End Of Chapter Exercises Part 1

EXERCISE 2.10

1.A force acts on an object. Name three effects that the force can have on the object.

Show Answer

2.Identify each of the following forces as contact or non-contact forces.

a)The force between the north pole of a magnet and a paper clip.

Show Answer

b)The force required to open the door of a taxi.

Show Answer

c)The force required to stop a soccer ball.

Show Answer

d)The force causing a ball, dropped from a height of $2\ \mathrm{m}$, to fall to the floor.

Show Answer

3.A book of mass $2\ \mathrm{kg}$ is lying on a table. Draw a labelled force diagram indicating all the forces on the book.

Show Answer

4.A constant, resultant force acts on a body which can move freely in a straight line. Which physical quantity will remain constant?

1.
acceleration

2.
velocity

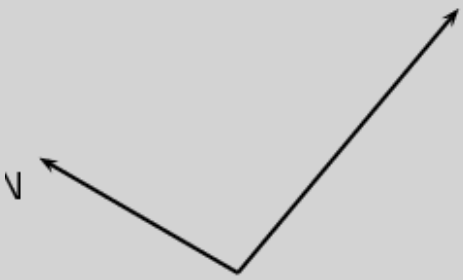
3.
momentum

4.
kinetic energy

[SC 2003/11]

Show Answer

5.Two forces, 10 N and 15 N, act at an angle at the same point.



Which of the following **cannot** be the resultant of these two forces?

1.
2 N

2.
5 N

3.
8 N

4.
20 N

[SC 2005/11 SG1]

Show Answer

6. A concrete block weighing $250\ \mathrm{N}$ is at rest on an inclined surface at an angle of $20°$. The magnitude of the normal force, in newtons, is

1.
250

2.
$250 \cos 20°$

3.
$250 \sin 20°$

4.
$2\ 500 \cos 20°$

Show Answer

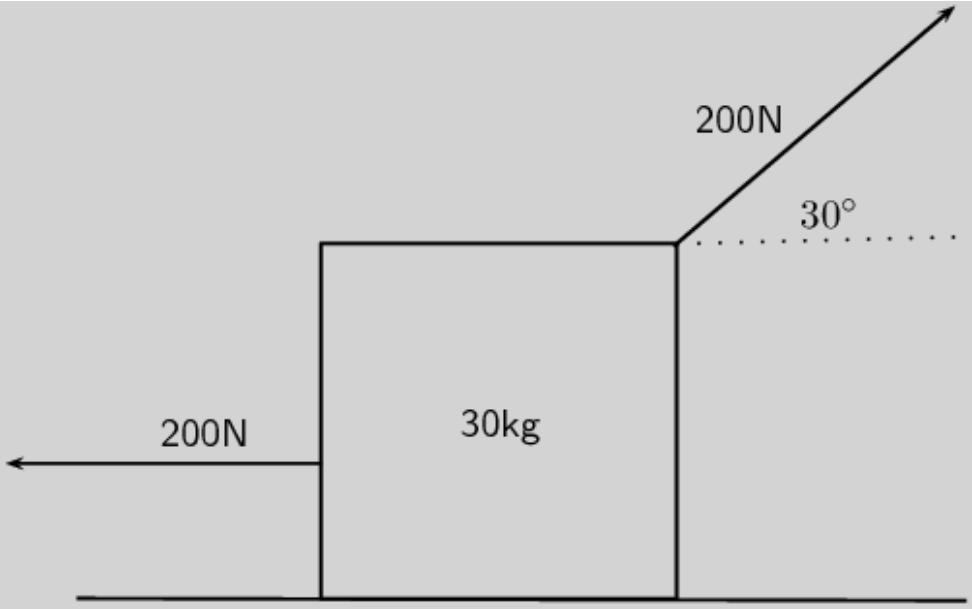
7. A $30\ \mathrm{kg}$ box sits on a flat frictionless surface. Two forces of $200\ \mathrm{N}$ each are applied to the box as shown in the diagram. Which statement best describes the motion of the box?

