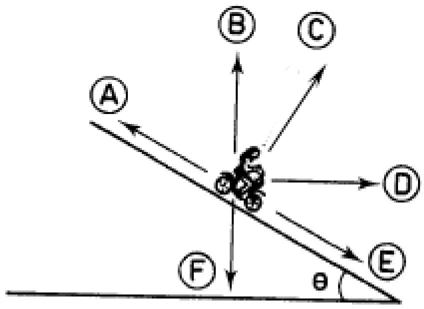
## Multiple Choice




**Example 1 (1976 Question 9, 1 mark)**

A cyclist is accelerating downhill with his brakes off. Which arrow (A – F) **best** represents the direction of the force of the road on the bicycle?

The cyclist now brakes so that his speed is constant.

**Example 2 (1976 Question 10, 1 mark)**

The mass of the cyclist is *m*; the road makes an angle θ with the horizontal. The magnitude of the vector sum of all forces acting on the cyclist is

**A.** $mg$

**B.** $mg \cos \theta$

**C.** $mg \sin \theta$

**D.** zero

**Example 3 (1976 Question 11, 1 mark)**

Which arrow (A – F) now **best** represents the direction of the force of the road on the bicycle?

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**Example 4 (1981 Question 5, 1 mark)**

A man of mass *m* is suspended from a parachute of mass *M* and descends at a constant speed. What is the net force acting on the man?

**A** $mg$

**B** $mg + Mg$

**C** $mg - Mg$

**D** zero

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A steel ball is dropped vertically on to a steel bench-top. *W* is the weight force acting on the ball and $F_C$ is the contact force exerted on the ball by the bench at the instant of rebound when the ball is at rest.

**Example 5 (1984 Question 24, 1 mark)**

Which **one or more** of the following statements about *W* and $F_C$ are correct?

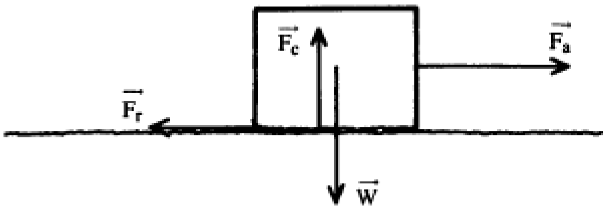
**A** *W* and $F_C$ form an action-reaction pair and so are equal in magnitude.

**B** The ball is instantaneously at rest, so *W* and $F_C$ cancel exactly to provide the necessary zero resultant force.

**C** the ball is accelerating upwards, so $F_C$ must be greater than *W*.

**D** $F_C$ may be greater or less in magnitude than *W* depending on whether the collision is elastic or inelastic.

Newton's third law of motion may be stated as follows: 'To every action there is an equal and opposite reaction, or the mutual reactions of two bodies upon each other are always equal and directed in contrary directions'.




The figure above shows a block being pulled along a rough surface at constant velocity. $\vec{F_a}$ is the applied force on the block, $\vec{F_r}$ the friction force between the block and the surface, $\vec{W}$ the weight force on the block and $\vec{F_c}$ the normal contact force exerted by the surface on the block.

**Example 6 (1985 Question 17, 1 mark)**

Which pair of forces (**A – D**) in this situation are action-reaction pairs in the sense of Newton's third law?

