Energy Sources & Transfer of Energy

Question Paper

Level	O Level
Subject	Physics
Exam Board	Cambridge International Examinations
Unit	Energy & Thermal Physics
Topic	Energy Sources & Transfer of Energy
Booklet	Question Paper

Time Allowed: **96 minutes**

Score: **/80**

Percentage: **/100**

Grade Boundaries:

1 A child slides down a slide.

7.0 m

The weight of the child is 250 N. The height of the slide is 7.0 m. The work done against friction as the child travels down the slide is 1300 J.

What is the change in gravitational potential energy and what is the final kinetic energy of the child?

	change in gravitational potential energy	final kinetic energy
A	1750	450
B	1750	1750
C	17 500	16 200
D	17 500	17 500

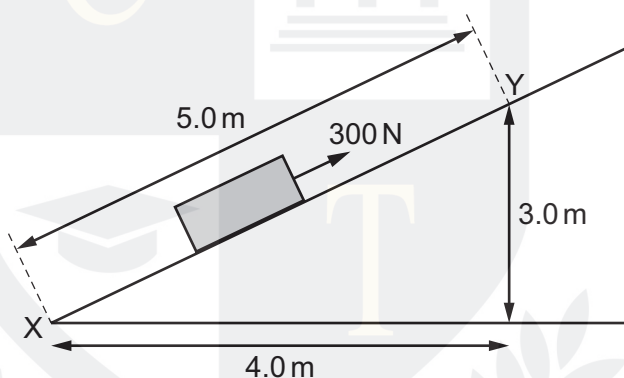**2** What uses non-renewable energy?

    A   a geothermal heating system

    B   a nuclear power station

    C   a solar panel

    D   a wind turbine

3 Which process in the Sun produces energy?

    A   burning

    B   nuclear fission

    C   nuclear fusion

    D   radiation

4 A 300 N force is applied to a box to move it up a ramp, as shown.

How much work is done by the force when moving the box from X to Y?

  A   900 J   **B**   1200 J   **C**   1500 J   **D**   3000 J

5   A cyclist travels along a horizontal track at constant speed.

    The work done by the cyclist is equal to

    A   the change in kinetic energy.

    B   the force of air resistance.

    C   the force of friction in the bicycle.

    D   the thermal energy (heat) produced.

6   A 2.0 kg mass has 300 J of kinetic energy.

What is the speed of the mass?

A   8.7 m/s   **B**   12 m/s   **C**   17 m/s   **D**   24 m/s

7   A rocket of total mass M is travelling at a speed v. The engine of the rocket is fired and fuel is used up. The mass of the rocket decreases to $M/2$ and its speed increases to $2v$.

What happens to the kinetic energy of the rocket?

A   it doubles

B   it halves

C   it increases by a factor of four

D   it stays the same

8   A builder lifts eight slabs from the ground on to the back of a lorry 1.5 m high.

The total time taken is 48 s and each slab weighs 200 N.

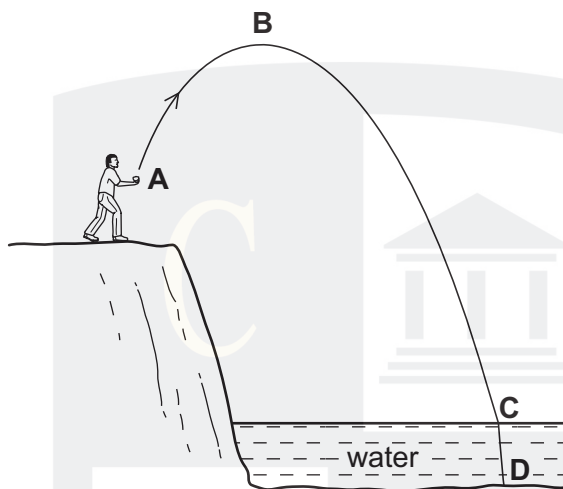How much useful power does the builder produce?

A   50 W   **B**   400 W   **C**   2400 W   **D**   3200 W

9   The input power to a lamp is 6.0 W. The lamp wastes 2.7 J of energy in 3.0 s.

What is the efficiency of the lamp?

A   0.15   **B**   0.45   **C**   0.55   **D**   0.85

10   A person throws a stone so that it follows the path shown in the diagram.

In which position does the stone have the most gravitational potential energy?

11   A piston of area $10\,cm^2$ is pushed slowly into a very large cylinder containing gas at a pressure of $10\,N/cm^2$. The pressure of the gas remains constant as the piston moves a distance of $0.10\,m$.

What is the force of the gas on the piston and what is the work done by the piston on the gas?

	force / N	work done / J
A	1.0	0.1
B	1.0	10
C	100	10
D	100	1000

12   Where is energy released by the fusion of hydrogen nuclei to form helium?

   A   in a nuclear power station

   B   in a radioactive isotope emitting alpha-particles

   C   in the core of the Earth

   D   in the core of the Sun

13   A crane lifts a load of 6000 N through a vertical distance of 15 m in 30 s.

What is the average useful power during this operation?

A   200 W   **B**   400 W   **C**   3000 W   **D**   12 000 W

14   A javelin has a mass of 0.80 kg.

The javelin is released with 250 J of kinetic energy.

What is the speed of the javelin?