1.
The box is lifted off the surface.

2.
The box moves to the right.

3.
The box does not move.

4.
The box moves to the left.



Show Answer

8.A concrete block weighing $200\ \mathrm{N}$ is at rest on an inclined surface at an angle of $20°$. The normal force, in newtons, is

1.
200

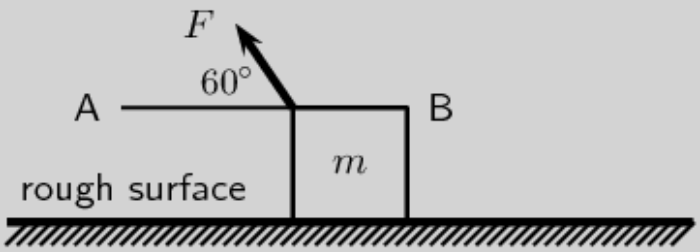
2.
$200 \cos 20°$

3.
$200 \sin 20°$

4.
$2\ 000 \cos 20°$

Show Answer

9.A box, mass m, is at rest on a rough horizontal surface. A force of constant magnitude F is then applied on the box at an angle of $60°$ to the horizontal, as shown.



If the box has a uniform horizontal acceleration of magnitude, a, the frictional force acting on the box is...

1. $F\cos 60° - ma$ in the direction of A

2. $F\cos 60° - ma$ in the direction of B

3. $F\sin 60° - ma$ in the direction of A

4. $F\sin 60° - ma$ in the direction of B

[SC 2003/11]

Show Answer

10. Thabo stands in a train carriage which is moving eastwards. The train suddenly brakes. Thabo continues to move eastwards due to the effect of:

1. his inertia.

2. the inertia of the train.

3. the braking force on him.

4. a resultant force acting on him.

[SC 2002/11 SG]

Show Answer

11.A $100\ \text{kg}$ crate is placed on a slope that makes an angle of $45°$ with the horizontal. The gravitational force on the box is $98\ \text{N}$. The box does not slide down the slope. Calculate the magnitude and direction of the frictional force and the normal force present in this situation.

Show Answer

12.A body moving at a *CONSTANT VELOCITY* on a horizontal plane, has a number of unequal forces acting on it. Which one of the following statements is TRUE?

1.
At least two of the forces must be acting in the same direction.

2.
The resultant of the forces is zero.

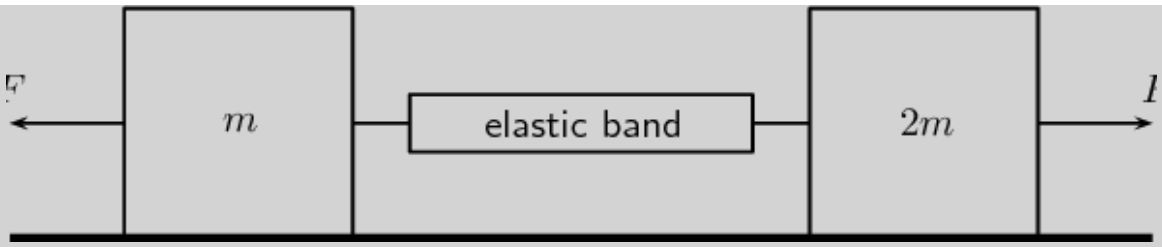
3.
Friction between the body and the plane causes a resultant force.

4.
The vector sum of the forces causes a resultant force which acts in the direction of motion.

[SC 2002/11 HG1]

Show Answer

13. Two masses of m and $2m$ respectively are connected by an elastic band on a frictionless surface. The masses are pulled in opposite directions by two forces each of magnitude F, stretching the elastic band and holding the masses stationary.



Which of the following gives the magnitude of the tension in the elastic band?

1.
zero

2.
$\frac{1}{2}F$

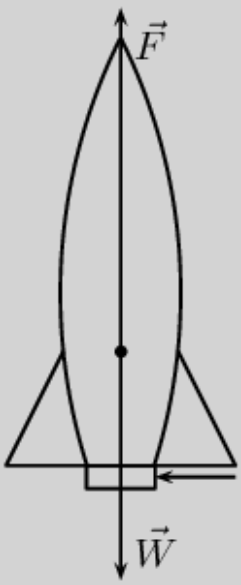
3.
F

4.
$2F$

[IEB 2005/11 HG]

Show Answer

14.A rocket takes off from its launching pad, accelerating up into the air.



