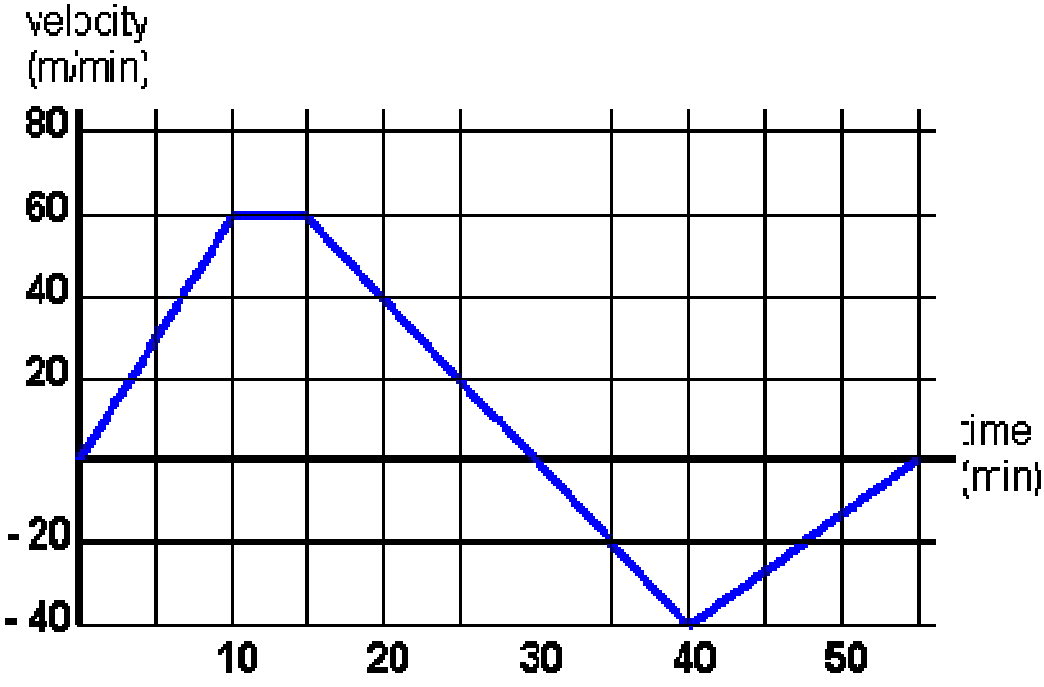
National 5

Dynamics and Space

Homework



Homework 1

1. Paul and Paula have been training to run the 200m race in a local competition. After the race, they would both like to know what their speed was.

Describe how they could measure their average speed over the race. Mention:
(i) Any equipment used.
(ii) Any measurements taken.
(iii) Any formulas that are to be used.

2. A car travels at a constant speed of 15m/s for a time of 45s. How far has the car travelled in this time?

3. A car travels a distance of 3km at a speed of 20m/s. How long will it take the car to complete its journey.

4. A train timetable for a journey between Glasgow Central and London Euston is shown below:

Destination	Time	Distance
Glasgow	0800	0km
Newcastle	0930	230km
Manchester	1145	480km
London	1430	800km

(a) Calculate the average speed of the train journey in m/s

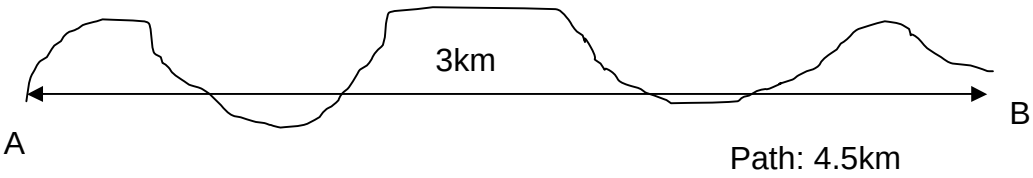
(b) Calculate the average speed, in m/s, between Glasgow and Newcastle.

Homework 1 Continued

5. A speed camera on Rouken Glen Road records a particular cars speed. The camera is set to react if the car is travelling faster than 12.5 m/s. The car passes through the speed camera zone in a time of 2.5s. If the speed camera zone is 30m, determine whether the car was speeding or not.

