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EB Education Revision Guide

How to work with Required Practicals: Part 8 Combined (AQA Physics Paper 2)

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Practical 1: Force and Extension

What you need to know

To investigate the relationship between the force and extension of a spring.

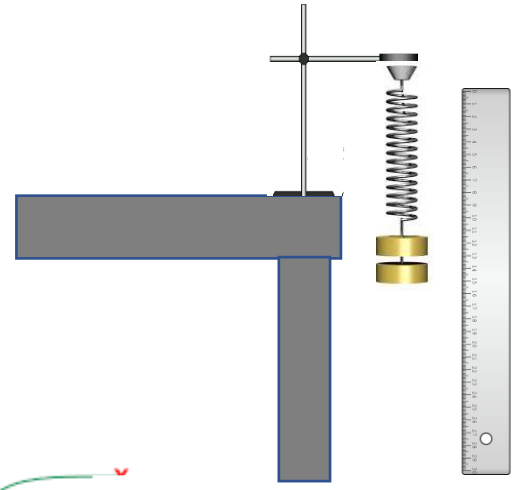
Known masses are placed on a spring, the total resultant length of the spring measured, and its extension calculated. The extension is the total increase from the original length. The extension will be zero with no weights, but the length of the spring will be a few cm.

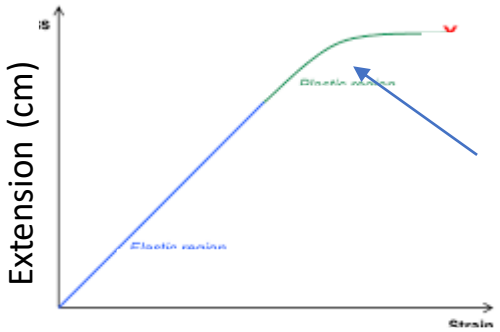
The mass (in grams) written on the weight stack needs to be converted into a weight in newtons, using the equation

weight (N) = mass (kg) x gravitational field strength (N/kg).

You may be asked to:

- Describe the relationship between force and extension. The proportional relationship is known as Hooke's Law.
- Label the limit of proportionality on an extension-force graph (where it's no longer a straight line, and extension is no longer proportional to force).





Limit of proportionality

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Practical 2: Acceleration

What you need to know

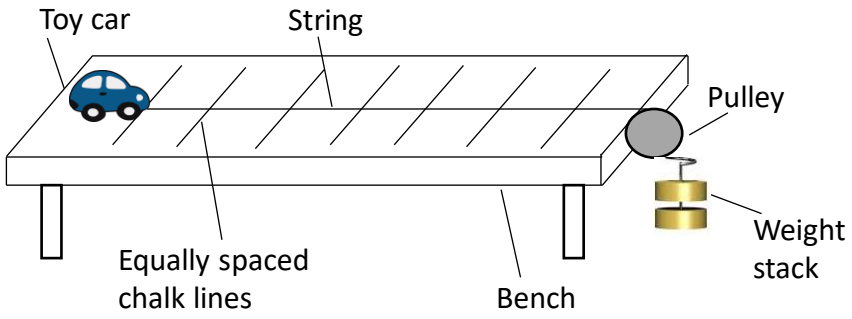
To investigate:

- **the effect of varying the force on the acceleration of an object of constant mass**
- **the effect of varying the mass of an object on the acceleration produced by a constant force**

Method:
Draw straight lines in chalk onto the bench at equally measured intervals to allow the time to travel set distances to be recorded. Set up a weight stack, string and pulley to provide force and attach to the toy car. Add weights to accelerate the car along the bench.
To investigate the effect of force on acceleration with constant mass, repeat the experiment with different masses on the end of the string ensure that the mass of the car is constant.
To investigate the effect of mass on acceleration with constant force, use the same mass on the string and add different masses to the top of the car.

