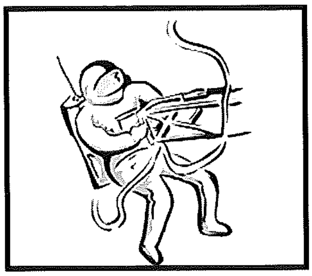
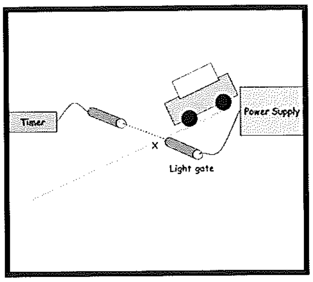
Your High School

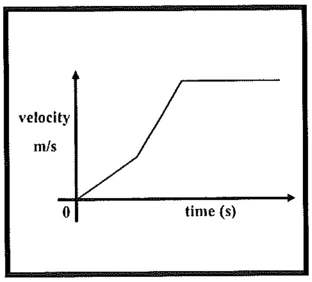
Your School Crest

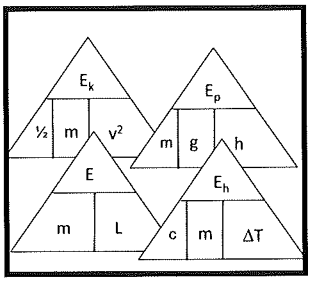
North Lanarkshire Council

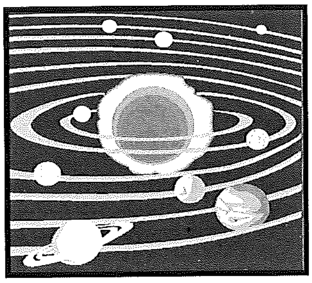
N4 N5 Physics

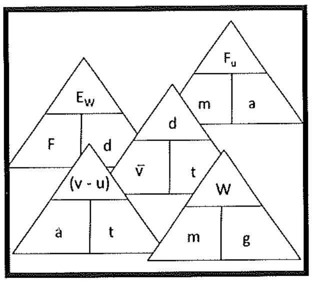


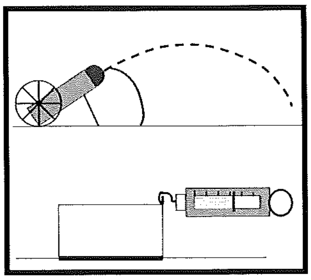


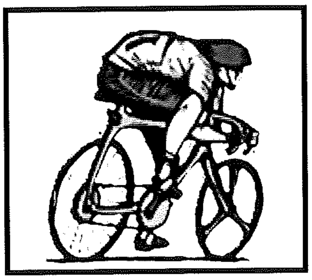


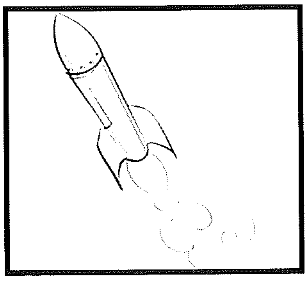












Dynamics & Space

Summary Notes

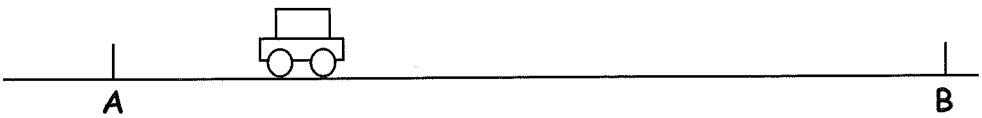
NQ5	Unit 2	Dynamics and Space	Summary Notes

A. Vectors and Scalars

1. Average speed.

Speed is a measure of the distance an object covers in a set ___________.
Over a certain distance the speed could change so the average speed is the constant speed required to cover the same distance in the same time.

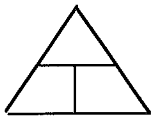
To find the average speed of this car between A and B



Measure the distance between A and B with a _____________ stick and the time taken for the car to travel from A to B with a _______________.

$$\text{average speed} = \frac{\text{distance travelled}}{\text{time taken}}$$

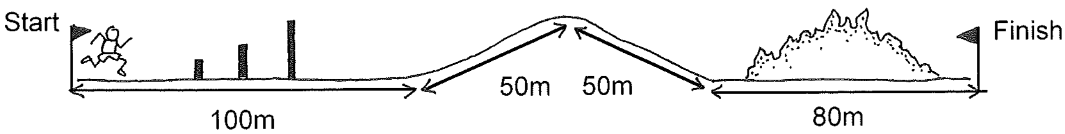
$$\bar{v} = \frac{d}{t}$$



term	units
d	
t	
$\bar{v}$	

Within this distance the speed at any point could have varied. If it travelled from A to B with this constant average speed it would have taken ___s.

Example An athlete completes the following assault course in 100s.



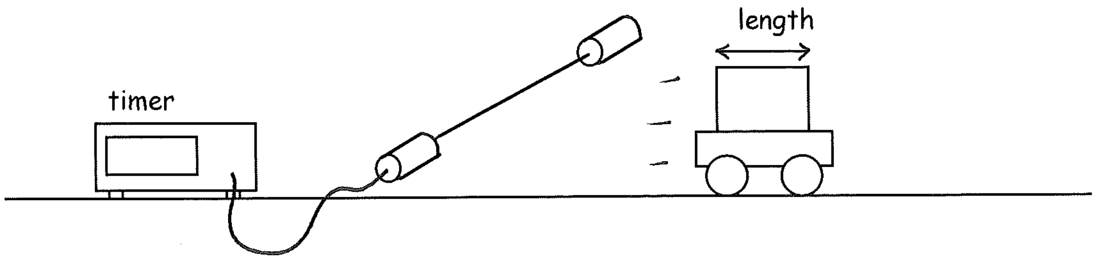
(a) Calculate his average speed

2. Instantaneous Speed

The instantaneous speed is the speed of an object at one particular ________ in the journey. It is the average speed over a very small ____________.

We usually measure instantaneous speed using a ____________ gate or in a car a s______________________ is used.

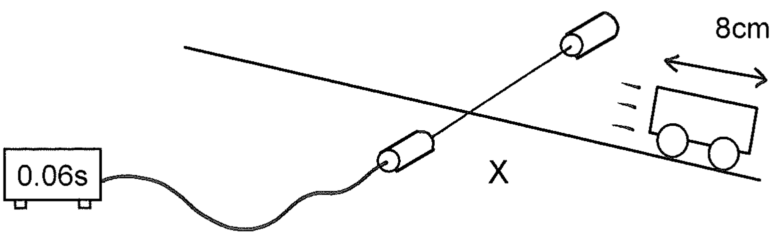
Connect the light gate to a ___________. Measure the length of the trolley with a ruler. When the trolley cuts the beam it is travelling a distance equal to its own _____________ in a time measured by the _____________.



$$\text{instantaneous speed} = \frac{\text{length of \_\_\_\_\_\_\_\_\_\_}}{\text{time it takes to cut the \_\_\_\_\_\_\_\_\_\_}}$$

$$v = \frac{d}{t}$$

Example Calculate the instantaneous speed of the trolley at point X?



3. Vectors and Scalars

Scalars are quantities which are defined by their ____________

Vectors are quantities which are defined by their size and ________________.
Fill in the table as you meet new quantities in this unit

Scalar quantity	Vector quantity

4. Distance and Displacement

Distance is defined as the total ________________ of a journey.
The symbol for distance is ____. It is a ____________ quantity.

The displacement is defined as the shortest _______________ between two points in a given _________________ from the starting point.
The symbol for displacement is ____. It is a ____________ quantity.
If there are two separate parts of the journey we add the distance vectors together to get the resultant displacement. We add vectors together nose to ________.

Example A jogger ran 60m East then 40m North.

(a) What distance did she travel?
(b) What was her displacement from the starting point?

5. Speed and Velocity

$$\text{speed} = \frac{\text{distance travelled}}{\text{time taken}} \qquad v = \frac{d}{t}$$

$$\text{velocity} = \frac{\text{displacement}}{\text{time taken}} \qquad v = \frac{s}{t}$$

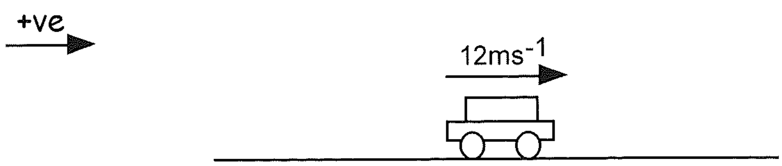
Velocity is the speed of an object in a particular direction

Example The runner from the last example ran the 60m East then 40m North in a time of 20s.

