# Physics preliminary course overview

**Business**, Industries



Physics Preliminary 8. 2 The World Communicates 1. The wave model can be used to explain how current technologies transfer information 1. Describe the energy transformations required in one of the following: – Mobile telephone – Fax/modem – Radio and television A. An energy transformation is a change in the type of energy, for example a change from sound energy to electromagnetic waves.

Relating this to the mobile telephone, it undergoes basic energy transformations of, sound wave (your voice), to electrical energy (in the wires inside the phone), to electromagnetic waves (from the phone to the tower), to electrical energy (at the tower), then to electromagnetic waves (to reach the receiving phone), then electrical energy (inside the receiving phone), then to sound waves (at the speaker of the receiving phone) 2. Describe waves as a transfer of energy disturbance that may occur in one, two or three dimensions, depending on the nature of the wave and the medium A.

Waves carry energy and sometimes they require a medium and sometimes they don't. Laser lights are an example of a 1 Dimensional wave, water waves are an example of a 2D wave while an example of 3D waves is a sound wave 3. Identify that mechanical waves require a medium for propagation while electromagnetic waves do not A. Mechanical waves, such as sound waves, water waves and earthquake waves need a medium (a substance) to travel through, they cannot move from one point to another if there is nothing (a vacuum) between the two points.

On the other hand electromagnetic waves do not need a medium to travel through. An example of this is in space, which is a vacuum, if you call out in https://assignbuster.com/physics-preliminary-course-overview/

space your sound waves do not penetrate out of your space suit. However electromagnetic waves do, therefore you can see the light from the sun. Even simpler, in space you can see a planet explode, but you cannot hear it. 4. Define and apply the following terms to the wave model: medium, displacement, amplitude, period, compression, rarefaction, crest, trough, transverse waves, longitudinal waves, frequency, wavelength, and velocity A.

Mechanical Waves: The group of waves that required a medium for transmission, e. g. sound waves Electromagnetic Waves: The group of waves that do not require a medium for transmission i. e. ultraviolet light, visible light etc. They all travel at the same speed in a vacuum, which is the speed of light. Transverse Waves: Waves in which the particles oscillate at right angles to the direction of motion of the wave, e. g. surface water waves. Direction of Propagation: The direction of motion of a wave

Longitudinal Waves: Waves in which the particles oscillate parallel to the direction of motion of the wave e. g. sound. Periodic Waves: Wave disturbance that repeat themselves at regular intervals. Compressions: Regions of a longitudinal wave where the particle are close together. The point where the medium has a maximum density Rarefactions: Regions of a longitudinal wave where the particles are spread apart. The point where the medium has a minimum density. Crest: The point of a wave where the particles of the medium have a maximum displacement upwards or in a positive direction.

Trough: The point of a wave where the particles of the medium have a maximum displacement downwards or in a negative direction Amplitude: https://assignbuster.com/physics-preliminary-course-overview/

The maximum displacement of the particles of a medium from their rest position Wavefront: An imaginary line joining any group of adjacent particles that are in a phase with each other. Wavelength: The distance between any two corresponding points of a wave Frequency: the number of waves that pass a point in one second Period: Number of crest passages per unit time. 5. Describe the relationship between particle motion and the direction of energy propagation in transverse and longitudinal waves A.

Particles in the medium move in a direction perpendicular to the motion of transverse wave. Particles in the medium move in a direction of parallel to the motion of longitudinal waves 6. Quantify the relationship between velocity, frequency and wavelength for a wave: A. V = fw (v = velocity, f= frequency, w = wavelength) 2. Features of a wave model can be used to account for the properties of sound 1. Identify that sound waves are vibrations or oscillations of particles in a medium A. Sound is a longitudinal wave that requires a medium to travel through.

As compressions and expansions (or rarefactions) of particles that make up the medium, sound is a vibration of the medium. 2. Relate compressions and rarefactions of sound waves to the crests and troughs of transverse waves used to represent them A. Compressions: Regions of a longitudinal wave where the particle are close together. The point where the medium has a maximum density Rarefactions: Regions of a longitudinal wave where the particles are spread apart. The point where the medium has a minimum density. Crest: The point of a wave where the particles of the medium have a maximum displacement upwards or in a positive direction.