Diagram

Newton's Second Law: if forces are unbalanced the speed and/or direction of the object may change
Force = mass x acceleration



You may be asked:

- How to improve the experiment. You could use light gates or use a phone to film the sequence in order to get more reliable data.
- To complete calculations

Force (N) = mass (kg) x acceleration (m/s^2)

$$\text{Acceleration } (m/s^2) = \frac{\text{change in velocity } (m/s)}{\text{time } (s)}$$

Practical 3: Generating and observing waves

What you need to know

To observe waves in a ripple tank and measure wavelength, frequency and wave speed.

- observing water waves in a ripple tank

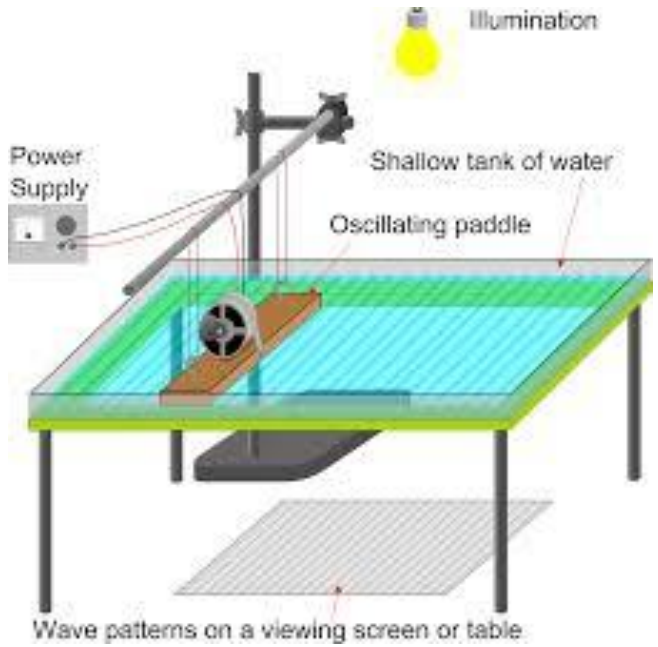
Around 5mm of water is placed into a ripple tank, and the wooden rod placed so it just touches the surface of the water. The ripple pattern can be viewed either on a large sheet of white card placed on the floor directly below the ripple tank or on the ceiling, depending on whether you set the lamp above or below the ripple tank. The position of the lamp should be adjusted to give a clear image. The lamp and motor are switched on, and the speed of the motor adjusted to produce low frequency water waves.

Wavelength –a metre ruler is positioned at right angles to the projected waves. Measurements are taken across as many waves as possible then the total length is divided by the number of waves.

Frequency –the number of waves passing a point in the pattern over a given time (e.g. 10 seconds) is counted. This is then divided by the time (10).

Wave speed = frequency x wavelength

Diagram



A stroboscope could be used to 'freeze' the pattern. The frequency of the stroboscope is then the frequency of the waves. As a stroboscope is a flashing light, it can cause epileptic fits, and this should be considered in the risk assessment.

Practical 3: Generating and observing waves

What you need to know

- observing waves on a stretched spring or elastic cord

The vibration generator is switched on and the string (or elasticated cord) should start to vibrate. The tension in the string can be adjusted, or the wooden bridge can be moved to change the length of the string in order to see a clear wave pattern. The waves should look like they are stationary.

Wavelength- a metre rule is used to measure across as many half wavelengths as possible (a half wavelength is one loop). Then divide the total length by the number of half waves and multiply this by 2 to find the actual wavelength