A   13 m/s   **B**   18 m/s   **C**   25 m/s   **D**   630 m/s

15   Which source releases carbon dioxide, a greenhouse gas, when generating electricity?

A   fossil fuels

B   geothermal

C   hydroelectric

D   nuclear

16   A student uses a newton meter to pull an object horizontally along rough ground. The student multiplies the newton meter reading by the distance moved by the object.

What does this calculation give?

A   the efficiency of the process

B   the kinetic energy of the object

C   the power generated

D   the work done on the object

17   A builder carrying six bricks climbs a ladder. Each brick weighs 25 N and the builder climbs a vertical distance of 4.0 m in 8.0 s.

What is the average power used to raise the bricks?

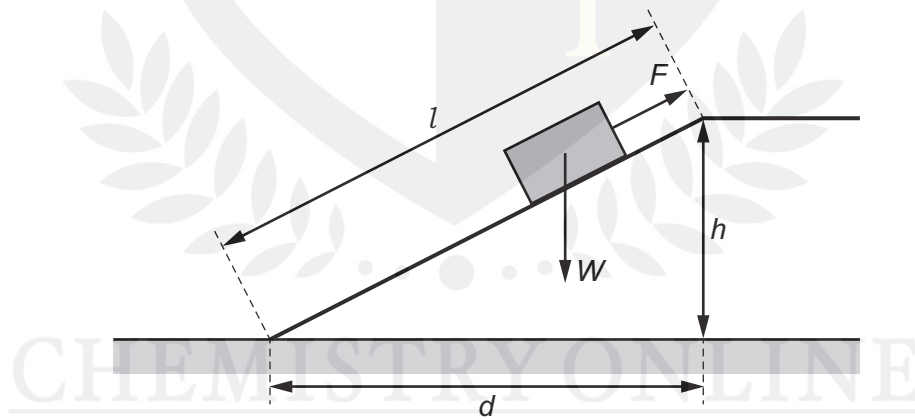**A**   13 W   **B**   75 W   **C**   750 W   **D**   4800 W

18 A child of mass 30 kg is moving at a speed of 4.0 m/s when she reaches the bottom of a slide.

4.0 m/s
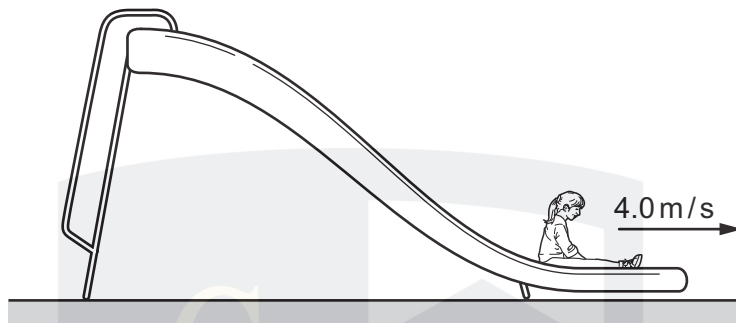
What is her kinetic energy?

A 60 J   **B** 120 J   **C** 240 J   **D** 480 J

19 A constant force F pulls a block of weight W up the slope shown.

F

l

h

W

d

How much work is done in pulling the block up the slope?

A $F \times h$ **B** $F \times l$ **C** $W \times d$ **D** $W \times l$

20 Energy is released in some power stations and in the Sun by either nuclear fission or nuclear fusion.

Which type of nuclear reaction applies in each case?

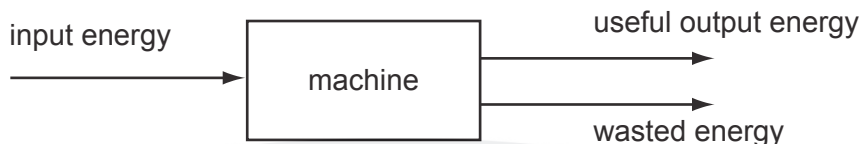|	power station	Sun
A	fission	fission
B	fission	fusion
C	fusion	fission
D	fusion	fusion

21 The diagram shows a girl lifting a box of weight 50 N from a low shelf to a high shelf.
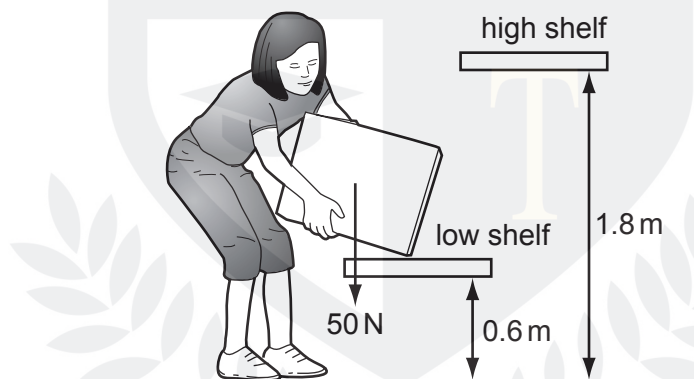
How much work is done on the box?

A   30 J   B   60 J   C   90 J   D   120 J

2**2** The diagram shows the energy transfer through a machine.

input energy → | machine | → useful output energy
→ wasted energy

The machine is 50% efficient.

Which equation is correct?

A input energy = useful output energy

B useful output energy = input energy + wasted energy

C wasted energy = input energy + useful output energy

D wasted energy = useful output energy

2**3** A swimmer dives into a very deep pool at high speed. He slows down as he moves towards the bottom of the pool.

What is the overall energy transformation as the diver moves downwards through the water?

