



Science Core Knowledge

Year 8

This booklet contains the core knowledge that we believe is the foundation of understanding for each of the topics taught in year 8.

Pupils are required to learn a selection of these questions each week for homework. Their teacher will then carry out regular quizzes to check pupil progress.

The first 10 questions in end of topic tests will always come directly from this booklet so that pupils who have applied themselves to revision will always be rewarded by predictable questions.

We suggest that pupils work with each other or with adults at home to memorise a few at a time in much the same way you may have prepared for spelling tests in the past.

To help prepare for the end of topic tests we have created a website that contains digital copies of these questions, the presentations that teachers use in their lessons, links to other websites, details of test dates and other things you may find useful.

bit.ly/aylshamscience

(You will need to type this in to the the address bar exactly as is because the site is hidden from Google.)

We also sell CGP KS3 revision guides from room 10 at lunch or break time at a significantly reduced price.



We've uploaded sets of these core questions onto Quizlet too, so you can use the smartphone app or find the website on a computer. All you have to do is search for AHS_science under users and lookup the topic number and name and quiz yourself.

8.1 Body Systems

Number	Question	Answer
1	What is a balanced diet?	A diet that includes all the important food groups in the correct proportions
2	What do fats and sugars provide?	Energy
3	What do dairy products provide?	Protein and minerals
4	What do meat, fish and eggs provide?	Protein, minerals and energy
5	What do carbohydrates provide?	Energy and fibre
6	What do fruit and vegetables provide?	Vitamins and fibre
7	What is the problem with taking in too much energy or not enough energy?	Too much - obesity Too little - poor development and organ failure
9	What is the recommended number of kcalories a person should consume each day?	2000 kcal for a woman 2500kcal for a man
10	In what order does food pass through your body?	1)Mouth 2)Oesophagus 3)Stomach 4)Small intestine 5)Large intestine 6)Rectum
11	What happens if you don't eat enough fibre?	You become constipated
12	What do the enzymes in your digestive system do?	Chemically break down food so that it can be absorbed
13	How are villi adapted to help absorb nutrients?	They have a large surface area
14	How is food transported around the body after it is absorbed?	In blood in the circulatory system
15	What are probiotics?	Bacteria that help you digest food
16	What is an antibiotic?	A drug that kills bacteria
17	What is immunity?	When your body has learnt how to fight of a specific disease
18	Which enzyme breaks down protein? Name the product formed.	Protease breaks down protein into amino acids
19	Which enzyme breaks down fat? Name the products formed.	Lipase breaks down fat into fatty acids and glycerol
20	Which enzyme breaks down carbohydrate? Name the product formed.	Carbohydrases such as amylase break down carbohydrates into sugars.
21	State two conditions that might affect the rate at which an enzyme works.	Temperature and pH
22	Describe how to test for starch in food.	<u>Iodine test.</u> Add iodine, the colour changes from yellow-orange to blue-black if starch is present.
23	Describe how to test for reducing sugars in food.	<u>Benedict's test.</u> Mix a food solution with equal parts Benedict's solution and heat. A green, orange or red precipitate forms if sugars are present.
24	Describe how to test for proteins.	<u>Biuret test.</u> Mix a food solution with potassium hydroxide and two drops of copper sulfate solution, the colour changes to purple if protein is present.
25	Describe how to test for fats and oils (lipids)	<u>Ethanol emulsion test.</u> Mix food with ethanol and shake. Pour some of that mixture into water and shake. Cloudy layer at the top forms if fats are present.

26	Name and describe the process that you can use to measure the amount of energy in food.	<u>Calorimetry</u> . Burn food under a container of water, record the temperature rise of the water.
27	List 3 physical barriers which provide us with protection from pathogens.	<ul style="list-style-type: none"> • Mucus in the nose • Cilia in the trachea • Skin
28	List 3 chemical barriers which provide us with protection from pathogens.	<ul style="list-style-type: none"> • Lysozymes in tears • Saliva and vaginal fluid • Hydrochloric acid in the stomach
29	What type of protein do pathogens have on their surface?	Antigens
30	What type of lymphocyte will be activated by a pathogen getting into the body?	One which has antibodies which fit with the pathogen's antigens.
31	What is a vaccine?	A drug which <u>triggers immunity to a pathogen</u> . It contains an inactive form of the pathogen.
32	Give three advantages to immunisation?	<ul style="list-style-type: none"> • Protects an individual from a particular disease for many years. • Some diseases are eradicated • Reduces risk of epidemics • Less chance of long term illness as a result of the infection • Herd immunity protects those not immunised • Using a vaccine is cheaper than treating a very ill person
33	Name a disadvantage to immunisation.	Some chance of side effects (some side effects can be severe).