(a) What was her average speed?
(b) What was her average velocity?

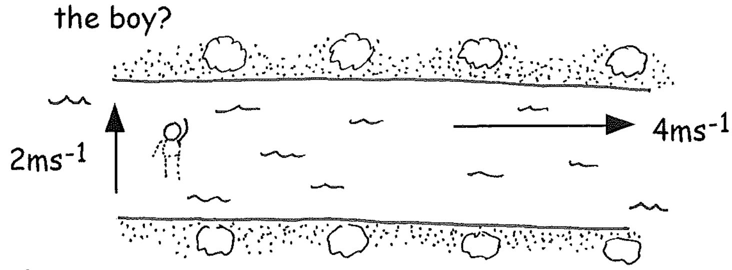
6. Velocity Vectors

When indicating the direction of an object, whether it's moving up or down or left or right we choose a direction to be positive. In the following example we have chosen to the _________ as the positive direction. The velocity of an object can be shown using a velocity vector. The following diagram indicates the car is travelling to the _________ with a velocity of ________.

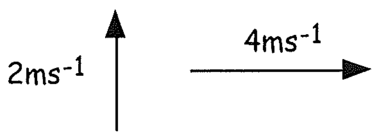


7. Adding Velocity Vectors.

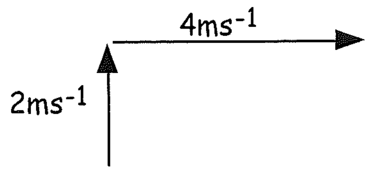
Example A boy swims across a river with a velocity of $2ms^{-1}$ (North). The river is flowing with a velocity of $4ms^{-1}$ (East.) What is the resultant velocity of the boy?



velocity vectors



add vectors nose to ________



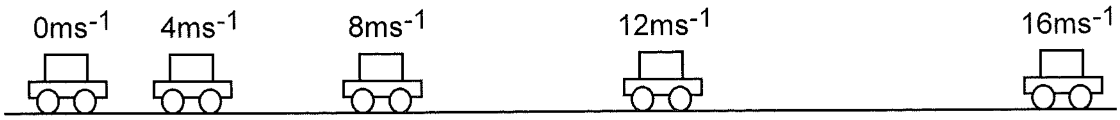
Magnitude of Resultant velocity

Direction of Resultant velocity

Velocity = ______________________

8. Acceleration

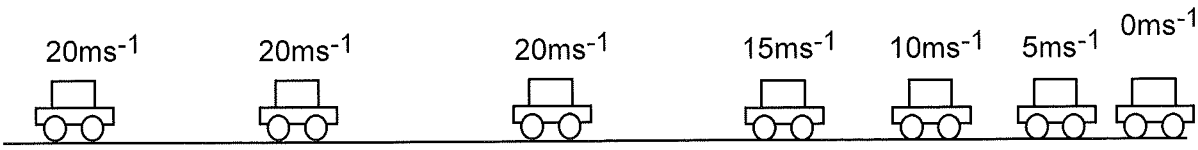
Acceleration tells you by how much the ______________ of an object has changed each second. The velocity of the following car is increasing by $4ms^{-1}$ each second.



so the acceleration = 4m/s/s or $4ms^{-2}$

If an object has an acceleration of $-4ms^{-2}$ then its velocity is decreasing at a rate of $4ms^{-1}$ each second.

This car is travelling a constant velocity of $20ms^{-1}$. The brakes are applied and the car decelerates at $5ms^{-2}$.



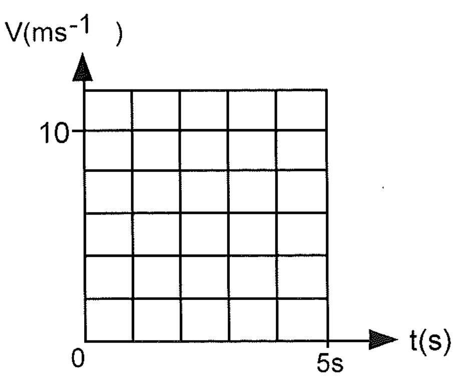
Its acceleration = -5m/s/s or $-5ms^{-2}$

If the object's velocity changes by the same amount each second we say that the object has a ________________acceleration.

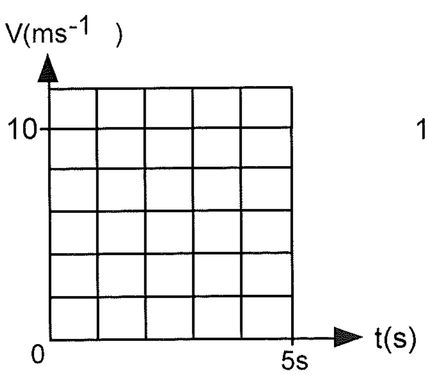
9. Velocity-Time Graphs.

A velocity time graph describes the motion of an object.

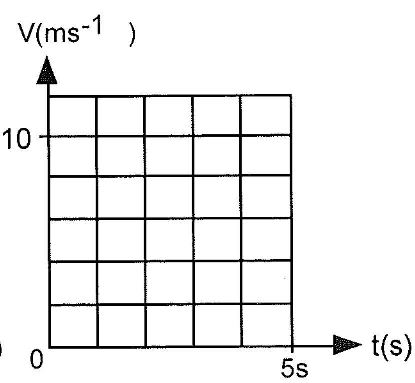
These velocity-time graphs show 3 important motions. Draw the graph which describes the motion indicated underneath



Object travelling at a constant velocity of $10ms^{-1}$ for 5s.



Object accelerating at a constant rate from rest to $10ms^{-1}$ in 5s.

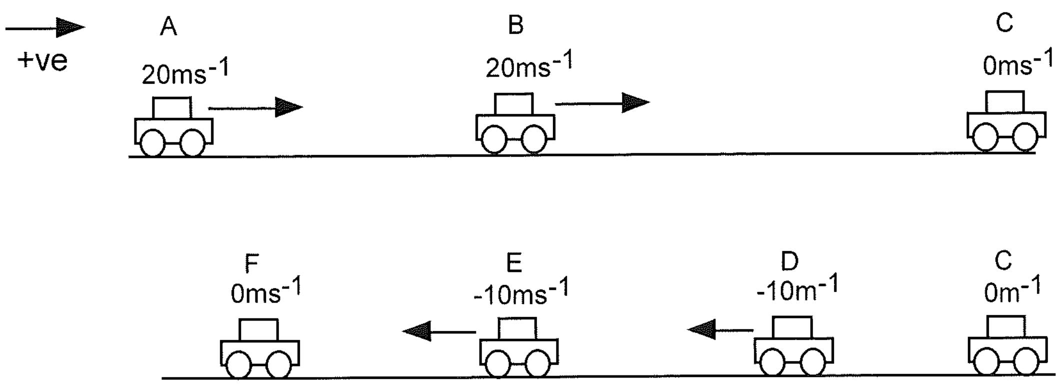


Object decelerating at a constant rate from $10ms^{-1}$ to rest in 5s

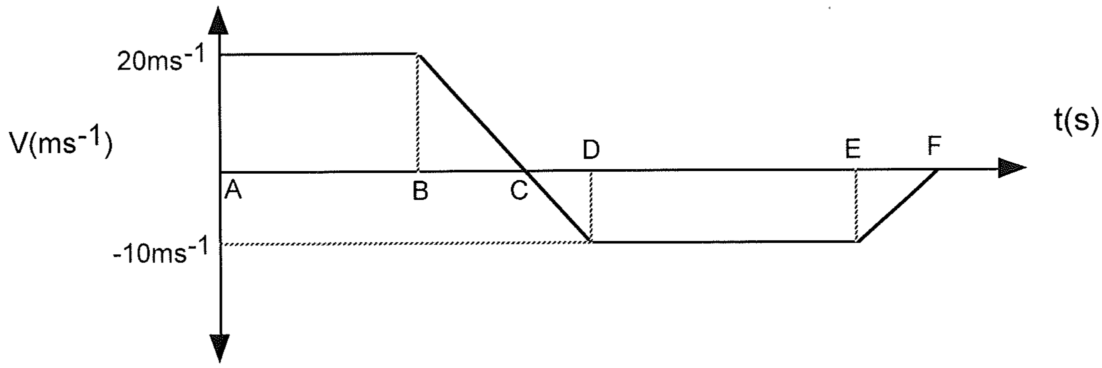
10. Velocity-Time Graphs when Object Changes Direction.

Velocity is a vector quantity so a velocity time graph can show an object changing ________________. When looking at an object changing direction it is important to say which direction is positive and which is ________________.

