Physics
Resultant Forces

Key Stage 4 Revision Programme

Pupil Name	
Handbook Designed by	Dr Adamaki

Timetable and Assignment Submission

Timetable – Tutorials

Tutorial	Date	Time	Location
1 (Baseline)			
2			
3			
4			
5			
6 (Final Assignment)			
7 (Feedback)			

Timetable – Homework Assignments

Tutorial 1		
Tutorial 2		
Tutorial 3		
Tutorial 4		
Tutorial 5		

Uni Pathways – Pupil Feedback Report

Name of PhD Tutor			
Title of Assignment			
Name of Pupil			
Name of School			
ORIGINAL MARK / 100		FINAL MARK / 100	
DEDUCTED MARKS		FINAL GRADE	

If marks have been deducted (e.g. late submission, plagiarism) the PhD tutor should give an explanation in this section:

Learning Feedback Comment 1 - *Enter Key Learning Priority Here*	
What you did in relation to this Key Learning Priority *Enter feedback here*	How you could improve in the future *Enter feedback here*
Learning Feedback Comment 2 – *Enter Key Learning Priority Here*	
What you did in relation to this Key Learning Priority *Enter feedback here*	How you could improve in the future *Enter feedback here*
Learning Feedback Comment 3 – *Enter Key Learning Priority Here*	
What you did in relation to this Key Learning Priority *Enter feedback here*	How you could improve in the future *Enter feedback here*
Resilience Comment	
How you showed learning resilience during the course *Enter feedback here*	How you could build learning resilience in the future *Enter feedback here*

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Course Rationale

During a windy day an aeroplane may have to make to cross-wind landing, to someone that observing the landing it seems like the aeroplane is going to get out of the runway. Why is that?

The pilot has calculated the resultant force acting on the plane because of the wind and engine thrust. The resultant force is actually forcing the plane to move in the direction of the runway.

During this tutorial you will practice just that! You will calculate resultant forces acting on various objects at various directions. You will also practice a bit of trigonometry to help with that.

To start though we will go back to basics and recall the definition of resultant force and the effect of a force on an object based on Newton's laws.

At the beginning and end of the handbook you can find the baseline and the final assessment in order to record your progress.

Subject Vocabulary

Word	Definition	Formula
Resultant force		
Newton's first law		
Newton's second law		
Newton's third law		
Free body diagram		
sin		
cos		
tan		

Tutorial 1 – Baseline

What is the Purpose of Tutorial 1?

Objective A: Test your current knowledge and skills
Objective B: Draw a concept map of the topic Forces and Motion

Objective A: Test your current knowledge and skills (Total marks = 25)

1. We use arrows to represent the magnitude and direction of a force.
   a. State the name for quantities than have both a magnitude and a direction.

   (1)

   b. Apart from forces, name one other quantity that has both a magnitude and direction.

   (1)

   c. State the name for quantities that have a magnitude but not a direction.

   (1)

   d. Give one example of a quantity that has a magnitude but not a direction

   (1)

(Total for question 1 = 4)

2. A car accelerates at 2 m/s2. The resultant force acting on the car is 3000 N. Calculate the mass of the car.

(Total for question 2 = 2)

3. A car's engine is producing a forward force of 1000 N. the resistance forces on the car add up to 2000 N.
   a. Draw a labelled free body force diagram showing the forces on the car

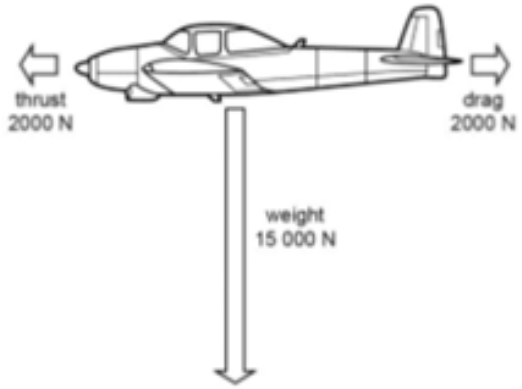
   (2)

   b. Calculate the resultant force on the car.

   (2)

(Total for question 3 = 4)

4. The drawing shows some of the forces acting on an aeroplane. The aeroplane is flying at 60 m/s at constant height, so the lift force (not shown on the diagram is equal to the weight.



a. State what will happen to the speed of the aeroplane if the horizontal forces remain as shown in the diagram.

(1)

b. The angle of the wings is changed to give a lift force of 12 000 N. Draw an arrow on the diagram to represent this force.

(1)

c. i Calculate the resultant force on the aeroplane in a vertical direction

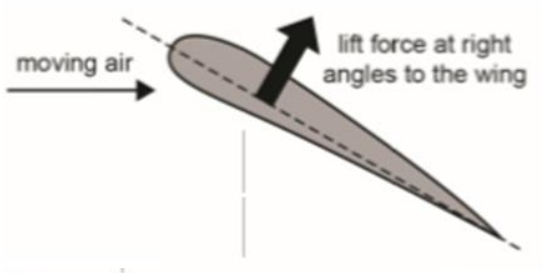
(2)

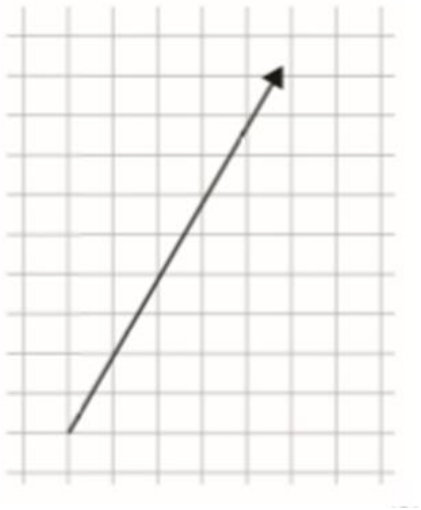
ii Explain what will happen to the aeroplane

(2)

(Total for question 4 = 6)

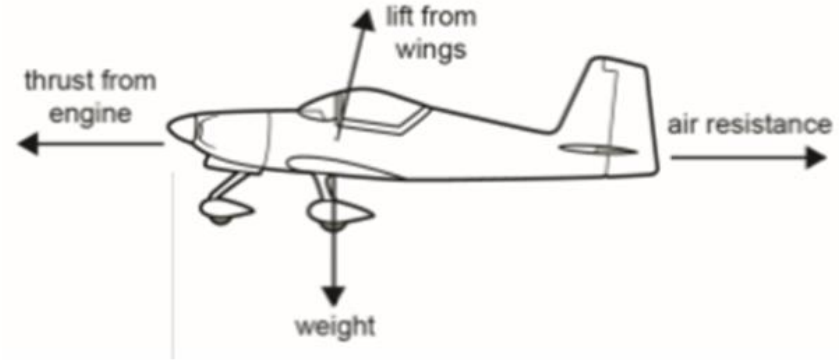
5. The diagram shows the lift force on the wing of a model aeroplane. The lift force is 50 N.
The lift force can be resolved into a vertical component acting upwards, and a horizontal component acting backwards (to the right in this diagram).
The force arrow on the grid below the diagram shows the lift force at a scale of 1 cm : 10 N.
Complete the scale drawing to find the size of the horizontal and vertical components of the lift. Label your diagram with the sizes of the component forces.





(Total for question 5 = 3)

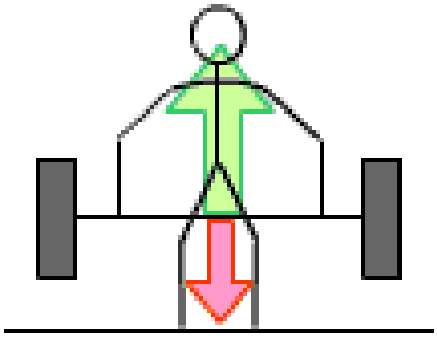
6. The drawing shows the forces on an aeroplane. Explain how you can work out the overall resultant force on the aeroplane if you are goven the sizes of the forces.



(Total for question 6 = 6)

Objective B: Draw a concept map of the topic Forces and Motion

Tutorial 2 – The Basics



What is the Purpose of Tutorial 1?

Objective A: Defining resultant force
Objective B: Calculating resultant forces on one axe
Objective C: Calculate resultant forces on two axes

Objective A: Defining Resultant Force

Forces are ***vector*** quantities and the unit is ***Newtons*** (N).
1 N is the force needed to accelerate a mass of 1Kg by $1m/s^2$.

We can draw diagrams to show the forces acting on objects to help us think about the effects the forces will have.
An object may have several different forces acting on it, which can have different strengths and directions.

The single force that has the same effect on the object as all the individual forces acting together is called resultant force.

Practice A

1. Define resultant force in 7 words

2. How much is 1 N?

3. Describe how you can calculate the resultant force if the forces are acting in the same direction

4. Describe how you can calculate the resultant force if the forces are acting in opposite directions

Assessment A

1. A force is a vector quantity.

   Choose the statement that best describes what this means.

   a. A force can be represented using an arrow

   b. A force has both a size and a direction

   c. Forces always act int he same direction

   d. Forces can be pushes or pulls

2. The arrows represent forces on a car.

Choose the arrow underneath that represents the resultant force on the car.

a.

b.

c.

d.

Objective B: Calculating resultant force on one axe

Worked example 1
The diagram shows the horizontal forces acting on Joe at one point as he is cycling.
a. Calculate the size of the resultant horizontal force acting on Joe and his bicycle.

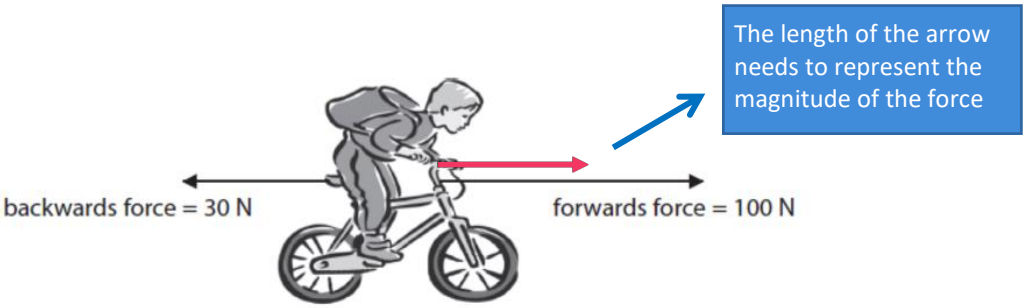
b. Draw the resultant force on the diagram.

a. Resultant force = forwards force - backwards force = 100 - 30 = 70 N

Resultant force = 70 N forwards

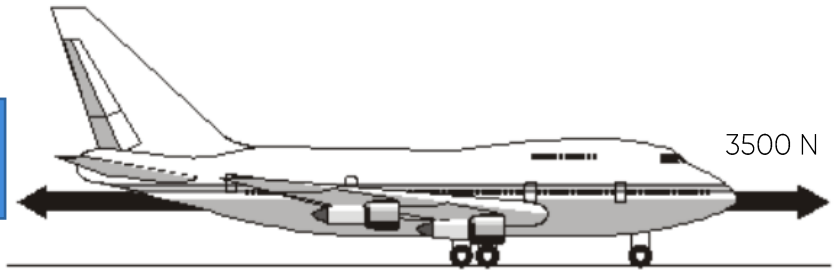
Don't forget units and direction

b.