8.2 Plants and Photosynthesis

Number	Question	Answer
1	What is photosynthesis?	A reaction that uses light energy to react carbon dioxide and water to produce glucose and oxygen.
2	What is the word equation for photosynthesis?	Carbon Dioxide + Water → Glucose + Oxygen
3	What is the symbol equation for photosynthesis?	$\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + \text{O}_2$
4	List three limiting factors of photosynthesis	<ul style="list-style-type: none"> • Temperature • light intensity • carbon dioxide concentration
5	How can the effect of light intensity on rate of photosynthesis be investigated?	The rate of oxygen production by a plant can be measured at different light intensities.
6	How does the rate of photosynthesis change with light intensity?	The rate of photosynthesis is directly proportional to light intensity.
7	How does the rate of photosynthesis change with distance from a light source?	The rate of photosynthesis is inversely proportional to the distance from the light source (the inverse square law).
8	What is the green pigment called that is necessary for photosynthesis?	Chlorophyll
9	In which organelle is this green pigment found?	Chloroplast
10	Where does gas exchange take place?	Stomata in the leaves
11	What is the process called by which plants exchange gases?	Diffusion
12	What chemical is used to test for starch?	Iodine
13	Give two ways that the structure of a root hair cell is adapted to absorb water and minerals?	<ul style="list-style-type: none"> • Large surface area to volume ratio • Maximises contact with the soil • Thin cell walls to allow water molecules and mineral ions through quickly
14	Give two ways that the xylem is adapted to their function in the plant?	<ul style="list-style-type: none"> • Dead cells with no cytoplasm so lots of room inside. • No walls between cells so they form a hollow tube. • Thick walls made of lignin so they don't burst.
15	Give two ways that the phloem is adapted to their function in the plant?	<ul style="list-style-type: none"> • Companion cell use energy to pump sucrose inside • Sieve tubes made of cells with holes in the ends for liquids to move through. • No nucleus and little cytoplasm in sieve tube cell so lots of room inside
16	Name 3 minerals that plants need for growth	<ul style="list-style-type: none"> • Nitrogen • Phosphorous • Potassium

17	Why are fertilisers used?	To add minerals to increase crop yield
18	Why is it important to reduce the number of weeds around food crops?	Weeds will compete for water and resources that the crop needs
19	What is transpiration?	The transportation of water molecules through the plant.
20	Give three ways that the structure of a leaf is adapted for photosynthesis and gas exchange?	<ul style="list-style-type: none"> • Large surface area to absorb sunlight • Palisade layer has lots of chloroplasts • Xylem vessels supply water to cells • Air spaces inside leaf allow carbon dioxide to diffuse into cells • Stomata in underside allow gases to diffuse in and out
21	List three environmental factors that could affect the rate of water uptake by a plant	<ul style="list-style-type: none"> • Light intensity, • air movement (wind) • temperature
22	List three ways in which plants are adapted to survive in extreme environments	They have adaptations that reduce water loss: <ul style="list-style-type: none"> • Narrow or needle-shaped leaves • Thick cuticle • Stems that can store water • Stomata in pits, or leaves that curl to cover stomata
23	List three pests that affect crops?	<ul style="list-style-type: none"> • Insects • Fungi • Viruses Bacteria
24	How do farmers deal with these pests?	<ul style="list-style-type: none"> • Use pesticides • Introduce a predator of the pest
25	List three negative impacts pesticides have on the environment.	<ul style="list-style-type: none"> • Can get into water supply • Pollute the air • Destroy soil health • Can effect biodiversity
26	State the three reproductive structures of a flowering plant	<ul style="list-style-type: none"> • Carpel – stigma; style; ovary • Ovule • Stamen – anther; filament
27	State three methods of seed dispersal	<ul style="list-style-type: none"> • Wind dispersal • Animal internal • Animal external • Explosive / self-propelled
28	Why do we need bees for our food supply?	<ul style="list-style-type: none"> • Without bees to spread pollen many plants would die off
29	What is chemosynthesis?	<ul style="list-style-type: none"> • Chemosynthesis is using chemical energy to produce nutrients, instead of using light