In the following example we have chosen to the "right" as the positive ____________. The diagram shows a car travelling along the road at a constant velocity of +20ms^{-1}. It decelerates to rest. It then reverses until its velocity reaches -10ms^{-1} then it continue on at this constant velocity for a few seconds before decelerating to rest.



The following velocity time graph describes the motion of the car. Positive velocities are shown above the time axis. The negative velocities are shown __________ the axis.

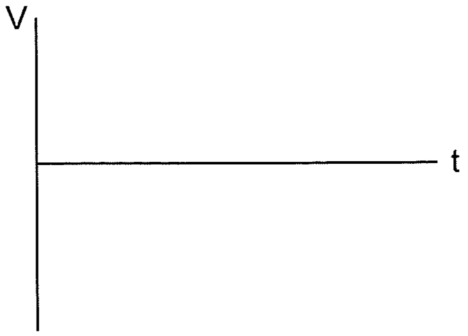


We can tell from the graph that the car changed direction at point _______ because the velocities changed from positive to________________.

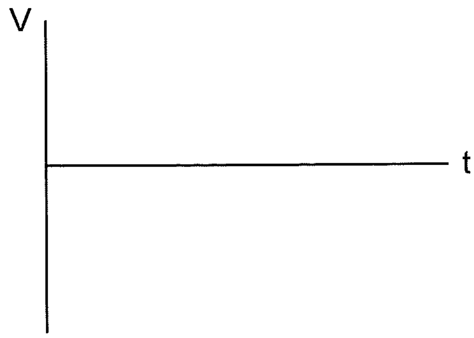
A to B shows the car travelling at a constant velocity of __________.
B to C car slows down to ____________.
C to D car reverses from rest to ______.
D to E car continues to reverse at a constant velocity of _______.
E to F car slows down to _______.

Example Draw the velocity time graphs to describe the following motion.
In these examples up is positive

Ball dropped from rest and bouncing once



Ball thrown up in the air and caught.



11. Acceleration Formula

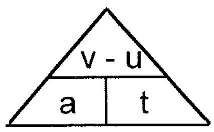
We know that acceleration is the change in the velocity of an object each second.

acceleration = change in the object's ______________ / ____________ for the change

We can write this in a simpler form using letters

u = ________________ velocity of the object
v = ________________ velocity of the object
a = acceleration
t = time for the _______________ of velocity to take place.

$$a = \frac{v - u}{t}$$

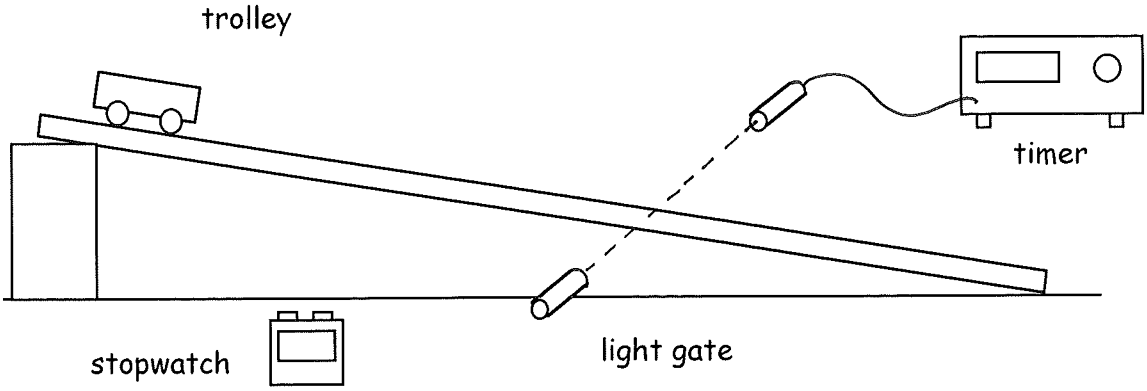


Term	Units
u	
v	
a	
t	

Example A car accelerates from rest to $24ms^{-1}$ in a time of 3s.
Calculate its acceleration.

12. Measuring Acceleration

Use a light gate, a ruler and a stopwatch. Set up the following apparatus



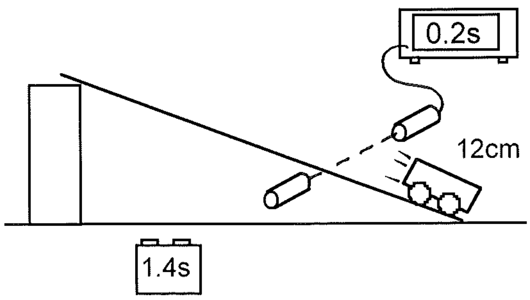
initial speed **u** = 0 (the trolley starts from rest)

final speed **v** = instantaneous speed at light gate **v** $= \dfrac{\text{length of \_\_\_\_\_\_\_\_\_\_\_\_}}{\text{time to cut the \_\_\_\_\_\_\_\_\_\_}}$

Stopwatch records the time **t** between velocities u and v.

Then we use $a = \dfrac{v - u}{t}$ to calculate the acceleration of the trolley

Example Look at this experiment. Use the information to calculate the acceleration of the trolley. The trolley starts from rest and accelerates down the slope at a constant rate.



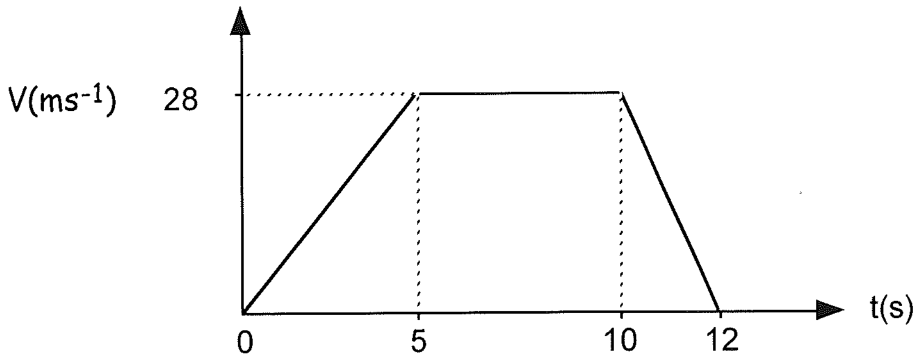
13 Rearranging uvat

Example A cyclist accelerates from $3ms^{-1}$ at a rate of $2.6ms^{-2}$. Calculate his final speed if he accelerates for 4s?

14. Acceleration from Velocity Time Graphs.

This velocity time graph represents the velocity of a skier travelling down a slope.

Example Calculate the acceleration during 0 - 5s and 10 - 12s



Acceleration between
_____s and ______s

Acceleration between
_____s and ______s

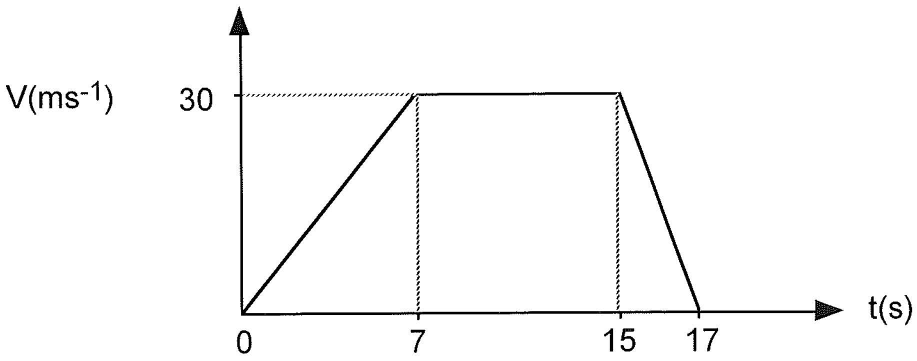
15. Calculating the Displacement From a Velocity-Time Graph

The displacement of an object = the ____________ under the velocity time graph

<u>Example</u> The following graph shows how the velocity of a car varied over a 17s journey.

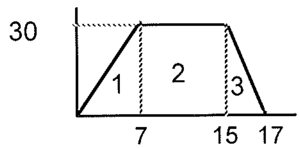
(a) Calculate how far the car travelled during the 17s?

(b) What was its average velocity?



displacement = area under the graph.

Split the area up into shapes whose areas we can easily work out.



Displacement s = Area 1 + Area 2 + Area 3

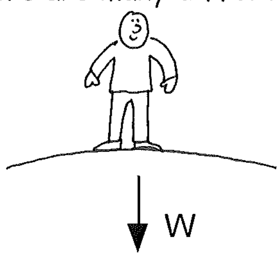
Average velocity $\bar{v} = \frac{s}{t}$

B. Newtons Law's of Motion

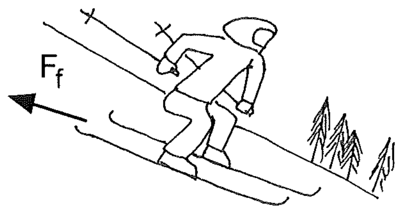
16. What is a Force?