Worked example 2
The diagram shows an aircraft and the horizontal forces acting on it as it moves along a runway. The resultant force on the aircraft is zero. Calculate how much the air resistance is.

The air resistance is acting in the opposite direction of the drive



Drive – air resistance = 0N
3500 N – air resistance = 0N
Air resistance = 3500 N – 0N=3500 N

Worked example 3
The diagram shows a cyclist during a race.

The diagram shows the horizontal forces acting on the cyclist.

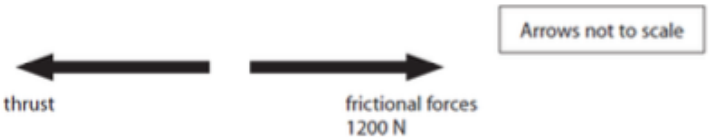
Calculate the resultant force on the cyclist.

250 N – 400 N = - 150 N → The positive direction was chosen to be the direction of the movement

the resultant force is acting in the opposite direction of the movement (to the left)

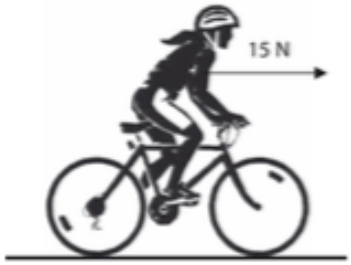
Practice B

1. The diagram represents the horizontal forces acting on a boat as it accelerates.



The size of the resultant force is 2600 N.
Calculate the size of the thrust.

2. The resultant force on the cyclist is zero. Draw an arrow on the diagram to show the size and direction of the resistive force acting in the cyclist.



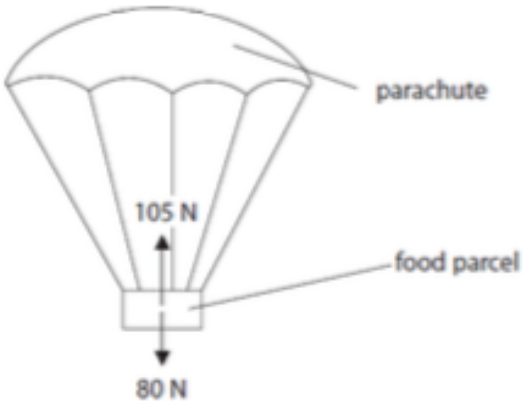
3. There is a resultant force on the rocket of 0.5 N upwards when it takes off.
The arrow on the diagram shows the size and direction of the force of gravity.
Add another arrow to the diagram to show the thrust produced by the burning fuel at the time the rocket takes off. You should label the arrow with the size of the thrust.

Assessment B

1. A fisherman pulls a boat towards land.
   The forces acting on the boat are shown in the diagram.
   The fisherman exerts a force of 300 N on the boat.
   The sea exerts a resistive force of 250 N on the boat.

   Choose the sentence that best describes the resultant force on the boat.
   a. The resultant force is 0.
   b. The resultant force is 50 N in opposite direction of the movement.
   c. The resultant force is 550 N in the direction of the movement.
   d. The resultant force is 50 N in the direction of the movement.

2. A relief organisation drops food parcels by parachute from a helicopter.
   The diagram shows the forces acting on the food parcel soon after the parachute has opened.



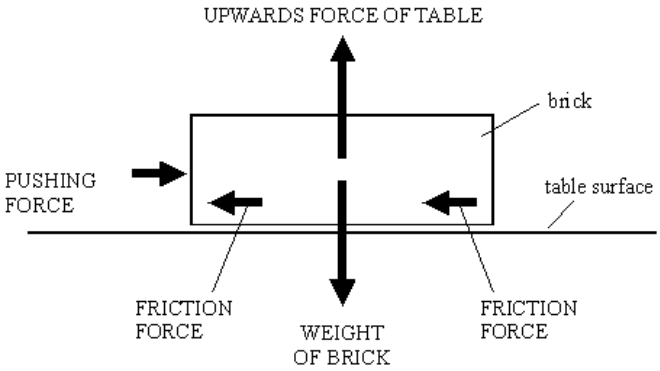
   Complete the sentence.
   The resultant force n the food parcel is
   a. 25 N downwards
   b. 25 N upwards
   c. 185 N downwards
   d. 185 N upwards

Objective C: Calculate resultant force on two axes

Tip: Work on the two axes separately

Worked example 1

Calculate the resultant force on the brick if its weight 5 N, the friction force is 10 N, the upwards force of the table is 5 N and the pushing force is 12 N.



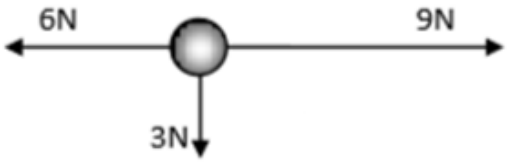
Vertical axe: weight – upward force from table = 5 N – 5 N = 0 N

Horizontal axe: Pushing force – friction force = 12 N – 10 N = 2 N to the right

Worked example 2

Calculate the resultant forces

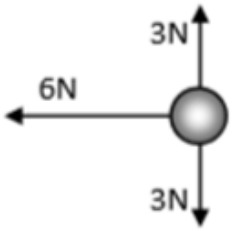
a.



Vertical axe: 3 N downwards

Horizontal axe: 9 N - 6 N = 3 N to the right

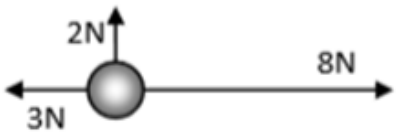
b.



Vertical axe: 3 N – 3 N = 0 N

Horizontal axe: 6 N to the left

c.

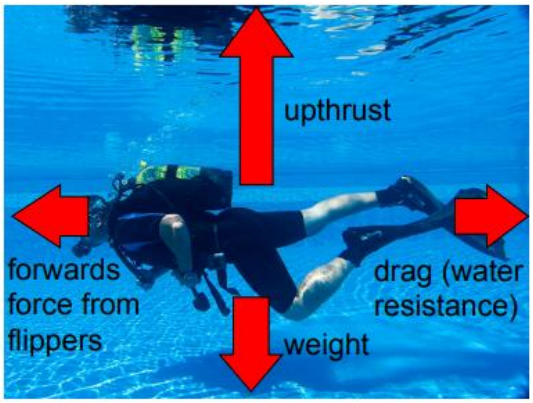


Vertical axe: 2 N upwards

Horizontal axe: 8 N – 3 N = 5 N to the right

Practice C

1. The photo shows some forces on a diver.

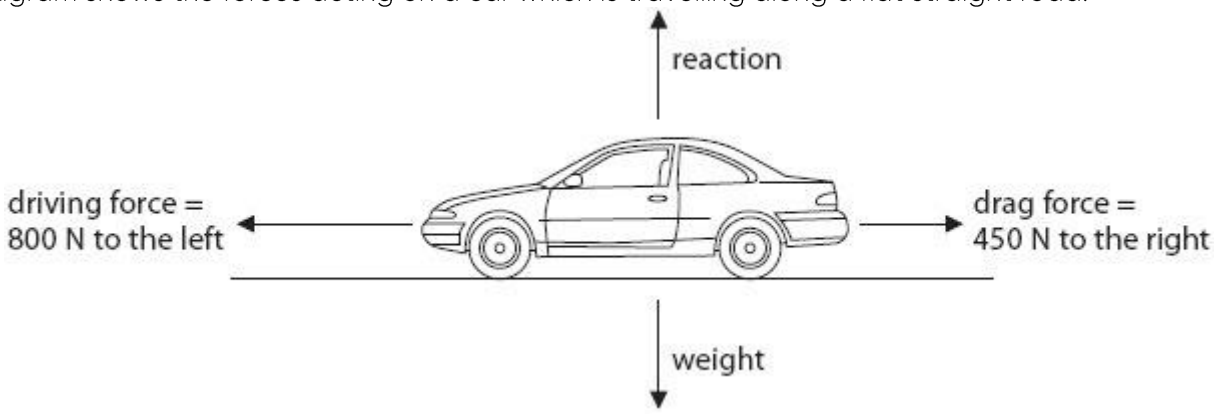


The upthrust on the diver is 1200 N and her weight is 1000 N.
The forwards force is 200 N and the drag is 50 N.
Calculate the resultant force in the vertical direction and the resultant force in the horizontal direction

2. A diver leaps from the 10 metre high board. His feet provide an upwards force of 960 N and a forwards force of 215 N. The diver's weight is 845 N.

Assessment C

The diagram shows the forces acting on a car which is travelling along a flat straight road.

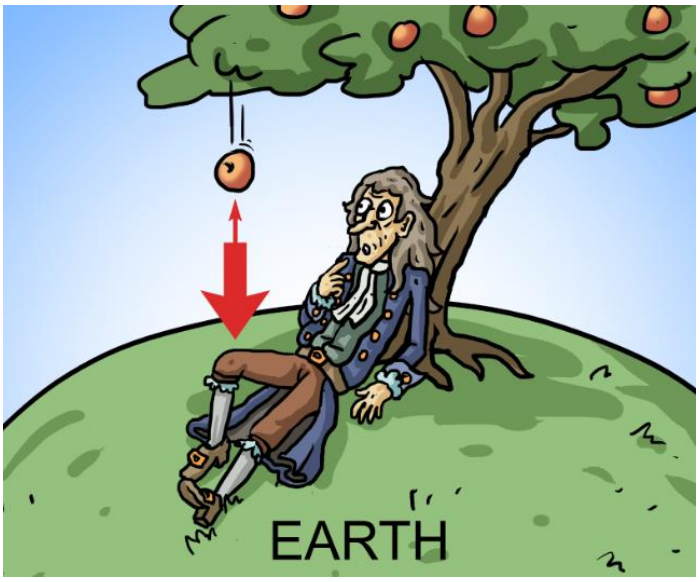


The size of the resultant force on the car is 350 N.
In which direction is the resultant force acting?
Put a cross (X) in the box next to your answer.

(1)

- ☒ A down ↓
- ☒ B to the left ←
- ☒ C to the right →
- ☒ D up ↑

Tutorial 3 – Newton's Laws



What is the Purpose of Tutorial 2?

Objective A: Apply Newton's law when resultant force is zero (Newton's 1st law)
Objective B: Apply F=mxa (Newton's 2nd law)
Objective C: Apply F=mxa and a=(change in velocity)/time

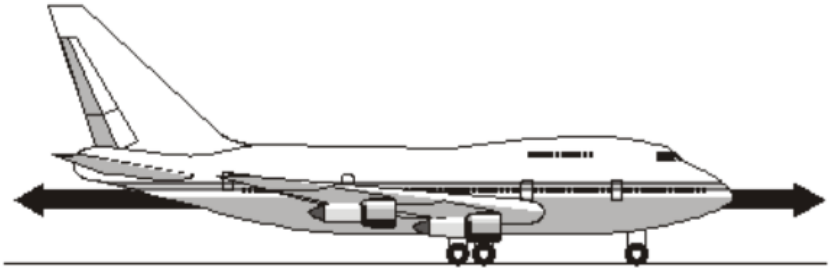
Objective A: Apply Newton's law when resultant force is zero (Newton's 1st law)

Newton's First Law of motion can be written as:

- A moving object will continue to move at the same speed and direction unless an external force acts on it
- A stationary object will remain at rest unless an external force acts on it

Worked example 1

The diagram shows an aircraft and the horizontal forces acting on it as it moves along a runway. The resultant force on the aircraft is zero. Describe the movement of the aircraft.