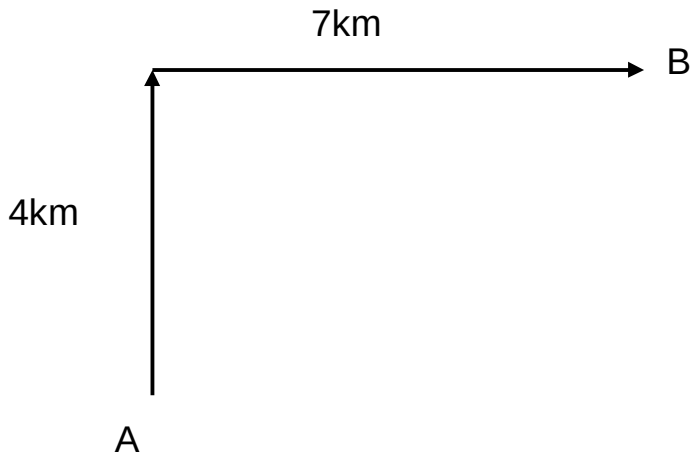
6. Describe the difference between a scalar quantity and a vector quantity.

7. The diagram below shows a path that a man has walked from A to B.



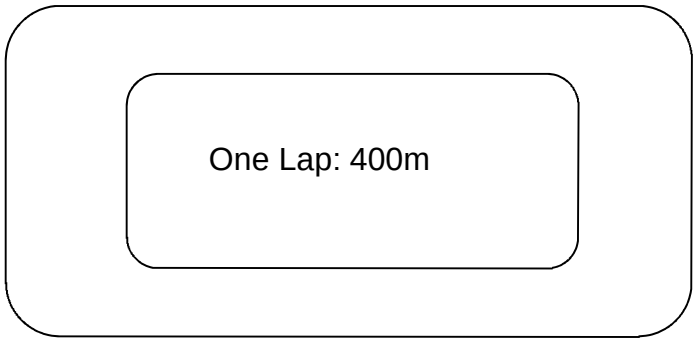
Calculate the distance and displacement that the man has travelled.

8. Using the diagram below, calculate the distance and displacement from A to B.



Homework 2

1. The diagram below shows a running track. An athlete runs round the track once. Calculate:



(a) The distance
(b) The displacement of the athlete.

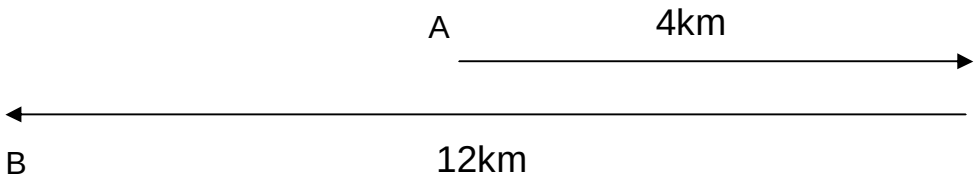
2. The same athlete runs the track 3 times in a time of 3 minutes 30s. Calculate:

(a) The speed of the athlete
(b) The velocity of the athlete.

3. A car travels a distance of 10km South followed by a distance of 8km East. Then travels a further 6km North.

(a) Using the above information, draw a diagram of the cars journey.
(b) What is the distance the car has travelled?
(c) The car travels this distance in a time of 30 minutes. What is the average speed of the car?

4. The diagram below shows the movements of a hill walker from A to B. He completes his journey in 2 hours. Using the diagram, calculate:

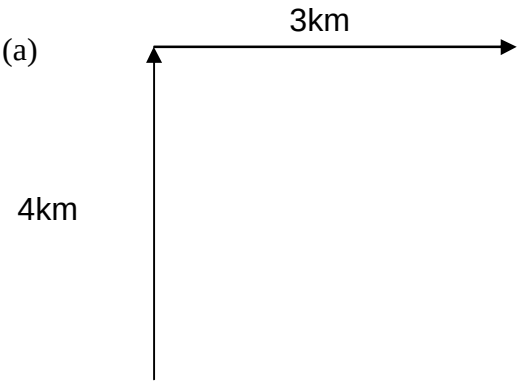


(a) The distance and displacement of the hill walker.
(b) The speed and velocity of the hill walker.