Force changes the speed ________________ or ________________ of an object.
Force is a vector quantity because it is important to state its size and ________________
Force is measured in units called ________________ or _____ for short.
Force is measured using a ________________ balance.

There are many different types of forces. Here are some important forces.

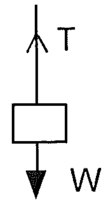


The force that pulls objects down to the centre of the Earth is called __________



The force which acts between touching surfaces and tries to stop them moving is called

____



The force carried through a stretched rope or wire is called

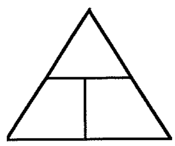
____

17. Mass and Weight

The mass of an object is a measure of how much stuff or ________________ an object contains. Mass is measured in ________________or ______ for short.
Your mass stays the ________________ no matter where in the universe you are.

The weight of an object = mass of the object x gravitational field strength.

$$W = mg$$



Term	Unit
W	
m	
g	

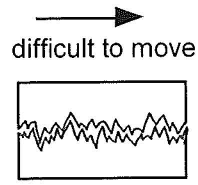
The gravitational field strength, g, is the downward ________________ acting on 1kg of mass. Here are the g values of different bodies.

Body	g (Nkg^{-1})
Earth	9.8
Moon	
Mars	
Venus	
Jupiter	

Compared to Earth we would feel ________________ on Jupiter and ________________on the moon.

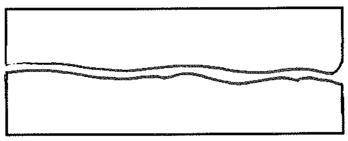
Example An astronaut of mass 86kg travels to Mars. What is his weight on Mars.

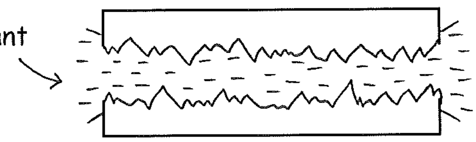
18. Friction



Friction is a force which acts between ______________________ surfaces. It is caused by the surfaces being rough. It tries to stop the surfaces ________________. It always acts ____________________ the direction of motion.

Decreasing friction by





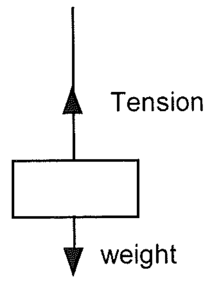
S__________________________ surfaces

S________________________________ surfaces.

If an object moves through a fluid like air or water, friction can be decreased by making the object ______________________________. A streamlined object has a _______________, rounded surface. It cuts through the fluid with little turbulence.

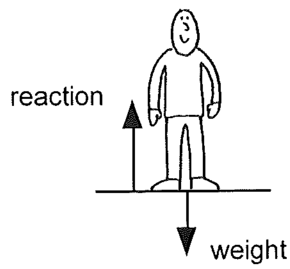
19. Tension

If you hang a box from a rope or a wire. The upward force stopping it falling is delivered through the r_______________ or wire. This force is called _____________________.



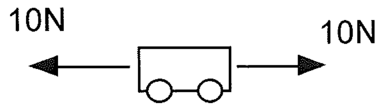
20. Reaction Force

When you stand on the floor your_____________ pulls you downwards. However you don't crash through the floor. This is because the floor applies an equal and upward force on you called the _____________________ force.



21. Newton's 1st Law

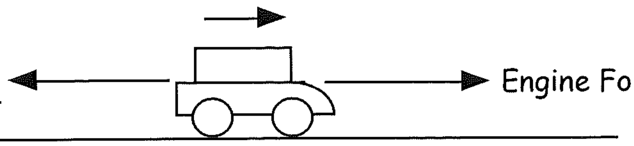
When the forces on an object are equal in size but opposite in direction we say the forces are ____________________.



Newton's 1st Law - If the forces on an object are zero or balanced the motion of the object does not ____________________.

Example   This car is travelling along the road at a **constant speed**.
State the size of the frictional force.

Frictional Force = ____________



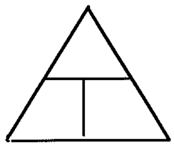
Engine Force = 1000N

22. Newtons' 2nd Law

If the forces on an object are unbalanced we can calculate the ____________________ force. It is this unbalanced force which makes the object ____________________.

Newton's 2nd Law - If an unbalanced force, F_u , acts on a mass **m**,, the mass accelerates at **a** ms^{-2}

$$F_u = ma$$

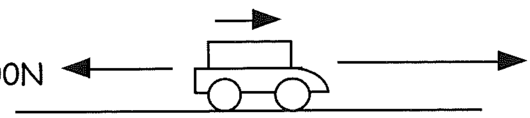


Term	Unit
F_u	
m	
a	

The bigger the unbalanced force the ____________________ the acceleration.
The bigger the mass the ____________________ the acceleration.

Example   The forces acting on this car are shown. The mass of the car is 800kg

Frictional Force = 400N



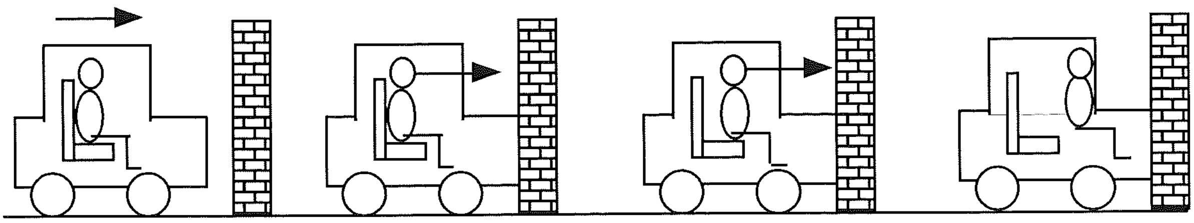
Engine Force = 1600N

(a) Calculate the unbalanced force F_u = __________ - __________ = __________

(b) Calculate the acceleration of the car.

23. Newton's Laws and Seat Belts

When a car crashes into a wall, the wall applies an _____________________ force to the car to decelerate it. If you are **NOT** wearing a seat belt you will continue to move at a ________________ speed until the windscreen applies an ____________________ force to decelerate you. A seat ___________ is designed to apply this unbalanced force to you to decelerate you to rest.

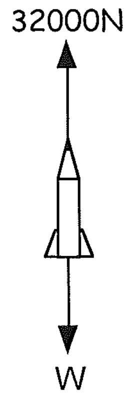


NO SEAT BELT WORN

24. Newton's Laws and Space Travel

At lift off a rocket accelerates upwards. So the upward thrust has to be bigger than the _________________ of the rocket.

Example The thrust on this 2000kg rocket shown is 32,000N at lift off from Earth.



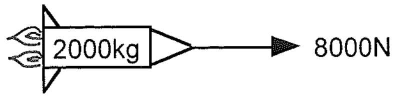
Calculate

(a) the weight of the rocket. (hint $g=9.8Nkg^{-1}$).

(b) the unbalanced force on the rocket.

(c) the acceleration of the rocket.

Example In deep space a **stationary** probe's rockets are fired.
The rocket thrust created is 8000N
(assume friction is negligible)



(a) Calculate the acceleration of the probe.