A gravitational potential energy → kinetic energy + thermal energy (heat)

B gravitational potential energy → kinetic energy → thermal energy (heat)

C kinetic energy + gravitational potential energy → thermal energy (heat)

D kinetic energy → gravitational potential energy + thermal energy (heat)

2**4** A lorry of mass 10 000 kg takes 5000 kg of sand to the top of a hill 50 m high, unloads the sand and then returns to the bottom of the hill.

The gravitational field strength is 10 N/kg.

What is the overall gain in potential energy?

A 250 000 J   **B** 750 000 J   **C** 2 500 000 J   **D** 7 500 000 J

25 Three objects P, Q and R have different masses and different speeds as shown in the table.

	$\dfrac{\text{mass}}{\text{kg}}$	$\dfrac{\text{speed}}{\text{m/s}}$
P	1	3
Q	2	2
R	5	1

What is the order of increasing kinetic energy (smallest first) of the objects?

A $P \rightarrow Q \rightarrow R$

B $P \rightarrow R \rightarrow Q$

C $R \rightarrow P \rightarrow Q$

D $R \rightarrow Q \rightarrow P$

26 Which energy resource comes from hot rocks beneath the Earth's surface?

A   geothermal energy

B   hydroelectric energy

C   solar energy

D   wind energy

27 On a cold afternoon, a house loses 54 MJ of thermal energy (heat) to its surroundings as shown.
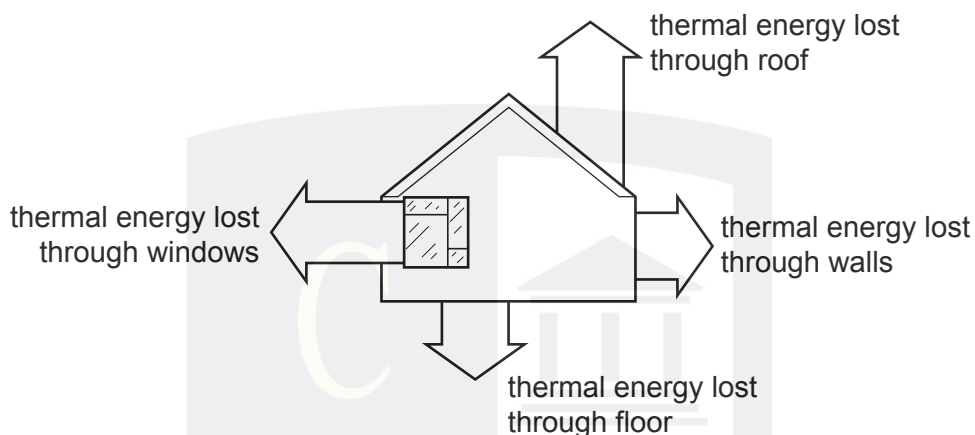
The heating system must supply more than 54 MJ of thermal energy to keep the temperature of the house constant.

Which statement explains this?

A   The extra thermal energy is lost from the house to the surroundings by other means.

B   The extra thermal energy keeps the house warmer than the surroundings.

C   The temperature of the surroundings decreases continuously during this period.

D   The thermal insulation of the roof is extremely ineffective.

28 When exposed to light, a solar cell generates electrical energy.

Two solar cells of equal area are tested. Each cell is exposed to sunlight of different brightness for the same time.

Which statement could apply to the more efficient cell?

A   It generates less electrical energy from light of greater brightness.

B   It generates less electrical energy from light of the same brightness.

C   It generates the same electrical energy from light of greater brightness.

D   It generates the same electrical energy from light of lower brightness.

29 The diagram shows the path of a diver after leaving a platform and before entering the water in a swimming pool.
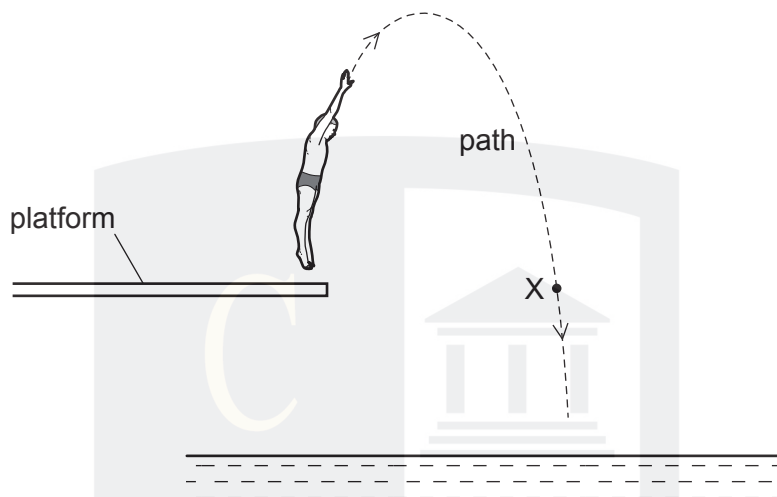
The gravitational potential energy of the diver is zero when he is at the surface of the water.

Which statement about the diver's energy along the path is correct?

A   At point X he has only gravitational potential energy.

B   At point X he has only kinetic energy.

C   His gravitational potential energy is always more than his kinetic energy.

D   The sum of his gravitational potential energy and kinetic energy is constant.

30   A ball is held at rest on one side of a curved track.

starting point

stopping point

The ball is released. It rolls down one side of the track and part of the way up the other side. It then stops, before rolling back down again. The height of the stopping point is less than that of the starting point.

