



Forces & Motion

2009

- 3 Shortly after opening her parachute, a free-fall parachutist of mass 60kg experiences the forces shown in the diagram.

drag (air resistance) = 900N



weight = 600N

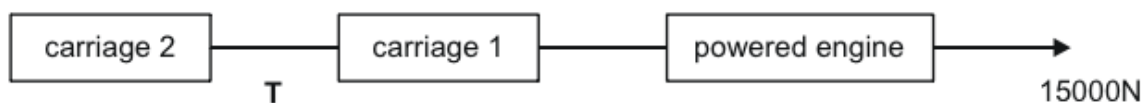
Which line in the table gives the size and direction of the acceleration of the parachutist at this instance?

	size of acceleration (m/s^2)	direction of acceleration
A	5.0	downwards
B	10.0	downwards
C	5.0	upwards
D	10.0	upwards
E	0.0	-



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- 23 A train consists of a powered engine pulling two unpowered carriages.



The engine has a mass of 20000kg, and each carriage has a mass of 5000kg. When the engine accelerates from rest it develops a thrust (driving force) of 15000N as shown.

Ignoring resistive forces, what is the tension (pulling force) T in the coupling between carriage 1 and carriage 2?

- A 2500N
- B 3750N
- C 5000N
- D 7500N
- E 15000N



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2011

- 15 A bullet of mass 50g is fired from a rifle with a velocity of 300m/s. It hits a bank of earth and after travelling 60cm into the bank comes to rest.

What is the average stopping force of the earth in the bank on the bullet?

- A 37.5N
- B $3.75 \times 10^3\text{N}$
- C $3.75 \times 10^4\text{N}$
- D $3.75 \times 10^6\text{N}$



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2012

- 11 The diagrams show, not to scale, three different situations in which a force F acts. Also shown in each case is a distance d .

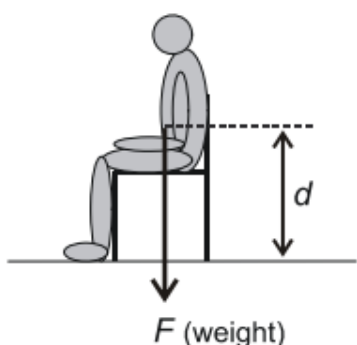


Diagram 1:
Person sitting on a chair

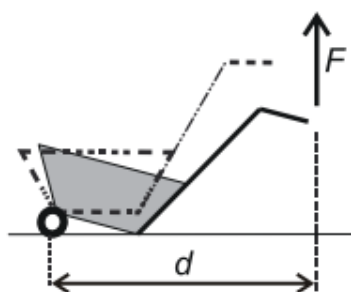


Diagram 2:
Wheelbarrow being lifted

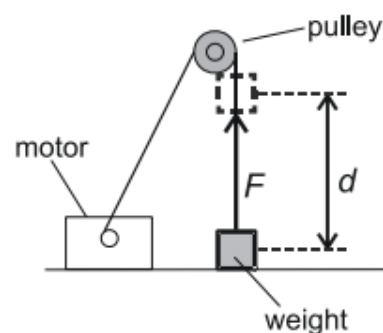


Diagram 3:
Weight being lifted by a motor

Which line in the table shows whether or not work is being done by force F in each situation and, if so, whether the work done is equal to $F \times d$?

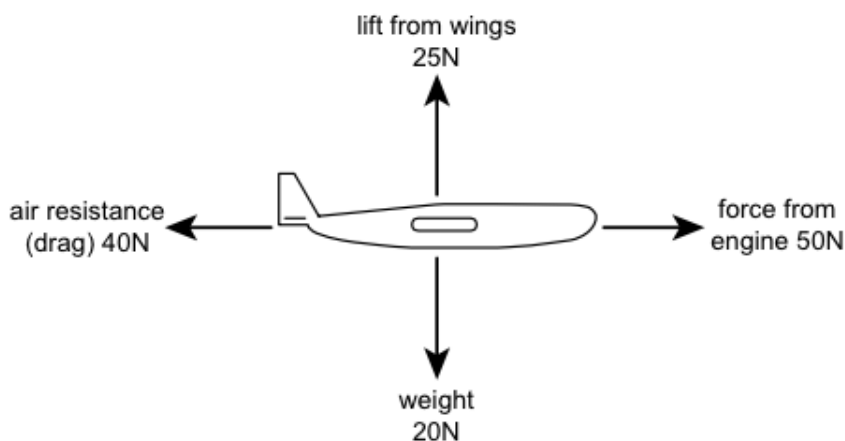
	Work being done by force F ?	Work done = $F \times d$?
A	only in diagrams 1 and 2	only in diagram 1
B	only in diagrams 1 and 2	only in diagram 2
C	only in diagrams 2 and 3	only in diagram 2
D	only in diagrams 2 and 3	only in diagram 3
E	in diagrams 1, 2 and 3	only in diagrams 1 and 2
F	in diagrams 1, 2 and 3	only in diagrams 2 and 3
G	only in diagrams 1 and 3	only in diagram 1
H	only in diagrams 1 and 3	only in diagram 3



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2015

- 15 The diagram shows the only four forces acting on a model aircraft of mass 2.0 kg whilst flying.



Which line in the table states the horizontal and vertical accelerations of the aircraft at this instant?