Since the resultant force is zero and the aircraft is already moving along the runway, it will continue to move in the same direction with a constant speed. → Both direction and speed will remain the same

Worked example 2

The diagram shows a cyclist during a race.

The diagram shows the horizontal forces acting on the cyclist.

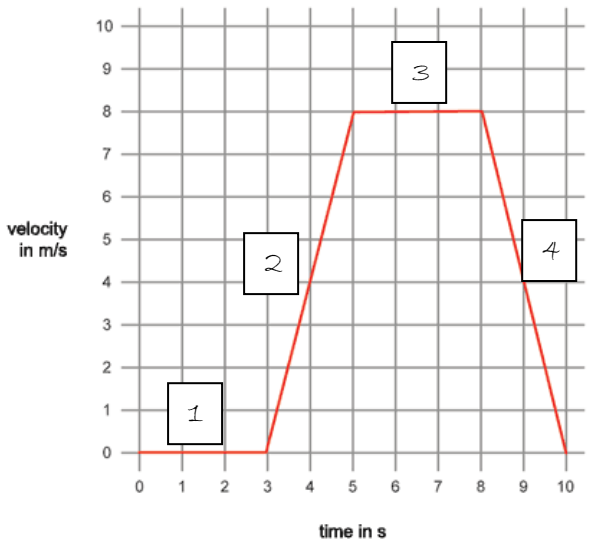
Does Newton's First Law apply to the cyclist?

The resultant force is not zero (250 N – 400 N = - 150 N)

Therefore the Newton's First Law of motion does not apply and the cyclist is not stationary and is not moving with a constant speed or direction

Worked example 3

Describe how the resultant is changing through the movement of the car shown on the velocity-time graph.

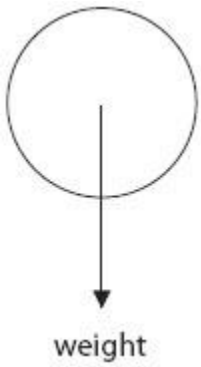


Tip: Divide the movement is sections that you can describe separately.

1. Between 0 and 3s the car is stationary so the resultant force on the car is zero.
2. The velocity is changing between 3s and 5s, so the resultant force is not zero.
3. The velocity of the car then until 8s is constantly 8 m/s and so the resultant force is zero.
4. Lastly the velocity between 8s and 10s is changing again; therefore the resultant force is not zero.

Practice A

1. Forces also act on objects when they fall through the air.
There are two forces acting on this ball as it falls through the air.
The weight is shown on the diagram.



(i) Draw and label an arrow on the diagram to show the other force acting on the ball.

(ii) Use words from the box to complete the sentences.

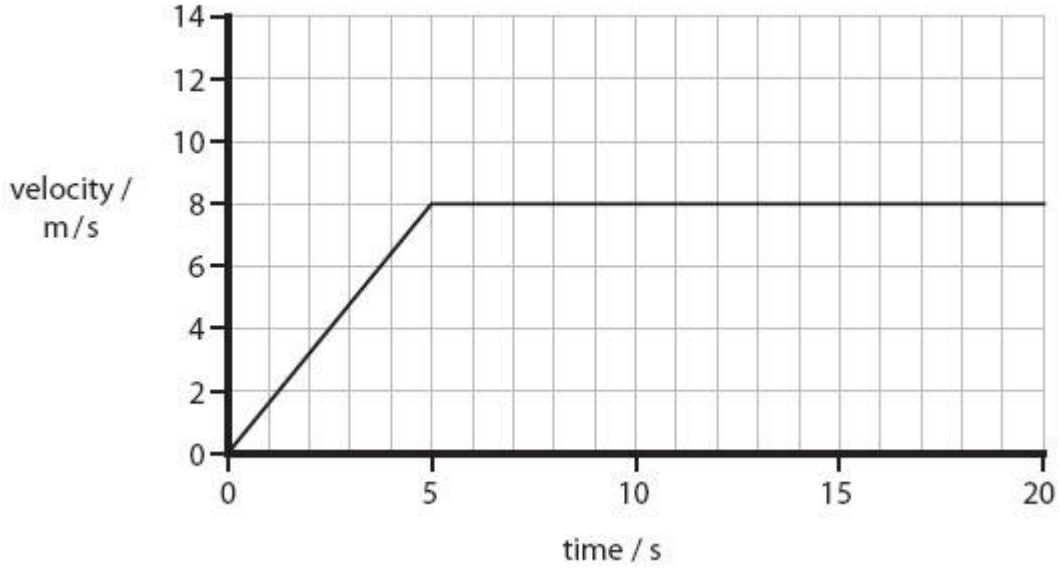
balanced	changing	greater	smaller	zero

After a short time the ball falls at a steady speed.

The forces acting on the ball are now .....

The acceleration of the ball is now .....

2. Here is the velocity-time graph for a car for the first 20 s of a journey.



State the size of the resultant force between 10s and 15s.

Assessment A

1. A car is travelling along a level road.

Complete the sentence by putting a cross (☒) in the box next to your answer.
When the velocity of the car is constant, the force of friction on it is

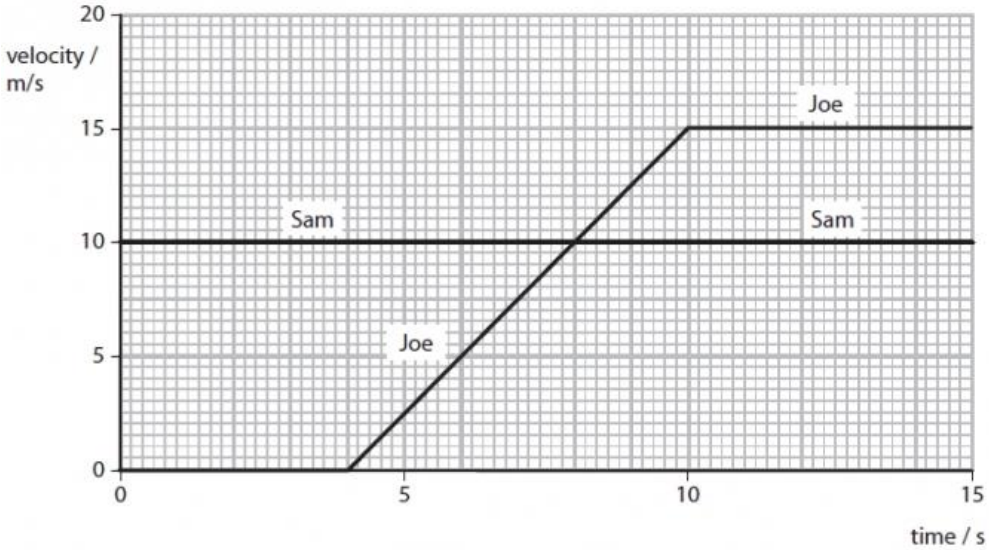
☐ A zero

☐ B greater than the driving force

☐ C smaller than the driving force

☐ D the same size as the driving force

2. Sam and Joe are on their bikes. They are on a flat, straight road.
Joe is stationary when Sam rides past at a constant velocity of 10 m/s.
Joe waits for 4 s and then follows Sam.
This is a velocity/time graph of their motion.



Choose the sentence that accurately describes the forces acting on Sam and Joe

- ☐ A The resultant force is zero for Sam and non-zero for Joe for all 15 s
- ☐ B The resultant for is zero only when Sam and Joe are moving with constant speed
- ☐ C The resultant force is not zero only when Joe is accelerating
- ☐ D The resultant force is zero only when Joe is stationary

Objective B: Apply F=mxa (Newton's 2nd law)

The acceleration of an object is a measure of how much its velocity changes in a certain time. Newton's Second Law of motion describes the factors that affect the acceleration of an object.
The acceleration in the direction of a resultant force depends on:

- The size of the force
- The mass of the object.

Newton's Second Law can be summarised with the equation:
Force (N) = mass (Kg) x acceleration (m/s^2) → F = m x a

Worked example 1
A motorcycle has a mass of 200 Kg. What force is needed to give it an acceleration of 7 m/s2?

F = m x a = 200 Kg x 7 m/s2 = 1400N

Worked example 2

The diagram shows the horizontal forces acting on Joe at one point while he is accelerating.

(a)Calculate the size of the resultant horizontal force acting on Joe and his bike.

Resultant force = 100 N - 30 N = 70 N forward

(b)The total mass of Joe, his heavy bag, and his bike is 55 kg.
Calculate the total weight.
Gravitational field strength, g = 10 N/kg

Weight = mass (kg) x gravitational field strength (N/kg) = 55 kg x 10 N/kg = 550 N

Weight = mass x g is a version of the equation F=mxa.
Weight if the force of gravity and it is measured in Newtons.
Gravitational potential strength is the acceleration because of gravity and it can be measured in m/s^2

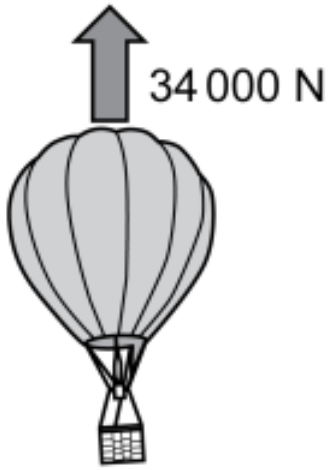
(c)On another day, Joe is riding the same bike on the same piece of road.

This time he does not have the heavy bag on his back.
He finds that it is easier to accelerate.
Explain why Joe finds it easier to accelerate.

F= m x a → a = F/m this means that mass is inversely proportional to acceleration.
The smaller the mass the higher the acceleration or the smaller the force needed to achieve the same acceleration.

Worked example 3

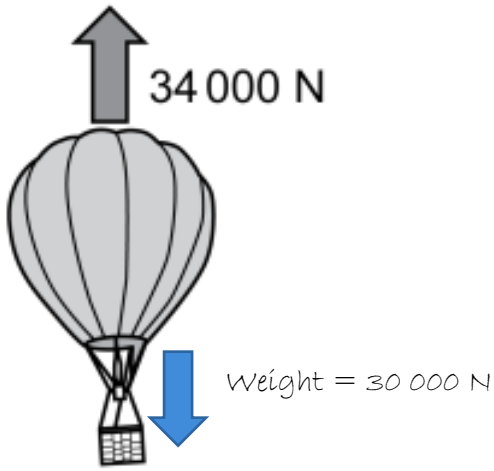
The drawing shows a hot air balloon. The mass of the balloon is 3000 kg.



a Calculate the weight of the balloon.
b Draw an arrow on the balloon to represent this force.
c What is the resultant force on the balloon?
d What will happen to the velocity of the balloon?