What is the sequence of energy changes between starting and stopping for the first time?

A   potential energy → kinetic energy → potential energy

B   potential energy → kinetic energy → heat → potential energy

C   potential energy → heat → kinetic energy → potential energy

D   potential energy → kinetic energy + heat → potential energy + heat

31   A transformer connected to a 240 V mains supply is used to light a 24 W lamp.

240 V
0.11A

⊗ 24 W
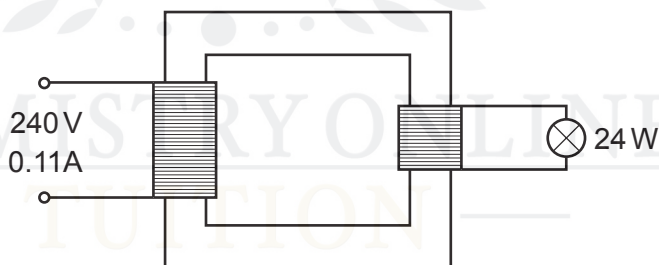
The input current to the transformer is 0.11 A and the input voltage is 240 V. The useful output power of the transformer is 24 W.

What is the efficiency of the transformer?

A   0.10   **B**   0.91   **C**   1.1   **D**   2.6

32   Two major components of a coal-fired power station are a turbine and a generator.

What are the output forms of energy from the turbine and from the generator?

	turbine	generator
A	electrical	electrical
B	electrical	kinetic
C	heat	kinetic
D	kinetic	electrical

33   What is efficiency?

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

B $\dfrac{\text{total power input}}{\text{useful energy output}}$

C $\dfrac{\text{useful energy output}}{\text{total energy input}}$

D $\dfrac{\text{useful power output}}{\text{total energy input}}$

34   Which is a non-renewable source of energy?

A   a battery in a watch

B   a hydroelectric power station

C   a solar panel

D   a wind turbine

35 A builder lifts eight slabs from the ground on to the back of a lorry 1.5 m high.

The total time taken is 48 s and each slab weighs 20 N.

How much useful power does the builder produce?

A   5 W   B   40 W   C   240 W   D   320 W

36 Hydroelectric, tidal and fossil fuel power stations generate electrical energy.

Do these use renewable sources of energy?

	hydroelectric	tidal	fossil fuel
A	no	yes	yes
B	no	no	yes
C	yes	no	no
D	yes	yes	no

37 An object of mass 5 kg is carried a distance of 4 m across a room at a constant height above the floor.

What is the work done on the object?

A   0   B   20 J   C   50 J   D   200 J

38 The diagram represents parts of a power station.

| coal-fired boiler | → | turbine | → | electricity generator |
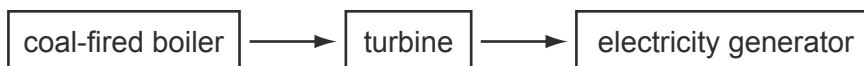
What is the order of the energy changes taking place?

A chemical → heat → kinetic → electrical

B chemical → kinetic → heat → electrical

C heat → chemical → kinetic → electrical

D kinetic → chemical → heat → electrical

39 The centre of the Sun produces large amounts of energy.

What is the source of this energy?

A chemical reaction

B nuclear fission

C nuclear fusion

D radioactive decay

40 A crane lifts a weight of 1000 N through a vertical height of 30 m.

It uses 60 000 J of energy.

What is the efficiency of the crane?

A 20 %   **B** 30 %   **C** 50 %   **D** 200 %

41 The efficiency of an electrical generator is 65 %.

The energy input to the generator is 12 kJ.

What is the useful energy output?

A 4.2 kJ   **B** 5.4 kJ   **C** 7.8 kJ   **D** 780 kJ

42 Coal is burned as fuel to heat water in a boiler, producing steam. The steam drives a turbine, which is connected to an electric generator.

In which order do the major energy transformations take place?

A chemical energy → heat energy → electrical energy → kinetic energy

B chemical energy → heat energy → kinetic energy → electrical energy

C heat energy → chemical energy → electrical energy → kinetic energy

D heat energy → chemical energy → kinetic energy → electrical energy

43 A crane moves its load diagonally, as shown.

By which distance is the weight of the load multiplied to calculate the change in gravitational potential energy of the load?
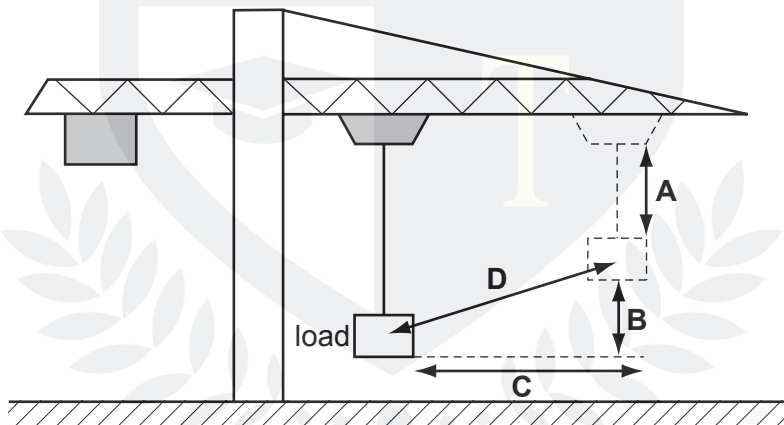
44 A parachutist has opened his parachute and is falling to Earth at constant speed.