**A** $\vec{W}$ and the gravitational force exerted by the block on the earth.

**B** $\vec{F_a}$ and $\vec{F_r}$.

**C** $\vec{W}$ and $\vec{F_c}$.

**D** none of these.

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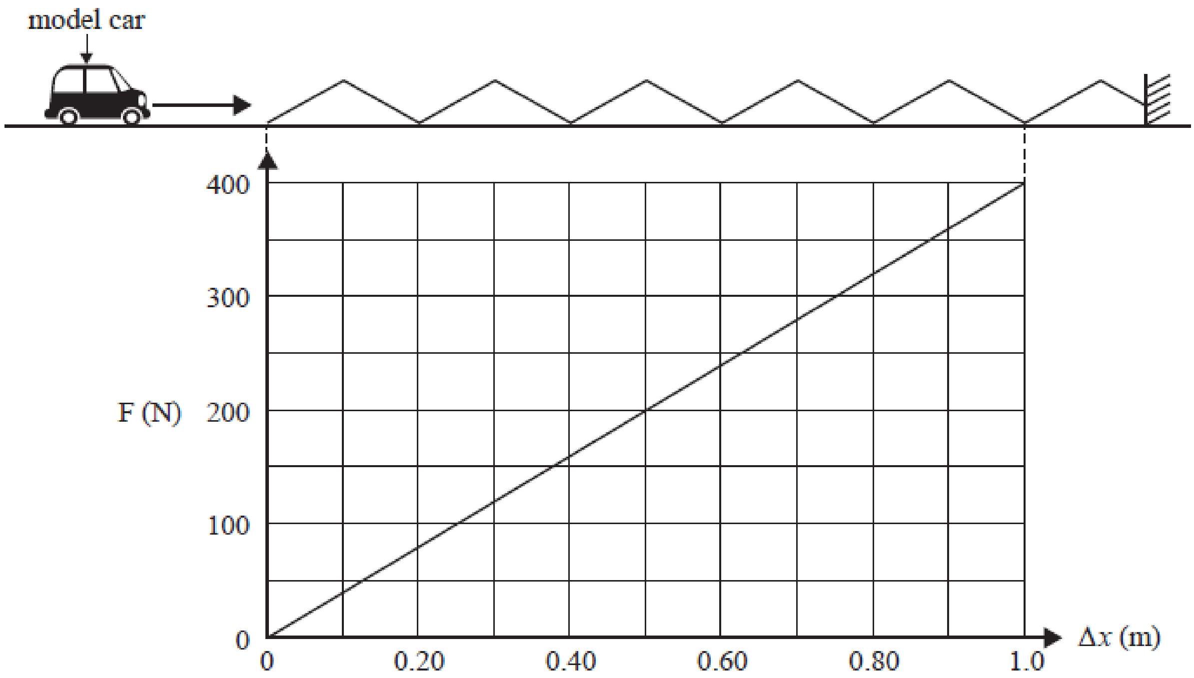
A model car is on a track and moving to the right. It collides with and compresses a spring that is considered ideal, as shown in the diagram below.
The car compresses the spring to 0.50 m when the car comes to rest. The force–distance graph for the spring is also shown below.
Assume that friction is negligible.




**Example 7** (**2017 Question 12, 1 mark)**

Based on the graph above, what is the best estimate of the spring constant, *k*?

**A.** 100 N m$^{-1}$

**B.** 200 N m$^{-1}$

**C.** 400 N m$^{-1}$

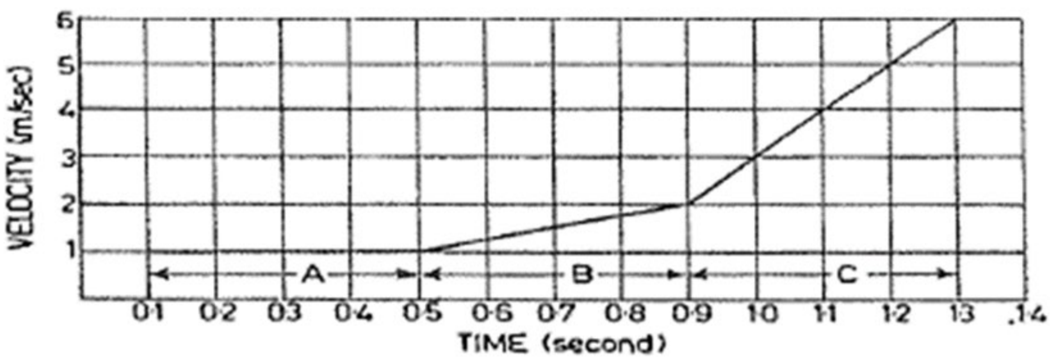
**D.** 800 N m$^{-1}$

**Extended questions**

A sled carrying *seven* bricks was pulled along a horizontal floor, in a straight line, by a rope which exerts a constant force on the sled.

The velocity-time graph is shown in the diagram. In the part of the motion represented by section A of the graph the sled was pulled across a carpeted floor; in sections B and C the floor surface was smooth (i.e. friction was negligible here). At the end of section B, several bricks fell from the sled.