A Weight = mass (kg) x gravitational field strength (N/kg) = 3000 kg x 10 N/kg = 30 000 N

B



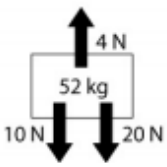
C Resultant force = 34 000 N – 30 000 N = 4 000 N upwards

D Since the resultant force is not zero, the balloon is accelerating

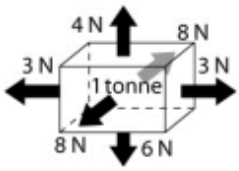
Practice B

1. For each object:
   Calculate the size and direction of the resultant force
   Calculate the size of its acceleration and state the direction

a



b

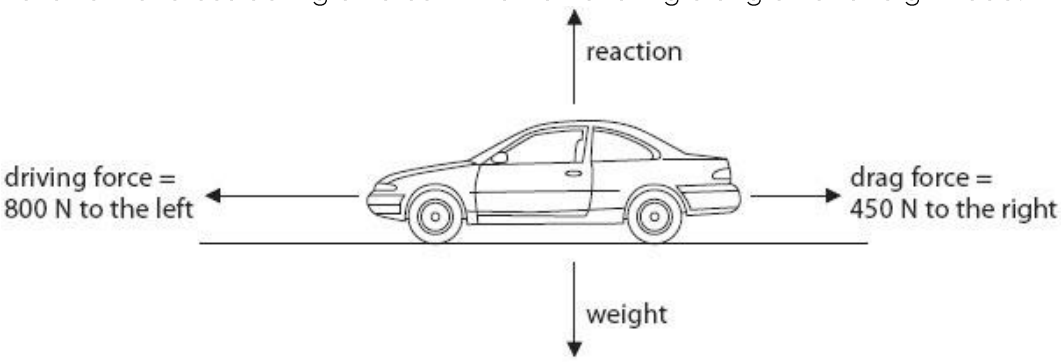


2. A jet fighter has a mass of 28 000 kg. The thrust from its engines when it starts to take off is 140 000 N. What is its initial acceleration?

3. The value of 10 N/kg we often use when calculating weights on Earth is a rounded value. A more accurate value is 9.81 N/kg.
   What is the difference in the weight of a 500 kg mass calculated using these two different values? Show your working.

Assessment B

1. The diagram shows the forces acting on a car which is travelling along a flat straight road.



(a)The size of the resultant force on the car is 350 N.
In which direction is the resultant force acting?
Put a cross (X) in the box next to your answer.

☐ A down ↓

☐ B to the left ←

☐ C to the right →

☐ D up ↑

(b) Complete the sentence by putting a cross (X) in the box next to your answer.

The car is

☐ A accelerating

☐ B decelerating

☐ C moving at a constant speed

☐ D not moving

2. (2)

(c) The mass of the car is 625 kg.
Calculate the weight of the car.
gravitational field strength = 10N/kg

2. The engine of a 300 kg motorbike produces a force of 1000 N. What is the acceleration?

Objective C: Apply F=mxa and a=(change in velocity)/time

Worked example 1
A car accelerates at a constant rate of 1.83 m/s^2 along a flat straight road.
The force acting on the car is 1.870 kN.
(a) Calculate the mass of the car.
Give your answer to three significant figures.

1.870kN x 1000 = 1870 N

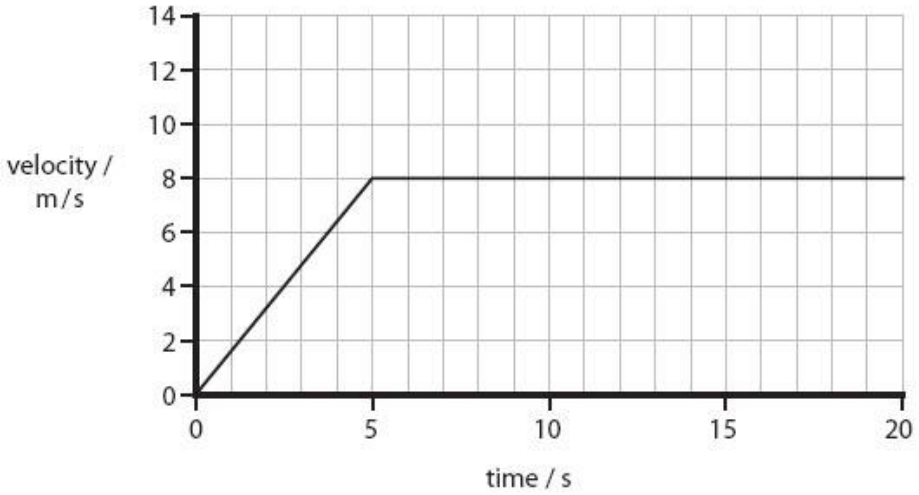
F = m x a ➔ m = F/a = 1870 N/ 1.83 m/s2 = 1 021. 85 kg

Rounding in three s.f. the mass is 1 022 kg

(b) The car accelerates from rest for 16 s.
Calculate the speed of the car after 16 s.

acceleration = change in velocity / time ➔ change in velocity = a x t ➔
Vfinal – Vinitial = a x t ➔ Vfinal – 0 = 1.83 x 16 ➔ Vfinal = 29.28 m/s

Worked example 2
Here is the velocity-time graph for a car for the first 20 s of a journey.



(a) Calculate the change in velocity of the car during the first 5 s.

The velocity is zero at the starting point and after 5s is 8m/s, so the velocity change is 8 m/s

(b)Calculate the acceleration of the car during the first 5 s.

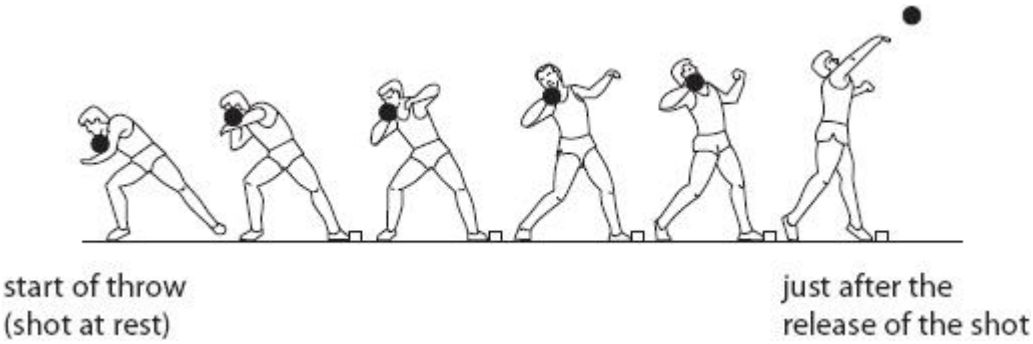
Acceleration = change in velocity / time ➔ a = 8/5 = 1.6 m/s2

(c) The mass of a car is 1200 kg.
Calculate the resultant force on the car required to produce an acceleration of 0.8 m/s^2.

F = m x a = 1200 x 0.8 = 960 N

Practice C

1. Shot-put is an Olympic event. The shot is a heavy ball. An athlete throws the shot as far as possible. The figure shows the pictures of one throw.



(a) The average acceleration of the shot while in the athlete's hand is 20.6 m/s2. The mass of the shot is 7.26 kg.

Calculate the average force that the athlete applies to the shot during the throw.

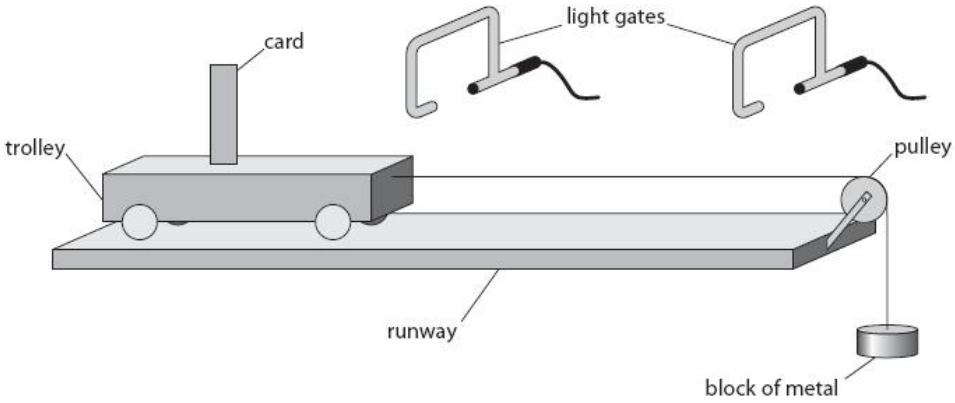
(b) In another throw, the shot is in the athlete's hand for 0.48 s.

The average acceleration during this time is 23 m/s2.
Calculate the velocity of the shot as it leaves the athlete's hand.

2. A supertanker carrying oil has a mass of 300 000 tonnes. By using its engines in reverse, a tanker like this can stop from a speed of 22 km/h in 14 minutes. a What acceleration is this? b What force is required?

Assessment C

A student investigates the motion of a trolley along a horizontal runway using the apparatus in the figure.



A trolley is attached to a string passing over a pulley.

A block of metal hangs on the end of the string.

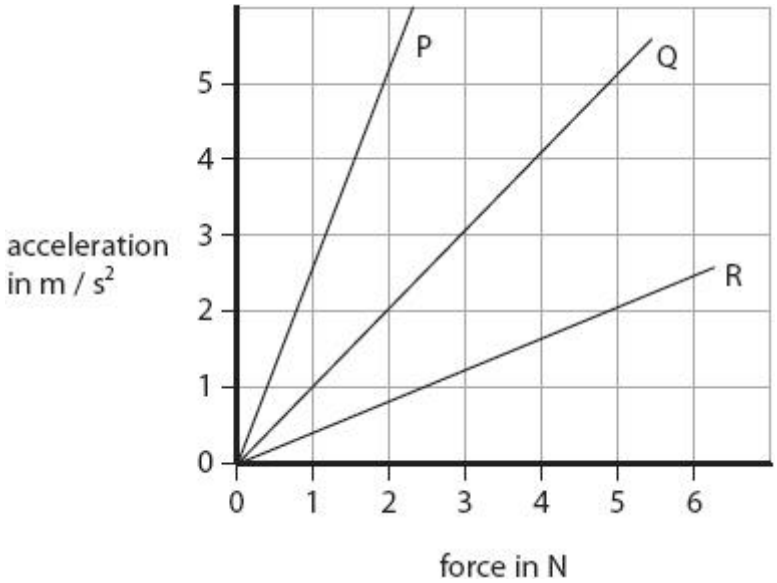
Each light gate measures the time it takes for the card to pass through the gate.

When the trolley is released, it moves along the track.

A computer measures the time it takes for the card to pass between each light gate.

Figure 5 shows a graph of acceleration against force for three trollies of different mass that are pulled along the runway.

The graphs for the trollies are labelled P, Q and R.



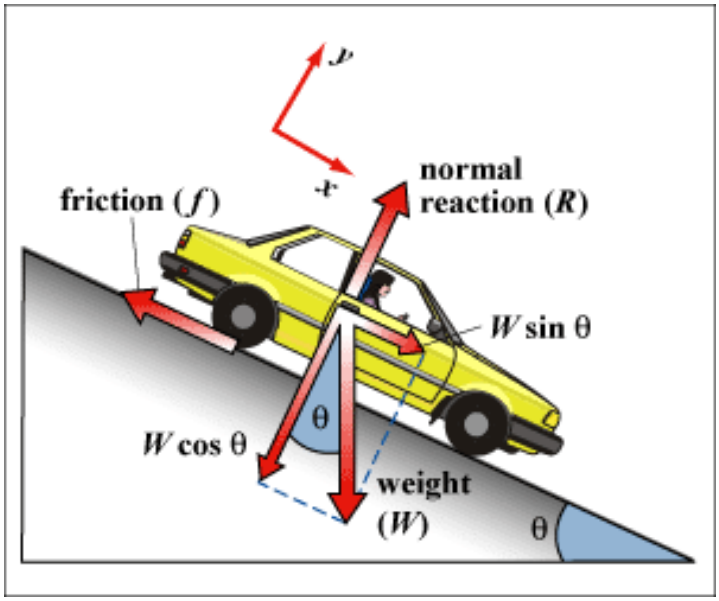
Use the information from the graph.