What is the principal energy conversion taking place as he falls?

A kinetic energy → potential energy

B kinetic energy → thermal energy (heat)

C potential energy → kinetic energy

D potential energy → thermal energy (heat)

45 A small emergency generator supplies 432 000 000 J of electrical energy in twenty-four hours.

What is the average power output of the generator?

A 5000 W

B 300 000 W

C 18 000 000 W

D 432 000 000 W

46 The diagram shows a curved track. A ball is released from the position shown.

At which point does the ball have the maximum gravitational potential energy?

47 When one radium nucleus decays, its mass decreases by 8.8×10^{-30} kg.

How much energy is equivalent to this loss in mass?
(speed of light $c = 3.0 \times 10^8$ m/s)

A 6.8×10^{-42} J   B 2.6×10^{-21} J   C 4.0×10^{-13} J   D 7.9×10^{-13} J

48 The energy output of a generator depends on its efficiency and the energy input.

Which set of values is correct?

	efficiency	energy input /MJ	energy output /MJ
A	0.1	50	25
B	0.2	30	6
C	0.4	120	30
D	0.6	60	24

49 Which process in the Sun produces energy?
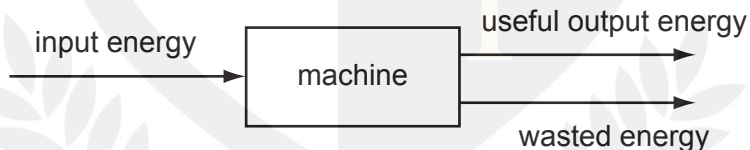
    A   burning

    B   nuclear fission

    C   nuclear fusion

    D   radiation

50 A crane lifts a load of 1000 N through a vertical height of 3.0 m in 10 s. The input power to the crane is 500 J/s.

What is the efficiency of the crane?

    A   0.17   **B**   0.50   **C**   0.60   **D**   0.67

51 The diagram shows energy transfer through a machine.

What is the efficiency of the machine?

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

    B $\dfrac{\text{useful output energy}}{\text{input energy}}$

    C $\dfrac{\text{useful output energy}}{\text{wasted energy}}$

    D $\dfrac{\text{wasted energy}}{\text{input energy}}$

52 A man weighs 600 N. He runs up a staircase of total height 4.0 metres in 3.0 seconds.

How much useful power is needed to do this?

    A   450 W   **B**   800 W   **C**   2400 W   **D**   7200 W

53 A workman rolls a barrel of weight 2000 N up a plank of length 2.00 m and on to a lorry. The back
    of the lorry is 0.80 m above the horizontal surface of the road.
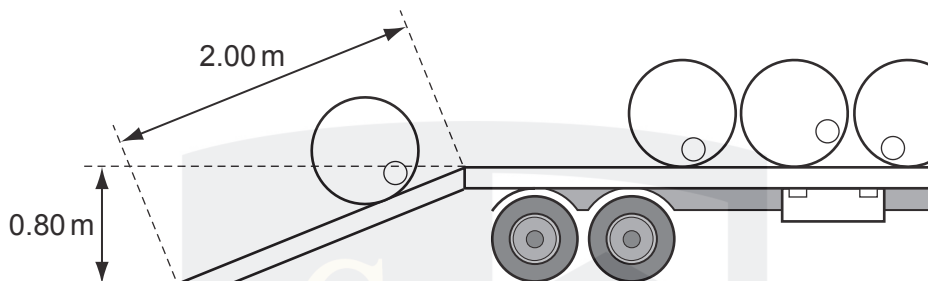
What is the work done on the barrel against gravity?

A   1000 J   **B**   1600 J   **C**   2500 J   **D**   4000 J

54 Energy from petrol is used to operate an engine. The engine drives a generator, which produces
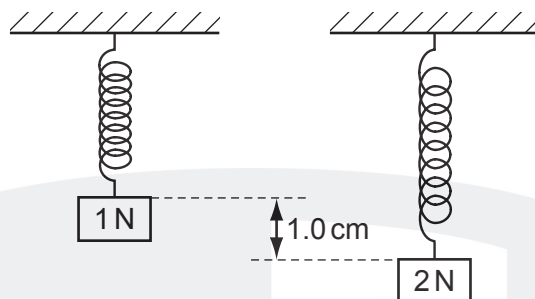   electrical energy.
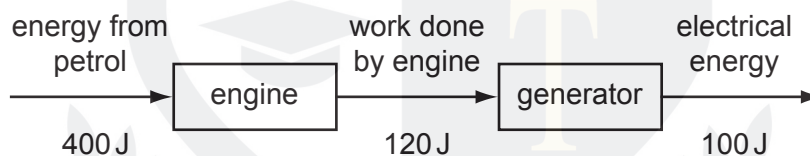
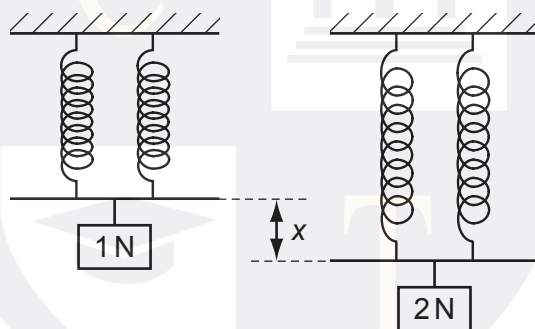
What is the overall efficiency of the process?