Mass of 1 brick = mass of sled = 2·0 kg.



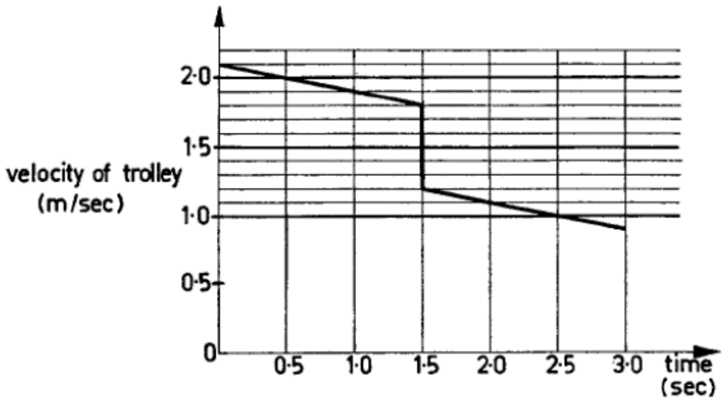
**Example 8 1969 Question 29, 1 mark**

What was the magnitude of the frictional force of the carpet on the sled over section A?

**Example 9 1969 Question 32, 1 mark**

How many bricks fell off the sled at the end of section B?

A trolley of mass 6.0 kilogram is given a push and then allowed to roll freely along a table. Its velocity is measured continuously. At time 1.5 second a lump of clay is dropped vertically onto the trolley.




**Example 10 1970 Question 12, 1 mark**

Calculate the frictional force acting on the trolley over the first 1.5 second.

**Example 11 1970 Question 15, 1 mark**

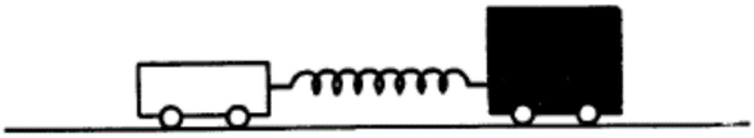
Note that the slopes of the graph before and after 1.5 second are equal. From this it may be deduced

**A.** that the frictional force is constant.

**B.** that the frictional force decreases linearly with time.

**C.** that the frictional force is directly proportional to the weight.

**D.** that the fictional force decreases linearly with the velocity.



A light spring is permanently connected between two trolleys of masses, 1.0 kg and 4.0 kg which can move along a straight horizontal track. The spring is compressed and then the trolleys are released simultaneously from rest.

**Example 12 1971 Question 41, 1 mark**

What is the acceleration of the lighter trolley when the acceleration of the heavier trolley is 8 m $s^{-2}$?

A car of mass 800 kg is towed along a straight road so that its velocity changes uniformly from 10 m $s^{-1}$ to 20 m $s^{-1}$ in a distance of 200 m. The frictional force is constant at 500 N.

**Example 13 (1977 Question 1, 1 mark)**

Calculate the acceleration of the car.

**Example 14 (1977 Question 2, 1 mark)**

What is the magnitude of the net force on the car during this 200 m?

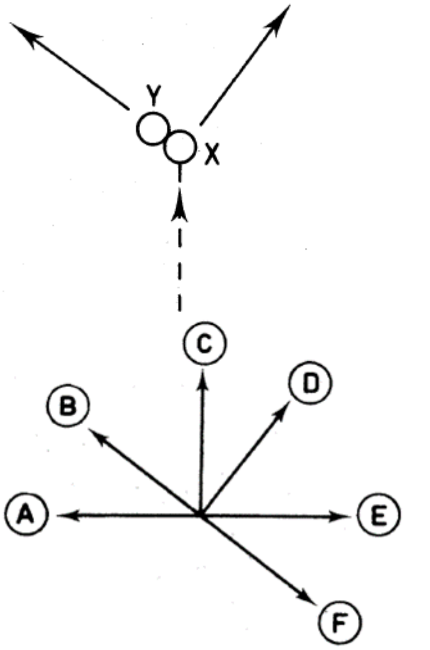
**Example 85 (1977 Question 3, 1 mark)**

What is the magnitude of the force exerted on the car by the towing vehicle?