(a)Calculate the mass of trolley Q

(b)Describe how the graph shows that trolley R has the greatest mass.

(c) Calculate the speed of the trollies after 2 s

Tutorial 4 – What does trigonometry have to do with resultant forces?

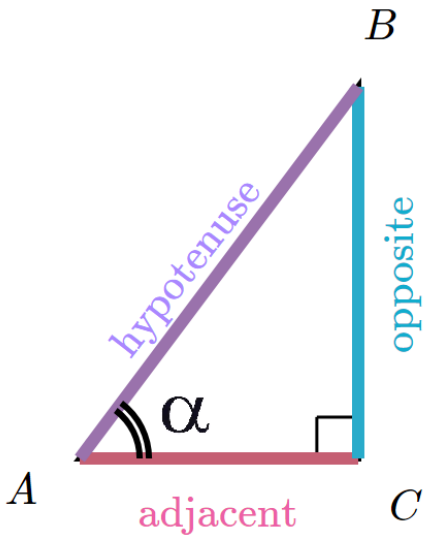


What is the Purpose of Tutorial 3?

Objective A: Defining trigonometric ratios
Objective B: Calculating a missing side of a triangle
Objective C: Calculating a missing angle in a triangle

Objective A: Defining trigonometric ratios

Trigonometric ratios relate the sides of a right-angled triangle to its angles.



$$\sin(\alpha) = \frac{\text{opposite}}{\text{hypotenuse}}$$

$$\cos(\alpha) = \frac{\text{adjacent}}{\text{hypotenuse}}$$

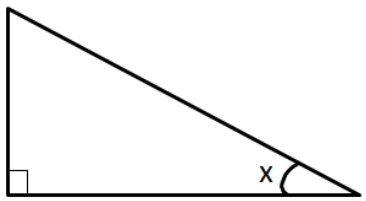
$$\tan(\alpha) = \frac{\text{opposite}}{\text{adjacent}}$$

In these definitions, the terms opposite, adjacent, and hypotenuse refer to the *lengths* of the sides

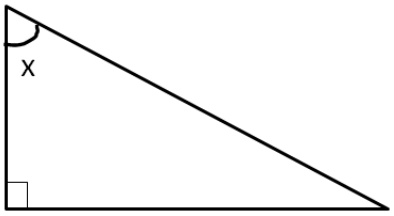
Practice A

1) Name the side of each right-angled triangle, related to the marked angle

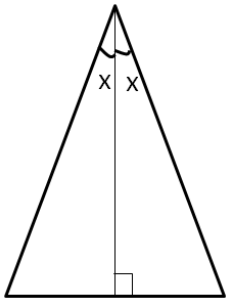
a-



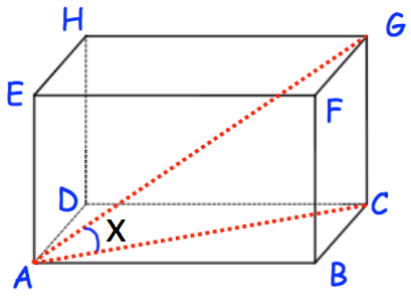
b-



c-

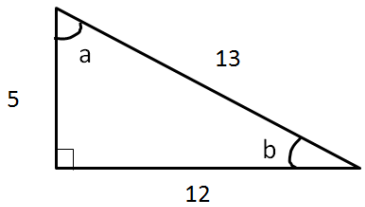


d-



2) Calculate the trigonometric ratios related to angle x

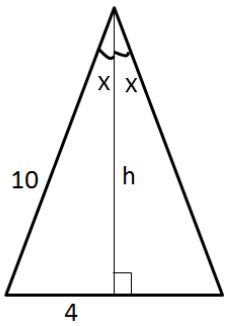
a.



cos(a)=
sin(a)=
tan(a)=

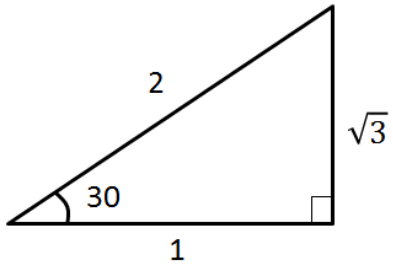
cos(b)=
sin(b)=
tan(b)=

b.



cos(x)=
sin(x)=
tan(x)=

c.



cos(30)=
sin(30)=
tan(30)=

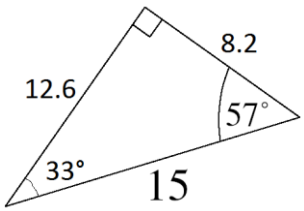
cos(60)=
sin(60)=
tan(60)=

Assessment A

1) Which statement is correct?

A The hypotenuse is always the longest side of the triangle
B The opposite side is opposite the right angle
C The adjacent side is next to the right angle
D The hypotenuse is opposite the angle considered

2) Which statement is correct?



A $\cos(57) = \frac{15}{8.2}$

B $\cos(33) = \frac{12.6}{15}$

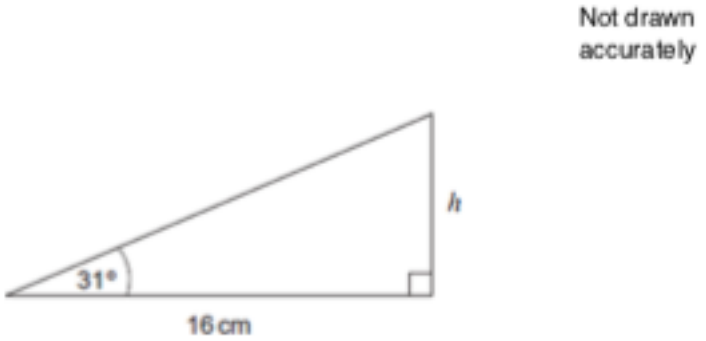
C $\sin(57) = \frac{15}{8.2}$

D $\tan(33) = \frac{15}{12.6}$

Objective B: Calculating a missing side of a triangle

Worked example 1

Work out the height h



tan31=h/16

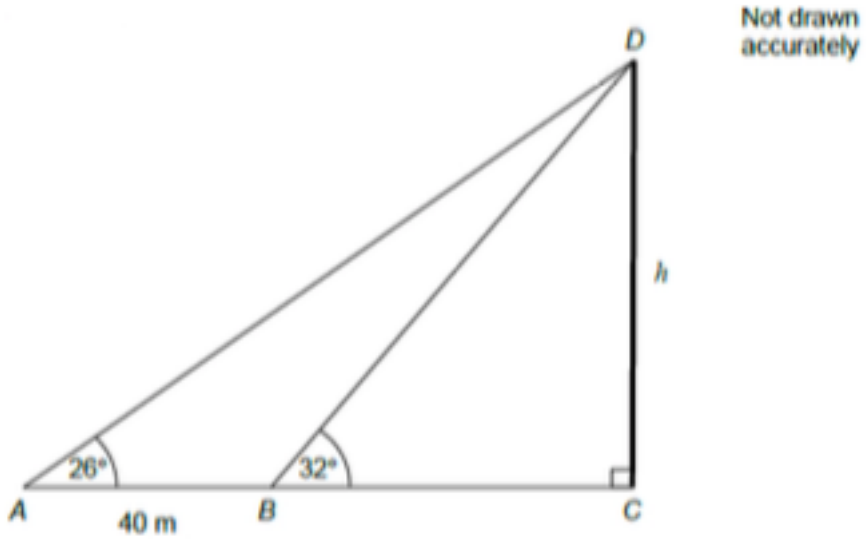
h=9.61 cm

Worked example 2

The diagram shows a vertical tower CD of height h meters.

ABC is horizontal.

AB=40meters.



Work out the height, h, of the tower

Tan26=h/(AB+BC)

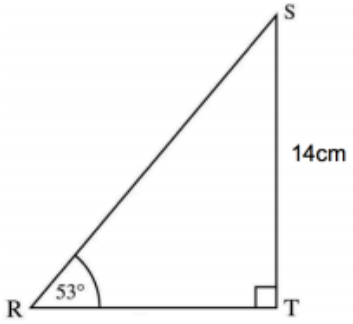
Tan32=h/BC ➔ h= 0.62 x BC

Tan26=(0.62 x BC)/ (40 + BC) ➔ 0.49 x (40 + BC) = 0.62BC ➔ 19.6 + 0.49BC = 0.62BC ➔ 19.6 = 0.13 BC ➔ BC = 19.6/0.13 = 150.77

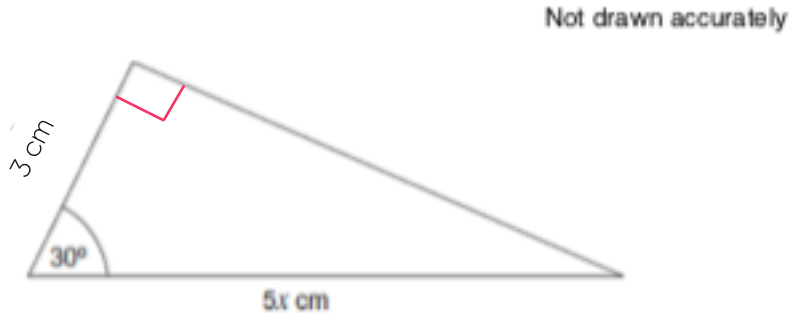
h= tan32xBC = 0.62 x 150.77= 95.2 meters

Practice B

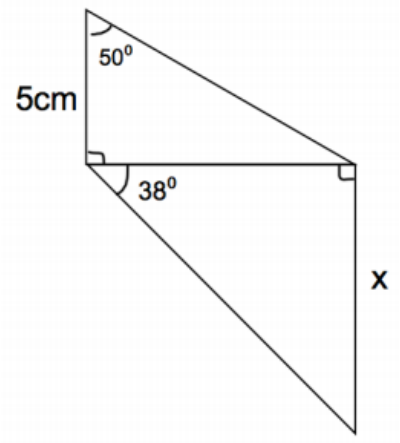
1) Find the length of RT in the triangle below



2) Work out the value of x

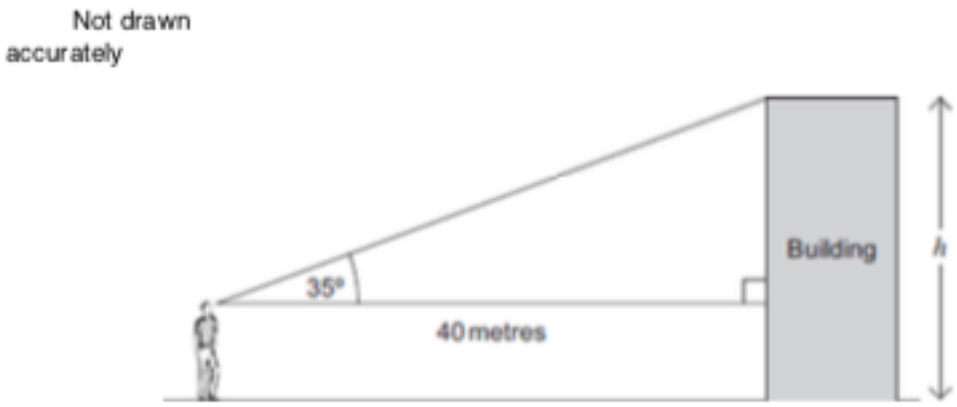


3) Calculate the value of x



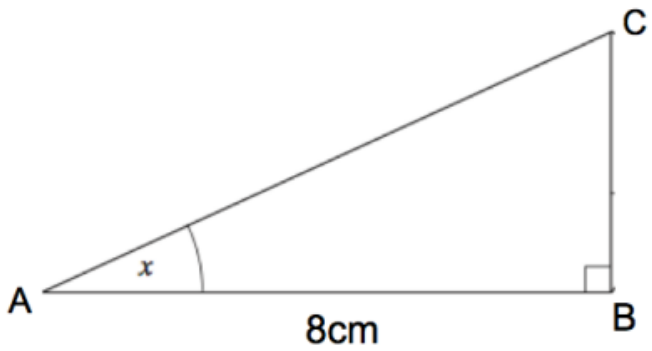
Assessment B

1.