The rocket accelerates because the magnitude of the upward force, F is greater than the magnitude of the rocket's weight, W. Which of the following statements **best** describes how

force F arises?

1.
F is the force of the air acting on the base of the rocket.

2.
F is the force of the rocket's gas jet *pushing down* on the air.

3.
F is the force of the rocket's gas jet *pushing down* on the ground.

4.
F is the reaction to the force that the rocket exerts on the gases which escape out through the tail nozzle.

[IEB 2005/11 HG]

Show Answer

15.A box of mass $20\ \text{kg}$ rests on a smooth horizontal surface. What will happen to the box if two forces each of magnitude $200\ \text{N}$ are applied simultaneously to the box as shown in the diagram.

The box will:

1.
be lifted off the surface.

2.
move to the left.

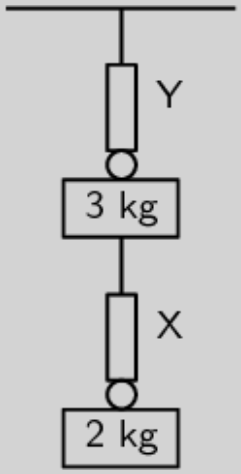
3.
move to the right.

4.
remain at rest.

[SC 2001/11 HG1]

Show Answer

16.A $2\ \text{kg}$ mass is suspended from spring balance X, while a $3\ \text{kg}$ mass is suspended from spring balance Y. Balance X is in turn suspended from the $3\ \text{kg}$ mass. Ignore the weights of the two spring balances.



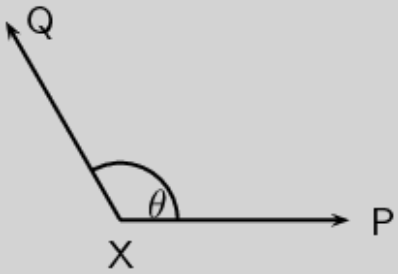
The readings (in N) on balances X and Y are as follows:

	X	**Y**
a)	19,6	29,4
b)	19,6	49
c)	24,5	24,5
d)	49	49

[SC 2001/11 HG1]

Show Answer

17.P and Q are two forces of equal magnitude applied simultaneously to a body at X.



As the angle θ between the forces is **decreased** from $180°$ to $0°$, the magnitude of the resultant of the two forces will

1.
initially increase and then decrease.

2.
initially decrease and then increase.

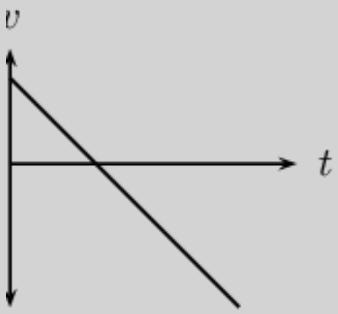
3.
increase only.

4.
decrease only.

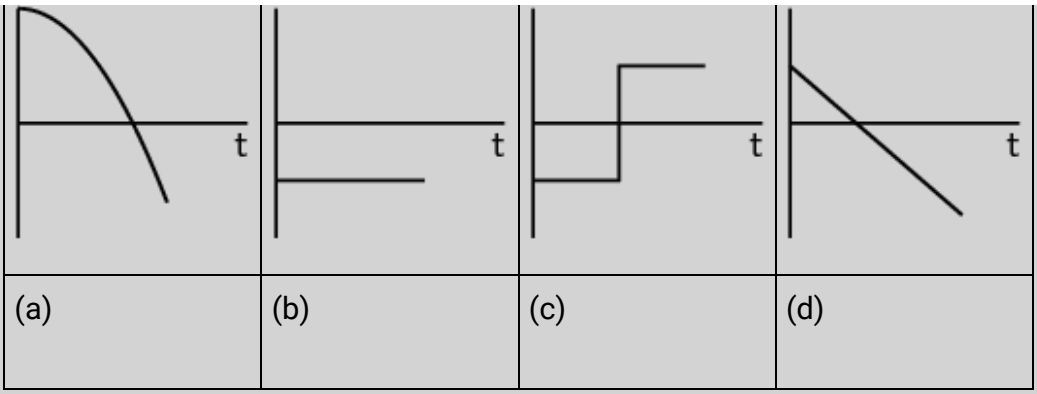
[SC 2002/03 HG1]