A   25 %   **B**   30 %   **C**   55 %   **D**   83 %

55 A single spring is loaded with a 1 N weight. The load is then increased to 2 N and the extension increases by 1.0 cm, as shown.
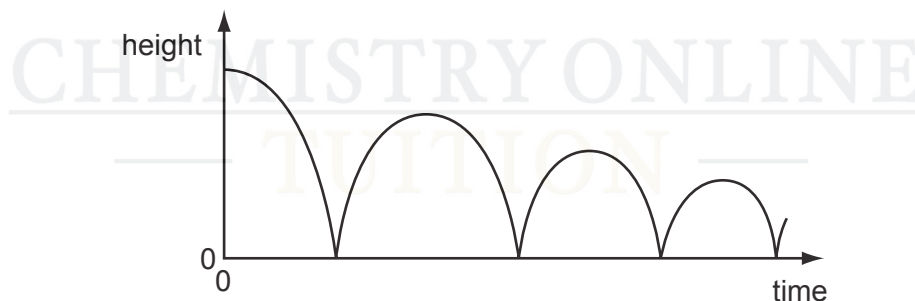

Two springs that are identical to the first one are put side by side. They are connected at both ends, and a 1 N weight is hung on them. The load is then increased to 2 N.

What is the new increase x in the extension?

**A**   0.5 cm   **B**   1.0 cm   **C**   2.0 cm   **D**   3.0 cm

56 The graph shows how the height above the ground of a bouncing ball changes with time.

Which statement explains why the height of each peak decreases with time?

A   Kinetic energy is converted to potential energy at each bounce.

B   Kinetic energy is converted to thermal energy at each bounce.

C   The ball gains energy on impact with the floor.

D   The ball is wearing out.

57 The diagram shows a battery-operated motor lifting a block of wood at constant speed.
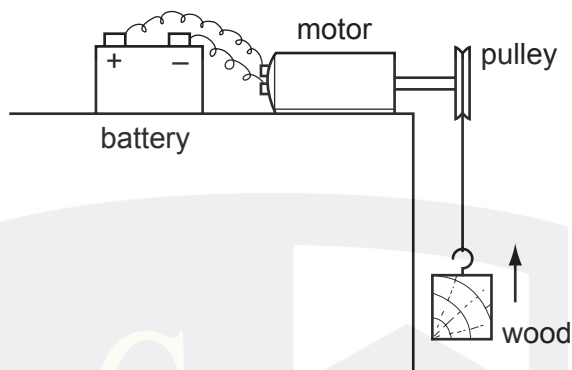
What is the overall energy change taking place?

A   chemical → gravitational potential

B   gravitational potential → electrical

C   gravitational potential → kinetic

D   kinetic → gravitational potential

58 Four students exercise in a gym.

Which student does the most work?

	exercise time / s	power developed / W
A	50	250
B	100	150
C	200	200
D	250	30

59 Which formula gives the efficiency of an energy conversion?

A   efficiency = total energy input - useful energy output

B   efficiency = useful energy output × total energy input

C   efficiency = $\dfrac{\text{useful energy output}}{\text{total energy input}}$

D   efficiency = $\dfrac{\text{total energy input}}{\text{useful energy output}}$

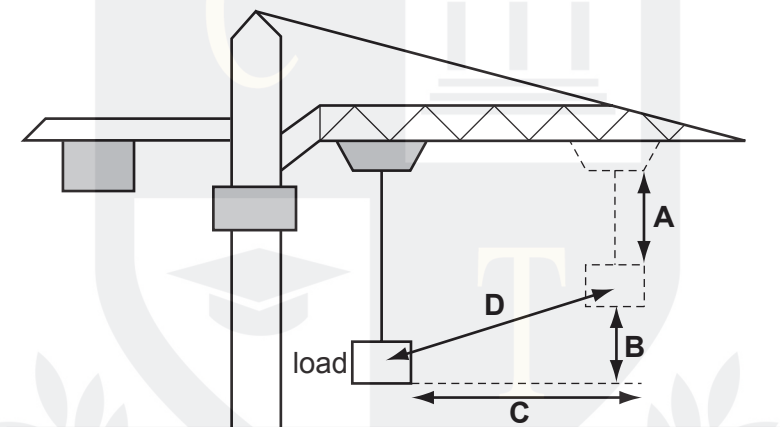60 A 2 kg mass is moving at constant speed.

The kinetic energy of the mass is 400 J.

What is the speed of the mass?

A 0.4 m/s   **B** 20 m/s   **C** 200 m/s   **D** 400 m/s

61 A crane moves its load diagonally, as shown.

By what distance is the weight of the load multiplied in order to calculate the increase in gravitational potential energy of the load?

62 The efficiency of an electrical generator is 65 %.

Which useful output can be expected if the energy input to the generator is 12 kJ?

A 4.2 kJ   **B** 7.8 kJ   **C** 19 kJ   **D** 780 kJ

63 In a hydroelectric power station, water from a reservoir falls down a long pipe before entering the turbines. The turbines then turn the generator.

What is the **overall** energy conversion?

A electrical energy into kinetic energy

B electrical energy into potential energy

C kinetic energy into chemical energy

D potential energy into electrical energy

64 Which statement about fission or fusion is correct?

    A   During fission, hydrogen converts into helium and releases energy.