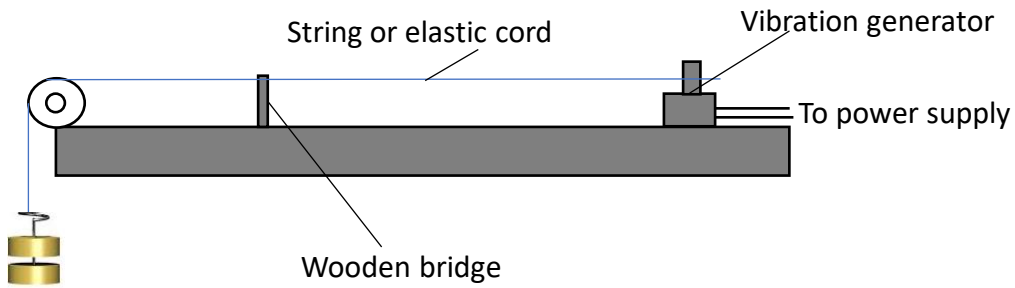
Frequency - this is the frequency of the vibration generator.

Wave speed = frequency x wavelength

You may be asked:

- How could you measure the waves more accurately. You could use a different colour or width string to make it easier to see the waves.
- To discuss repeatability, reproducibility, uncertainty and calculate means.

Diagram



Wave Speed = frequency x wavelength.
If the frequency is doubled, the wavelength is halved and vice versa.
Wave **speed stays the same** because it's always the same material.

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Practical 4: Radiation and absorption

What you need to know

To investigate how the amount of infrared radiation absorbed or radiated by a surface depends on the nature of that surface.

The Leslie cube, which has different coloured surfaces, is placed on to a heat proof mat. The cube is filled with very hot water, and the lid replaced. The infra-red detector is used to measure the amount of infra-red radiated from each surface. The detector needs to be the same distance from each surface. This experiment could also be carried out using different coloured cans and measuring the temperature of the water.

You may be asked:

- To explain why lids should be placed on the cube/containers. This is to reduce any heat loss through convection.
- To explain what the control variables are – containers should be the same size, volume and thickness, and the starting temperature of the water should be the same.

Matte black surfaces **absorb** and **emit** much more radiation than shiny smooth surfaces.

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Your turn:

1. Objects can be weighed using a newton meter.

a) The spring inside a newton meter behaves elastically. What will happen to the length of the spring when an object is removed from a newton meter?

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b) Sarah carries out a practical to investigate the extension of a spring.
Write a method that she could have used.

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Your turn:

c) What could improve the accuracy in her investigation. Tick two boxes.

Use a stronger spring in the practical	
Make sure the spring is stationary between each reading	
Use a pointer from the spring to measure the length	
Use a longer rule when measuring length	
Use a new spring between each reading	

d) Using the graph determine the additional force which would be required to increase the extension in the spring from 5cm to 7cm.

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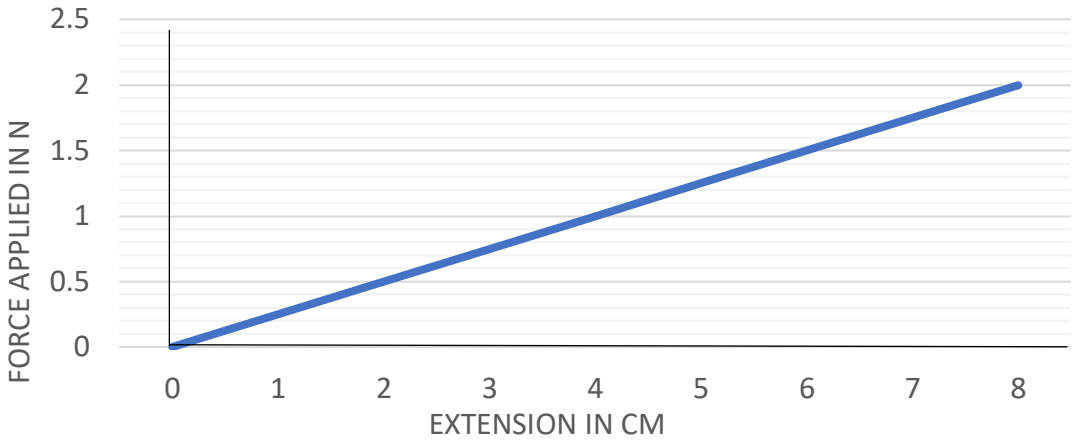

e) Looking at the graph above, tick which box describes the relationship between force applied and extension

Extension increases by smaller values as force increases	
Extension is directly proportional to force	
Extension is inversely proportional to force	

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Your turn:

f) Sarah carried out another investigation with a different spring. Her results are below.