Show Answer

18. The graph below shows the velocity-time graph for a moving object:



Which of the following graphs could best represent the relationship between the resultant force applied to the object and time?

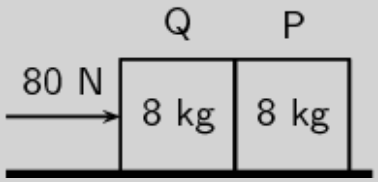


(a)	(b)	(c)	(d)

[SC 2002/03 HG1]

Show Answer

19. Two blocks each of mass $8\ \text{kg}$ are in contact with each other and are accelerated along a frictionless surface by a force of $80\ \text{N}$ as shown in the diagram. The force which block Q will exert on block P is equal to ...



1.
$0\ \text{N}$

2.
$40\ \text{N}$

3.
$60\ \text{N}$

4.
$80\ \text{N}$

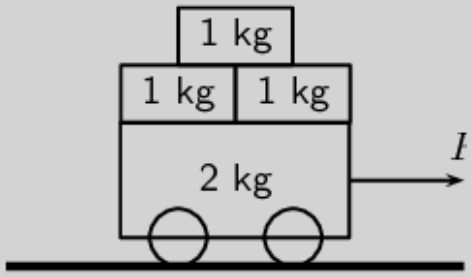
[SC 2002/03 HG1]

Show Answer

20.A $12\ \text{kg}$ box is placed on a rough surface. A force of $20\ \text{N}$ applied at an angle of $30°$ to the horizontal cannot move the box. Calculate the magnitude and direction of the normal and friction forces.

Show Answer

21. Three $1\ \text{kg}$ mass pieces are placed on top of a $2\ \text{kg}$ trolley. When a force of magnitude F is applied to the trolley, it experiences an acceleration a.



If one of the $1\ \text{kg}$ mass pieces falls off while F is still being applied, the trolley will accelerate at ...

1. $\frac{1}{5}a$
2. $\frac{4}{5}a$
3. $\frac{5}{4}a$
4. $5a$

[SC 2002/03 HG1]

Show Answer

22.A car moves along a horizontal road at constant velocity. Which of the following statements is true?

1.
The car is not in equilibrium.

2.
There are no forces acting on the car.

3.
There is zero resultant force.

4.
There is no frictional force.

[IEB 2004/11 HG1]

Show Answer

23.A crane lifts a load vertically upwards at constant speed. The upward force exerted on the load is F. Which of the following statements is correct?

1.
The acceleration of the load is $9{,}8\ \mathrm{m{\cdot}s^{-1}}$ downwards.

2.
The resultant force on the load is F.

3.
The load has a weight equal in magnitude to F.

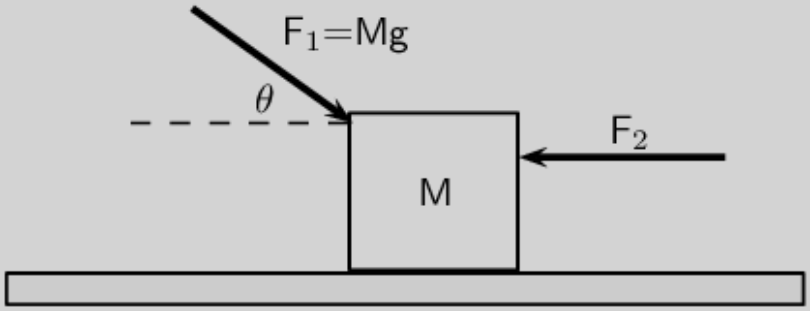
4.
The forces of the crane on the load, and the weight of the load, are an example of a Newton's third law 'action-reaction' pair.