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qualitatively that pitch is related to frequency and volume to amplitude of sound waves A. Frequency is the number of waves that pass a point in one second while the pitch is related to the number of vibrations per second. The pitch of a sound relates to the frequency of the sound emitted while the amplitude relates to the volume of that sound. E. g. if you have a high amplitude you will have a loud sound.

When the frequency increases so does the pitch. 4. Explain an echo as a reflection of a sound wave A. An echo occurs when a sound wave is reflected off a surface and returns to the source. 5. Describe the principle of superposition and compare the resulting waves to the original waves in sound A. When two separate waves meet they can be added to or subtracted to make a new wave. An example of this with sound waves is, if you have one person shout, and then you get two people to shout, each at the same volume as the first person, the resulting volume will be the sum of the two volumes. . Recent technological developments have allowed greater use of the electromagnetic spectrum 1. Describe electromagnetic waves in terms of their speed in space and their lack of requirement of a medium for propagation A. Electromagnetic waves do not need a medium to travel through because electromagnetic waves do not vibrate particles so they don't need a vaccum. In space (a vacuum) electromagnetic waves travel at the speed of light, a constant equal to 2. Identify the electromagnetic wavebands filtered out by the atmosphere, especially UV, X-rays and gamma rays A.

The Earth's atmosphere provides a protective shield from harmful electromagnetic radiation. Fortunately this portion of the EM spectrum (UV rays, X-rays and Gamma rays) is filtered by the Earth's atmosphere. Earth's atmosphere filters out most of the electromagnetic waves except for visible light and radio waves. 3. Identify methods for the detection of various wavebands in the electromagnetic spectrum A. - Radio waves are detected with radio receivers that are connected to aerials. - Microwaves are detected with piezoelectric crystals. - Visible light is detected by photoelectric cells. 4.

Explain that the relationship between the intensity of electromagnetic radiation and distance from a source is an example of the inverse square law: A. The strength of a signal is proportional to the square of the distance from the source of that signal. This means that at twice the distance the signal has 1? 4 of its original strength. 5. Outline how the modulation of amplitude or frequency of visible light, microwaves and/or radio waves can be used to transmit information A. Modulation is the process of conveying a message signal inside another signal that can be physically transmitted.

With amplitude modulation (AM), the amplitude or strength of the carrier signal is varied, which corresponds to changes in the sound, while its frequency remains constant. With frequency modulation (FM), the frequency of the carrier wave is altered according to changes in sound while the amplitude remains constant. 6. Discuss problems produced by the limited range of the electromagnetic spectrum available forcommunicationpurposes A. There is only a limited range of wavelengths in the electromagnetic spectrum that can be used for communication purposes. 4.

Many communication technologies use applications of reflection and refraction of electromagnetic waves 1. Describe and apply the law of reflection and explain the effect of reflection from a plane surface on waves A. Reflection is the bouncing of a wave when it hits a surface or obstacle. Reflections of all types of waves follow the law of reflection. Angle of Incidence = Angle of Reflection The law of reflection states that the angle of the incident wave must equal the angle of the reflected wave and the incident wave and the reflected wave must lie in the same plane.

It is important to remember that the angle of incidence and the angle of reflection is measured from the normal. The normal is perpendicular to the plane of reflection (e.g. a mirror). 2. Describe ways in which applications of reflection of light, radio waves and microwaves have assisted in information transfer A. Reflection of light is used fibre optics and in CD's. Fibre optics allow for massive amounts of information transfer. Reflection of radio waves are utilised when radio waves are reflected off the ionosphere. Television and radio use this reflection to transfer information. . Describe one application of reflection for each of the following: - Plane surfaces - Concave surfaces - Convex surfaces - Radio waves being reflected by the ionosphere A. Reflection on a plane surface is used in applications such as, CD-ROM, where the laser beam is either reflected of the CD or not. Reflection of convex surfaces is used in security mirrors, where it widens the field of view. Reflection of concave surfaces is used in torches, where the rays of light travelling backwards are projected forward, for more brightness. It is also used in satellite dishes.