8.3 Atoms, Elements and Compounds

	Question	Answer
1	What is an atom?	The smallest particle that has the properties of that chemical element.
2	Describe the structure of an atom.	A nucleus containing protons and neutrons, surrounded by electrons in shells.
3	What are the relative charges and masses of protons, neutrons and electrons.	Protons: mass 1, charge +1 Neutrons: mass 1, charge 0 Electrons: mass almost zero, charge -1.
4	Why do atoms contain the same number of protons and electrons?	<u>Atoms are neutrally charged</u> so they must have the same number of positive particles (protons) as negative particles (electrons)
5	How are elements in the modern periodic table arranged?	<u>In order of increasing atomic number</u> in rows called periods and elements with similar properties are placed in the same vertical columns called groups.
6	Where are the non-metals found in the periodic table?	At the top on the right hand side.
7	What do we call group 1, group 7 and group 0 in the periodic table?	The alkali metals, the halogens and the noble gases.
8	What do all elements in the same row of the periodic table have in common?	They have the same number of shells of electrons.
9	What do all elements in the same column of the periodic table have in common?	They have the same number of electrons in their outer shell (and therefore have similar chemical properties).
10	What is an element?	One type of atom
11	How are the particles arranged in a solid element?	Regularly arranged and all touching each other
12	How are the particles arranged in a liquid?	Irregularly arranged, with very few spaces in between.
13	How are the particles arranged in a gas?	Irregularly arranged and far apart
14	Name the interconversion between the solid to the liquid state	Melting
15	Name the interconversion between the liquid to the gaseous state	Evaporating
16	Name the interconversion between gaseous state to the liquid state	Condensing
17	Name the interconversion between liquid to the solid state	Freezing
18	Describe how the particles arrangement, movement and energy changes during melting.	The particles <u>energy increases</u> on heating causing the vibrations between particles to increase to an extent that they <u>break free from their regular arrangement</u> and start <u>moving over one another</u> .
19	Describe how the particles arrangement, movement and energy changes during freezing.	The particles <u>energy decreases</u> on cooling causing the particles to <u>slow down</u> and become <u>attracted to other particles</u> .
20	What is the difference between a pure substance and a mixture?	A pure substance is made of <u>just one chemical substance</u> whereas a mixture is made of <u>more than one chemical substance</u> which are not chemically joined.
21	Where do we find metals on the periodic table?	Towards the left and the bottom
22	What are metalloids?	They are elements that behaves like a metal sometimes and like a non-metal other times (intermediate behaviour)
23	What is a physical reaction?	A change that is easily reversible
24	What is a chemical reaction?	A change that is not easily reversible

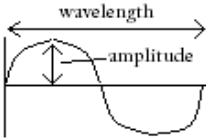
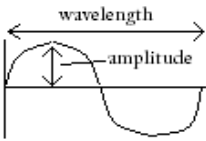
25	What are the four signs that a chemical reaction has taken place?	<ul style="list-style-type: none"> • Colour change • Temperature change • A gas is given off (bubbles/fizzing) A change in state e.g a precipitate is made
26	What two things does the formula of a compound tell us?	<ul style="list-style-type: none"> • What elements are in a compound • What ratio of those elements in the compound
27	Give three ways in which a mixture is different from a compound.	<ul style="list-style-type: none"> • The ratio of the elements is not fixed • The properties of a mixture are often the “average” of those of the elements (whereas compounds can have properties that are entirely different from those of the elements that make them up.) • The components of a mixture are not chemically joined together.
28	Describe what “distillation” is	Distillation is the <u>separation of two miscible liquids</u> (liquids that mix, e.g. water and alcohol), by means of their <u>different boiling points</u> .
29	What type of mixtures can be separated by simple distillation	A dissolved solid where you want to keep the liquid or 2 liquids with very different boiling points.
30	What type of mixtures can be separated by fractional distillation	A large sample of a mixture of liquids with similar boiling points
31	What type of mixtures can be separated by filtration	An insoluble solid and a liquid.
32	What type of mixtures can be separated by crystallisation	A dissolved solid where you do not want the liquid.
33	What type of mixtures can be separated by paper chromatography	A small sample of a soluble substances
34	What is the principle of “conservation of mass”?	Matter cannot be created or destroyed. The total mass of the products of a reaction is the same as the total mass of the reactants.