Force applied in N	Extension in m
0.0	0.000
0.5	0.025
1.0	0.050
1.5	0.075

What would the extension be when a force of 2N is applied?

……

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……

g) Calculate the work done in stretching the spring until the extension of the spring is 0.050m.

The spring constant for the spring is 20N/m

elastic potential energy = 0.5 × spring constant × (extension)^2

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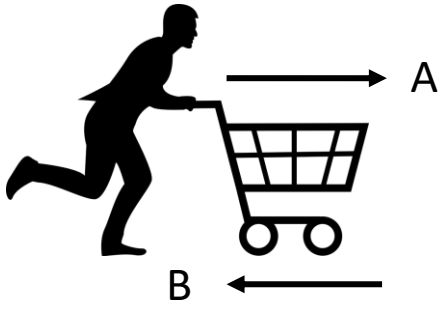
Your turn:

2. Lewis is pushing a shopping trolley at a constant speed. The arrows on the diagram represent the horizontal forces on the trolley.



i) Compare the size of force A to force B.

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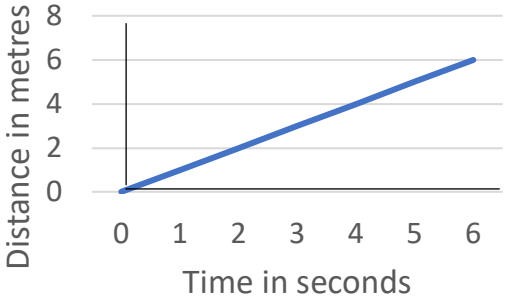
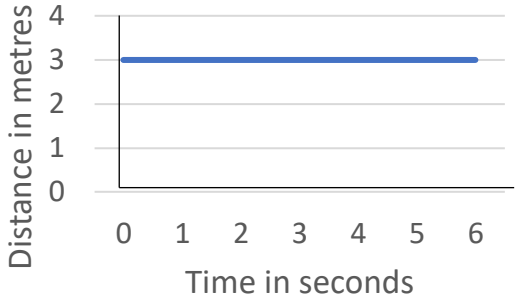
ii) Which of the following distance-time graphs shows the motion of the trolley?

D



E



b) What is acceleration?

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c) The same size of force is used to push three trolleys and make them accelerate.

A B C

State which trolley will have the smallest acceleration and explain your reason why.

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Your turn:

3. A train accelerates at a constant rate in a straight line. In 60 seconds, the velocity of the train increases from 30m/s to 42m/s.

a) Calculate the change in the velocity of the train.

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b) Calculate the acceleration of the train and include units in your answer.

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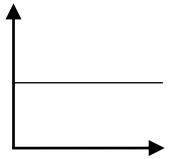
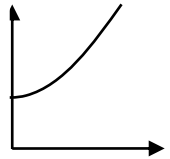
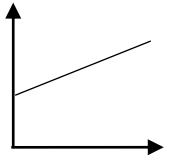
c) Which of the graphs below shows how the velocity of the train changes as it accelerates?