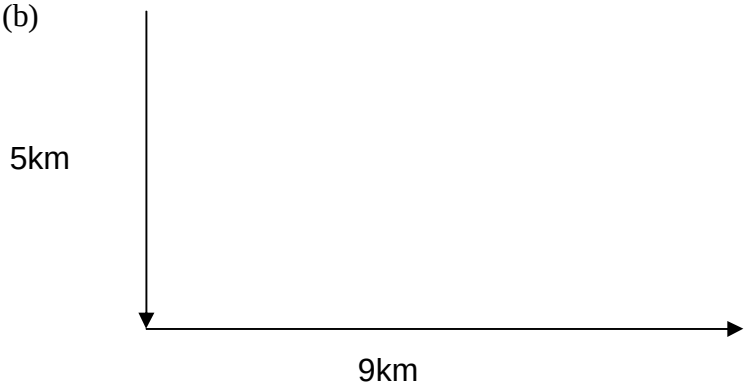
Homework 2 continued

5. Calculate the distance and displacement for each of the following diagrams:

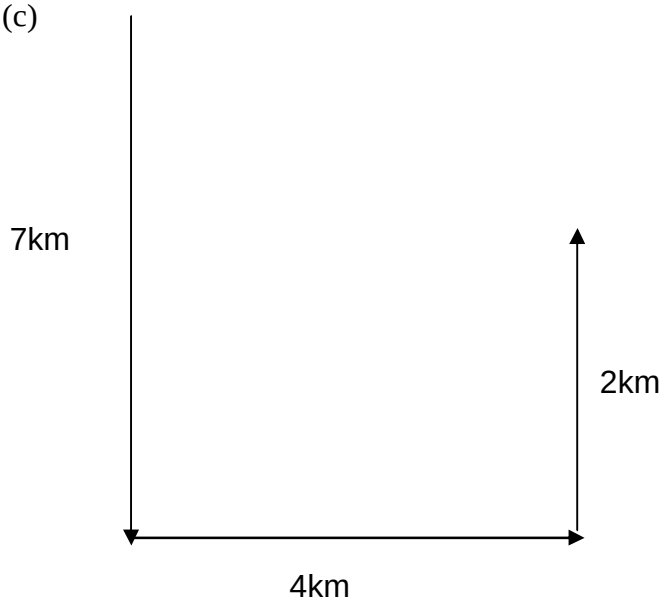
(a)



(b)



(c)



Homework 3

1. A car has an acceleration of 5m/s^2.
   (a) What does the term acceleration mean ?
   (b) What does it mean in terms of the car?

2. A man starts running from rest and reaches a top speed of 18m/s. What is his acceleration if it takes him 9s to get to this speed?

3. A car is travelling along at a constant speed of 10m/s. The car then begins to accelerate to a speed to 16m/s. If it takes the car 4s to get to this final speed, what is the acceleration of the car?

4. A car has an acceleration of 4m/s^2. If it took 10s to get to a final speed of 25m/s, what was the initial speed of the car?

5. A bullet fired from a gun reaches a top speed in 0.5s. If the acceleration of the fired bullet is 120m/s^2, what is the top speed of the bullet?

6. A car starts from rest and continues to accelerate at 4.5m/s^2 for a total time of 15s. What will be the final speed of the car after this time?

7. How long will it take an aircraft to get from 30m/s to 75m/s if the acceleration of the aircraft is 15m/s^2?

8. A car is driving along a road at a constant speed of 15m/s. How long does it take the car to come to a stop if the car decelerates at 2m/s^2?

9. A car is travelling at a constant speed of 6m/s before it begins to accelerate at 2.5m/s^2.

   (a) If the car accelerates for 4s, what is the final speed of the car?
   (b) The car continues to travel at this new speed for a further 15s. How far does the car travel at this speed?