The man is 1.8 meters tall.
Work out and choose the correct height of the building, marked h on the diagram

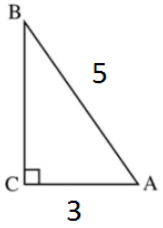
2. Below is a right-angled triangle. (Non-calculator question) tan x = 0.6 AB is 8cm
Work out the length of BC



Objective C: Calculating a missing angle in a triangle

Worked example 1

1) Calculate the size of angle BAC



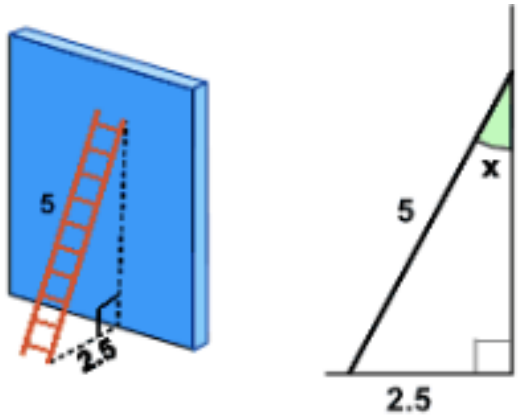
Study tip
We apply the inverse function to both sides of the equality

Study tip
Inverse functions « undo » the function :
$\cos^{-1}(\cos(a))=a$
$\sin^{-1}(\sin(a))=a$
$\tan^{-1}(\tan(a))=a$

Cos(BAC) = adjacent/hypotenuse = 3/5
Cos-1(cos(BAC))=cos-1(3/5)
BAC=cos-1(3/5)

Worked example 2

The ladder leans against a wall as shown.

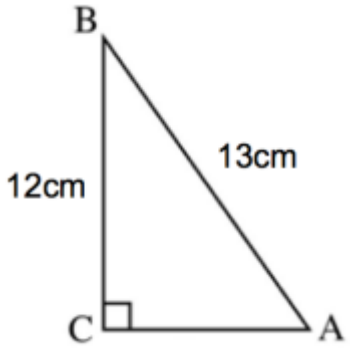


What is the angle between the ladder and the wall?

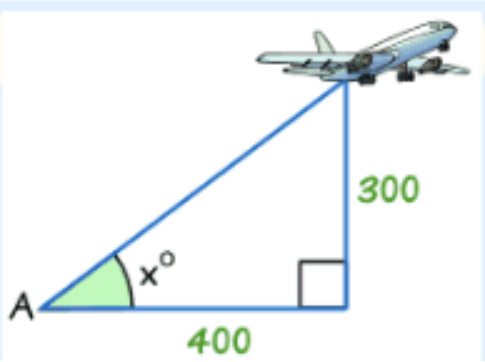
Sin (x) = opposite/hypotenuse = 2.5/5 = 0/5
x= sin-1(0.5)=30°

Practice C

1) Calculate the size of angle BAC

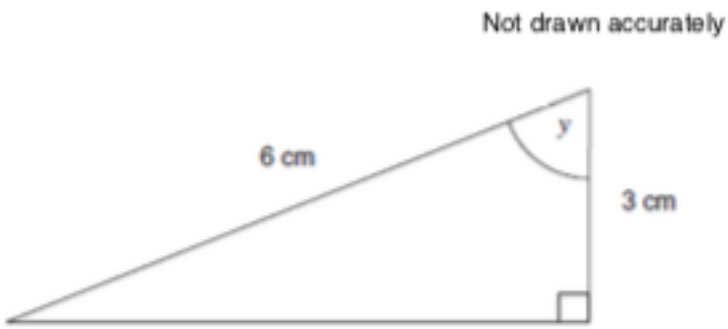


2) Find the angle of elevation of the plane from point A on the ground.



Assessment C

1.



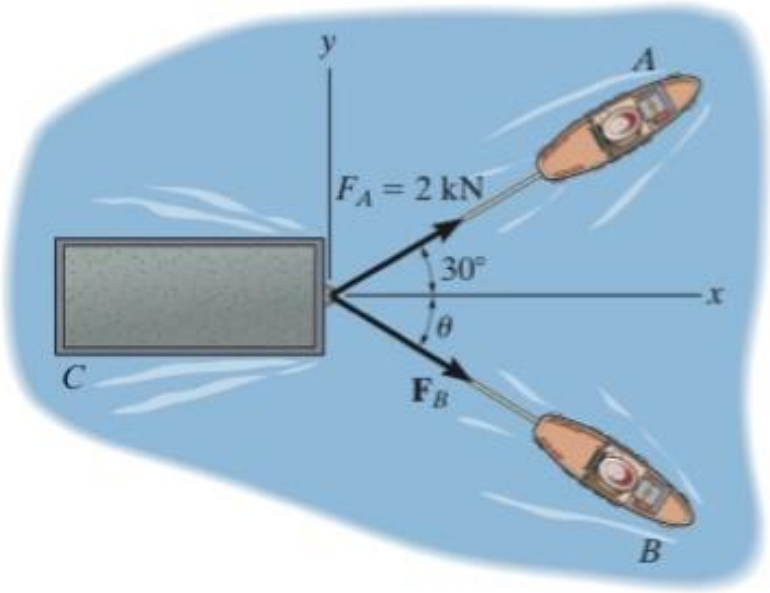
Circle the size of angle y

30° 36° 45° 50° 60°

2. A 15 foot plank has one end on the ground and one end 6 feet off the ground. What is the angle formed by the plank and the ground?

24° 10° 50° 70°

Tutorial 5 – Use vector diagrams to illustrate resolution of forces, a net force and equilibrium situations



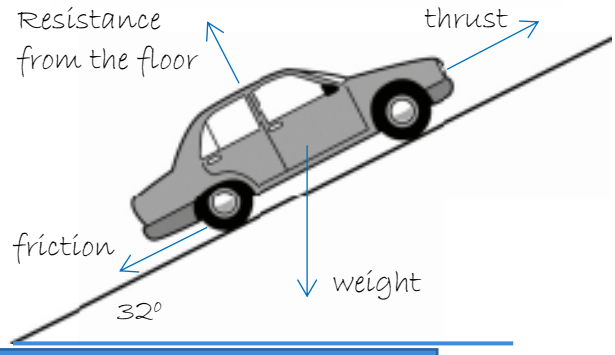
What is the Purpose of Tutorial 4?

Objective A: Draw free-body diagrams
Objective B: Calculate resultant forces using scale diagrams
Objective C: Calculate resultant forces by resolving forces on two axes

Objective A: Draw free-body diagrams

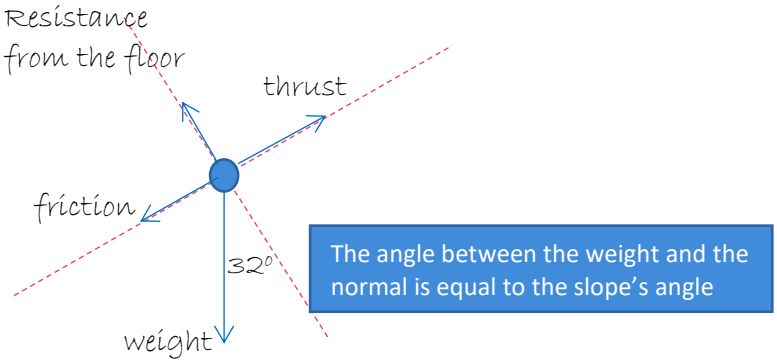
Worked example 1

Draw the forces acting on the car moving forward.



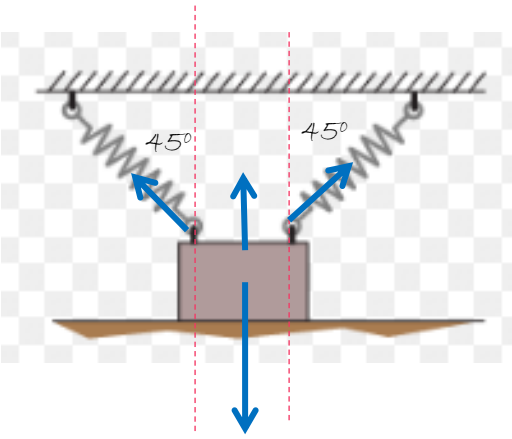
Use a protractor to measure the angle

or using the point-mass method

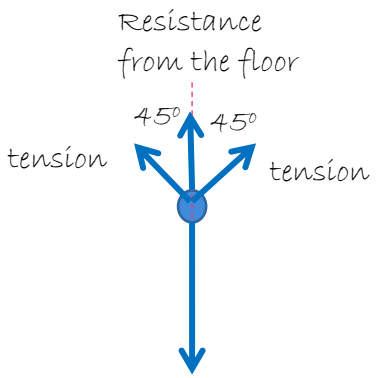


Worked example 2

A block of mass m sits on a floor partially suspended by two springs. Draw the free-body diagram of the block.



or using the point-mass method



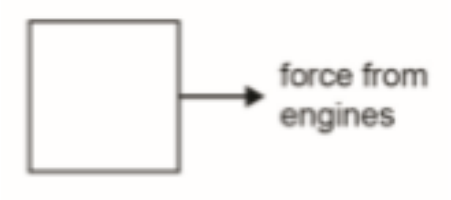
weight

Practice A

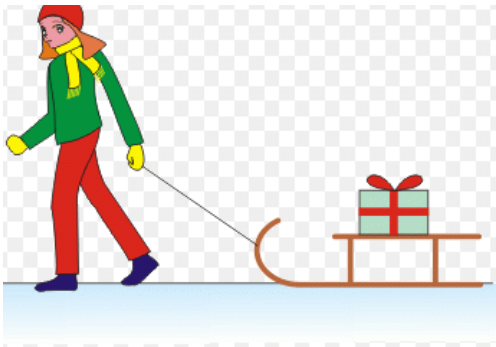
1. The diagram is a free force diagram showing one the forces on a submarine. The submurine is travelling at a steady speed. The upthrust and weight are balanced and are much larger than the force from the engines.

(a) Draw a point-mass diagram and add the missing arrows and labels.