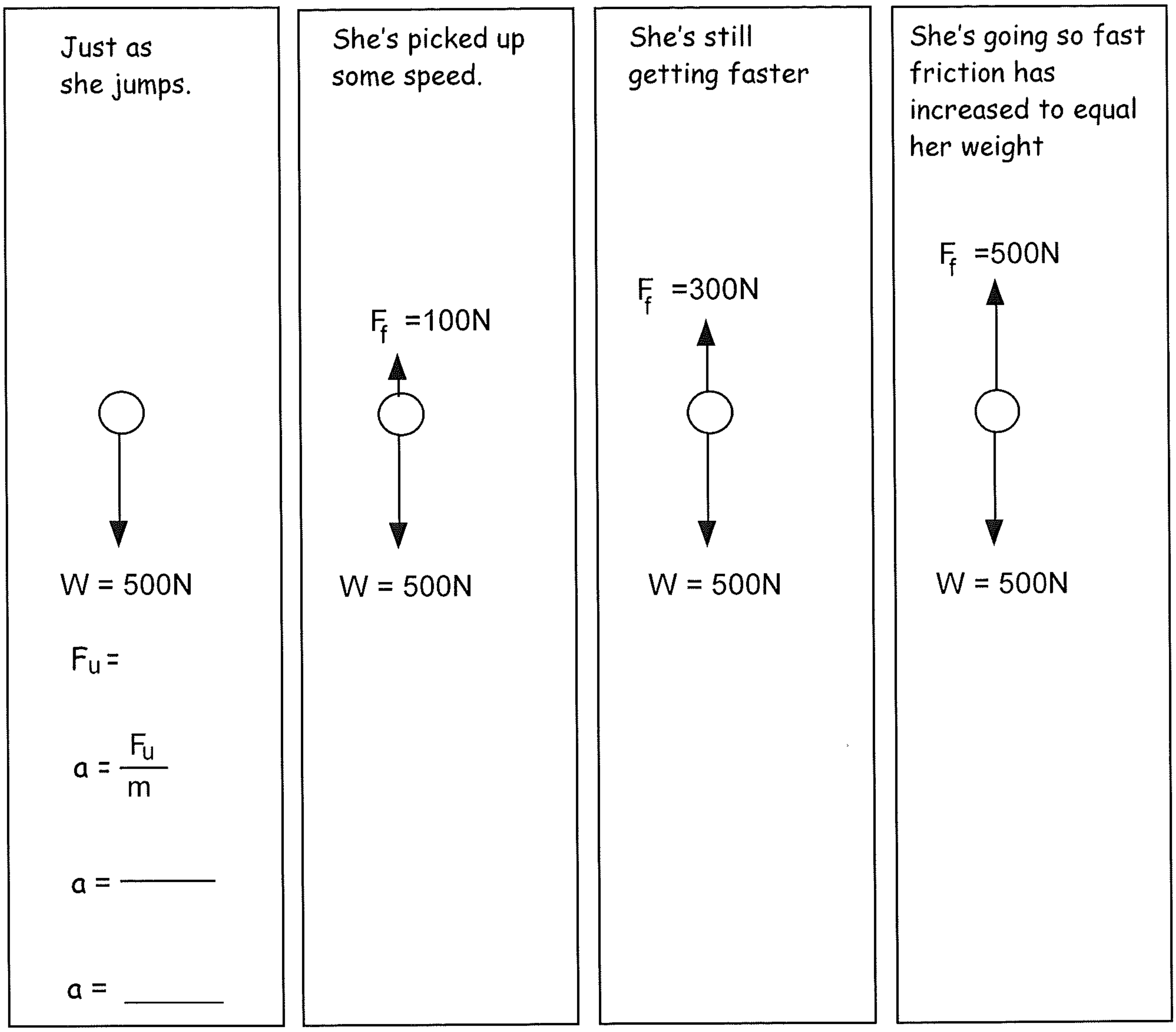
(b) After 3s the rockets are switched off. The probe's been accelerating from rest for 3s. What is the speed of the probe at 3s?
(Do this in your head)

(c) Describe the motion of the probe 20s after the rockets have been switched off?

(d) Using Newton's laws describe why you arrived at your answer to question (c)

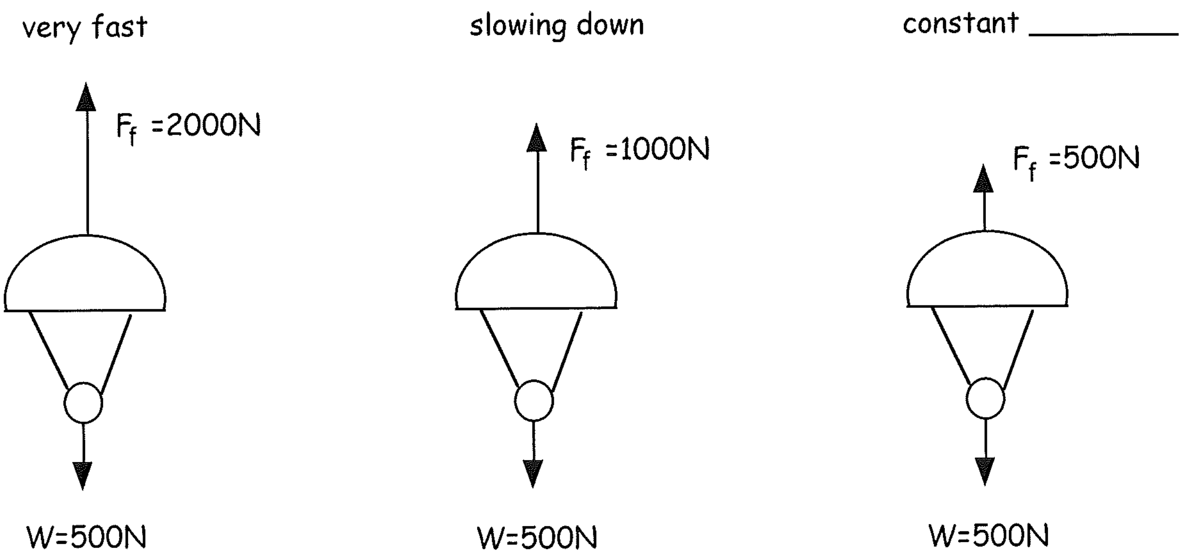
25. Newton's Laws and Freefall

When a 50kg skydiver jumps from a plane her weight W, pulling her downwards, stays ________________ but the upwards frictional forces, F_f ____________________ as she speeds up. For each diagram calculate the unbalanced force acting on her and her acceleration at that point. (We are going to take g = 10Nkg^{-1} for simplicity)



As she steps out of the plane her velocity is fairly low, so the air resistance acting on her can be considered to be almost____________.
As she falls, her velocity _________________, therefore the air resistance acting on her also ___________________. The difference between her weight and the air resistance is called the _______________________ force. As time progresses the unbalanced force ______________________ therefore the acceleration ______________________.
At one point the size of the air resistance is the same size as the weight. The forces are now ____________________. Therefore by Newton's 1st law, the object will now fall at a ______________________velocity. This is called ______________________ velocity.
It is important to realise that even though her acceleration is decreasing she is still getting faster but by a smaller amount each second.

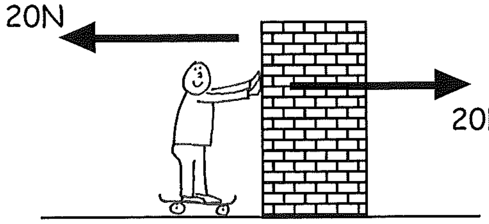
When she puts up her parachute the upward frictional force becomes much _____________ than her weight so she ______________________. As she slows down her velocity _______________ and therefore so does the ____________ force acting on her. After a few seconds the upward frictional force balances her ____________ and again she falls at a reduced ____________________ velocity.



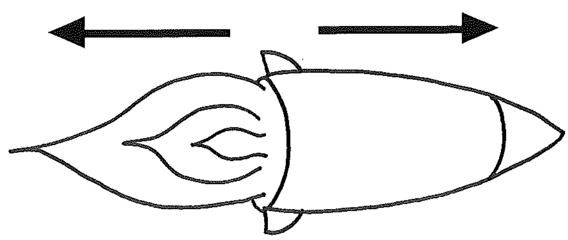
26. Newton's 3rd Law of Motion.

When you apply a force to an object the object will apply an _______________ and _____________________force back on you. These forces are sometimes called Newton's ______________.

Boy applies a force of 20N to wall	Wall applies a force of ______ to ________



Rocket applies a force of 20,000N on the exhaust gas	Exhaust applies a force of _________ on the _________



Newton's pairs are NOT balanced forces because they are acting on different objects. In the first example the 20N is being applied separately to the wall and to the boy.

In the 1st example above, there is now an unbalanced force of ______N acting on the boy. Therefore the boy will ________________________ to the ___________.

In the rocket example there is an unbalanced force of ____________N acting on the rocket. Therefore the rocket will ___________________ to the __________.

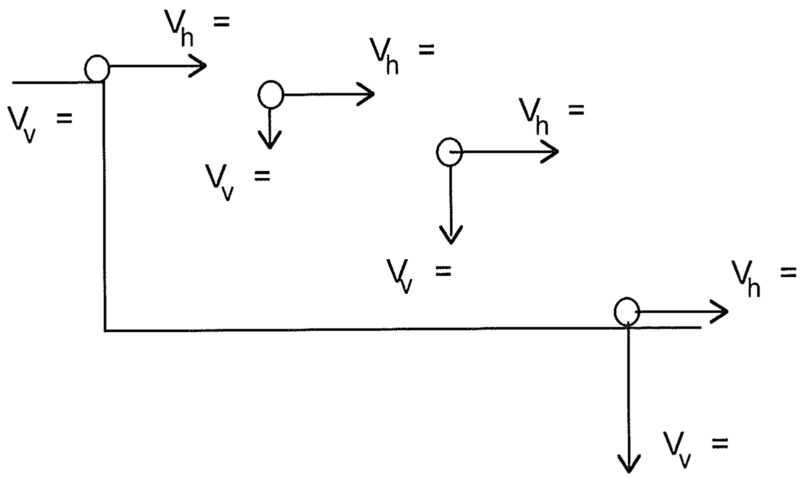
27. Projectile Motion

A projectile is an object which has both a horizontal and ____________________ motion.