The ionosphere reflects a percentage of radio waves sent up, back towards earth. This allows for data to be sent through the radio waves over long distances. 4. Explain that refraction is related to the velocities of a wave in different media and outline how this may result in the bending of a wavefront A. Refraction is the bending of light as it changes speed upon entering a medium with different optical density. 5. Define refractive index in terms of changes in the velocity of a wave in passing from one medium to another A. The refractive index of a medium is the change in velocity of a wave from one medium to another.

Therefore refractive index is related to the speed of a wave in that medium 6. Define Snell's Law: A. 7. Identify the conditions necessary for total internal reflection with reference to the critical angle A. The critical angle is the angle of incidence, which forms an angle of refraction at 90°. If the angle of incidence is less than the critical angle then you will have normal refraction, and if the angle of incidence is greater than the critical angle then you will have total internal reflection. 8. Outline how total internal reflection is used in optical fibres A.

Optical fibres work by having one medium coated by another medium with a lower refractive index. The angle that enters this is greater than the critical angle so therefore the ray of light bounces around inside and travels from one end to another, never exiting the fibre. Therefore a light ray can travel through the wire. The ray of light never has an angle of incidence of less than the critical angle, so the ray never escapes the optical fibre. 5. Electromagnetic waves have potential for future communication technologies and data storage technologies 1.

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Identify types of communication data that are stored or transmitted in digital form A. Digital data is data that can be defined by numbers. Examples of digital communication include; fax, Internet, telephone calls, etc 8. 3 Electrical Energy in the Home 1. Society has become increasingly domestic energy dependent on electricity over the last 200 year 1. Discuss how the main sources of domestic energy have changed over time A. The first main source of domestic energy used by humans was fire, through wood, and then came domesticated animals, wind and water, coal, coal gas, electricity, fuel oils, solar and lastly nuclear energy.

These have developed from the start of human existence to now. 2. Assess some of the impacts of changes in, and increased access to, sources of energy for a community -Morepollution-More demand for electrical energy -More electrical devices -Increased demand for energy 3. Discuss some of the ways in which electricity can be provided in remote locations Alternative power sources can be used, such as solar or wind. 2. One of the main advantages of electricity is that is can be moved with comparative ease from one place to another through electric circuits . Describe the behaviour of electrostatic charges and the properties of the fields associated with them A. An object becomes electrostatically charged when there is either a deficiency or excess of electrons. The two types of charge are called positive charge and negative charge. Electrostatic charges cause charged particles to move of change direction. Electrostatic charges create a field of charge. An electric field is a region in which a charged particle will experience a force. 2. Define the unit of electric charge as the coulomb. A.

The SI unit of charge is the coulomb (C). A charge of 1 C is equal to the charge provided by 6.  $25 \times 10$  (to the power of 18) electrons. This gives a charge of -1.  $6 \times 10$  (-19 power) C for one electron. One coulomb is defined as the amount of charge that passes a point when a current of one ampere flows for one second. 3. Define the electric field as a field of force with a field strength equal to the force per unit charge at that point 4. Define electric current as the rate at which charge flows (coulombs/ second or amperes) under the influence of an electric field A.

Electric current is defined as the amount of electric charge flowing past a given point in a given time interval. The SI unit of electric current is coulombs per second (C. s-1) or ampere (A), 1 amp is equal to 1 coulomb of charge passing a given point in 1 second. Conventional current runs from + to -. The electron movement is in the opposite direction of conventional current. 5. identify that current can be either direct with the net flow of charge carriers moving in one direction or alternating with the charge carriers moving backwards and forwards periodically A. AC current involves the oscillation of electrons due to an electric field that is constantly changing direction. Most generators produce alternating current by means of a coil rotating in a magnetic field. - With DC current flow, the electrons in a wire have an overall flow in only one direction. This is the method used in batteries, torches, portable radios, lights in cars, and toys. 6. Describe electric potential difference (voltage) between two points as the change in potential energy per unit charge moving from one point to the other (joules/coulomb or volts). A. 7.

