Investigation 2.5: acceleration due to gravity of different masses

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Investigation 2. 5: Acceleration Due to Gravity of Different Masses SPH 4CI-01 Al Einstein, James Maxwell, Isaac Newton, James Watt Mrs.

Joldwcks Due Date: July 19, 2008 Cut-Off Date: July 21, 2008 Purpose: To determine if the mass of a falling object affects its acceleration rate. Hypothesis: The greater the mass of an object, the greater its rate of acceleration because more massive objects have more gravitational force exerted on them by the Earth. Materials:- 3 spheres of different mass – spark timer – spark timer tape – measuring tape recycle bin Safety: Ensure that the masses fall directly into the recycle bin to avoid them landing on toes and/or injuring team members. Procedure: Refer to Nelson Physics 11, pp. 561-562. Notes: 3 spheres were used instead of 3 hooked masses.

A recycle bin was used instead of a safety net. Observations & Analysis: Table 1: Experimental Accelerations Due to Gravity for Different Masses Sphere Mass (kg)Trial #Number of Time IntervalsTotal Time (s)Displacement (m [D])Acceleration (m/s/s [D])Average Acceleration (m/s/s [D]) 0. 371250. 4170. 8609.

919. 9 2240. 4000. 929.

90 3260. 4330. 9239. 83 0. 554250.

4170. 8559. 859. 9 5260.

4330. 9259. 87 6250. 4170.

8609. 91 0. 897250. 4170. 8589.

889. 9 8260. 4330. 9269. 86 9260. 4330.

9249. 84 Sample Calculations: Given: V1 = 0 ? d = 0. 860 m [D] ? t = 0. 417 s a = ? ? d= V1 (? t) + ? a (? t)2 a= 2(? d) / (? t)2 = 2(0.

860 m [D]) / (0. 417 s)2 = 9. 91 m/s/s [D] Given: a1 = 9. 91 m/s/s [D] a2 = 9. 90 m/s/s [D] a3 = 9.

83 m/s/s [D] aaverage = ? aaverage = (a1 + a2 + a3) / 3 = (9. 91 m/s/s [D] + 9. 90 m/s/s [D] + 9. 83 m/s/s [D]) / 3 = 9. 88 m/s/s [D] = 9. 9 m/s/s [D] Sources of Error: The results of this laboratory investigation may have been misleading due to: •the spark timer skipping a mark causing a need to estimate the displacement for certain time intervals.

•inconsistent frictional resistance between the spark timer tape and spark timer as well as between each sphere and the air. •not enough trials being completed for each sphere of different mass. Given: accepted value = 9. 8 m/s/s [D] experimental value = 9. 9 m/s/s [D] % error = ? % error = (experimental value – accepted value) x 100% accepted value = (9. 9 m/s/s [D] – 9.

8 m/s/s [D]) / 9. m/s/s [D] x 100% = 1. 0% These sources of error could have been improved by: •ensuring the spark timer tape runs smoothly through the spark timer and repeating the trial if a skip occurs, potentially using another spark timer if available. •using laser guided motion sensors with spheres that were identical in shape and size.

•completing more trials, preferably more than 10, for each sphere before calculating average acceleration values. Conclusion: The results of this laboratory investigation support the notion that the mass of an object has no affect on its acceleration rate. The acceleration due to gravity of all objects (each with varying mass) in this experiment was calculated to be 9. 9 m/s/s [D]. The 1.

0% error was easily accounted for by the sources of error present. Synthesis: Acceleration due to gravity has many practical applications including: •the design and construction of amusement park rides, like Drop Zone at Canada’s Wonderland, which use this acceleration to increase the thrills and enjoyment of riders of all masses. •the sports of skydiving and bungee jumping which rely on predictable acceleration rates for safety. the engineering of all transportation vehicles, specifically airplanes and space craft, which use precise mathematical analysis with gravitational acceleration rate as a variable to ensure mission success. Inquiry: pp. 562-563 #1, 2 1.

A free-falling object, of any mass, experiences non-uniform motion in the form of uniform acceleration with an averaged accepted rate of 9. 8 m/s/s [D] on Earth. 2. Given: ? d = ? V1 = 115. 2 m/s [U] ? t = 5.

00 s a = 9. 8 m/s/s [D] ? d= V1 (? t) + ? a (? t)2 = (115. 2 m/s [U])(5. 00 s) + ? (9.

8 m/s/s [D])(5. 00 s)2 = 454 m [U] At 5. 00 seconds after launch, the missile has a displacement of 450 m [U].