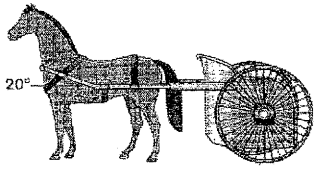
Basic exercise Multiple-choice

7.1

1 In physics, which of the following statements about work is **incorrect**?
A Work is the resultant force acting on an object.
B Work results in displacement of an object.
C Work is the transfer of energy to an object by a force.
D Work is a scalar. A

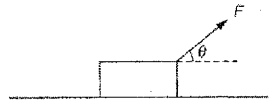
2 Leo walks 10 m with a school bag of mass 3 kg on his back. Find the work done by him on the bag.
A Zero
B 30 J
C 100 J
D 300 J B

3



A horse pulls a cart with a string that makes an angle of 20° with the horizontal. If the horse pulls the cart with a force of 200 N and travels a distance of 5 m, what is the work done by the horse?
A 342 J
B 940 J
C 1000 J
D 1064 J B

(For Q4–5.) A force F acts on a block so that the block moves forwards.



4 ★ If the work done is the largest, find the value of θ.
A Zero
B 30°
C 45°
D 90° A

5 ★ If the work done is the smallest, find the value of θ.
A Zero
B 45°
C 60°
D 90° D

★6 Statements: (For instructions, see inside back cover.)
1st statement: We feel tired when we walk steadily with heavy objects on our backs.
2nd statement: When we walk steadily with heavy objects on our backs, we do work on the heavy objects.

7.2

7 A car of mass 2000 kg travels with a speed of 108 km h^{-1}. Find its kinetic energy.

Helper: Pay attention to the unit of speed.

A 9×10^5 J
B 1.8×10^6 J
C 1.17×10^7 J
D 2.33×10^7 J A

8 Thomas kicks a stationary football forwards at a speed of 8 m s^{-1}. The mass of the football is 0.45 kg. Find the work done by Thomas on the ball.

Helper: What is the relation between the work done by Thomas on the ball and the KE gained by the football?

A Zero
B 3.6 J
C 14.4 J
D 36 J C

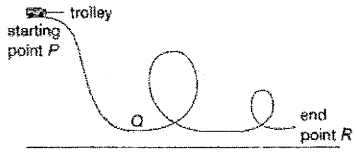
9 When a bullet of mass 0.005 kg is fired, its kinetic energy is 25 J. Find the speed of the bullet when fired.
A 10 m s^{-1}
B 25 m s^{-1}
C 70.7 m s^{-1}
D 100 m s^{-1} D

10 A crane lifts up a load of mass 1000 kg to a height of 5 m above the ground. Find the gain in the potential energy of the load.
A 5000 J
B 50 000 J
C 10 000 J
D 100 000 J B

★11 Cherry of mass 40 kg takes a lift from the 2nd floor. If her gain in the potential energy is 3600 J, which floor does she go to? Assume each floor is 3 m high.
A The 3rd floor
B The 4th floor
C The 5th floor
D The 6th floor C

7.3

12



A trolley moves down from rest at starting point P along a rough track. Which of the following statements is **incorrect**?

A The trolley has maximum PE at P.
B The trolley has maximum KE at Q.
C When the trolley moves down, some energy is converted to work done against friction along the track.
D As there is energy loss, the trolley will never reach the end point R.

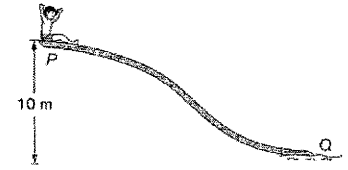
D

13 The re-entry capsule of a spaceship burns when it returns to the Earth. Which of the following best explains this phenomenon?

A There is a layer of inflammable material on the surface of the capsule.
B There are many inflammable gases in the atmosphere.
C Large amount of heat is produced due to friction.
D The capsule can be identified easily to facilitate the rescue.

C

14

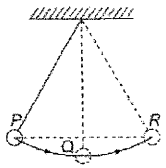


A boy slides down from rest at P along a water slide. P is 10 m above Q. Find the speed of the boy at Q. Assume the friction between the slide and the boy is negligible.