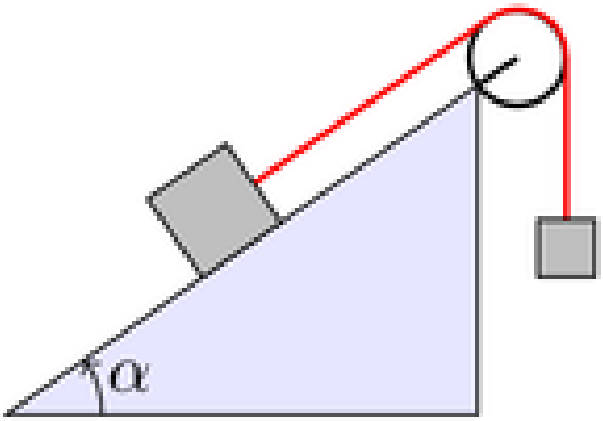
(b) Explain how the diagram would be different if the submarine were accelerating



2. Draw the forces acting on the sledge when it is moving with a constant speed. Then draw a point-mass diagram.



3. Draw the forces acting on the two masses



Assessment A

1. Draw point-mass diagrams for the following forces:

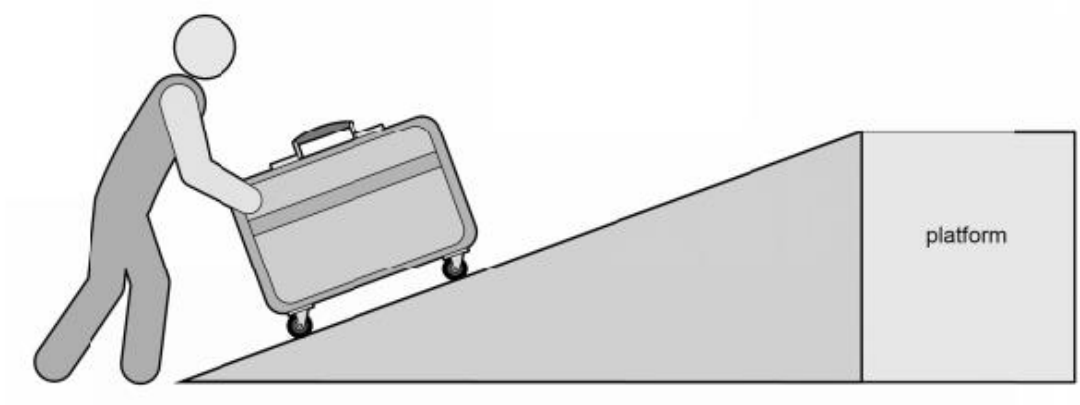
(a)An 8N force acting horizontally to the right and a 3N forces acting horizontally to the left. A 2N force is acting upwards at a right angle.

(b) A 6 N force acting horizontally to the left. Two 3 N forces acting upwards and downwards respectively at right angles.

(c) An 8 N force acting horizontally to the right and a 6 N force acting upwards at 60° from the horizontal force.

(d) an 8 N force acting horizontally to the left and a 6 N force acting downwards at 120o from the horizontal force.

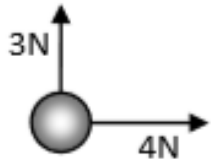
2. Draw the forces acting on the suitcase as it is moving up the ramp at a constant speed



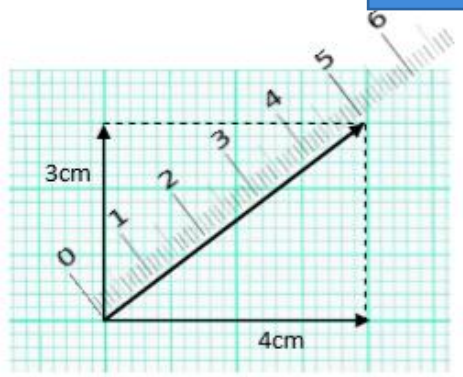
Objective B: Calculate resultant forces using scale diagrams

Worked example 1

Calculate the resultant force using a scale diagram



Tip: Decide the scale you will use. Draw the forces according to this scale. Draw a parallelogram. The diagonal of the parallelogram is the resultant force. Measure the length of the resultant force and use the scale to calculate its magnitude.

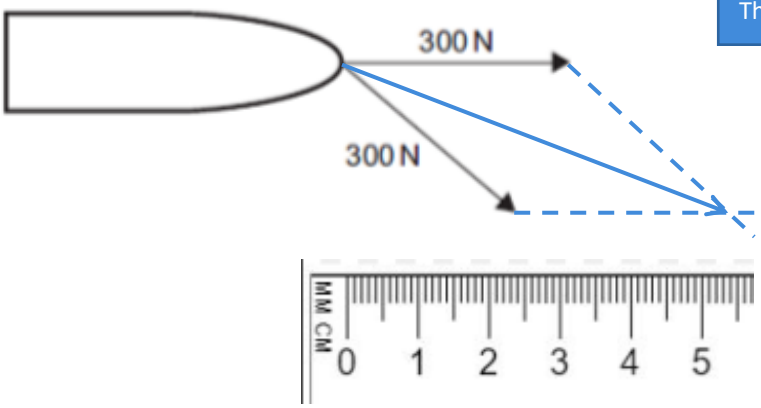


In this scale diagram 1cm is 1 N. Therefore the resultant force is 5N

Worked example 2

Two fishermen pull a boat. Each fisherman pulls with a force of 300 N, as shown in the diagram.
The diagram is draw to scale.
Draw the resultant force and determine its magnitude.

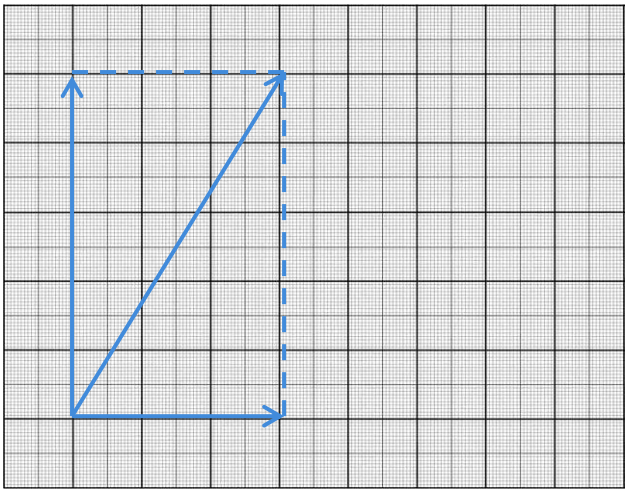
The scale of the diagram is 1cm = 100 N



The length of the resultant force is 5.5cm, therefore the resultant force is 550 N.

Worked example 2

Draw a scale diagram to find the resultant of a 50 N force acting at 90o to a 30 N force.

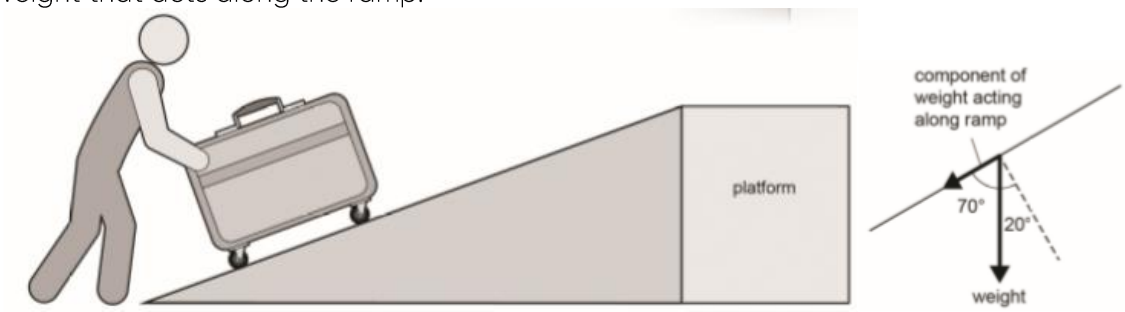


The scale of the diagram is 1sq = 10 N

The length of the resultant force is 6sq, therefore its magnitude is 60 N.

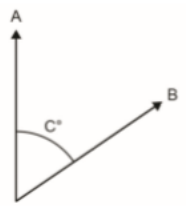
Practice B

1. The diagram shows a person pushing a loaded suitcase up the ramp at an angle of 20° to the ground. The weight of the loaded suitcase is 800 N. Draw a scale diagram to work out the component of the weight that acts along the ramp.



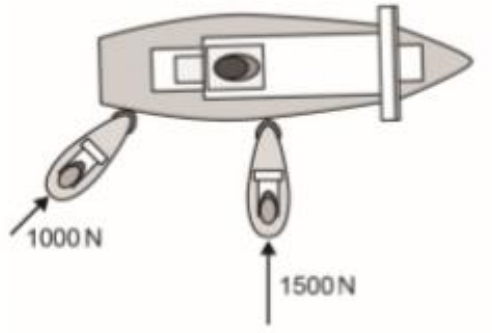
2. The diagram shows two forces at an angle. Draw scale diagrams to work out the size and direction of the resultant force if:

(a) A= 50 N, B= 25 N, C= 90o
(b) A= 100 N, B= 40N, C= 60o
(c) A= 20 N, B= 50 N, c= 40o

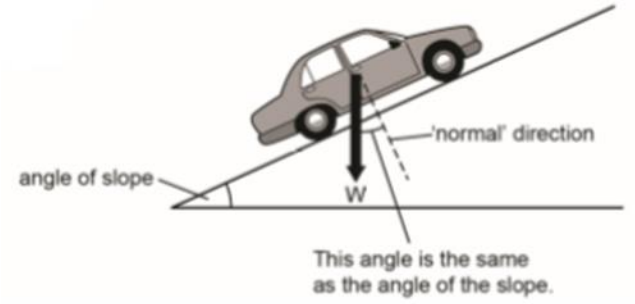


Assessment B

1. Two tug boats are pushing a ship. The angle between the two 'pushes' is 45o. Draw a scale diagram to work out the size and direction of the resultant force.



2. When a car is driven up a hill, part of its weight is acting normal to the surface and part is acting to pull it down the hill. Use a scale diagram to resolve the weight if the car into components normal surface and down the hill if the weight is 1200 N and the angle of the slope is 10o.



Objective C: Calculate resultant forces by resolving forces on two axes

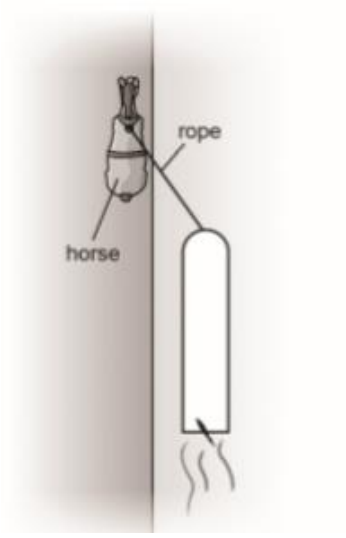
Worked example 1

The diagram on the right shows a horse pulling a canal boat.

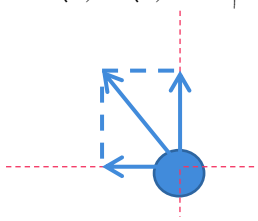
(a) Explain why a person has to steer the boat to make sure it does not run into the bank

(b) Sketch a diagram showing the force along the rope and the components of this force along the canal and towards the bank

(c) Explain why using a longer rope between the horse and the boat would be more efficient. Include a sketch of resolved forces in your answer.