Homework 4

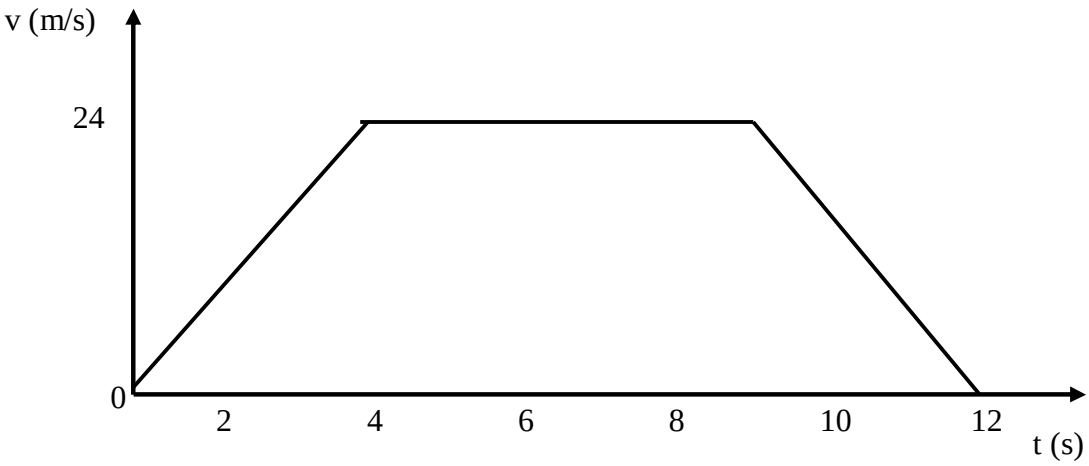
1. An athlete in the 100m sprint completes the race in 9.8s

   (a) What is the average speed of the athlete?
   (b) What is the difference between average speed and instantaneous speed?

2. Draw a velocity-time graph using the following information:

   A car starts from rest and accelerates to a top speed of 14m/s. This acceleration takes 5 seconds. The car then travels at this speed of 14m/s for a further 6 seconds. The car then brakes suddenly and comes to a stop in 4 seconds.

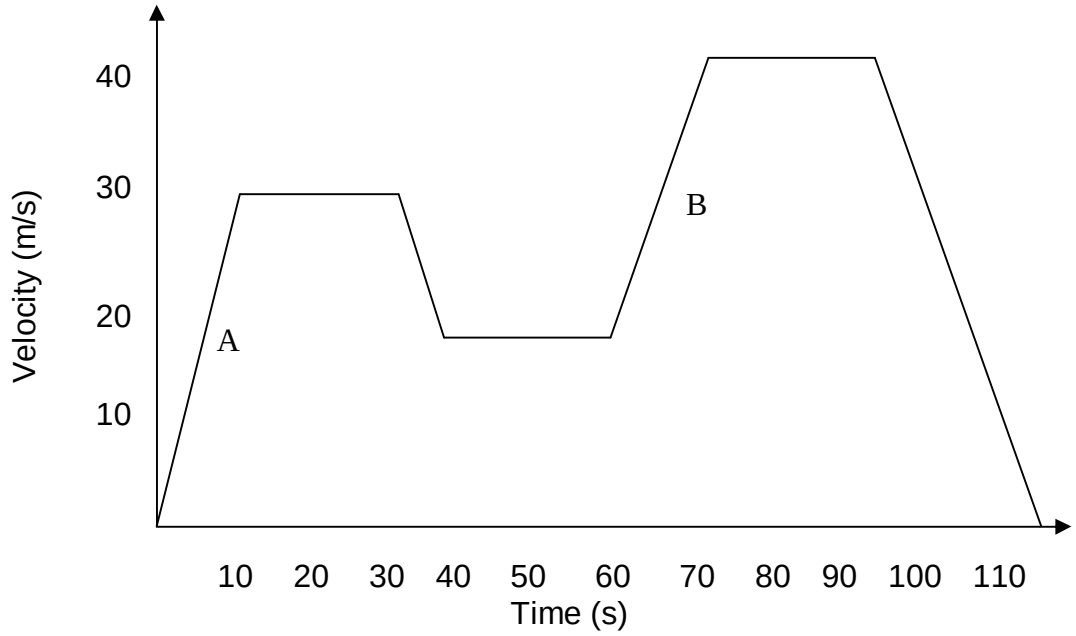
3. The velocity-time graph below shows the motion of a given object:



   (a) What is the acceleration of the car over the first 4 seconds of the journey?
   (b) What is the acceleration of the car over the final 3 seconds of the journey?
   (c) Calculate the distance the car has travelled during 4 and 9s.

Homework 4 continued

4. The following velocity-time graph represents the motion of a car over a time:



(a) Calculate the initial acceleration of the car.
(b) Calculate the distance travelled by the car between 40 and 60 seconds.
(c) Calculate the total distance travelled by the car.
(d) The car goes through two periods of acceleration. During which section, A or B, does the car have a greater acceleration?

Homework 5

1. (a) What three factors can be affected by a force?
   (b) What are the units of force and what can be used to measured the force acting on an object?