A 10 m s^{-1}
B 14.1 m s^{-1}
C 20 m s^{-1}
D 24.1 m s^{-1}

B

15



Which of the following about the bob is **correct**?

A The bob has maximum KE at P and R, and maximum PE at Q.
B The bob has maximum PE at P and maximum KE at R.
C The bob has maximum PE at P and R, and maximum KE at Q.
D The bob has same KE at P, Q and R.

C

★**16** Statements: (For instructions, see inside back cover.)

1st statement: In a simple pendulum, the greater the mass of the bob, the smaller its speed at the lowest position.
2nd statement: The kinetic energy of an object depends on the mass of the object.

D

★**17** Statements: (For instructions, see inside back cover.)

1st statement: The sum of KE and PE of an object must remain constant.
2nd statement: Energy cannot be created or destroyed.

D

7.4

18 A crane lifts up a load of mass 500 kg to a height of 5 m in 10 s. Find the output power of the crane.

A 250 W
B 500 W
C 2500 W
D 25 000 W

C

19 A truck of mass 5000 kg accelerates from rest to 15 m s^{-1} in 15 s along a horizontal road. Find the average output power of the truck.

A 12 500 W
B 25 000 W
C 37 500 W
D 50 000 W

C

20 Eurocopter EC155B1 helicopter has two engines. The output power of each engine is 789 kW. Find the energy output by the helicopter in 10 s.

A 7.89 kJ
B 15.8 kJ
C 7.89 MJ
D 15.8 MJ

D

21 Kenny of mass 45 kg runs up a flight of 200 steps in 1 minute. Each step is 0.2 m high. Find his power.

A 90 W
B 300 W
C 1500 W
D 18 000 W

B

22 A car travels at a constant velocity of 20 m s^{-1}. If the total of air resistance and the friction acting on the car is 350 N, find the output power of the car engine.

A 0.057 W
B 17.5 W
C 700 W
D 7000 W

D

★**23** A car of mass 1200 kg accelerates from rest at 3 m s^{-2} for 5 s on a straight road. Find the average output power of the car engine.

Helper: First find the gain in KE of the car in 5 s.

A 27 kW
B 54 kW
C 135 kW
D 180 kW

A

★**24** Statements: (For instructions, see inside back cover.)

1st statement: When a car moves at constant velocity, the output power of its engine is not zero.
2nd statement: The car must generate power to overcome friction and air resistance.

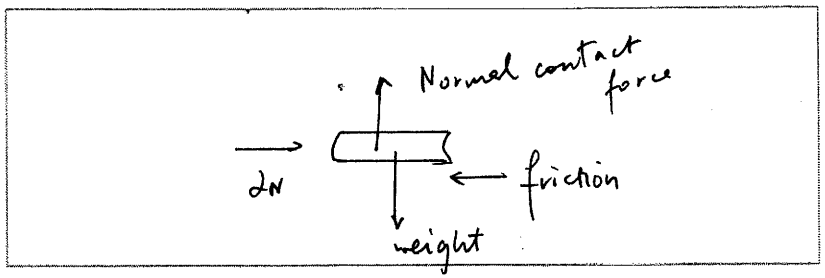
A

Basic exercise — Short questions

7.1

1 Lily applies a horizontal force of 2 N to move a book a distance of 1 m on a rough table.

(a) Draw the free-body diagram for the book. (3 marks)



(b) Find the work done by Lily on the book. (2 marks)

W.D = F×S = 2 × 1 = 2 J

(c) Describe the energy change that takes place. (2 marks)

Chemical energy from hand → K.E of book

2 When a car is braked, the friction between a tyre of the car and the road is 800 N. The tyre makes a mark of 20 m on the road.

(a) Find the work done by friction on the tyre. (2 marks)

Helper: Friction and displacement act in opposite directions, they have different +/− signs.

W.D. by friction = F × S
= 800 × 20
= 16000 J

(b) Describe briefly the energy change in braking the car. (1 mark)

K.E of car → Internal Energy of Tyre + Sound

3 A horizontal force of 10 N is applied to move a block on a rough horizontal surface. The block travels a distance of 7 m at constant velocity.