Discuss how potential difference changes at different points around a DC circuit A. Voltage or potential difference is defined as the change in energy when one unit of charge is moved from one point to another or the work done to move one unit of charge from one point to another. Decreases as it move around the circuit. 8. Identify the difference between conductors and insulators A. -A conductor is a substance in which there are ' free' charged particles and so a charge is able to flow through it. -An insulator is a substance in which ' free' charged particles are limited and so a charge is not able to flow through it. . Define resistance as the ratio of voltage to current for a particular conductor: 10. Describe gualitatively how each of the following affects the movement of electricity through a conductor: A. -Length: The longer the material the higher the resistance is. - Cross sectional area: The larger the cross sectional area the lower the resistance is. So the thicker the wire then lower the resistance. - Temperature: The higher the temperature of a material, the higher the resistance is. - Material: Different materials have different resistances. This is called the resistivity of that material. . Series and parallel circuits serve different purposes in households 1. Identify the difference between series and parallel circuits A. -A Parallel circuit is a closed circuit in which the current divides into two or more paths before recombining to complete the circuit. - A series is a circuit having its parts connected serially Advantages of using parallel circuitry over series circuitry in household wiring include: - You can have some devices on and others off at the same time. - If one device fails the others still work. - All devices receive the highest possible voltage. 2.

Compare parallel and series circuits in terms of voltage across components and current through them A. In a parallel circuit the voltage is the same throughout the whole circuit while the current is divided between evenly throughout the circuit. In a series circuit the current is the same throughout the circuit while the voltage is divided evenly through the components of the circuit. 3. Identify uses of ammeters and voltmeters A. Ammeters are used to measure current. Voltmeters are used to measure voltage. To measure the voltage of a component the voltmeter is placed in parallel with the component.

To measure the current passing through a component, the ammeter is placed in series with the component. When an ammeters work best if they have a low resistance. And voltmeters work best if they have a high resistance. 4. Explain why ammeters and voltmeters are connected differently in a circuit A. Voltage is sometimes called potential difference. So it is measuring the difference between two points, so is must be placed in parallel so that it can measure the difference between before and after that component. Current is a measure of the rate at which charge flows, and therefore must be connected in series.

Ammeters have a low resistance. 5. Explain why there are different circuits for lighting, heating and other appliances in a house A. Because if they were all on the same circuit there would not be enough power to run all the appliances so they are spread out on several circuits so there is enough power. 4. The amount of power is related to the rate at which energy is transformed 1. Explain that power is the rate at which energy is transformed from one form to another A. Power is the term used to describe how quickly

energy (otherwise known as work) is transformed from one form to another, or transmitted from one point to another. . Identify the relationship between power, potential difference and current A. 3. Identify that the total amount of energy used depends on the length of time the current is flowing and can be calculated using: Energy = VIt A. - Energy = Voltage ? Current ? Time -Energy = Power ? Time - Energy is measured in joules (J). 4. Explain why the kilowatt-hour is used to measure electrical energy consumption rather than the joule A. 1 kWh is 1 kW every hour. The kWh is used to measure energy consumption. 5. Electric currents also produce magnetic fields and these fields are used in different devices in the home . Describe the behaviour of the magnetic poles of bar magnets when they are brought close together A. Magnetic fields are from north to south. When two bar magnets are brought close together the magnetic fields around their poles will produce a force between the two magnets. If two like poles (north pole and north pole OR south pole and south pole) are brought close together they will repel each other while if two unlike poles (a north pole and a south pole) are brought close together they will attract each other. Like poles repel: Unlike poles attract. 2.