2. (a) Describe the differences between mass and weight.
   (b) State the value of the gravitational field strength of Earth.

3. Calculate the weight of a 40kg girl.

4. A sack of potatoes has a weight of 620N. What is the mass of the sack of potatoes?

5. An astronaut is preparing to go to the Moon. He must first get his mass and weight checked.

   (a) The astronauts mass is measured to be 75kg. What is his weight?
   (b) Gravity on the Moon is much less, with a value of only 1.6N/kg. State the mass and weight of the astronaut on the Moon.

6. The following table identifies the strength of gravity on the planets of the Solar System:

   (a) Calculate the weight of a 70kg astronaut on:
   (i) Mars
   (ii) Venus

   (b) Another astronaut on Neptune has a weight of 649N. What is the mass of this astronaut?

   (c) A third astronaut weighs 2118N on Jupiter. What will be the weight of this astronaut on Earth?

Planet	g (N/kg)
Mercury	3.7
Venus	8.8
Earth	10
Mars	3.8
Jupiter	26.4
Saturn	11.5
Uranus	11.7
Neptune	11.8
Pluto	4.2

Homework 6

1. When an object is moving, there is said to be friction acting upon it. What is friction?

2. Give two examples where friction can be useful/needed, and two examples where friction is a nuisance.

3. Give two examples of how to reduce friction, and two examples of how to increase friction.

4. State Newton's first law of motion. Use a diagram to aid your explanation.

5. The following free body diagram shows the forces acting on a car which is travelling at a constant speed:

   (a) If the engine exerts a force of 20,000N moving the car forward, what is the value of friction? Explain your answer.

   (b) Describe how the friction of the car could be reduced without making changes to the car.

Homework 6 continued

6. The following picture is of a sky diver of mass 50kg falling through the air:

Mass = 50kg

(a) Copy and complete the diagram (using a box for the sky diver), correctly identifying the forces acting on him.

(b) The sky diver is falling at a constant speed. What is the name given to this speed?

(c) What is the size of the frictional force.

(d) Draw a velocity-time graph showing the motion of the sky diver during his descent.

Homework 7

1. State Newton's second law of motion.

2. A car of mass 1200kg has an acceleration of 5m/s^2. Calculate the force produced by the car.

3. A trolley of mass 500g is pushed by a force of 7N. Calculate the acceleration of the trolley.

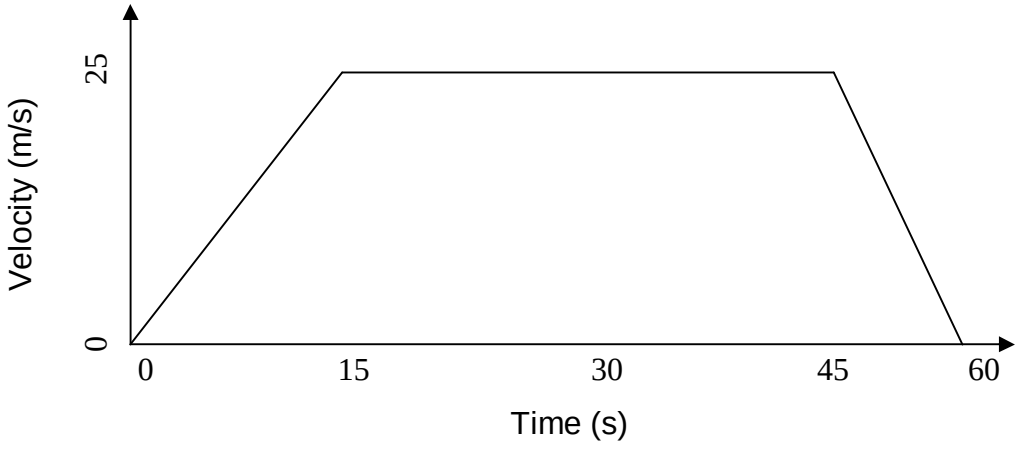
4. A car of mass 900kg is travelling at a constant speed of 6m/s. The car begins to travel faster and it takes 9s to get to a speed of 12m/s. Calculate the unbalanced force produced by the car.

5. A van of mass 1500kg has an engine force of 10,000N. There is a frictional force of 3500N acting on the van. Calculate:
   (a) The unbalanced force of the van.
   (b) The acceleration of the van.