A



B



C

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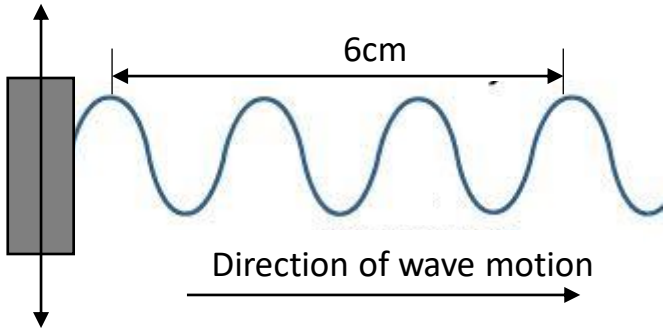
Your turn:

4. Jamie is using a ripple tank to investigate the behaviour of water waves. A bar moves up and down to make the waves.



a) What is the wavelength of each wave in the diagram above?

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b) If the ripple tank produces 10 waves in 2 seconds what is the frequency of the waves?

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c) Jamie makes the bar move faster so that it produces waves with

- A wavelength of 0.5cm
- A frequency of 20 Hz

Calculate the speed of the water waves in cm/s

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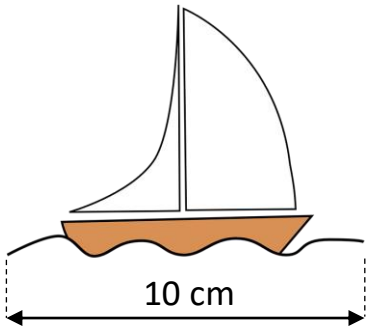
Your turn:

5. Imogen tests a design for a sailing boat using a scale model in a tank of water.



a) Waves are produced on the surface of the water. Use the diagram above to calculate the wavelength of one wave.

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b) Once the scale model had been tested, a full-size boat was built and tested at sea.
The frequency of the waves was 0.5Hz, and they had a wavelength of 6m.
Calculate the speed of the water waves.

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c) Suggest why a scale-model is tested before a full-size boat is built.

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Your turn:

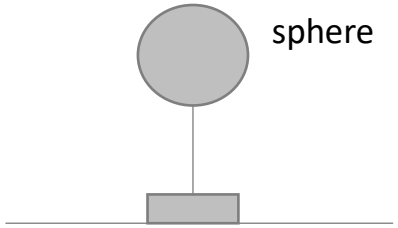
6. Objects all emit and absorb infrared radiation.

a) Using the correct words from the selection below, complete the sentences.

dark shiny dark matte light shiny light matte

The best emitters of infrared radiation have ..... surfaces.
The worst emitters of infrared radiation have ..... surfaces.

b) The sphere shown below is at a much higher temperature than its surroundings.
Energy is transferred from the sphere to the surroundings.



The table below shows readings for the sphere in three different conditions.

Condition	Temperature of sphere in °C	Temperature of surroundings in °C
A	75	3
B	85	0
C	95	35

The sphere transfers energy to the surroundings at a different rate in each of the conditions.
Put the conditions A, B and C in the correct order.

☐ ☐ ☐

Greatest rate of energy transfer → Least rate of energy transfer

Give a reason for your answer.
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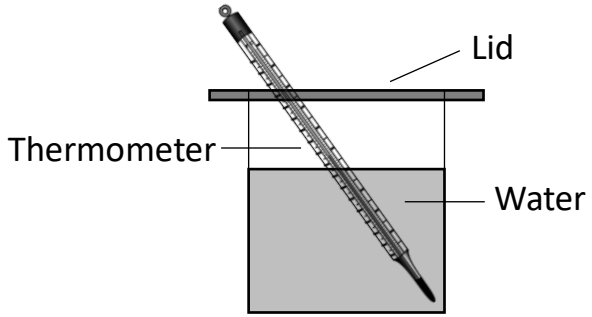
Your turn:

7. The diagram below shows a can containing water.
Toby investigates how quickly a can of water heats up when it is cooler than the room temperature.



He has four cans, each of them is made of the same material, with the following outer surfaces.

light matte light shiny dark matte dark shiny

He measures how long it takes the water in each can to reach room temperature.
The same mass of water is place in each can, at the same starting temperature.

a) Which can of water will reach room temperature the quickest?
Explain why.