(a) Find the net force acting on the block. (1 mark)

0 N

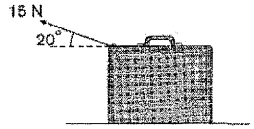
(b) Find the friction between the block and the surface. (1 mark)

$F_{net} = 0 = 10 - f_{friction}$ ∴ friction = 10 N

(c) Find the work done against friction. (2 marks)

= F × S
= 10 × 7 = 70 J

4 ★ Winnie pulls a suitcase with a force of 15 N. The suitcase travels a distance of 10 m. The force makes an angle of 20° with the horizontal



(a) How much work does she do? (2 marks)

$W.D = \vec{F} \cdot \vec{S} = FS\cos\theta$
$= 15 \times 10 \times \cos 20° = 141$ J

(b) If the force makes an angle of 40° with the horizontal, does the work done by her increase or decrease? (2 marks)

Decrease. $\cos 40° < \cos 20°$

7.2

5 Complete the following table. (4 marks)

	Object	Mass (m)	Velocity (v)	Kinetic energy
(a)	Tennis ball	0.1 kg	30 m s^{-1}	45 J
(b)	Car	1000 kg	10 m s^{-1}	50000 J
(c)	Iron ball	0.2 kg	2 m s^{-1}	0.4 J
(d)	Runner	50 kg	5 m s^{-1}	625 J

6 Which of the following has a smaller kinetic energy?
A bowling ball of mass 5 kg moving at 2 m s^{-1}.
A football of mass 0.45 kg moving at 20 m s^{-1}. (3 marks)

For bowling, $K.E = \frac{1}{2} \times 5 \times 2^2 = 10$ J (Smaller)

For football, $K.E = \frac{1}{2} \times 0.45 \times 20^2 = 90$ J

7 Take the gravitational potential energy at ground level as zero. Complete the following table. (4 marks)

	Object	Mass (m)	Height above the ground (h)	Potential energy
(a)	Battery	0.1 kg	10 m	10 J
(b)	Barbell	10 kg	1.5 m	150 J
(c)	Iron ball	0.2 kg	0.2 m	0.4 J

8 Keith and Alex are climbing up a vertical rock surface. Their masses are both 70 kg. When they are 1 m and 2 m above the ground respectively, they take a rest. Take the gravitational potential energy at ground level as zero.

(a) Find the potential energy of each of them when they are at rest. (2 marks)

For Keith, $P.E = 70 \times 10 \times 1 = 700$ J

For Alex, $P.E = 70 \times 10 \times 2 = 1400$ J

(b) After the rest, each of them continues to climb up a distance of 3 m.

(i) Find the gain in potential energy of each of them. Do they gain the same amount of potential energy? (3 marks)

Keith, gain in $P.E = 70 \times 10 \times 3 = 2100$ J

Alex gain in $P.E = 70 \times 10 \times 3 = 2100$ J

Same gain in P.E

(ii) If they are of different masses, do they gain the same amount of potential energy? (1 mark)

No.

7.3

9 A water melon of mass 5 kg falls freely from a height of 1.5 m above the ground. Take the gravitational potential energy at ground level as zero.

(a) Find the potential energy of the water melon before it falls. (2 marks)

$5 \times (1.5) \times (10) = 75$ J

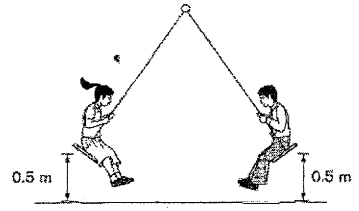
(b) Find the kinetic energy of the water melon when it is 1 m above the ground. (2 marks)

K.E = loss in P.E

$= 5(10)(1.5 - 1)$

$= 25$ J

10 Jenny and Simon are on swings. They both rise to a height of 0.5 m above the ground before they move down. The masses of Jenny and Simon are 30 kg and 45 kg respectively.



(a) Find the speed of Jenny at the lowest position. (2 marks)

$\frac{1}{2}(30)(v^2) = 30(10)(0.5)$

$v = 3.16$ m s^{-1}

(b) Find the speed of Simon at the lowest position. (2 marks)

$\frac{1}{2}(45)(v^2) = 45(10)(0.5)$

$v = 3.16$ m s^{-1}

(c) What can you conclude when you compare the results in (a) and (b)? (1 mark)

falling speed does not depend on mass

11 A roller-coaster is hauled to a height of 80 m above the ground. Then it goes down the track. The mass of the roller-coaster is 4000 kg. Take the gravitational potential energy at ground level as zero.