**Example 96 (1977 Question 4, 1 mark)**

When the speed of 20 m $s^{-1}$ is reached, the towing force is adjusted so that the car now moves at constant velocity. What is now the magnitude of the towing force?

During a game of billiards, ball X strikes the stationary ball Y so that X and Y follow the paths shown.




**Example 17 1978 Question 23, 1 mark**

At the instant of impact, which of the arrows above could represent the direction of

(i) the force exerted on ball Y by ball X?

(ii) the force exerted on ball X by ball Y?

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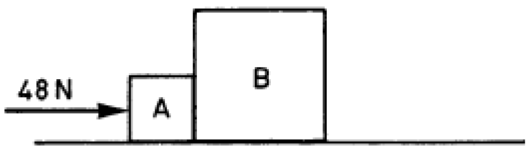



Two masses **A** and **B** are accelerated together along a smooth surface by a force of 48 N, as shown above. The acceleration of **A** and **B** is 4.0 m $s^{-2}$.
The mass of **A** is 4.0 kg

**Example 108 (1979 Question 8, 1 mark)**

What is the mass of **B**?

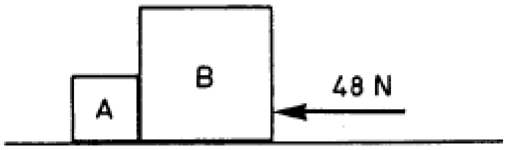
**Example 119 (1979 Question 9, 1 mark)**

What is the magnitude of the force exerted by **A** on **B**?

**Example 20 (1979 Question 10, 1 mark)**

What is the magnitude of the force exerted by **B** on **A**?

The bodies are now accelerated together along a smooth surface in the opposite direction by a force of 48 N, as shown below.




**Example 12 (1979 Question 11, 1 mark)**

What now is the magnitude of the force exerted by **B** on **A**?

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A 1.0 kg mass is suspended from a spring balance which is attached to the roof of a lift. The balance is graduated in newton and reads 10 N when the lift is stationary.

**Example 2213 (1980 Question 14, 1 mark)**

What is the reading of the spring balance when the lift moves up with an acceleration of 2.0 m $s^{-2}$?

**Example 23 (1980 Question 15, 1 mark)**

What is the reading of the spring balance when the lift moves up with an upward constant velocity of 2.0 m $s^{-1}$?

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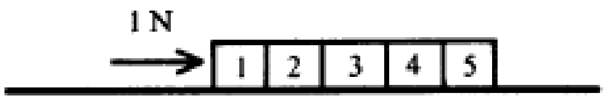
Five identical blocks each of mass 1.0 kg are on a smooth, horizontal table.
A constant force of 1 N acts on the first block as shown in the figure below.



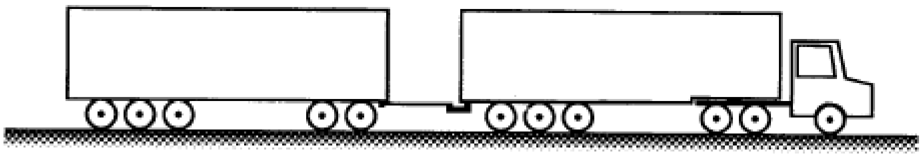

**Example 2414 (1985 Question 14, 1 mark)**

What force does block 4 exert on block 5?

**Example 25 (1985 Question 15, 1 mark)**

What force does block 3 exert on block 4?

A road train consists of a large truck towing a trailer, as shown below. The truck and the trailer have a mass of 2.0 x $10^4$ kg each. When moving along a level road, the truck and the trailer experience a constant retarding force of 2.5 x $10^3$ N each.




**Example 156 (1991 Question 4, 1 mark)**

If the driving force on the road train when it is accelerating is 3.9 x $10^4$ N, what is the magnitude of the acceleration?

