Physics assessment task??”??”research task

Physics Assessment Task??”??” Research TaskEinstein??™s Special Theory of Relativity: * Velocity of light is constant regardless of relative motion of the sources and observer. * All inertial frame of reference are equal and no inertial frame of reference is truer than others. * Special relativity only holds in inertial frame of reference. Impacts of Special Relativity: 1) Relative Simultaneity * Events that take place in space at the same time are considered to be simultaneous. * Two events that are simultaneous to one observer may not necessary appear simultaneous to another observer who is in a different frame of reference.

2) Time Dilation * Time dilation is the phenomenon that the time appears to go slower in a moving frame with constant velocity than in a stationary frame. 3) Length Contraction * Length contraction is the phenomenon that length of a moving object appears shorter to a stationary observer than when the object is at rest. 4) Mass Dilation * Mass dilation is the phenomenon that mass of a moving object appears heavier to a stationary observer than when the object is at rest. 5) E= mc? * E-Energy(J)M-mass (kg)C-speed of light (3? 108m/s)Experiment 1: NIST scientists performed the new “ time dilation” experiments by comparing operations of a pair of the worlds best experimental atomic clocks. Aim: To prove time passes more slowly when you move fasterEquipment: atomic clocks, an observer, airplane.

Procedure: 1. Put two clocks to unequal gravitational forces due to their different elevations above the surface of the Earth. One put in the lab, the other put on the flying airplane. 2.

Let the observer be moving to observe. Discussion: According to Einsteins theory of gravity and space time, clocks in strong gravity tick slower than clocks in weak gravity, so time passes more slowly when the atomic clock is put in a higher elevation. Results: 1. The higher clock which on the flying airplane experiencing a smaller gravitational force, so it runs faster.

The time no longer synchronized. 2. When the observer is moving, a stationary clocks tick appears to last longer, so the clock appears to run slow. Experiment 2: One of the most striking observations of length contraction is in the phenomenon of muon decay. Aim: To prove length contraction works in muonsEquipment: Cosmic radiation detector, muons. Procedure: Muons are detected by the cosmic radiation detector which on the earth??™ surface. Discussion: In a stationary frame of reference, muons have an average “ life time” of 0. 000002 seconds before they decay to something else.

? Muons generated by cosmic rays have a velocity of about 99. 8% of the speed of light. But even at these speeds we expect the muon to decay before it reaches the ground. That is, the muon does not live long enough to travel such a long distance before decaying. We can use the formula for the magnitude of the time dilation effect, With v = 0. 998c and TB = 0.

000002 seconds and we find that to us, the life time of the speeding muon is not 0. 000002 seconds, but 0. 000032 seconds instead.? That is, on account of its very high velocity relative to us, the lifetime of the muon appears to be 16 times greater.? The range of a muon with this lifetime is given by0. 998 ?

300, 000, 000 ? 0. 000032 = 9, 600 metersThis is quite long enough for muons to reach the earth??™s surface, as we do indeed observe.

Results: Length contraction works in muons??™ favour. Hence the observation that a moving object appears shorter than a stationary object.? Simple electric motor: Aim: Perform s simple electric motor in the lab with DC motors. Equipment: one 1. 5V battery, one ferromagnetic screw, a few copper wines, a round magnet.

Procedure: 1. Set the screw on the magnet, bend the wire. 2.

Attach the magnet to one end of the battery. 3. Press and hold the top end of the wire to the top end of the battery, making an electrical connection from the top battery end to the wire. 4. Lightly touch the free end of the wire to the side of the magnet.

Result: The magnet and screw start to spin immediately. Discussion: Watch out the screw and magnet can easily fly out of control, and you do not want that screw ending up in your eye. Also note that some of the components, like the wire, can get very warm while doing this.