Define the direction of the magnetic field at a point as the direction of force on a very small north magnetic pole when placed at that point A. The direction of a magnetic field at any point is defined as the direction the north pole of a compass would indicate at that point. 3. Describe the magnetic field around pairs of magnetic poles A. The magnetic field around pairs of magnetic poles is best described by describing the lines of magnetic flux. Lines of flux are directed from the north pole to the south pole and never

cross. In a strong magnetic field they are close together while in a weak magnetic field they are well apart. . Describe the production of a magnetic field by an electric current in a straight current carrying conductor and describe how the right hand grip rule can determine the direction of current and field lines A. When current is passed through a conductor, a magnetic field is created around it. The direction of the magnetic field can be found using the right hand rule. Point your right hand thumb in the direction of the current and the direction of your fingers is the direction of the magnetic field. 5. Compare the nature and generation of magnetic fields by solenoids and a bar magnet A. A solenoid is coil of wire.

When a current is passed though a solenoid, a magnetic field similar to that of a bar magnet is produced. 6. Safety devices are important in household circuit 1. Discuss the dangers of an electric shock from both a 240volt AC mains supply and various DC voltages, from appliances, on the muscles of the body A. There are several dangers when the muscles of the body are exposed to electric shocks. These are: - Pain receptors are usually activated. - Involuntary contraction of the muscles usually means that the person will not be able to let go of the power source. - The heart is stunned and goes into fibrillation. Severe burns are inevitable. - Instant death often occurs. 2. Describe the functions of circuit breakers, fuses, earthing, double insulation and other safety devices in the home A. - Double Insulating works by wrapping or encasing the electric components of an appliance with insulating material The insulating property of these materials sets up a physical barrier to prevent the flow of electricity from the electric appliance to its user. - A fuse is a short piece of an alloy of lead and tin, connected in series with the

devices that it controls. The fuse is designed to melt when the current passing through it exceeds its threshold value. Circuit Breakers breaks the circuit when the current passing through it exceeds the threshold value by mechanical means - The active and neutral wires are connected to the functional electric unit of the appliance to deliver electricity. The earth wire is attached to the case of the appliance, which is made of metal. 8. 4 Moving About 1. Vehicles do not typically travel at a constant speed 1. Identify that a typical journey involves speed change A. Motion occurs when an object

changes its position relative to other objects or within some coordinate system.

A frame of reference is an object or a coordinate system that can be used to describe or compare motions. At the start of a journey your speed is 0 by the end of the journey you would have had to stop at traffic lights go up and down hills and e. g. 2. Distinguish between the instantaneous and average speed of vehicles and other bodies A. Average Speed Is your total distance taken by the time it took you to go that distance. Instantaneous Speed is the speed that you are travelling at any given instant 3. Distinguish between scalar and vector quantities in equations A. Scalar uantites have a magnitude but no direction examples include distance, speed and time. Vector quantities have a magnitude and a direction. Examples include velocity, force and displacement 4. Compare instantaneous and average speed with instantaneous and average velocity A. Instantaneous speed is a scalar quantity, on the other hand instantaneous velocity is a vector quantity. Average speed is also a scalar quantity and average velocity is a vector quantity. Average speed takes into account your whole journey,

where as average velocity only takes into account the starting and ending points. 5. Define average velocity as:

A. 2. An analysis of the external forces on vehicles helps to understand the effects of acceleration and deceleration 1. Describe the motion of one body relative to another A. Motion occurs when an object changes its position relative to other objects or within some coordinate system. e. g. You are watching Coyote chase Road Runner. Road Runner's velocity is 17 m. s east and Coyote's velocity is 15 m. s east. Road Runner's velocity RELATIVE to you is 17 m. s east. Road Runner's velocity RELATIVE to Coyote is 2 m. s east. 2. Identify the usefulness of using vector diagrams to assist solving problems A.

Vector diagrams are used to add vectors, to find the resultant vector. This can be used to find the net force on an object from many smaller forces. Addition of vectors is also used to find total displacement 3. Explain the need for a net external force to act in order to change the velocity of an object A. An object remains at rest, or in uniform motion in a straight line unless acted on by an external force. This is also known as the law of inertia. It basically means that a moving object will travel in a straight line at a constant velocity until an external unbalanced force acts pon the object. 4. Describe the actions that must be taken for a vehicle to change direction, speed up and slow down A. As stated by Newton's 1st law of motion, in order to change a vehicles direction or speed, you need an external force, to act on the vehicle. However on earth there is, gravity, air resistance and friction to slow a car down, and trust from the engine and friction with the ground and the tyres to

speed up a car. 5. Describe the typical effects of external forces on bodies including: – Friction between surfaces – Air resistance A.