6. A car of mass 800kg drives down a straight road. The engine of the car produces a force of 8000N. The road produces a frictional force of 2000N and the value of air resistance is 2800N.

   (a) Draw a free-body diagram showing the forces acting on the car.
   (b) State the unbalanced force acting on the car.
   (c) Calculate the acceleration of the car.

7. The following velocity time graph shows the journey of a 1000kg car over a given time. Using the graph, calculate the unbalanced force acting on the car during the period of acceleration.



Homework 8

1. A trolley of mass 50kg has an acceleration of 3m/s^2. Calculate the unbalanced force on the trolley.

2. A pupil pushes a box along a desk with a force of 300N. If the pupil pushes the box for a distance of 3m, calculate the work done.

3. A crane lifts a box with a force of 15,000N. If the work done to lift the box is 100,000J, calculate how high the box has been lifted.

4. The work done by a car is 20,000J. If the car travels a distance of 45m, calculate the force of the car.

5. A car of mass 700kg has an acceleration of 3m/s^2. The car travels a distance of 100m. Calculate the work done by the car over this distance.

6. A car of mass 800kg does 4000J of work over 30m. The car initially started at rest and took 15s to get to the maximum speed. Calculate:

   (a) The force of the car.
   (b) The acceleration of the car.
   (c) The final speed of the car.

7. A lorry of mass 5000kg travels down a straight road. The lorry has an acceleration of 5m/s^2. The road has a frictional force acting on the lorry of 3000N and air resistance has a value of 500N.

   (a) Draw a free-body diagram to show the forces acting on the lorry.
   (b) Calculate the unbalanced force acting on the lorry.
   (c) If the lorry travels for 150m, calculate the work done by the lorry.

Homework 9

1. A boy kicks a ball horizontally off a cliff. The ball travels with a speed of 15m/s. If it takes the ball 5s to fall to the ground, how far from the cliff has the ball landed?

2. A ball is kicked horizontally off a cliff with a speed of 10m/s. The ball lands 40m from the base of the cliff.

   (a) Calculate how long it takes for the ball to travel this distance.
   (b) Calculate the vertical speed of the ball as it strikes the ground.

3. A model plane is thrown horizontally from the top off a cliff. The plane lands 100m from the base of the cliff after it was initially thrown with a horizontal speed of 10 m/s.
   Calculate:

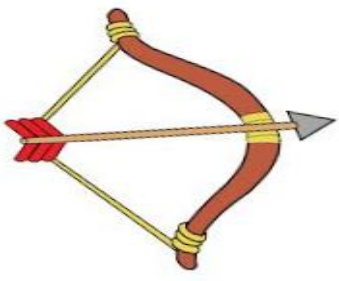
   (a) The time for the plane to travel this distance.
   (b) The vertical speed of the plane as it hits the ground.

4. During an archery competition, an arrow is fired horizontal from a bow with a speed of 70m/s. The target is 210m away.

   (a) Calculate the time it takes for the arrow to hit the target.
   (b) Calculate the distance the arrow has fallen since being fired.
   (c) Describe what the archer must do in order to hit the centre of the target.

5. A ball is kicked horizontally off a cliff with a speed of 12m/s. The ball takes 4 seconds to fall to the ground.

   (a) Draw velocity-time graphs representing the horizontal and vertical motions of the ball.
   (b) From the graphs, or other wise, calculate the horizontal and vertical distances travelled by the ball.



Homework 10

1. Copy and complete the table giving the definitions of the following terms:

Object	Definition
Planet	
Moon	
Star	
Solar System	
Galaxy	

2. What is meant by the term “light-year”?

3. Light from the Sun takes 8 minutes to travel to Earth. Calculate how far the Earth is from the Sun.

4. The Voyager 1 satellite is currently 18×10^9 km away from Earth. How long would a radio wave signal take to reach Voyager 1 from Earth?

5. The next galaxy to our own, Andromeda, is 2.5 million light years away. Describe what is meant by this statement.

6. The Moon is 400,000 kilometres away from Earth. In 1969, 3 astronauts went to the Moon for the first time. From the moment of lift-off, it took 3 days to get to the Moon.

   (a) Calculate the speed the rocket was travelling at. (Assuming the speed was constant).
   (b) Draw a free-body diagram showing the forces acting on the rocket during lift-off.

7. Using textbooks or the internet, research how solar and lunar eclipses occur. Also find out when the next total solar and total lunar eclipses are going to occur.