8.4 Rocks, Atmosphere and Climate Change

	Question	Answer
1	Name the 4 layers of the earth	Crust, Mantle, outer core and inner core.
2	Name the three types of rock in the rock cycle.	Sedimentary, igneous and metamorphic rock
3	Describe how sedimentary rocks are formed	<u>Layers of sediment</u> are laid down over thousands of years, which are <u>compressed</u> by the sediment above to form porous rock. Examples are: Chalk, limestone, sandstone and shale,
4	Describe how igneous rocks are formed	<u>Molten rock solidifies</u> - Molten (liquid) rock forms when rocks melt. The molten rock is called magma. When the magma cools and solidifies, a type of rock called igneous rock forms. Examples are obsidian, basalt, granite and gabbro.
5	Describe how metamorphic rocks are formed	Rocks become deeply buried or squeezed. As a result, the rocks are <u>heated and put under great pressure</u> . They do not melt, but the minerals they contain are changed chemically, forming metamorphic rocks. Examples are marble and slate
6	Name the three types of weathering	<ul style="list-style-type: none"> • Chemical weathering • Physical weathering • Biological weathering.
9	Which greenhouse gas is responsible for recent climate change	Carbon Dioxide
10	Name two greenhouse gases other than carbon dioxide	Methane Water vapour
11	Where does the independent variable go on a graph?	On the X axis
12	Where does the dependant variable go on the a graph	On the Y axis
13	Which gas is responsible for acid rain?	Sulphur Dioxide
14	Why does acid rain occur?	Sulphur dioxide is dissolved in <u>rain water</u> . Which forms <u>sulphuric acid</u> . Which makes rain water more acidic.
15	Describe 3 problems associated with acid rain?	<ul style="list-style-type: none"> • Acid rain makes rivers, lakes and soils acidic, harming the organisms living there. • Acid rain damages the leaves and roots of plants and trees. • Acid rain can speed up the weathering of limestone (rocks or buildings) and marble.
16	How are nitrogen oxides produced?	The high temperatures in engines cause the nitrogen and oxygen from the air combine to produce oxides of nitrogen.
17	What is a non-renewable fuel?	A fuel that will run out eventually
18	How was the earth's first atmosphere formed?	From gases produced by volcanic activity.
19	What are thought to be the relative proportions of the gases that formed the early atmosphere?	Little or no oxygen, large amounts of carbon dioxide, large amounts of water vapour and small amounts of other gases.
20	Why can't we be certain about how the earth's atmosphere formed?	There is only limited evidence (e.g. from rocks and ice cores) about the earth's early atmosphere.
21	How were the earth's oceans formed?	Water vapour, released by volcanoes, cooled and condensed to form the oceans.

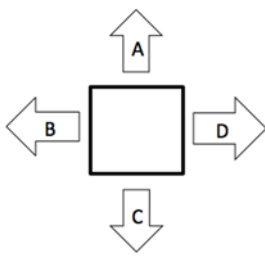
22	How did the amount of oxygen in the atmosphere gradually increase?	<u>Green plants evolved</u> . The growth of these primitive plants used carbon dioxide and released oxygen by <u>photosynthesis</u> .
23	Describe two processes, other than photosynthesis, that reduced the amount of carbon dioxide in the atmosphere.	<ul style="list-style-type: none"> • Carbon dioxide dissolved into the oceans. • Dissolved carbon dioxide was incorporated into the shells of marine organisms. • When marine organisms die their shells can eventually form carbonate rocks.
24	What is the greenhouse effect?	<ul style="list-style-type: none"> • This is when various gases are added to the atmosphere, including carbon dioxide, methane and water vapour. • These gases <u>absorb heat radiated from the Earth and subsequently release the energy</u> that keeps the Earth warm.
25	What evidence do we have for global warming and why can we not be absolutely certain about it?	<ul style="list-style-type: none"> • Scientists have discovered a correlation between historical global temperature and carbon dioxide levels. • They also know how much carbon dioxide we are presently adding to the atmosphere.
26	List the percentages of the gases in our modern atmosphere.	Nitrogen 78%, oxygen 21%, 1% other gases (argon, carbon dioxide and water vapour).
27	What are the potential of climate change?	<u>The climate will warm up</u> (although we cannot be certain by how much). It is also suspected we will have a <u>long term change in weather patterns</u> (e.g. more/less rain and more extreme weather events).
28	How might the climate change be mitigated (reduced)?	Reduce the use of fossil fuels