(a) Find the potential energy of the roller-coaster at the height of 80 m above the ground. (2 marks)

$4000(10)(80)$

$= 3.2 \times 10^6$ J

(b) The speed of the roller-coaster at the lowest point B is 20 m s^{-1}. B is 50 m above the ground.

(i) What is the energy loss when the roller-coaster reaches B? (3 marks)

loss in P.E = (4000)(10)(80 − 50)

= 1.2×10^6 J

gain in K.E = $\frac{1}{2}(4000)(20)^2$

= 8×10^5 J ∴ Energy loss = 4×10^5 J

(ii) In what way is the energy lost? (1 mark)

work done against friction

12 A car of mass 1000 kg is travelling at 30 m s^{-1}.

(a) Find the kinetic energy of the car. (2 marks)

K.E. = $\frac{1}{2}(1000)(30)^2$

= 4.5×10^5 J

(b) When the car is braked, the braking distance is 30 m. Find the average braking force of the car. (2 marks)

Helper: Do the braking force and the motion of the car have the same direction?

W.D. against friction = loss in K.E.

$f(30) = 4.5 \times 10^5$

$f = 15000$ N

13 A waterfall is 180 m high. Assume all kinetic energy of water reaching the bottom of the waterfall from the top is changed into internal energy. Find the temperature difference of the water between the top and the bottom of the waterfall. The specific heat capacity of water is 4200 J kg^{-1} °C^{-1}. (2 marks)

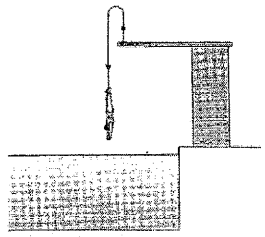
P.E → K.E → Internal Energy

$mgh = mc\Delta T$

$(m)(10)(180) = m(4200)\Delta T$

∴ $\Delta T = 0.43$ °C

★14 Shirley of mass 45 kg jumps up 1 m above a 3-m springboard before she enters into water.



(a) Find the speed of Shirley when she leaves the springboard. (2 marks)

using $v^2 = u^2 + 2gs$ (set upward as +ve)

$0^2 = u^2 + 2(-10)(1)$

$u = +\sqrt{20}$ or $+4.47$ ms^{-1}

(b) Find the speed of Shirley when she reaches the water surface. (2 marks)

loss in P.E = gain in K.E.

$45 \times 10 \times (4) = \frac{1}{2}(45)v^2$

$v = 8.94$ ms^{-1}

From $v^2 = u^2 + 2gs$ ↑ +ve

or $v^2 = (\sqrt{20})^2 - (2)(10)(-3)$

$= -8.94$ ms^{-1}

(downward)

(c) Assume the average resistive force exerted by water on Shirley is 2500 N. Find the depth in the water she reaches. (3 marks)

From water level, loss in P.E + loss in K.E = W.D. against resistive force

$mgh + \frac{1}{2}mv^2 = f \cdot h$

$45 \times 10 \times h + \frac{1}{2}(45)(8.94)^2 = 2500(h)$

$h = 0.88$ m

7.4

15 Complete the following table. (4 marks)

	Power (P)	Energy (W)	Time (t)
(a)	1000 W	100 000 J	100 s
(b)	1 W	3600 J	1 h
(c)	500 W	10000 J	20 s
(d)	20 W	3000 J	150 s

16 An air-conditioner consumes 4.32 MJ of electrical energy in an hour. Find its power. (2 marks)

$P = \frac{W}{t} = \frac{4.32 \times 10^6}{60 \times 60}$

$= 1200$ Watt

17 A sports car travels at a constant velocity of 288 km h^{-1} on a straight road. The output power of the car engine is 32 000 W. Find the friction acting on the car. (Assume air resistance is negligible.) (2 marks)

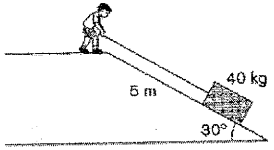
Under constant speed Power = Fv

$32000 = F\left(\frac{288}{3.6}\right)$

$\therefore F = 400$ N

friction = driving force of car = 400 N

★18 In the figure, Edward pulls a wooden box of mass 40 kg up a smooth inclined plane. The inclined plane makes an angle of 30° with the horizontal and is 5 m long. The box is pulled from the bottom of the inclined plane to the top in 25 s. Find the average useful output power of Edward. (4 marks)