Homework 11: Research Task

The question as to whether there is life on other planets has been discussed for many years. Your task is the following:

- Choose your side of the argument - “yes there is life on other planets” or “no there is not”.
- Carry out research.
- Note at least 3 ideas for your argument .
- Present your information to the class as part of a debate.

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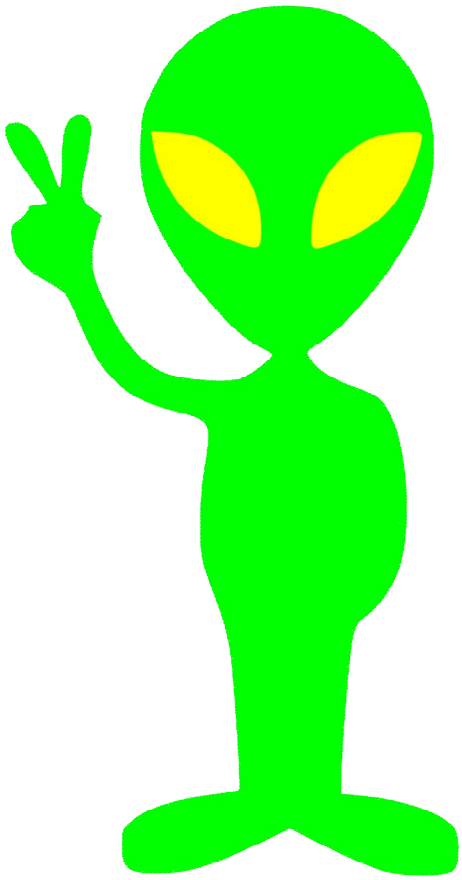


Homework 12

1. (a) In order of increasing wavelength, list the members of the Electromagnetic Spectrum.
   (b) State the speed at which these group of waves travel at.

2. When white light is passed through a prism it can split up into a number of different colours. This is known as the Visible Light Spectrum.

   (a) How many colours make up the Visible Light Spectrum?
   (b) Which of these colours has the longest wavelength?
   (c) Using your knowledge of the Electromagnetic Spectrum, copy and complete the table below matching the following wavelengths and colours:

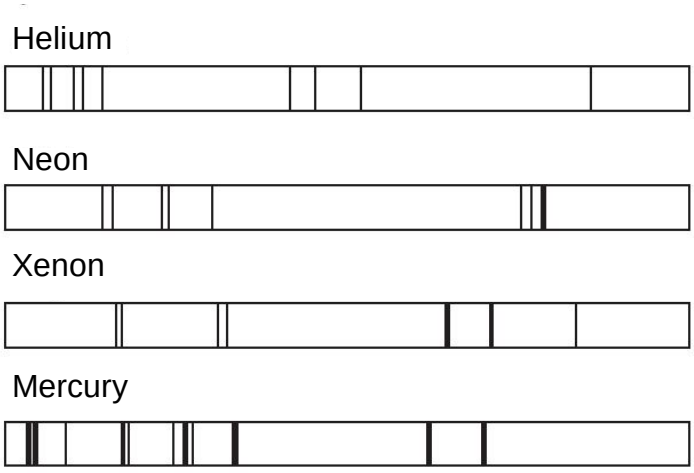
Colour	Wavelength (m)
	7×10^{-7}
	6.4×10^{-7}
Yellow	5.9×10^{-7}
	5.5×10^{-7}
	4.5×10^{-7}

3. (a) Explain how a line spectra can identify different elements that are present in a star?
   (b) An electromagnetic wave of frequency 5×10^{12} Hz is detected from a distant star.
   Using the information provided, identify the electromagnetic radiation present.

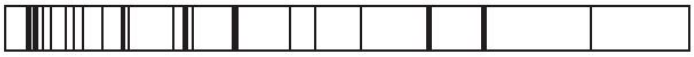
Electromagnetic Radiation	Wavelength (mm)
Microwave	3
Infrared	0.06
Ultraviolet	0.0004