[IEB 2004/11 HG1]

Show Answer

24.A body of mass M is at rest on a smooth horizontal surface with two forces applied to it as in the diagram below. Force F_1 is equal to Mg. The force F_1 is applied to the right at

an angle θ to the horizontal, and a force of F_2 is applied horizontally to the left.



How is the body affected when the angle θ is increased?

1.
It remains at rest.

2.
It lifts up off the surface, and accelerates towards the right.

3.
It lifts up off the surface, and accelerates towards the left.

4.
It accelerates to the left, moving along the smooth horizontal surface.

[IEB 2004/11 HG1]

Show Answer

25. Which of the following statements correctly explains why a passenger in a car, who is not restrained by the seat belt, continues to move forward when the brakes are applied suddenly?

1.
The braking force applied to the car exerts an equal and opposite force on the passenger.

2.
A forward force (called inertia) acts on the passenger.

3.
A resultant forward force acts on the passenger.

4.
A zero resultant force acts on the passenger.

[IEB 2003/11 HG1]

Show Answer

26. A rocket (mass $20\ 000\ \text{kg}$) accelerates from rest to $40\ \text{m·s}^{-1}$ in the first $1{,}6$ seconds of its journey upwards into space.

The rocket's propulsion system consists of exhaust gases, which are pushed out of an outlet at its base.

a) Explain, with reference to the appropriate law of Newton, how the escaping exhaust gases exert an upwards force (thrust) on the rocket.

Show Answer

b) What is the magnitude of the total thrust exerted on the rocket during the first $1{,}6$ s?

Show Answer

c) An astronaut of mass $80\ \text{kg}$ is carried in the space capsule. Determine the resultant force acting on him during the first $1{,}6$ s.

Show Answer

d) Explain why the astronaut, seated in his chair, feels “heavier” while the rocket is launched.

Show Answer

i)State Newton's second law of Motion.

Show Answer

26e)A sports car (mass $1\ 000\ \text{kg}$) is able to accelerate uniformly from rest to $30\ \text{m}\cdot\text{s}^{-1}$ in a minimum time of $6\ \text{s}$.

i)Calculate the magnitude of the acceleration of the car.

Show Answer

ii) What is the magnitude of the resultant force acting on the car during these $6\ \text{s}$?

Show Answer

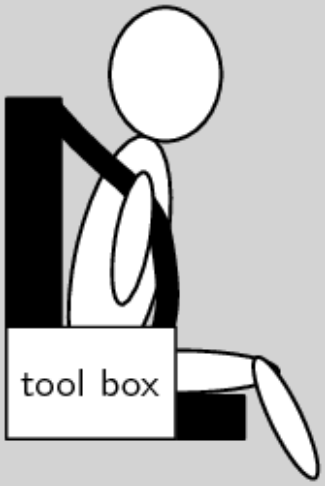
iii) The magnitude of the force that the wheels of the vehicle exert on the road surface as it accelerates is $7\ 500\ \text{N}$. What is the magnitude of the retarding forces acting on this car?

Show Answer

iv) By reference to a suitable Law of Motion, explain why a headrest is important in a car with such a rapid acceleration.

Show Answer

26f)A child (mass $18\ \mathrm{kg}$) is strapped in his car seat as the car moves to the right at constant velocity along a straight level road. A tool box rests on the seat beside him.



The driver brakes suddenly, bringing the car rapidly to a halt. There is negligible friction between the car seat and the box.

i)Draw a labelled free-body diagram of **the forces acting on the child** during the time that the car is being braked.

Show Answer

ii) Draw a labelled free-body diagram of **the forces acting on the box** during the time that the car is being braked.