W.D by Edward = gained P.E of Box

$= mg(5\sin 30°)$

$= (40)(10)(5\sin 30°)$

$= 1000$ J

Average useful power output $= 1000/25$ s

$= 40$ W

II Revision

Multiple-choice

Section A

1 Which of the following statements about work is **incorrect**?

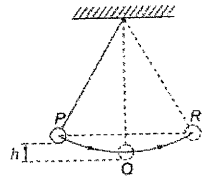
A Work = force in the direction of displacement × displacement

B The unit of work is N m.

C Work cannot be negative.

D Work is a scalar. [A]

(For Q2–3.) A pendulum bob of mass m is pulled to one side and released. It swings to and fro. The speed of the bob at the lowest position Q is 2 m s^{-1}.



2 Find the height h.

A 0.2 m B 0.4 m

C 1 m D 2 m [A]

3 Which of the following statements is/are **correct**?

(1) The kinetic energy of the bob is the smallest at Q.

(2) The bob can reach a position above R.

(3) The string does not do work on the bob during the swing.

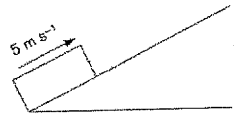
A (2) only

B (3) only

C (1) and (2) only

D (2) and (3) only [B]

4



A block moves up a smooth inclined plane at an initial velocity of 5 m s^{-1}. Find the maximum height that the block can reach.

A 0.75 m

B 1.25 m

C 2.5 m

D 5 m [B]

5 A bus moves forwards at a constant speed of 20 m s^{-1}. If its average output power is 25 kW, find the friction acting on the bus.

A 625 N

B 1250 N

C 2500 N

D 5000 N [B]

6 A block is pushed by a horizontal force of 10 N on a horizontal surface. It moves forwards at a constant speed of 2 m s^{-1} along a straight line. Find the work done against friction in 3 s.

A Zero

B 10 J

C 20 J

D 60 J [D]

7 Statements: (For instructions, see inside back cover.) F

1st statement: The work done against friction must be positive. T

2nd statement: Work is a scalar. [D]

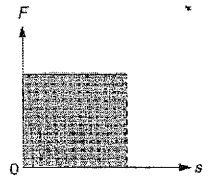
Section B

8 A car of mass 1000 kg accelerates from rest at 8 m s^{-2} for 4 s. Find the average output power of the car engine.

A 12 800 W
B 25 600 W
C 64 000 W
D 128 000 W

D

★**9**

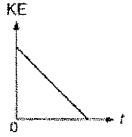


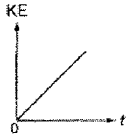
The figure above shows the variation of a force F acting on an object with the displacement s of the object. What physical quantity does the area of the shaded region represent?

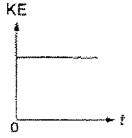
A Work
B Power
C Velocity
D Acceleration

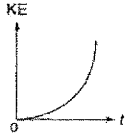
A

★**10** An object falls freely from rest. Which of the following graphs shows the variation of its kinetic energy KE with time t?

A 

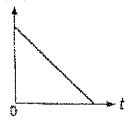
B 

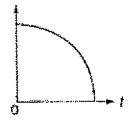
C 

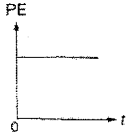
D 

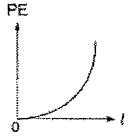
D

★**11** An object falls freely from rest. Which of the following graphs shows the variation of its potential energy PE with time t?

A 

B 

C 

D 

B

★**12** 

A bar tender can push bottles of beer towards customers accurately on a horizontal table. He pushes a bottle of beer at an initial speed of 5 m s^{-1} towards a customer 2 m away. What is the initial speed of a bottle of beer if a customer is 4 m away?

A 1.41 m s^{-1}
B 5 m s^{-1}
C 7.07 m s^{-1}
D 10 m s^{-1}

C

★**13** Statements: (For instructions, see inside back cover.)