	<i>Horizontal acceleration</i>	<i>Vertical acceleration</i>
A	5.0 m/s ² to the right	2.5 m/s ² upwards
B	5.0 m/s ² to the right	10 m/s ² downwards
C	5.0 m/s ² to the right	zero
D	25 m/s ² to the right	10 m/s ² downwards
E	25 m/s ² to the right	2.5 m/s ² upwards
F	25 m/s ² to the right	zero
G	zero	2.5 m/s ² upwards
H	zero	10 m/s ² downwards



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2016

8 The mean mass of a group of N people is 75 kg.

Jim, Karen and Leroy join this group, without anyone leaving; the new mean mass is 78 kg.

The mean mass of Jim, Karen and Leroy is 90 kg.

What is the value of N ?

A 4

B 12

C 15

D 30

E 48

F 90



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2017

- 16 The acceleration due to gravity at the surface of a planet is given by $g = \frac{GM}{R^2}$, where M and R are the mass and radius of the planet respectively, and G is the gravitational constant.

It is given that

$$g = 10 \text{ N/kg}$$

$$G = 7 \times 10^{-11} \text{ N m}^2/\text{kg}^2$$

$$R = 6 \times 10^6 \text{ m}$$

What is M , correct to one significant figure?

- A $5 \times 10^{24} \text{ kg}$
- B $2 \times 10^{24} \text{ kg}$
- C $5 \times 10^{20} \text{ kg}$
- D $2 \times 10^{20} \text{ kg}$
- E $5 \times 10^{18} \text{ kg}$
- F $2 \times 10^{18} \text{ kg}$



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23 A book rests on a table, which in turn rests on the floor. The floor exerts a force P on the table.

Force P and one other force constitute a Newton's Third Law interaction pair of forces.

What is the other force?

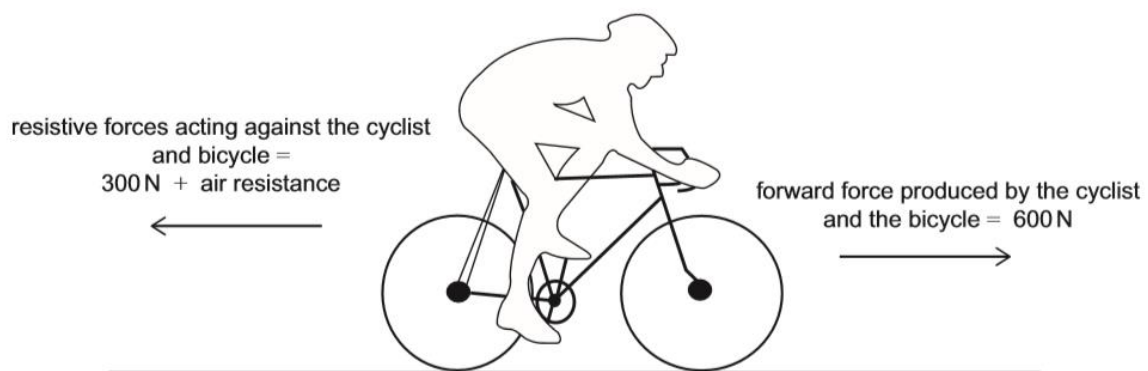
- A the force that the book exerts on the table
- B the force that the book exerts on the Earth
- C the force that the Earth exerts on the book
- D the force that the Earth exerts on the table
- E the force that the floor exerts on the Earth
- F the force that the table exerts on the floor



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2019

- 3 The diagram shows the forces acting on a cyclist as she accelerates at 4.0 m s^{-2} on a straight, horizontal section of road. The constant resistive forces are air resistance and a 300 N force due to friction.



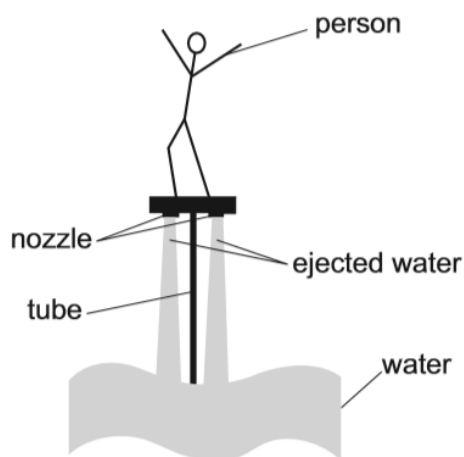
The combined mass of the cyclist and bicycle is 50 kg .

What is the value of the air resistance?

- A 50 N
- B 100 N
- C 200 N
- D 300 N
- E 450 N


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- 23 A water jet pack has lifted a person vertically upwards, as shown in the sketch. He is now stationary at a constant height.



Water rises through the tube and is ejected at a speed of 15 m s^{-1} through two nozzles.

In a time of 12 s, each of the nozzles ejects 400 kg of water vertically downwards.

What is the momentum of the water ejected by **each** nozzle in 12 s, and what is the upward force due to the water ejected by the jet pack?

	<i>momentum / kg m s⁻¹</i>	<i>force / N</i>
A	6000	1000
B	6000	2000
C	12 000	1000
D	12 000	2000
E	45 000	3750
F	45 000	7500
G	90 000	7500
H	90 000	15 000