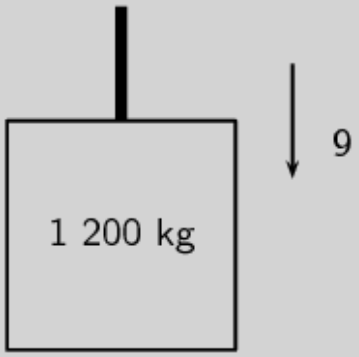
Show Answer

iii)*Modern cars are designed with safety features (besides seat belts) to protect drivers and passengers during collisions e.g. the crumple zones on the car's body. Rather than remaining rigid during a collision, the crumple zones allow the car's body to collapse steadily.*

State Newton's second law of motion.

Show Answer

26g) The total mass of a lift together with its load is $1\ 200\ \text{kg}$. It is moving downwards at a constant velocity of $9\ \text{m·s}^{-1}$.



i)What will be the magnitude of the force exerted by the cable on the lift while it is moving downwards at constant velocity? Give an explanation for your answer.

Show Answer

ii) *The lift is now uniformly brought to rest over a distance of* $18\ \text{m}$.

Calculate the magnitude of the acceleration of the lift.

Show Answer

iii) Calculate the magnitude of the force exerted by the cable while the lift is being brought to rest.

Show Answer

26h)A driving force of $800\ \mathrm{N}$ acts on a car of mass $600\ \mathrm{kg}$.

i)Calculate the car's acceleration.

Show Answer

ii) Calculate the car's speed after $20\ \mathrm{s}$.

Show Answer

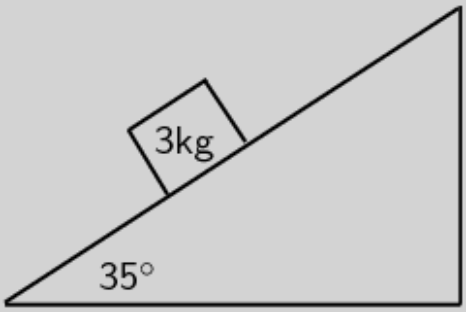
iii) Calculate the new acceleration if a frictional force of $50\ \mathrm{N}$ starts to act on the car after $20\ \mathrm{s}$.

Show Answer

iv) Calculate the speed of the car after another $20\ \mathrm{s}$ (i.e. a total of $40\ \mathrm{s}$ after the start).

Show Answer

26i)A stationary block of mass $3\ \mathrm{kg}$ is on top of a plane inclined at $35°$ to the horizontal.



i)Draw a force diagram (not to scale). Include the weight of the block as well as the components of the weight that are perpendicular and parallel to the inclined plane.

Show Answer

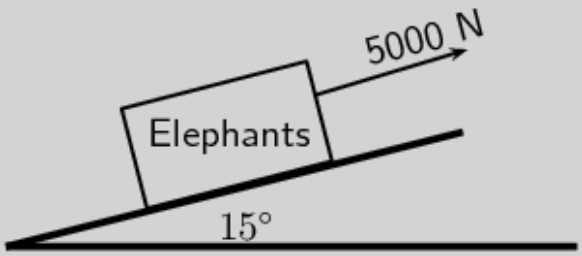
ii) Determine the values of the weight's perpendicular and parallel components.

Show Answer

26j)A crate on an inclined plane

Elephants are being moved from the Kruger National Park to the Eastern Cape. They are loaded into crates that are pulled up a ramp (an inclined plane) on frictionless rollers.

The diagram shows a crate being held stationary on the ramp by means of a rope parallel to the ramp. The tension in the rope is $5\ 000\ \mathrm{N}$.



i)Explain how one can deduce the following: “The forces acting on the crate are in equilibrium”.

Show Answer

ii) Draw a labelled free-body diagram of the forces acting on the elephant. (Regard the crate and elephant as one object, and represent them as a dot. Also show the relevant angles between the forces.)

Show Answer

iii) The crate has a mass of $800\ \mathrm{kg}$. Determine the mass of the elephant.

Show Answer

iv) The crate is now pulled up the ramp at a constant speed. How does the crate being pulled up the ramp at a constant speed affect the forces acting on the crate and elephant? Justify your answer, mentioning any law or principle that applies to this situation.