Friction examples are constantly seen throughout a normal day and it normally slows you down or helps change direction 6. Define average acceleration as A. 7. Define the terms ' mass' and ' weight' with reference to the effects of gravity A. Mass is the amount of matter in a body whereas weight is the force due to gravity acting on that mass. Weight is equal to mass times force due to gravity, which on earth is 9.8 m. s. This is an extension of newton's 2nd law of motion. F= ma 8. Outline the forces involved in causing a change in the velocity of a vehicle when: - Coasting with no pressure on the accelerator Pressing on the accelerator – Pressing on the brakes - Passing over an icy patch on the road - Climbing and descending hills – Following a curve in the road A. 9. Interpret Newton's Second Law of Motion and relate it to the equation: A. The net force of an object is equal to the product of its mass and its acceleration in the direction of the force. 10. Identify the net force in a wide variety of situations involving modes of transport and explain the consequences of the application of that net force in terms of Newton's Second Law of Motion A. Net force is defined as the vector sum of all forces.

The net force is the resultant force of all individual forces acting on an object at that time. If the net force is zero, then the forces acting are described as balanced. The object will obey Newton's first law of motion, that is, it will either continue to move at a constant velocity or remain stationary. If the net force is not a zero value, it is described as an unbalanced force. In this case, the object follows Newton's second law of motion and acceleration will result.

3. Moving vehicles have kinetic energy and energy transformations are an important aspect in understanding motion. Identify that a moving object possesses kinetic energy and that work done on that object can increase that energy 2. Describe the energy transformations that occur in collisions Elastic potential energy is the energy stored in elastic materials as the result of their stretching or compressing. In an elastic collision, the EK after the collision is equal to the kinetic energy before the collision. Inelastic collisions result in the transformation of energy into other forms. It is usually lost to the surroundings in the form of heat or sound and is no longer in a useful form. . Define the law of conservation of energy Energy can neither be created nor destroyed but can be transferred from one body to another or transformed from one type to another. 4. Change of momentum relates to the forces acting on the vehicle or the driver 1. Define momentum as: Momentum is a measure of an object's tendency to move in a straight line with constant speed. Momentum is the product of mass and velocity p? mv 2. Define impulse as the product of force and time Impulse is force applied over a period of time Impulse = Force (Times) Time 3.

Explain why momentum is conserved in collisions in terms of Newton's Third Law of motion In any collision, the total momentum before the collision is equal to the total momentum after the collision 5. Safety devices are utilised to reduce the effects of changing momentum 1. Define the inertia of a vehicle as its tendency to remain in uniform motion or at rest The inertia of a vehicle is its tendency to remain at rest or in uniform motion unless acted on by an external force. That is why when you crash a vehicle into a wall, it will continue to collide and squash into the wall instead of just stopping. This is also why a passenger in a vehicle continues to go forward when the breaks of a vehicle are applied. Because the car may have forces slowing it down but the passenger has a tendency to continue forward 2. Discuss reasons why Newton's First Law of Motion is not apparent in many real world situations There is always some type of friction that will oppose motion. Whether it is air resistance or friction between the object and the surface it travels on, it is impossible to completely eliminate friction. This is why objects do not remain in uniform motion. 3.

Assess the reasons for the introduction of low speed zones in built-up areas and the addition of air bags and crumple zones to vehicles withrespectto the concepts of impulse and momentum Air Bags and Crumple Zones both increase the stopping distance of a vehicle. Relating back to Impulse = Force ? Distance, If the distance is increased, the force is lower, this reduces the forces put on an the vehicle, and the occupants inside it. Low Speed zones are in place because, the slower your velocity, the less momentum you have and the faster you can stop 4. Evaluate the effectiveness of some safety features of motor vehicles 8. 5 The Cosmic Engine