falls from the top of a building that is 25 m high. Air resistance is negligible.

What is the speed of the object when it hits the ground? **(extended only)**

A 10 m/s **B** 22 m/s **C** 25 m/s **D** 625 m/s

97 A crane takes 2.0 minutes to lift a load to the top of a building. The change in gravitational potential energy of the load is 360 kJ.

What is the useful power output of the crane?

A 3.0 kW **B** 180 kW **C** 720 kW **D** 43 200 kW

98 A force F acts on a body and the body moves a distance d in the direction of the force.

Which expression for the work done W is correct?

A $W = Fd$ **B** $W = Fd^2$ **C** $W = \frac{1}{2}Fd$ **D** $W = \frac{1}{2}Fd^2$

99 A boy produces an average power output of 60 W as he rides his bicycle for 2.0 minutes.

How much useful energy does he expend?

A 0.50 J **B** 30 J **C** 120 J **D** 7200 J

100 An object, initially at rest, is dropped from a height of 12.0 m. The change in gravitational potential energy when it falls to the ground is 565 J.

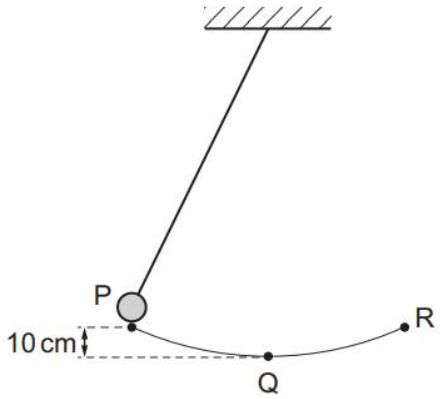
(extended only)

The frictional forces are negligible.

What is its speed when it hits the ground?

A 4.71 m/s **B** 15.5 m/s **C** 47.1 m/s **D** 240 m/s

101 The diagram shows a pendulum. **(extended only)**



The pendulum swings from P to Q to R and back to P.

P is 10 cm higher than Q.

At which speed does the pendulum bob pass through Q?

A 0.44 m/s **B** 1.0 m/s **C** 1.4 m/s **D** 2.0 m/s

102 A crane on a building site lifts bricks of total mass 200 kg, initially at rest on the ground, with uniform acceleration. **(extended only)**

When the bricks are 5.0 m from the ground, they have a speed of 5.0 m/s.

How much work is done during this process?

A 2.5 kJ **B** 10.0 kJ **C** 12.5 kJ **D** 35 kJ

103 A ball of mass 1.2 kg is dropped from a height of 30 m. As it falls, 25% of its initial gravitational potential energy is transferred to thermal energy. **(extended only)**

What is the kinetic energy of the ball just before it hits the ground?

A 27 J **B** 90 J **C** 270 J **D** 360 J

104 A girl hangs by her hands from a bar in the gymnasium. She pulls herself up until her chin is level with the bar.

The mass of the girl is 48 kg.

She pulls herself up through a distance of 0.25 m.

She does this in 2.0 s.

What is the useful power she uses to pull herself up?

A 6.0 W **B** 24 W **C** 60 W **D** 240 W

105 The work done W by a force is related to the magnitude F of the force and the distance d moved in the direction of the force.

Which equation for W is correct?

A $W = d \div F$

B $W = d + F$

C $W = F \div d$

D $W = F \times d$

106 A crane on a construction site lifts concrete beams.

The useful work done by the crane is 4000 kJ in a time of 160 s.

What is the useful output power of the crane?

A 0.04 kW **B** 25 W **C** 25 kW **D** 640 kW