Homework 12 continued

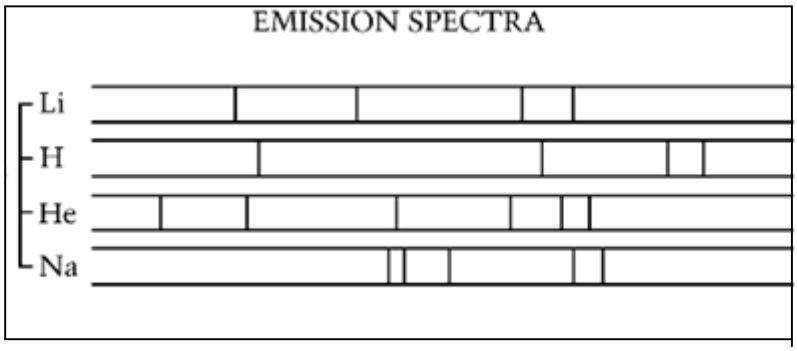
4. The following elements are represented by their line spectra.



Use the above information to identify the elements present for the following distant star:



5. The elements below have been identified in a distant star:



Draw the line spectrum representing this star.

Homework 13: Revision

1. (a) A car travels a distance of 5km while travelling at a constant speed of 6m/s. How long will it take the driver to travel this distance?

   (b) On the way home, the driver completed the journey in 10 minutes. Assuming the car was travelling at a constant speed, calculate the speed of the return journey.

2. A girl is taking part in a cross country competition. During one stage of the competition the girl runs 3km North, 2km East and then a further 5km South.

   (a) Using an appropriate scale, draw a diagram representing the girl's journey.

   (b) What is the girl's distance and displacement travelled at the end of the stage?

   (c) She takes 1 hr 30 mins to complete this stage of the race. What is her velocity at the end of the race?

3. A car is stopped at a set of traffic lights. The car begins to accelerate at 4 m/s^2 for 5s.

   (a) What is the final speed of the car after the 5s?

   (b) The car continues at this speed when the driver notices another set of red traffic lights. The car needs to come to a stop in 3s. If the car has a constant deceleration of 7m/s^2, explain whether he will he stop in time.

4. Draw a velocity-time graph for the following motion:

   (a) A car starts from rest and accelerates at 2m/s^2 for 4 seconds. The car travels at this speed for a further 5 seconds. The car decelerates for 3 seconds until it has stopped. The car then turns around. It accelerates at 1m/s^2 for 3 seconds and then travels at this constant speed for 5 seconds.

   (b) Calculate the distance travelled and the displacement of the car.

Homework 13 continued

5. An astronaut is preparing to travel to Mars. On Earth and Mars, the gravitational fields strengths are 9.8 N/kg and 3.7 N/kg respectively. Just before take-off, the astronaut's mass is measured to be 65kg.

   Calculate his weight on Earth, mass on Mars and weight on Mars.

6. A car of mass 800kg has a constant acceleration of 4m/s^2. When moving, the car has a frictional force of 600N acting on it. Calculate the force produced by the engine.

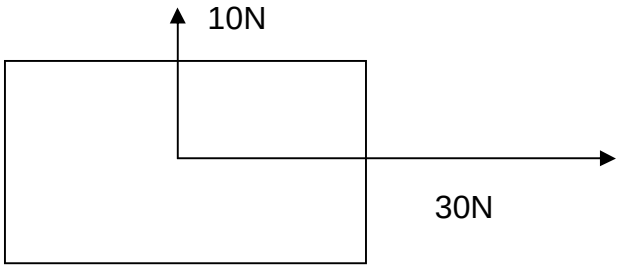
7. A rocket of mass 17 x10^7 kg prepares for take-off. The engines produce a thrust of 4x10^9 N.

   (a) Draw a free body diagram, correctly labelling the forces acting on the rocket.

   (b) Calculate the initial acceleration of the rocket.

   (c) If the rocket constantly accelerates at this value for 30s, what will be the rockets final speed?

8. Two forces act on an object at right angles as shown.



   Calculate:

   (a) the magnitude of the resultant force.
   (b) the direction of the resultant forces relative to the 30N force.

Homework 13 continued

9. A man pushes a crate along a 50m platform. The crate has a mass of 95kg. When the box is being pushed it has an acceleration of 1.5m/s^2. If the frictional force acting on the box is 32.5 N, calculate the energy used by the man in pushing the box.

10. A model plane is thrown horizontally from the top of a cliff. The plane is thrown with a horizontal speed of 5 m/s. The plane lands 75m from the base of the cliff. Calculate:

    (a) The time it takes for the plane to land.
    (b) The final vertical speed of the plane
    (c) The height of the cliff.