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b) Suggest three control variables, other than the material of the can, mass of water and starting temperature.

1 ……
2 ……
3 ……

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Your turn:

c) The photographs below show two different foxes.

Fox A

Fox B

Which fox is better adapted to survive cold conditions?
Explain why

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Answers:

1. Objects can be weighed using a newton meter.

a) The spring inside a newton meter behaves elastically. What will happen to the length of the spring when an object is removed from a newton meter?

The spring will get shorter

b) Sarah carries out a practical to investigate the extension of a spring.
Write a method that she could have used.

set up a clamp stand with a clamp and hang a spring on it
use another clamp and boss to fix a half metre ruler alongside the spring
record the metre ruler reading that is level with the bottom of the spring
hang a weight from the bottom of the spring
record the new reading on the ruler and the extension on the spring
remove the weight and check the length of the spring
repeat by adding more weights and record the readings

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Answers:

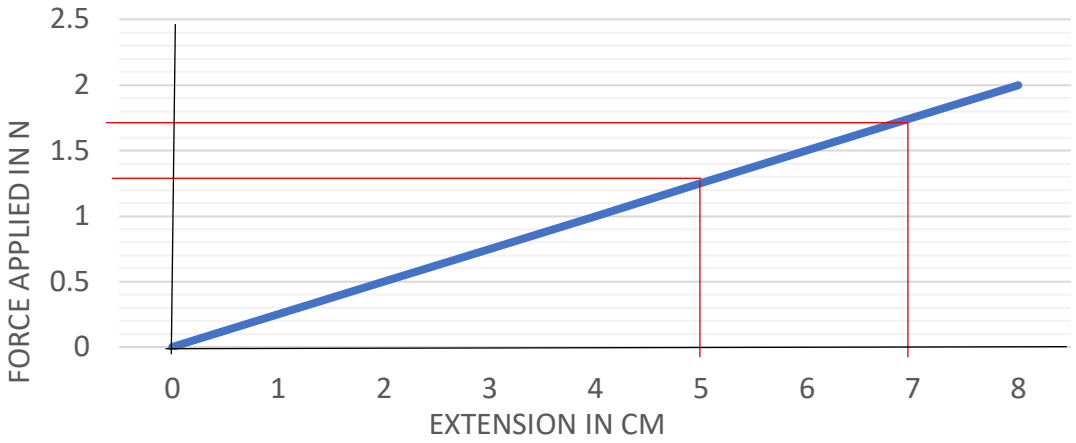
c) What could improve the accuracy in her investigation. Tick two boxes.

Use a stronger spring in the practical	
Make sure the spring is stationary between each reading	X
Use a pointer from the spring to measure the length	X
Use a longer rule when measuring length	
Use a new spring between each reading	

d) Using the graph determine the additional force which would be required to increase the extension in the spring from 5cm to 7cm.

……0.5 N……

……..



e) Looking at the graph above, tick which box describes the relationship between force applied and extension

Extension increases by smaller values as force increases	
Extension is directly proportional to force	X
Extension is inversely proportional to force	

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Your turn:

f) Sarah carried out another investigation with a different spring. Her results are below.

Force applied in N	Extension in m
0.0	0.000
0.5	0.025
1.0	0.050
1.5	0.075

What would the extension be when a force of 2N is applied?

0.100m

g) Calculate the work done in stretching the spring until the extension of the spring is 0.050m.
The spring constant for the spring is 20N/m
elastic potential energy = 0.5 × spring constant × (extension)^2

$0.5 \times 20 \times (0.05^2) = 0.025$ J

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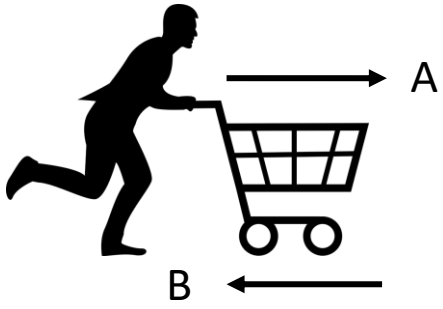
Answers:

2. Lewis is pushing a shopping trolley at a constant speed. The arrows on the diagram represent the horizontal forces on the trolley.