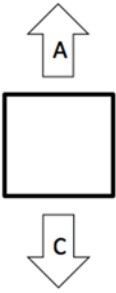
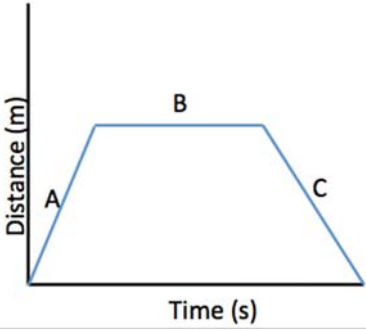
8.5 Waves – Core questions

	Question	Answer
1	What do waves transfer?	Energy and information (but not matter).
2	Give two examples of longitudinal waves	<ul style="list-style-type: none"> • Sound waves (including ultrasound and infrasound) • Seismic P (primary) waves
3	Describe a longitudinal wave	The direction of the vibration is <u>parallel</u> to the direction of the energy travel
4	Describe a transverse wave	The direction of the vibration is <u>perpendicular</u> to the direction of the energy travel
5	Give two examples of transverse waves	All of the electromagnetic waves (including light, seismic S (secondary) waves, water waves and waves on a string.)
6	What is a medium?	material that energy, eg sound, light or heat, passes through
7	What is the wavelength and what is it measured in?	<p>The length of 1 complete wave cycle. It is measured in meters (m).</p>  <p>The diagram shows a transverse wave on a horizontal line. A horizontal double-headed arrow above the wave is labeled 'wavelength', spanning one full cycle from a crest to the next crest. A vertical double-headed arrow from the horizontal center line to a crest is labeled 'amplitude'.</p>
8	What is the amplitude and what is it measured in?	<p>The distance from the centre of a wave to the top of the wave. It is measured in meters (m).</p>  <p>The diagram shows a transverse wave on a horizontal line. A horizontal double-headed arrow above the wave is labeled 'wavelength', spanning one full cycle from a crest to the next crest. A vertical double-headed arrow from the horizontal center line to a crest is labeled 'amplitude'.</p>
9	What is the frequency of a wave and what is it measured in?	The number of waves in 1 second and the unit is Hertz (Hz)
10	As the wavelength of a wave increases, how does frequency change? (Assuming that it is travelling at a constant speed).	The frequency would decrease.
11	To measure the speed of a sound wave, which two things do you need to measure?	<p>How far it has travelled (distance)</p> <p>How long it took to get there (time)</p>
12	Give two equations which can be used to find the velocity of a wave?	<ul style="list-style-type: none"> • Distance / time • frequency x wavelength.
13	Name the first part of the ear to detect a sound	The eardrum
14	What does the cochlea do?	Turn vibrations into electrical signals that can be sent to the brain
15	Which unit of measurement is used for the loudness of a sound?	Decibels
16	What is ultrasound?	Sound with a frequency/pitch above the range of human hearing
17	What is infrasound?	Sound with a frequency/pitch below the range of human hearing
18	What does a translucent material do?	It scatters visible light as it passes through it
19	Which mediums can light travel through?	Through solids, liquids, gasses and a vacuum.
20	What type of substances absorb waves?	<ul style="list-style-type: none"> • Light waves are absorbed by black materials. • Sound waves can be absorbed by soft furnishings.

21	What type of substances reflect waves?	<ul style="list-style-type: none"> • Mirror and shiny materials reflect light waves. • Hard flat surfaces reflect sound waves.
22	What type of substances transmit waves?	<ul style="list-style-type: none"> • Clear materials like glass and plastic transmit light waves. • Sound can be transmitted through thin materials like walls, doors and windows.
23	What property of the wave is the behaviour (absorption, transmission, reflect or refract) dependent on?	The wavelength of the wave.
24	Why do blue objects look blue?	White light lands on the object, all the other colours of light are absorbed, blue is reflected into the eye.
25	What happens to light as it passes from one material to another?	Some of it will be reflected (bounced off) and some will be refracted (bent through).
26	What is refraction and what causes it?	<u>Refraction is the bending (change of direction) of a wave as it passes between different materials of different densities. It is caused by the slowing down or speeding up of the wave as it travels from one density to a different density.</u>
27	As light travels from a more dense material to a less dense material, what direction will it bend in?	Away from the normal line.
28	If light is allowed the travel into a glass block and out of the other side again, what would you notice about the incident ray and the emergent ray?	They will be <u>parallel to each other</u> . You might also notice the incident ray is slightly brighter than the emergent ray as some energy may have been absorbed by the glass as the wave is transmitted through.
29	If a wave travels 90° to the surface (along the normal line) of a material what <u>will not</u> change and what <u>will</u> change?	<u>Direction will not change but speed still will.</u> This means that the wavelength will change for a constant frequency but the direction of the wave will continue in a straight line and not bend.
30	What are the colours of light in the visible spectrum? (Start with the longest wavelength)	Red, Orange, Yellow, Green, Blue, Indigo, Violet.
31	What is the order of waves in the electromagnetic spectrum? (Start with the longest wavelength)	Radio waves, Microwaves, Infrared waves, Visible light, Ultraviolet rays, X-rays, Gamma rays.