**Example 167 (1991 Question 5, 1 mark)**

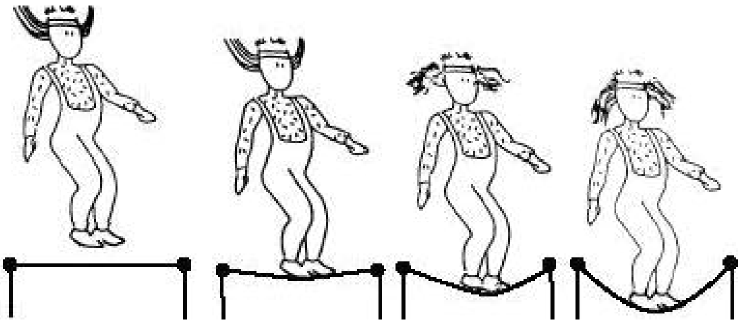
What is the tension force in the coupling between the truck and trailer when the road train is moving at constant speed?

When the road train is travelling along a straight, level road at 20 m $s^{-1}$ the truck is put into neutral gear and the train allowed to roll to a stop.

**Example 178 (1991 Question 6, 1 mark)**

How far will it travel before coming to rest?

Anna is jumping on a trampoline. The figure below shows Anna at successive stages of her downward motion.



**a** **b** **c** **d**

**Figure c** shows Anna at a time when she is **travelling downwards** and **slowing down**.

**Example 189 (1999 Question 6, 2 marks)**

What is the direction of Anna's acceleration at the time shown in **Figure 4c**? **Explain** your answer.

**Example 30 (1999 Question 7, 3 marks)**

On **Figure c** draw arrows that show the **two individual** forces acting on Anna at this instant. **Label each arrow** with the name of the force and indicate the **relative magnitudes** of the forces by the **lengths** of the arrows you draw.

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A car of mass 1300 kg has a caravan of mass 900 kg attached to it. The car and caravan move off from rest. They have an initial acceleration of 1.25 m $s^{-2}$.

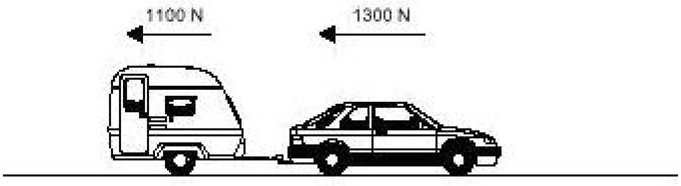

**Example 31(2000 Question 11, 2 marks)**

What is the net force acting on the total system of car and caravan as it moves off from rest?

**Example 3219 (2000 Question 12, 3 marks)**

What is the tension in the coupling between the car and the caravan as they start to accelerate?

After some time the car reaches a speed of 100 km $h^{-1}$, and the driver adjusts the engine power to maintain this constant speed. At this speed, the total retarding force on the car is 1300 N, and on the caravan 1100 N.




**Example33 (2000 Question 13, 2 marks)**

What **driving** force is being exerted by the car at this speed?

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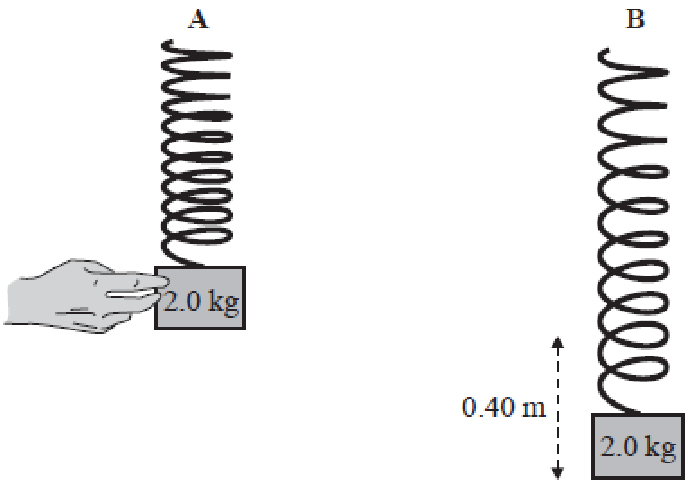


Figure A shows an ideal spring with a 2.0 kg mass attached. The spring-mass system is held so that the spring is not extended. The mass is **gently** lowered and the spring stretches until, in Figure B, the spring-mass system is at rest. The spring has extended by 0.40 m.

**Example 34** (**2010 Question 13, 1 mark)**

What is the value of the spring constant, *k*, of the spring?