    B   During fission, uranium converts into daughter products and releases energy.

    C   During fusion, helium converts into hydrogen and releases energy.

    D   During fusion, uranium converts into daughter products and releases energy.

65 The input power to a motor is 300 W. In 20 s it lifts a load of 400 N through a height of 6.0 m.

What is the efficiency of the motor?

    A 12 %   **B** 25 %   **C** 40 %   **D** 75 %

66 A young child holds a ball over the edge of a balcony. The ball has gravitational potential energy. The ball is then released. It falls onto a concrete path below, and bounces back up.
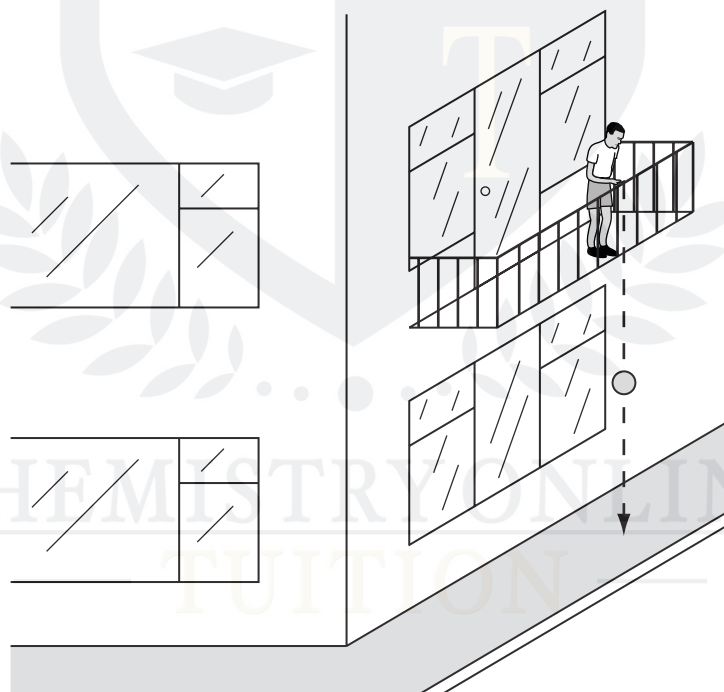
Which sequence represents, in the correct order, the transformations of the gravitational potential energy after the ball is released?

    A   → elastic potential energy → kinetic energy → chemical potential energy

    B   → elastic potential energy → kinetic energy → gravitational potential energy

    C   → kinetic energy → elastic potential energy → kinetic energy

    D   → kinetic energy → gravitational potential energy → kinetic energy

67 How much energy would be released if 1×10^{-20} kg of matter was entirely converted to energy?
(The speed of light is 3×10^8 m/s.)

A 3×10^{-12} J   **B** 9×10^{-7} J   **C** 4.5×10^{-4} J   **D** 9×10^{-4} J

68 The diagram shows a curved curtain rail that has a steel ball rolling on it. The ball is released at point **A**.

At which point does the ball have maximum kinetic energy?
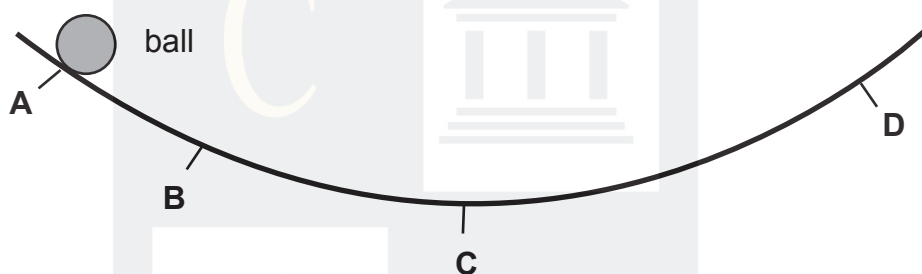
69 The speed of light is 3×10^8 m/s.

What is the energy equivalent of 2 kg of matter?

A $2 \times 3 \times 10^8$ J

B $2000 \times 3 \times 10^8$ J

C $\frac{1}{2} \times 2 \times (3 \times 10^8)^2$ J

D $2 \times (3 \times 10^8)^2$ J

70 A mass hangs on a string fixed at point P. It starts from position 1 and swings to the furthest position on the opposite side, position 2. It then oscillates several times with decreasing amplitude before ending at position 3.

P

1

2
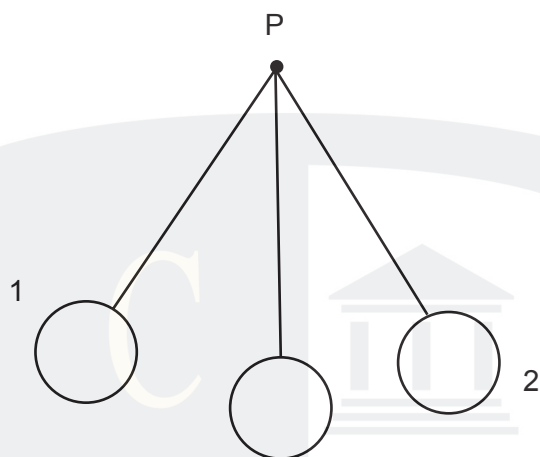
Where does the ball have the most kinetic energy?