8.6 Force and Speed – Core questions

	Question	Answer
1	Name 8 forces	<ul style="list-style-type: none"> • Thrust • Air resistance • Friction • Weight/gravity • Reaction • Upthrust • Lift • Magnetism
2	State the unit for force	Newton, N
3	Explain the difference between a scalar and vector quantity	<p>A vector has: <u>magnitude/size</u> <u>direction</u></p> <p>A scalar quantity has: It has a <u>magnitude/ size</u> But <u>no direction</u></p>
4	Name three examples of a scalar quantity	<ul style="list-style-type: none"> • Distance • Speed • Mass • energy
5	Name three examples of a vector quantity	<ul style="list-style-type: none"> • Displacement • Velocity • Acceleration • Force/weight • momentum
6	State an example where friction is useful	<ul style="list-style-type: none"> • shoes on floor • tyres on road • brakes on any vehicle • any other reasonable example
7	State Newton's third law of motion	If object A exerts a forces on object B, then object B exerts an equal but opposite force on object A
8	What is the motion of any object if all forces are balanced?	<u>Constant speed</u> including stationary
9	Describe what will happen to an object if the forces are unbalanced.	It will accelerate
10	How do you calculate change in velocity?	Change in velocity = final velocity – initial velocity (v – u)
11	Recall the equation for acceleration	Acceleration = (final velocity – initial velocity) ÷ time
12	<p>If C is weight/gravity and the object is on a surface what is the force A?</p> 	Reaction

13	State the formula for speed	Speed = distance / time
14	Suggest how you can decrease friction	Using a lubricant such as oil, Vaseline or ball bearings
15	What is the standard unit for speed?	Metres per second, m/s
16	If force A is 10N and force C is 10N, what is the resultant force acting on this object: 	0N
17	What is the unit for weight?	Newtons, N
18	At which points A, B or C, does the object have the greatest speed? 	A - where the graph has the steepest gradient
19	If an object has a resultant force of 0N, describe its motion	It is moving at a constant speed (including stationary)
20	Describe how to calculate the distance an object has travelled using a velocity-time graph	By calculating the area under the graph
21	Describe how to calculate acceleration using a velocity-time graph	<ul style="list-style-type: none"> • Calculate the change in time from the x-axis • Calculate the change in velocity from the y-axis • Divide the change in velocity by the change in time
22	State Newton's second law of motion	If the forces on an object are unbalanced then the object will accelerate resulting in a change of velocity or direction
23	Which equation states Newton's second law?	$F=ma$ (resultant force = mass x acceleration)
24	State an example of when friction is not useful	<ul style="list-style-type: none"> • in an engine • axles • motor • machinery
25	What is the acceleration due to gravity on earth? (g)	10 m/s ²
26	How is weight calculated from mass?	Weight (N) = Mass (kg) x g (N/kg)
27	What is meant by conservation of momentum?	The total momentum before a collision is equal to the total momentum after a collision. (Remember - direction is really important here!).

28	What is the thinking distance?	The distance travelled in the time it takes the driver to react. It is measured in m.
29	Which factors affect the thinking distance?	<ul style="list-style-type: none"> • speed of the vehicle • the driver's reaction time • visibility
30	What is the braking distance?	<ul style="list-style-type: none"> • The distance travelled in the time it takes between the driver applying the brakes and the vehicle stopping. It is measured in m.
31	Which factors affect the braking distance?	<ul style="list-style-type: none"> • mass of the vehicle • speed of the vehicle • the condition of the brakes • road conditions (frictional forces) • weather
32	How do you calculate stopping distance?	• Thinking distance + Braking distance. It is measured in m.
33	How do crumple zones, air bags and seat belts help protect passengers?	• They all are designed to <u>increase the time it takes to reduce the momentum of the vehicle to zero</u> and so they <u>reduce the force</u> on the passengers.