Show Answer

26k)Car in Tow

Car A is towing Car B with a light tow rope. The cars move along a straight, horizontal road.

i)Write down a statement of Newton's second law of Motion (in words).

Show Answer

ii) As they start off, Car A exerts a forwards force of $600\ \mathrm{N}$ at its end of the tow rope. The force of friction on Car B when it starts to move is $200\ \mathrm{N}$. The mass of Car B is $1\ 200\ \mathrm{kg}$. Calculate the acceleration of Car B.

Show Answer

iii) After a while, the cars travel at constant velocity. The force exerted on the tow rope is now $300\ \mathrm{N}$ while the force of friction on Car B increases. What is the magnitude and direction of the force of friction on Car B now?

Show Answer

iv) Towing with a rope is very dangerous. A solid bar should be used in preference to a tow rope. This is especially true should Car A suddenly apply brakes. What would be the advantage of the solid bar over the tow rope in such a situation?

Show Answer

v)The mass of Car A is also $1\ 200\ \mathrm{kg}$. Car A and Car B are now joined by a solid tow bar and the total braking force is $9\ 600\ \mathrm{N}$. Over what distance could the cars stop from a velocity of $20\ \mathrm{m{\cdot}s^{-1}}$?

Show Answer

26l)Testing the Brakes of a Car

A braking test is carried out on a car travelling at $20\ \mathrm{m{\cdot}s^{-1}}$. A braking distance of $30\ \mathrm{m}$ is measured when a braking force of $6\ 000\ \mathrm{N}$ is applied to stop the car.

i)Calculate the acceleration of the car when a braking force of $6\ 000\ \mathrm{N}$ is applied.

Show Answer

ii)Show that the mass of this car is $900\ \mathrm{kg}$.

Show Answer

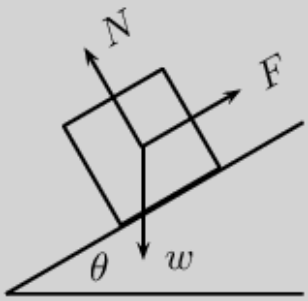
iii) How long (in s) does it take for this car to stop from $20\ \mathrm{m{\cdot}s^{-1}}$ under the braking action described above?

Show Answer

iv)A trailer of mass $600\ \mathrm{kg}$ is attached to the car and the braking test is repeated from $20\ \mathrm{m{\cdot}s^{-1}}$ using the same braking force of $6\ 000\ \mathrm{N}$. How much longer will it take to stop the car with the trailer in tow?

Show Answer

v)A box is held stationary on a smooth plane that is inclined at angle θ to the horizontal.



F is the force exerted by a rope on the box. w is the weight of the box and N is the normal force of the plane on the box. Which of the following statements is correct?

1. $\tan\theta = \frac{F}{w}$

2. $\tan\theta = \frac{F}{N}$

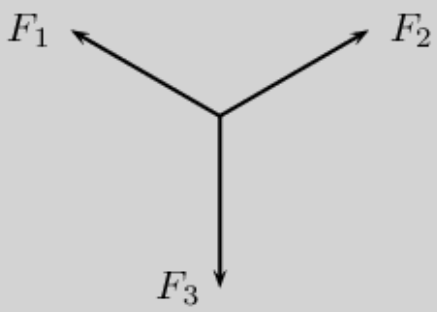
3. $\cos\theta = \frac{F}{w}$

4. $\sin\theta = \frac{N}{w}$

[IEB 2005/11 HG]

Show Answer

vi) As a result of three forces F_1, F_2 and F_3 acting on it, an object at point P is in equilibrium.



Which of the following statements is **not true** with reference to the three forces?

1.
The resultant of forces F_1, F_2 and F_3 is zero.

2.
Force F_1, F_2 and F_3 lie in the same plane.

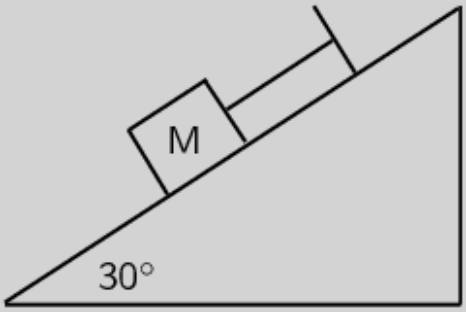
3.
Force F_3 is the resultant of forces F_1 and F_2.