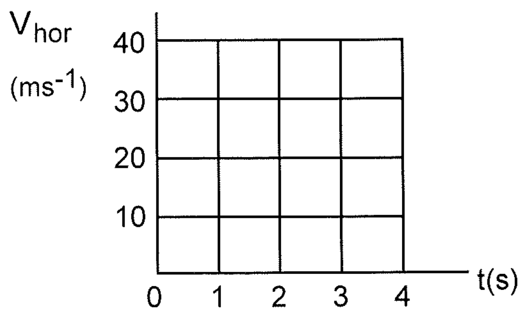
In the horizontal direction the object travels at a _________________ speed.
In the vertical direction, on Earth, the object accelerates downwards at ______ ms^{-2} .

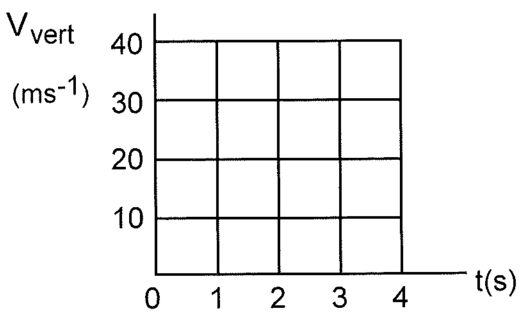
This ball is kicked off a cliff with a horizontal velocity of 20ms^{-1} . It takes 3s to hit the ground. It is travelling horizontally for ___s and accelerating downwards for 3s at a rate of ______ ms^{-2} .

On the diagram state the horizontal and vertical velocity of the object each second as it falls.



The horizontal and vertical motion of a projectile can be described on two velocity time graphs.





To find the horizontal distance travelled we use $d_h = v_h \times t$

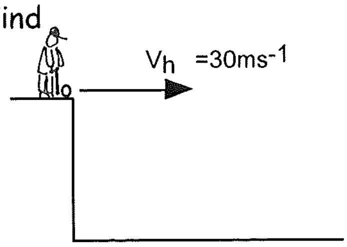
To find the final vertical velocity at time t we use $v_v = u +$ ____

On different planets g is different so acceleration caused by g will be different.
The g force and the acceleration caused are numerically _____________.

On Jupiter g = 25Nkg^{-1} and therefore acceleration caused by this gravity = 25ms^{-2}

On the moon g = _____Nkg^{-1} so acceleration caused by this gravity = ______ms^{-2}

Example. A golfer hits a ball from the top of a raised tee with a horizontal velocity of $30ms^{-1}$. It takes the ball 4.5s to hit the ground. Find



(a) the horizontal distance the ball travels.

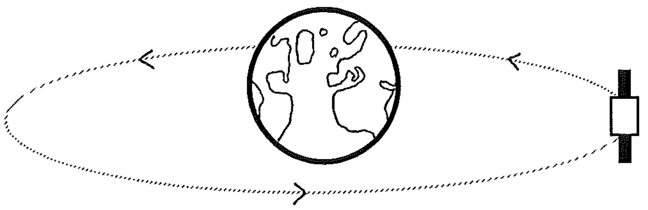
(b) the final horizontal speed of the ball when it lands.

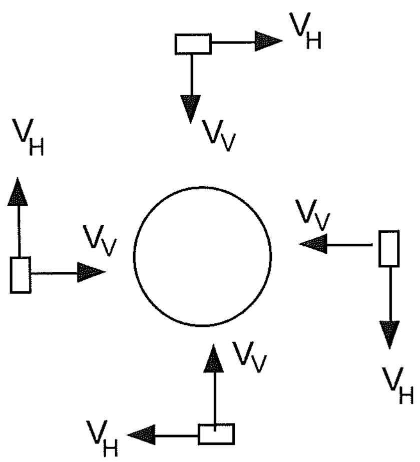
(c) the final vertical speed of the ball when it lands.

(d) How would your answers to (b) and (c) be different if we did not ignore air friction?

28. Satellites

A satellite is an object which orbits another object. The moon is a satellite of ___________. The Earth is a satellite of the ________.
A satellite moves as a ________________. It has a vertical velocity, as it is accelerating towards the ground at a rate of nearly _____ms^{-2} . However the reason it does not hit the ground is because it is given a ____________________ velocity. The resultant velocity means that although it falls towards the Earth the Earth is curving away from it.

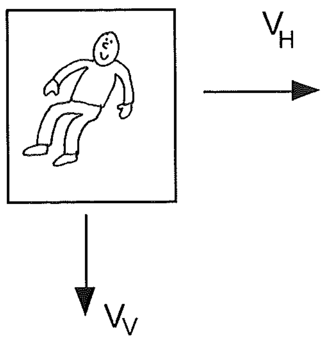




Draw actual or resultant velocity vector for each picture in red

For each orbital height it is important to calculate the _____________ velocity required to keep the satellite in orbit.

Astronauts appear to be "floating" about in the space station as if they are in _______ gravity. However they, and the space station are both in free __________, hurtling towards the Earth. However the space station is given a horizontal velocity and this prevents the station crashing back to Earth.



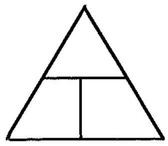
The space station is a satellite of E_____________ and is moving as a p_______________.

29. Work Done

If you pull a box across the floor the box moves. You have transferred energy from yourself to the box. We call this energy transfer ______________ done. We measure Work Done in ________________ or ______ for short

Work Done = Force applied x distance force is applied

$$E_W = Fd$$



Term	Unit
E_W	
F	
d	

Example A boy pulls a box a distance of 4m across the floor with a force of 20N. How much work is done by this action?

If there is no friction acting, the box will now have _____ of _____________ energy

Work can also be done when a force is applied over a distance to slow an object down. The force is being used to remove or transfer its kinetic energy to heat.

Example A car has 4000J of kinetic energy.

(a) How much work requires to be done to bring the car to a halt?

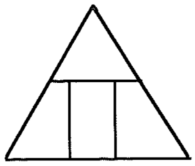
(b) What braking force must be applied to bring the car to a halt in 50m?

Work is only done if the force is applied over a distance. No work is done by simply applying a force to hold a shopping bag in a stationary position.

30. Kinetic Energy E_k

Kinetic energy is the energy possessed by ________________ objects.

$$E_k = \frac{1}{2}mv^2$$



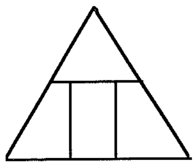
Term	Unit
E_k	
m	
v	

Example A car of mass 800kg moves with a speed of $5ms^{-1}$.
Calculate the kinetic energy of the car.

31. Gravitational Potential Energy Ep

When work is done to lift an object up, it gains gravitational potential energy. Gravitational potential energy is possessed by objects which are __________ a certain datum point.

$$E_p = mgh$$



Term	Unit
E_p	
m	
g	
h	

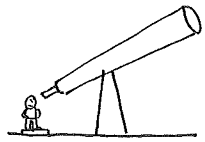
Example A boy of mass 54kg stands on a diving platform 6m above the water. How much gravitational potential energy does he have relative to the water?

C. Space Exploration & Cosmology

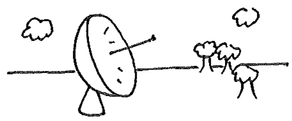
32. Looking into Space.

Up until the 1950s we studied the universe from Earth using terrestrial telescopes which could pick up visible light and __________waves . However lots of interesting parts of the electromagnetic ______________cannot penetrate our _____________________ and this affected our understanding of the universe.

1. Terrestrial (On Earth) Telescopes



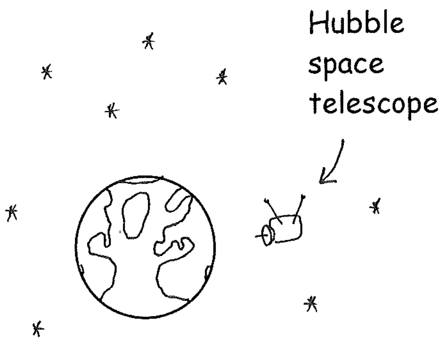
Optical Telescopes - allow us to study the v______________ light being emitted from distant stars and galaxies



Radio Telescopes - allow us to study the r_____________ waves being emitted from distant stars and galaxies.