A   at position 1

B   at position 2

C   the first time at position 3

D   the last time at position 3

71 A girl of weight 500 N runs up a flight of stairs in 10 seconds. The vertical height of the stairs is 5 m.

flight of stairs

5 m
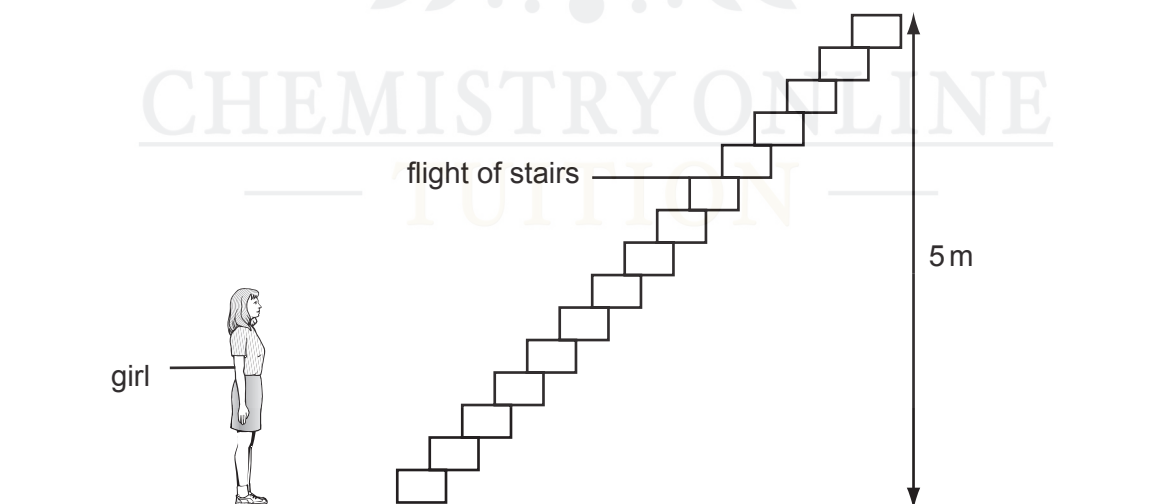
girl

What is the average power developed by the girl?

A   50 W   B   100 W   C   250 W   D   1000 W

72 When a nucleus of Uranium-235 absorbs a neutron, nuclear fission occurs. In a typical reaction the total mass decreases by 3×10^{-28} kg.

Given that the speed of light c is 3×10^8 m/s, approximately how much energy is released?

    A 9×10^{-20} J

    B 2×10^{-13} J

    C 3×10^{-11} J

    D 3×10^{-5} J

73 A car is driven along a level road. The total energy input from the petrol is 60 kJ, and the car wastes 45 kJ of energy.
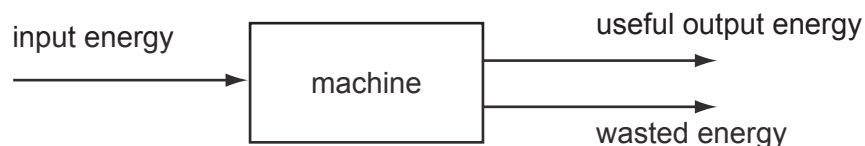

What is the efficiency of the car?

  A 15 %   **B** 25 %   **C** 45 %   **D** 75 %

74 Hydroelectric, tidal and fossil fuels are three sources of energy.

Which of these are renewable energy sources?

|	hydroelectric	tidal	fossil fuels
A	no	yes	yes
B	no	no	yes
C	yes	no	no
D	yes	yes	no

75   The diagram shows the energy transfer through a machine.

The machine is 50 % efficient.

Which is correct?

A   input energy = useful output energy

B   useful output energy = input energy + wasted energy

C   wasted energy = input energy + useful output energy

D   wasted energy = useful output energy

76   When a 300 N force is applied to a box weighing 600 N, the box moves 3.0 m horizontally in 20 s.
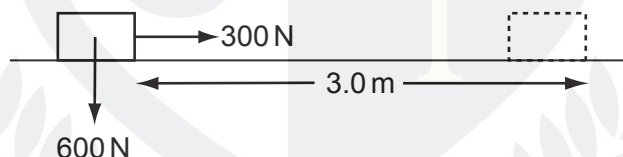
What is the average power?

A   45 W   B   90 W   C   900 W   D   1800 W

77   Which energy changes take place when a pedalling cyclist uses a generator (dynamo) to light his bicycle lamp?

A   chemical → kinetic → electrical → light

B   electrical → chemical → kinetic → light

C   kinetic → chemical → light → electrical

D   light → electrical → kinetic → chemical

78 A boy, who weighs 50 N, runs up a flight of stairs 6.5 m high in 7 seconds.

How much power does he develop?

A $\dfrac{6.5}{50 \times 7}$ W

B $\dfrac{7 \times 6.5}{50}$ W

C $\dfrac{50}{7 \times 6.5}$ W

D $\dfrac{50 \times 6.5}{7}$ W

79 A student who weighs 500 N climbs up a flight of stairs 10 metres high in 5 seconds.

What power does she develop?

A $500 \times 10 \times 5$ W

B $\dfrac{500 \times 0}{5}$ W

C $\dfrac{500 \times}{10}$ W

D $\dfrac{5}{500 \times 10}$ W

80 A rock of mass 20 kg is travelling in space at a speed of 6 m/s.

What is its kinetic energy?

A 60 J

B 120 J

C 360 J

D 720 J