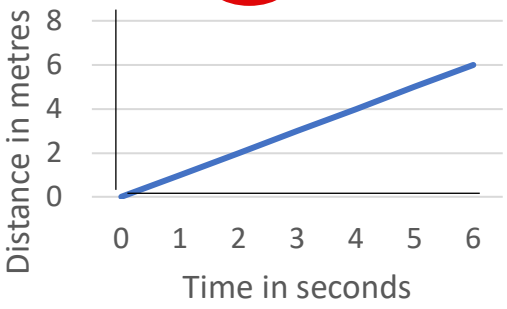


i) Compare the size of force A to force B.

They are the same size

ii) Which of the following distance-time graphs shows the motion of the trolley?

D



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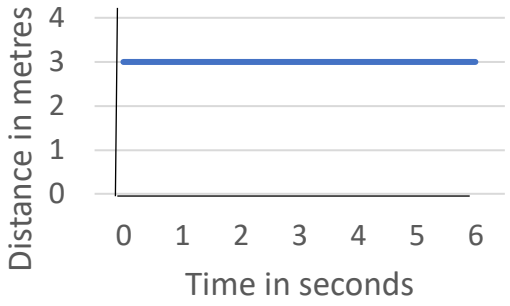

b) What is acceleration?

The rate of change of velocity

c) The same size of force is used to push three trolleys and make them accelerate.

A B C

State which trolley will have the smallest acceleration and explain your reason why.

C will have the smallest acceleration as it has the greatest mass

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Your turn:

3. A train accelerates at a constant rate in a straight line. In 60 seconds, the velocity of the train increases from 30m/s to 42m/s.

a) Calculate the change in the velocity of the train.

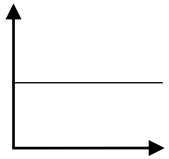
42 – 30 = 12m/s

b) Calculate the acceleration of the train, and include units in your answer.

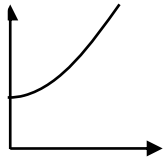
Acceleration = $\frac{\text{change in velocity}}{\text{time taken for change}}$ $\frac{12}{60}$

= $0.2 m/s^2$

c) Which of the graphs below shows how the velocity of the train changes as it accelerates?



A



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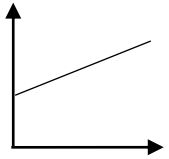

C

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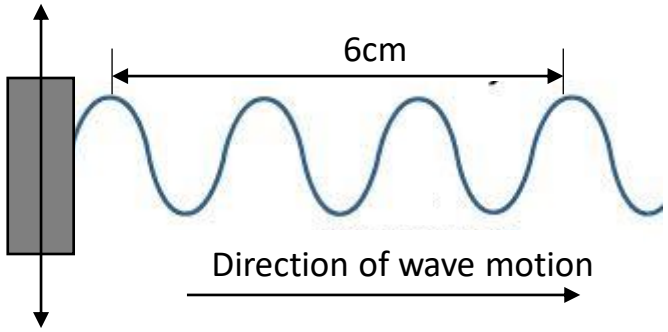
Your turn:

4. Jamie is using a ripple tank to investigate the behaviour of water waves. A bar moves up and down to make the waves.



a) What is the wavelength of each wave in the diagram above?

2cm

b) If the ripple tank produces 10 waves in 2 seconds what is the frequency of the waves?