1st statement: At the same height, a ball is thrown vertically upwards and another of same mass is dropped with same initial speed. Both will reach the ground at the same speed. T

2nd statement: The two balls reach the ground at the same time.

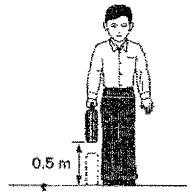
C

F

Conventional

Section A

1 Sunny lifts a briefcase of mass 10 kg vertically up 0.5 m above the ground at constant velocity.



(a) Find the force acting on the briefcase by Sunny. (1 mark)

F = weight = 10 × (10) = 100 N

(b) Find the work done by Sunny on the briefcase. (2 marks)

W.D = F(s) = 100 × (0.5)
= 50 J

(c) Sunny carries the briefcase and moves a distance of 20 m. Does he do work in this process? Explain briefly. (2 marks)

NO, W.D = F(s)
= (0)(20) = 0 J

2 A young man and an old man walk up a hill. The time for the old man to reach the top of the hill is 5 times that of the young man. Both of them have the same mass. The gain in the potential energy of the young man is 2000 J and his power is 50 W.

(a) Find the gain in the potential energy of the old man. (1 mark)

2000 J (same height reached by both boy & man)

(b) Find the time for the young man to reach the top of the hill. (2 marks)

P = Energy / time
50 = 2000 / t t = 40 s

(c) Find the power of the old man. (2 marks)

P = 2000 / 40×5 = 10 W

3 A basketball of mass 0.6 kg is thrown vertically upwards at a speed of 15 m s^{-1}.

(a) Find the initial kinetic energy of the basketball. (2 marks)

$K.E = \frac{1}{2}(0.6)(15)^2$

$= 67.5\,J$

(b) Find the gain in the potential energy of the basketball after 1 s. (4 marks)

using $s = ut + \frac{1}{2}gt^2$ (set downward as -ve)

$= (15)(1) + \frac{1}{2}(-10)(1)^2$

$= 10$ m

gain in P.E $= mgh = (0.6)(10)(10)$

$= 60\,J$

4 The 29th annual Bank of America Empire State Building Run-Up was held on 7 February 2006. Runners had to climb 1576 steps and reached the finish line on the 86th floor. Thomas Dold of German finished in 10 minutes 19 seconds and was the men's champion. Assume his mass is 75 kg and the 86th floor is 320 m high above the ground.

(a) Estimate his gain in the potential energy. (2 marks)

$P.E = mgh = (75)(10)(320)$

$= 2.4 \times 10^5\,J$

(b) Describe the energy change that took place. (1 mark)

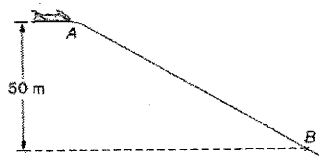
Chemical energy → P.E

(c) Estimate his average power. (3 marks)

Power $= E/t = (2.4 \times 10^5)/(10 \times 60 + 19)$

$= 387.7\,W$

5 A bob-sled of mass 500 kg slides down a slope from rest at A. It reaches point B with a speed of 20 m s^{-1}. A is 50 m above B. The average friction between the bob-sled and the slope is 1500 N.



(a) Find the potential energy of the bob-sled at A. (Take the potential energy at B as zero.) (2 marks)

$P.E = (500)(10)(50)$

$= 2.5 \times 10^5\,J$

(b) Find the kinetic energy of the bob-sled at B. (2 marks)

$K.E = \frac{1}{2}(500)(20)^2$

$= 10^5\,J$

(c) Assume air resistance is negligible. Find the distance travelled by the bob-sled. (3 marks)

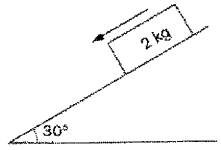
W.D. against friction = loss in P.E - gain in KE

$1500(s) = 2.5 \times 10^5 - 10^5$

$s = 100$ m

Section B

6 A block of mass 2 kg slides down an inclined plane at constant speed. The inclined plane makes an angle of 30° with the horizontal.