4.
The sum of the components of all the forces in any chosen direction is zero.

[SC 2001/11 HG1]

Show Answer

26m)A block of mass M is held stationary by a rope of negligible mass. The block rests on a frictionless plane which is inclined at $30°$ to the horizontal.



i)Draw a labelled force diagram which shows all the forces acting on the block.

Show Answer

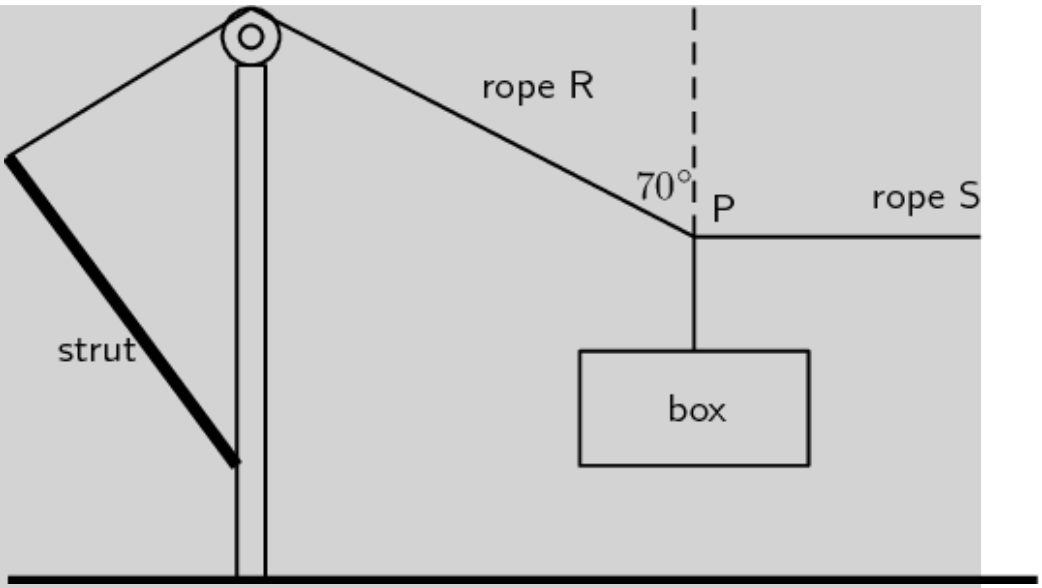
ii) Resolve the force due to gravity into components that are parallel and perpendicular to the plane.

Show Answer

iii) Calculate the weight of the block when the force in the rope is $8\ \mathrm{N}$.

Show Answer

26n)A heavy box, mass m, is lifted by means of a rope R which passes over a pulley fixed to a pole. A second rope S, tied to rope R at point P, exerts a horizontal force and pulls the box to the right. After lifting the box to a certain height, the box is held stationary as shown in the sketch below. Ignore the masses of the ropes. The tension in rope R is $5\ 850\ \mathrm{N}$.



i)Draw a diagram (with labels) of all the forces acting at the point P, when P is in equilibrium.

Show Answer

26o) By resolving the force exerted by rope R into components, calculate the...

i)magnitude of the force exerted by rope S.

Show Answer

ii)mass, m, of the box.

Show Answer

26p)A tow truck attempts to tow a broken down car of mass $400\ \text{kg}$. The coefficient of static friction is $0{,}60$ and

the coefficient of kinetic (dynamic) friction is $0{,}4$. A rope connects the tow truck to the car. Calculate the force required:

i)to just move the car if the rope is parallel to the road.

Show Answer

ii)to keep the car moving at constant speed if the rope is parallel to the road.

Show Answer

iii)to just move the car if the rope makes an angle of $30°$ to the road.

Show Answer

iv)to keep the car moving at constant speed if the rope makes an angle of $30°$ to the road.

Show Answer