10/2 = 5 Hz

c) Jamie makes the bar move faster so that it produces waves with

- A wavelength of 0.5cm
- A frequency of 20 Hz

Calculate the speed of the water waves in cm/s

Wave speed = frequency x wavelength

Wave speed = 20 x 0.5

= 10cm/s

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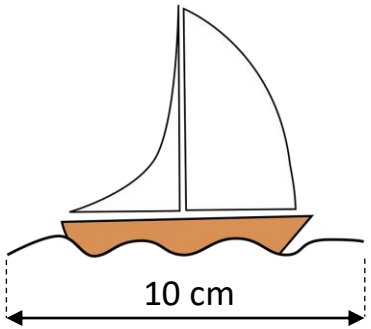
Answers:

5. Imogen tests a design for a sailing boat using a scale model in a tank of water.



a) Waves are produced on the surface of the water. Use the diagram above to calculate the wavelength of one wave.

10 ÷ 4 = 2.5cm

b) Once the scale model had been tested, a full-size boat was built and tested at sea.
The frequency of the waves was 0.5Hz, and they had a wavelength of 6m.
Calculate the speed of the water waves.

Wave speed = Frequency x Wavelength
0.5 x 6 = 3m

c) Suggest why a scale-model is tested before a full-size boat is built.

Cheaper/for safety/easier to make adjustments

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Your turn:

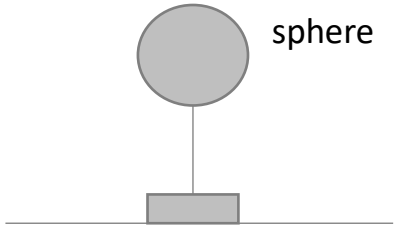
6. Objects all emit and absorb infrared radiation.

a) Using the correct words from the selection below, complete the sentences.

dark shiny dark matte light shiny light matte

The best emitters of infrared radiation have ……dark matte…… surfaces.
The worst emitters of infrared radiation have ……light shiny…… surfaces.

b) The sphere shown below is at a much higher temperature than its surroundings.
Energy is transferred from the sphere to the surroundings.



The table below shows readings for the sphere in three different conditions.

Condition	Temperature of sphere in °C	Temperature of surroundings in °C
A	75	3
B	85	0
C	95	35

The sphere transfers energy to the surroundings at a different rate in each of the conditions.
Put the conditions A, B and C in the correct order.

B → A → C

Greatest rate of energy transfer → Least rate of energy transfer

Give a reason for your answer.

……Biggest temperature difference in B……

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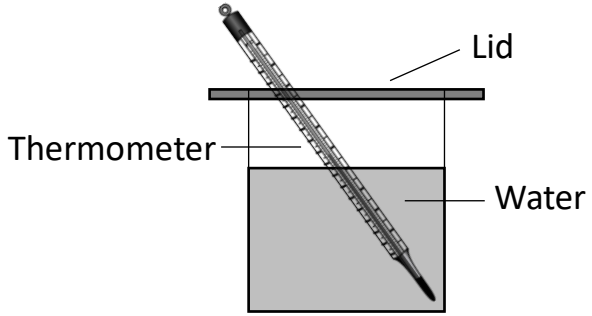
Answers:

7. The diagram below shows a can containing water.
Toby investigates how quickly a can of water heats up when it is cooler than the room temperature.



He has four cans, each of them is made of the same material, with the following outer surfaces.

light matte light shiny dark matte dark shiny

He measures how long it takes the water in each can to reach room temperature.
The same mass of water is place in each can, at the same starting temperature.

a) Which can of water will reach room temperature the quickest?
Explain why.

Dark matte because it is the best absorber of infra-red radiation

b) Suggest three control variables, other than the material of the can, mass of water and starting temperature.

1 Same surface area /shape of can
2 Same position in the room
3 Same surface underneath the can
Surrounding temperature the same for all cans

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Your turn:

c) The photographs below show two different foxes.

Fox A

Fox B

Which fox is better adapted to survive cold conditions?
Explain why

Fox A

Smaller ears , thicker fur to minimise energy transfer

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For more help and resources, or to work with us as a tutor, please contact us

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