(a) Find the friction acting on the block. (2 marks)

At Const. speed $f = mg\sin 30°$

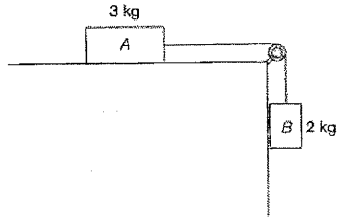
$= 2(10)(0.5) = 10\,N$

(b) Describe the energy change of the block. (1 mark)

P.E → W.D. against friction

(Internal energy of block)

7 Two blocks A and B are connected by an inextensible light string over a smooth pulley. A is placed on a smooth horizontal table. The masses of A and B are 3 kg and 2 kg respectively.



(a) When B falls down a distance of 0.5 m,

(i) find the potential energy lost by B. (2 marks)

$P.E = (2)(10)(0.5)$

$= 10\ J$

(ii) find the speeds of blocks A and B. (3 marks)

P.E (lost by B) = K.E. gained by A & B

$10 = \frac{1}{2}(3+2)v^2$

$\therefore v = 2\ ms^{-1}$

(b) Assume the table is rough. When B falls down a distance of 0.5 m, the speeds of blocks A and B are both 1.5 m s^{-1}. Find the friction acting on block A. (3 marks)

W.D. against friction = Energy lost

$f(0.5) = 10\ J - \frac{1}{2}(3+2)(1.5)^2$

$f = 8.75\ N$

Andy modifies an air gun. A bullet of mass 2 g is fired at a speed of 100 m s^{-1}.

(a) The law states that the kinetic energy of a bullet fired from air gun should not exceed 2 J. Does Andy's air gun obey this law? (3 marks)

K.E of Andy's bullet

$= \frac{1}{2}(0.002)(100)^2$

$= 10\ J > 2\ J$

$\therefore$ Andy breaks the law

(b) When the bullet passes through a piece of paper, its speed reduces to 80 m s^{-1}. How many pieces of paper at most can the bullet pass through? (3 marks)

Energy lost by passing through a piece of paper $= \frac{1}{2}(0.002)[(100)^2 - \quad]$

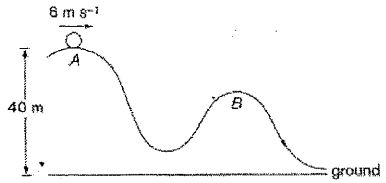
$= 3.6\ J$

$\therefore$ No. of paper $= 10/3.6$

$= 2.78$

Ans = 2 pieces

★9 A ball of mass 3 kg travels down a rough track from A at 6 m s^{-1}. It reaches point B at a speed of 16 m s^{-1}. The distance between A and B is 120 m. The average friction along the track is 1 N.



(a) Find the gain in the kinetic energy of the ball at point B. (2 marks)

gain in K.E $= \frac{1}{2}(3)[(16)^2 - (6)^2]$

$= 330\ J$

(b) Find the work done against friction. (2 marks)

W.D. against friction $= fs$

$= 1(120) = 120\ J$

(c) Find the height of B above the ground. (3 marks)

lost in P.E − gain in K.E = fs

$3(10)(40 - h_B) - 330 = 120$

$\therefore h_B = 25\ m$

(d) If there is no friction acting on the track, does the speed of the ball at B increase or decrease? Explain briefly. (2 marks)

Increase. P.E. changes completely to K.E.

★10 Read the following passage and answer the questions that follow.

Roller-coasters

To a certain extent, a roller-coaster looks like a train. Both consist of a number of carriages joined together and move on tracks. The difference is that a roller-coaster does not need any engine.

For most of the ride, a roller-coaster is moved by inertia and forces of gravity. Energy is required only at the very beginning of the ride to pull the roller-coaster up to the top of the first hill. When the roll-coaster is lifted to a high position, it has a very large potential energy with reference to the ground level. The higher the position it is, the larger potential energy it has. After it rolls down from the highest position, its speed and kinetic energy increase.

As the roller-coasters move along the track, the hills decrease in height. This is necessary because the total energy gained in the rise of the first hill is gradually used to overcome friction. When the roller-coasters come to stop at the end of the track, the energy gained in the rise of the first hill is completely lost.

(Souce: HowStuffWorks)

(a) Roller-coasters do not have engines. What makes them move along the track? (2 marks)

Energy come from P.E at the original height.

(b) Give two sources of friction when roller-coasters travel along the track. (2 marks)

1. friction due between rail & wheels
2. friction between axle & wheels