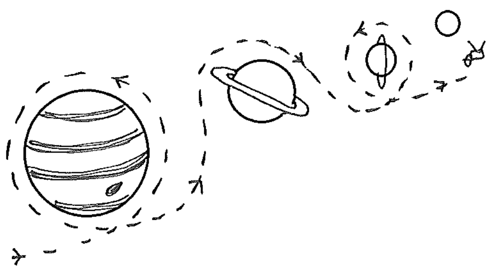
Since the 1950's our understanding of the universe has improved vastly due to the following advancements.

2. Space Telescopes



A lot of interesting electromagnetic radiation like UV, X rays and gamma rays cannot get through the Earth's atmosphere so telescopes like the ________________ telescope are positioned on _________________ in orbit around the Earth. They provide extremely clear and detailed images of distant galaxies and can detect signals from all parts of the __________________________ spectrum.

3. Space Probes



Space probes are sent on journeys of many billions of km to distant ___________ such as Mercury and Jupiter, and out through the solar _____________. The space probes _____________ __ and ___ were launched in _______ and took amazing photographs of Jupiter's ____________ and the ________ of Saturn. Voyager ___ is now beyond ___________ but is still sending information back to Earth.

33. Benefits of Space Travel.

1 Technologies Developed through Space Exploration:

The smoke d__________________ and LCD s________________ which have low energy consumption. Dried and frozen f_____________ which stay fresh for months in space. Here are some more examples of other technologies which have been developed as a result of space exploration.

____

____

____

____

____

____

2. Satellites

Satellites orbiting the Earth have improved our understanding of our own p____________ as well as improving communications.

Satellites are placed in orbit around the Earth. A satellite which stays above the same point on the planet is called a ___________________________ satellite.
It has a period of _____ hours. The higher the orbit the longer its _____________.

Weather Satellites

Weather satellites allow us to understand the w______________ on Earth. We can predict and study dangerous storms called h________________. We can study the impact of global w_____________ on the planet.

Global Positioning Satellites (GPS)

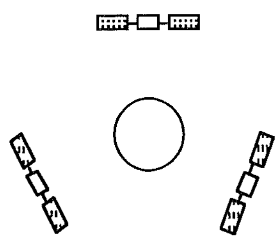
Global _________________ satellites or GPS make use of satellites to allow the position of a receiver on ____________ to be pinpointed to within 10cm. It can be used by

____

____

____

Communications Satellites



Communications satellites allow t__________________ calls, and T___and radio programmes to be broadcast around the world. It also allows worldwide i_____________ communication.

Agriculture and Forestry.

Satellites allow governments to monitor the quality of the s__________ and the health, quantity and quality of c____________. This allows farmers to p___________ ahead to maximise production.

Defence and Security.

Satellites allow governments to monitor the a__________ and nu___________ capabilities of other countries, to ensure that they are not becoming a threat. During war, satellites allow armies to locate and track enemy p_________________.

Geology.

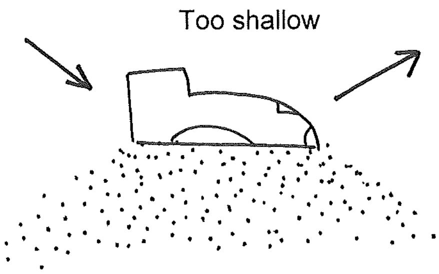
Satellites allow geologists to locate deposits of o______ and m___________________. They can be used to monitor how land masses are moving due to _______________ tectonics.

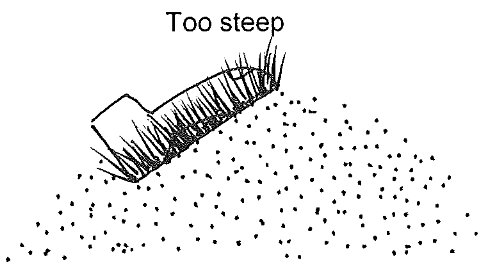
Cartography.

Satellites are an accurate method of m________________ the planet. As satellites are continually monitoring the Earth, maps can be continually u________________.

34. Reentry 1 - Frictional Heating

Future space travel will involve space shuttles flying into space and returning safely to ____________. If the space shuttle reenters the Earth's atmosphere at too shallow an angle it will ______________ off the upper atmosphere. If it reenters at too steep an angle it will ___________ up.





35. Energy Conservation during Reentry.

When an object reenters the Earth's atmosphere it is travelling very _________.
It has a lot of movement or _________________ energy.

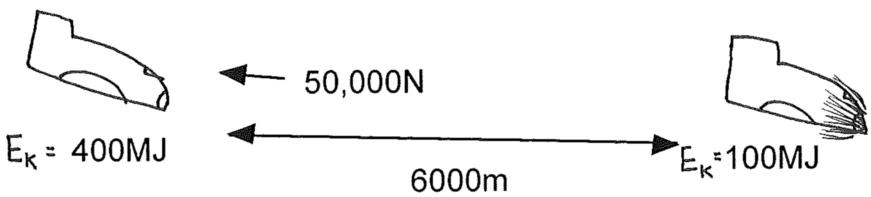
The shuttle uses the force caused by air resistance during reentry to
____________________ itself to a safe landing speed.
The kinetic energy it is losing is transferred to ___________ due to a air resistance.

We say that the force casued by air resistance has done _________ over a distance to transfer kinetic energy to __________ energy.

$$E_K \text{ lost} = E_W \quad \text{(work done by air friction)}$$

$$\frac{1}{2} m v^2 = Fd$$

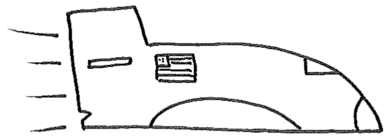
This diagram shows air friction acting on a shuttle as it enters the Earth's atmosphere.



This shuttle has lost_____________ of kinetic energy. It has been transferred to _____________ energy by a force of _________N being applied for _________m

The metal body of a spacecraft is covered in a material which prevents the metal _____________. This material is called a __________ shield. The heat shield protects the metal body by absorbing the heat, and heating up instead of the ___________ body.

Example The diagram shows a space shuttle of mass 96,000kg entering the lower atmosphere at a speed of 8000ms^{-1}



(a) How much kinetic energy does it have at this point?

(b) After travelling through the atmosphere for 20km its kinetic energy has reduced to 1.2×10^{12} J. How much kinetic energy has been transferred to heat over this distance?

(c) What is the name of the force which has done the work to transfer the kinetic energy to heat energy?

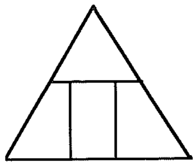
(d) Calculate the size of the frictional force which transfers this energy or does this work during the 20km?

36. Specific Heat Capacity.

We need a heat shield which absorbs a lot of __________energy, but for only a small rise in its temperature, because you are trying to prevent the shields melting.

The specific heat capacity of a substance tells you the amount of heat energy required to raise the temperature of 1kg of the substance by ____^{o}C.

$E = mc\Delta T$



Term	Unit
E	
m	
c	
ΔT	

The specific heat capacity of water is _______________. This means that to heat 1kg of water by 1°C, the water needs to absorb _____________of heat energy.

A heat shield has a high specific heat capacity so it can absorb a huge amount of __________ energy for only a small change in its __________________. As the shuttle's shields are absorbing most of the heat, the metal body of the shuttle stays intact.

Example On reentry the temperature of the heat shields covering the shuttle's nose cone rose by 4000°C. If the mass of the nose cone shields is 260kg and its specific heat capacity is $3800 J kg^{-1} \,^{o}C^{-1}$ then calculate the heat energy it absorbed.

37. Reentry II - Heat Shields Melt.

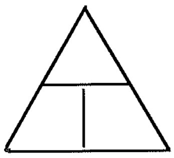
After a few minutes heating up, the shielding material may reach its melting point.
The process in which the shields melt requires even more __________ energy.
The shields absorb more ___________ energy and melt and so prevent the m___________ body of the shuttle absorbing the heat and melting. The amount of heat energy required to change the state of 1kg of material is the Specific Latent heat of the material.

38. Specific Latent Heat.

The specific Latent heat of fusion L_f of a material is the amount of ___________ energy required to change 1kg of solid to 1kg of liquid at a _____________ temperature.

The specific latent heat of vaporisation L_v of a material is the amount of __________ energy required to change 1kg of liquid into 1kg of gas at a _____________temperature.

$E = mL_f$ or $E = mL_v$



Term	Unit
E	
m	
L	

If the liquid substance then freezes or the gaseous substance condenses the energy E is ____________________ by the substance.