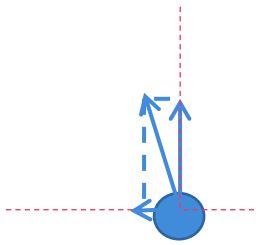


(a) – (b) The point-mass diagram shows the components of the force pulling the boat.



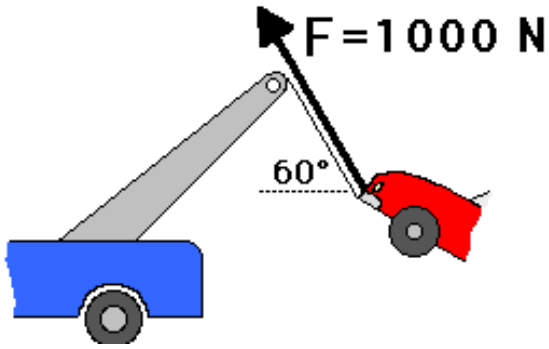
Apart from the component pulling the boat along the canal, there is a component pulling the boat towards the bank that is why a person needs to steer the boat away from the canal.

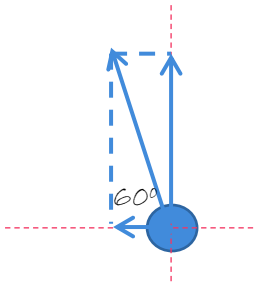
(c) The mass-point diagram below shows the components of the force pulling the boat if the rope was longer



As shown in the diagram the angle between the pulling force and the direction along the canal is small and show this force component is larger. It is therefore more efficient to pull the boat with a longer force.

Worked example 2
Consider the tow truck at the right. If the tensional force in the cable is 1000 N and if the cable makes a 60° angle with the horizontal, then what is the vertical component of the force that lifts the car off the ground?



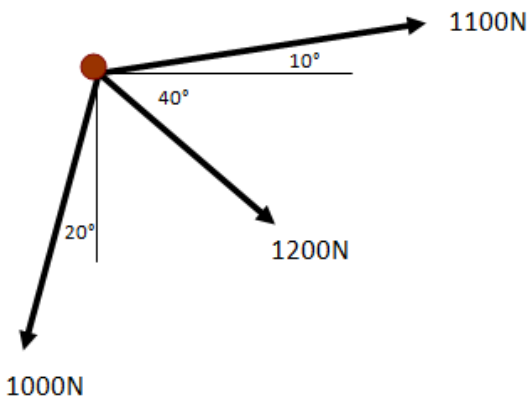


The vertical component of the force is equal to the
cos60° x 1000N = 500 N

Practice C

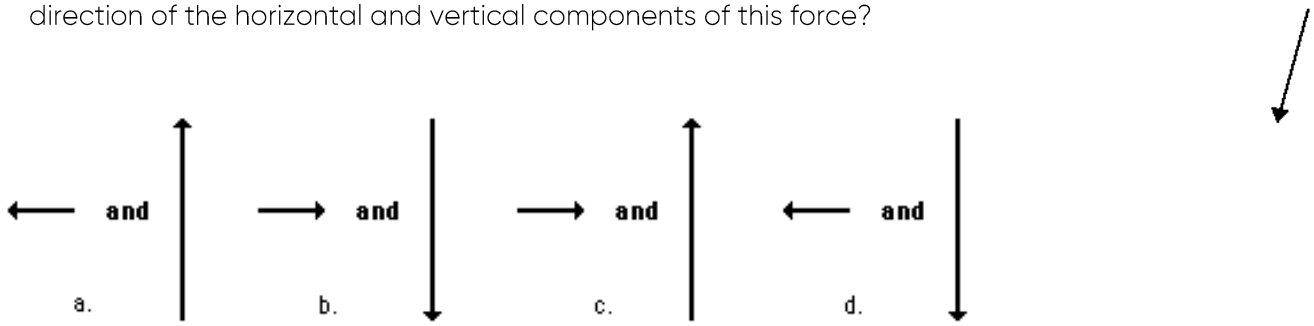
1. An aeroplane is approaching a runway. Its engines are producing 40kN of thrust. The wind is pushing the aeroplane at right angles to the runway with a force of 10kN. Calculate the angle to the runway at which the aeroplane must point if it is to land safely.

2. A large rock is being pulled by 3 people as shown in the force vector diagram. Determine the magnitude of the resultant force on both axes.



Assessment C

1. The diagram at the right shows a force that makes an angle to the horizontal. This force will have horizontal and vertical components. Which one of the choices below best shows the direction of the horizontal and vertical components of this force?



2. Diagram A shows the boat sailing across the wind. A boat can sail much faster at this angle to the wind compared with the angle in diagram B, even though the sail produces the same force. Explain why this is so.

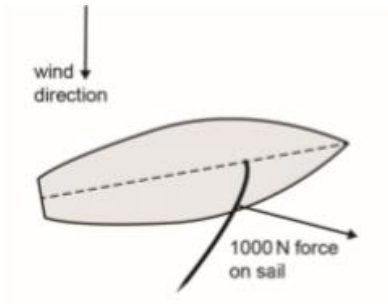


Diagram A

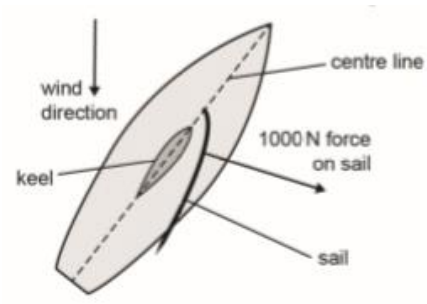


Diagram B

Tutorial 6 – Final Assignment
(Total marks = 25)

1. We use arrows to represent the magnitude and direction of a force.
   c. State the name for quantities than have both a magnitude and a direction.

(1)

   d. Apart from forces, name one other quantity that has both a magnitude and direction.

(1)

   c. State the name for quantities that have a magnitude but not a direction.

(1)

   d. Give one example of a quantity that has a magnitude but not a direction

(1)

(Total for question 1 = 4)

2. A jumping flea has an acceleration of 2000 m/s^2. The mass of a flea is 0.5 mg. Calculate the force exerted by the flea as it jumps.

(Total for question 2 = 2)

3. A car's engine is producing a forward force of 1000 N. the resistance forces on the car add up to 2000 N.
   c. Draw a labelled free body force diagram showing the forces on the car

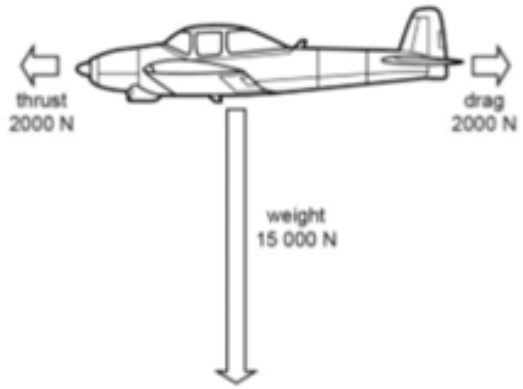
(2)

   d. Calculate the resultant force on the car.

(2)

(Total for question 3 = 4)

4. The drawing shows some of the forces acting on an aeroplane. The aeroplane is flying at 60 m/s at constant height, so the lift force (not shown on the diagram is equal to the weight.



d. State what will happen to the speed of the aeroplane if the horizontal forces remain as shown in the diagram.

(1)

e. The angle of the wings is changed to give a lift force of 12 000 N. Draw an arrow on the diagram to represent this force.

(1)

f. i Calculate the resultant force on the aeroplane in a vertical direction

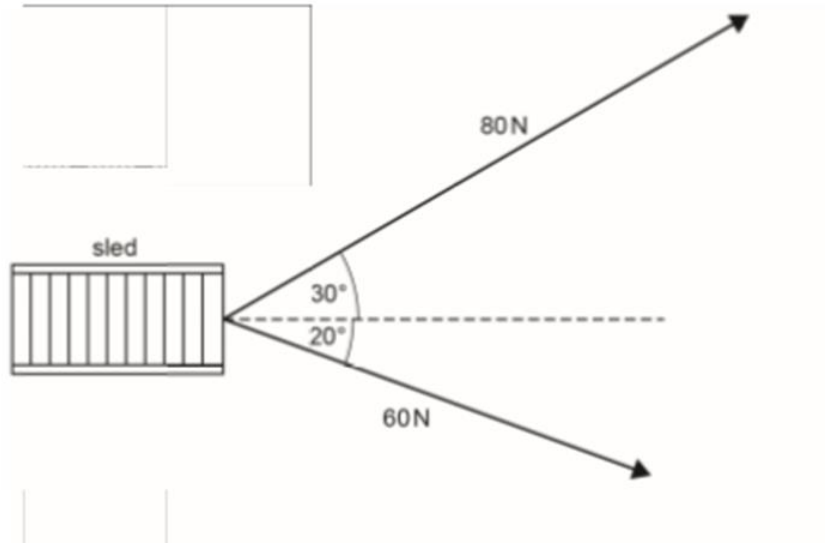
(2)

ii Explain what will happen to the aeroplane

(2)

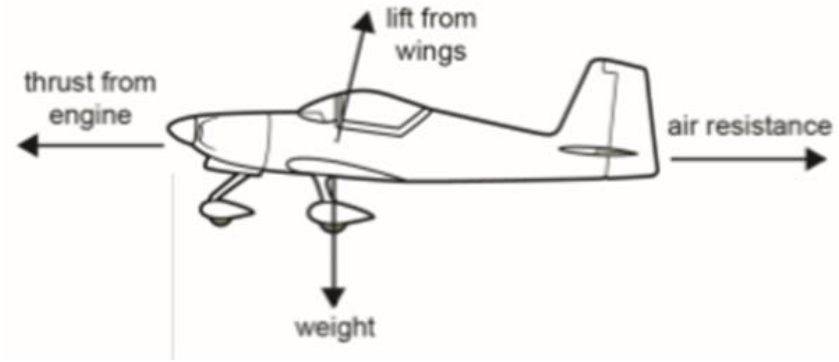
(Total for question 4 = 6)

5. Two people are pulling a sled. The diagram is a scale drawing showing the forces on the two ropes. The scale is 1 cm : 10 N.
Complete the scale drawing to find the size of the resultant force on the sled.



(Total for question 5 = 3)

6. The drawing shows the forces on an aeroplane. Explain how you can work out the overall resultant force on the aeroplane if you are goven the sizes of the forces.



(Total for question 6 = 6)

Tutorial 7 – Feedback

What is the Purpose of Tutorial 6?

- To receive feedback on final assignments.
- To share examples of best practice with the other pupils in your group.
- To write targets for improvement in school lessons.
- To reflect on the programme including what was enjoyed and what was challenging.

Final assignment feedback

What I did well…	What I could have improved on…
•	•
•	•
•	•

My target for future work is…

Reflecting on Uni Pathways

What did you most enjoy about Uni Pathways?
•   •   •

What did you find challenging about the programme?	How did you overcome these challenges?
• • •	• • •

Notes

Notes

Notes

Physics
Resultant Forces

Key Stage 4 Programme

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