Example

At one point during the re entry 5kg of shield material begins to melt. If the latent heat of fusion of the shield material is 4.8×10^5 Jkg^{-1} calculate the energy absorbed by the shields while melting.

39. Cosmology

A light year is the distance light travels in a year. It also tells us how long it would take a beam of ______________to travel that distance. The distance from Earth to the Sun is 8 light minutes. This means it takes a beam of light _____ minutes to travel from the sun to Earth.
The distance to the centre of our galaxy is 25,000 light years. So it would take a beam of light _____________ years to travel from the centre of the galaxy to Earth. So in effect when the light arrives at us we are seeing the centre of the galaxy as it was ____________ years ago.

40. Converting Light Years to Metres

The nearest star to the Sun is Proxima Centauri. It is 4.2 light years from the Sun.
So it takes the light 4.2 years to reach us from Proxima Centauri. What distance, in metres has it travelled in this time?

Light travels 3×10^8 m in 1 second. So how far will it travel in 4.2 years.

We need to find out what 4.2 light years is in seconds.

No of days - 4.2 years x 365 = 1533 days

No of hours - ________________________________

No of minutes - ________________________________

No of seconds - ________________________________

So the question is. How far will light travel in this _______________________seconds

v=

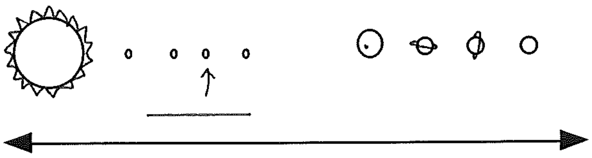
t =

d = ?

41. The Observable Universe

Earth is part of a family of ____ planets which orbit a star called the _________.
This star family is called the _____________ system. The solar system is located on the outer arm of a s_______________ galaxy called the _____________ _________.
The Milky Way contains about ________ billion stars.
There are ______ nearby galaxies,for example _________________________.
This group of nearby galaxies is called the ____________ group.
Astronomers estimate that there are _______ billion galaxies in the vast universe, mostly clustered together in _______________ clusters. Some parts of the universe are so far away that light has not had time to reach us, so this part of the universe is unobserved.

Solar ___________

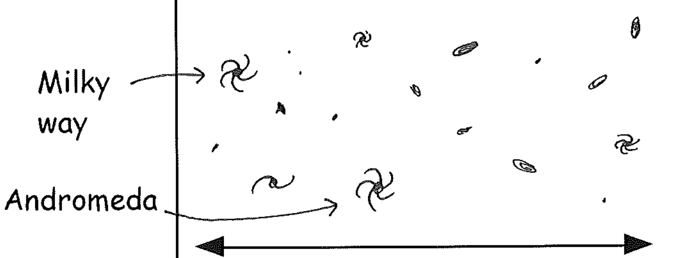


__________ light hours

Milky ________ Galaxy

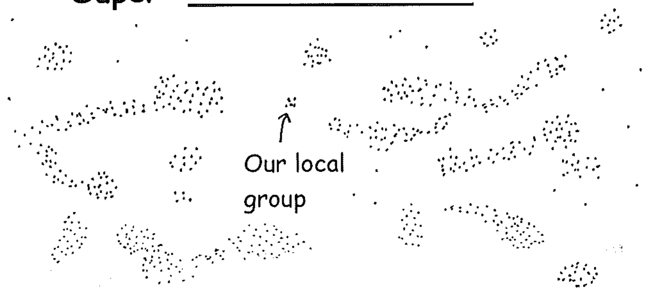
____________light years

Local ____________

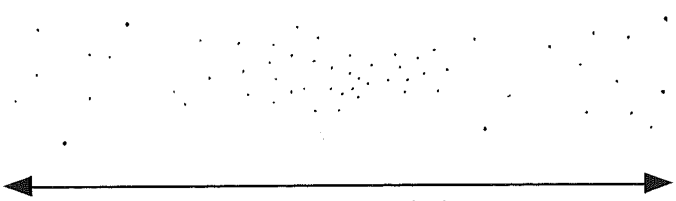


____________light years

Super ______________



Observable Universe



________________light years

Location	Distance
to moon	_____ light seconds
to sun	_____ light mins
to Jupiter	
to edge of solar system	
to proximi centauri	
across milky way	
to Andromeda	
to furthest galaxy	

42. The Big Bang.

In the 1920s Edwin ________________ observed that all the galaxies were moving a________________. If all these galaxies were moving apart then at one time they must have all been squashed together. Scientists concluded that all the matter and energy and space in the Universe must have been, at one time, squashed into an extremely small space called a s________________________. About 13.7_______________ years ago this tiny ball must have exploded apart in a hot, dense fireball. As the Universe expanded it cooled down, and some energy turned to ____________. A new force called _________________ started to clump the mass together to form a__________, then stars, then g____________ When the stars exploded, p_____________ formed out of the debris.

43. Exo Planets

Exo planets are planets which exist outside our _______________ system. We can detect them because they cause their star to d_______ as they pass is front of it.
Planets orbiting a star also cause the star to w________________ on its axis.
For life similar to that on Earth to develop the planet would require

A. to be close to a long lived s________ which is a stable source of e__________.
B. not to be too close to the centre of its __________________ as the planet would be zapped by too much dangerous radiation.
C. to have a s_______________ surface and a supply of a liquid like w____________.
D. to be the correct distance from its s_________. Too close, and all the liquid would _________________. Too far away and the temperature would be too __________ for life to form.
E. to be the correct size. Too small, and the atmosphere would be too t_________. Too big and the atmosphere would be too d______________.
F. a protective ___________________ field to deflect the solar wind from the star.

44. Electromagnetic Spectrum.

People have been studying the visible light coming from stars and galaxies for thousands of __________. However stars, galaxies and even planets are constantly emitting waves at all wavelengths of the electromagnetic ________________. The Earth's atmosphere absorbs many of these waves.

The first non-visible radiation we picked up from the universe were __________ waves in the 1930s. Since then we have found clever ways of detecting all the electromagnetic waves the universe emits.

Microwave radiation comes from every corner of the ______________. It is believed that this radiation is the heat left over from the ___________ bang. The microwaves started off as infra red heat but as the universe expanded the infra red was stretched to microwaves.

Infra red radiation or __________ energy is given off by most objects in the universe.

UV, X rays and **Gamma rays** are high f____________________ waves which therefore are high energy waves. These waves are given off by hot stars and extreme astronomical events, for example exploding stars called ____________________ and Black ______________.

45. Continuous Emission Spectra.

When a solid or liquid is heated it gives off a complete range of wavelengths of visible light. This is called a ____________________________ emission spectrum. The sun and light bulbs give off ____________________________ emission spectra.
We can analyse the light given off by stars using a ________________________.
A spectroscope splits light up into a spectrum according to the different wavelengths or frequencies in the light.

Continuous Emission Spectrum

__________ frequency waves

__________ frequency waves

46. Judging the Temperature of a Star.

As a star becomes hotter it gives off increasingly shorter __________________.
of light. We can use this fact to judge how _________ a star is.
So, cool stars gives off mostly long wavelengths so appear _______ in colour. A yellow star is hotter because it gives off more yellow wavelengths and a bluish white star is very hot as it gives off all the colours but with a lot of the very short wavelength ___________ light.
Our Sun is yellow so it is a medium __________ star.

47. Line Emission Spectra.

Each gaseous element, when heated, gives off only certain ______________ of light. If we look at this light using a spectroscope we see a __________ emission spectrum. Each line indicates a different ______________ of light. We can use the line spectra of elements to identify the elements present in a __________.

Line Emission Spectra

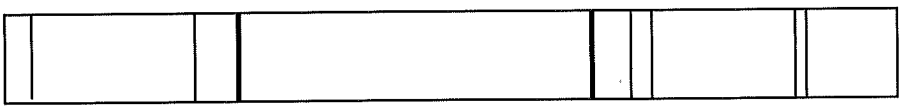
line emission spectra of hydrogen

line emission spectra of mercury

Stars are usually made from many elements, so the line spectra of all these hot elements are usually mixed up. A trained eye is able to pick out the individual ______________ present

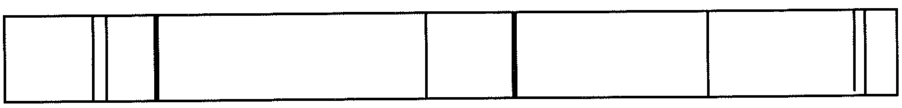
Example The first diagram shows the line spectrum from a distant unknown star.

unknown star



The next 3 diagrams show the spectra from 3 different elements

Element 1



Element 2

Element 3

Which elements are present in the unknown star?

Ans: ______________________________