

Alpha School

Physics Lab

Homework Assignment

Aligned with Experiments 1-11. Design tasks: be specific enough that a classmate could run your experiment from your plan.

Name: _____

Date: _____

Grade: _____

Score: _____ / _____

1. DESIGN YOUR OWN EXPERIMENT. Question: does the MASS of a pendulum bob change its period? Write: hypothesis, independent/dependent/controlled variables, materials, step-by-step method, and a blank data table you would fill in.

2. DATA ANALYSIS. A ball is dropped from 100 cm. Bounce heights: 1st bounce 68 cm, 2nd 46 cm, 3rd 31 cm. Compute the percentage of height kept each time (bounce height / drop height x 100) for the first bounce, and describe the pattern.

3. Explain in your own words: Newton's Third Law. Give TWO everyday examples that are NOT the balloon rocket. Write 4-6 sentences.

4. **DENSITY.** Design a water-displacement measurement for an irregular rock. Then compute density for: Rock A: mass 90 g, volume 30 cm³; Rock B: mass 45 g, volume 30 cm³. Which is denser?

5. **SOUND.** Plan an experiment testing whether string length changes pitch (like a guitar string). Write hypothesis, variables, and how you will measure pitch fairly.

6. **TROUBLESHOOTING.** You build a circuit and the bulb will NOT light. List FOUR checks in the order you would try them, and what each check rules out.

7. **MOMENTUM.** Two identical marbles: Marble X rolls at 20 cm/s and hits still Marble Y. Predict the speeds of X and Y just after the collision, and explain using conservation of momentum.

8. FRICTION. Design a fair test comparing **THREE** surfaces for a sliding block. Include your data-table design (columns and rows) and how many trials you will run.

9. PROJECT. Build and test **THREE** paper airplane designs. For each design, record 3 flights in a table, compute the average distance, and write a conclusion: which design flew farthest, and what feature might explain it?

10. ESSAY. In one paragraph: how do the experiments in this course show that energy is never lost, only changed from one form to another? Use at least **TWO** experiments as evidence.

ANSWER KEY -- For Teacher/Parent Use

1. Rubric: hypothesis (e.g. mass does not change the period); IV = bob mass, DV = period, controls = same string length, same release angle, same timing method; method: vary mass (e.g. 50/100/200 g), time 10 swings x3 trials; data table with Mass / Time for 10 swings / Period columns.
2. First bounce keeps $68/100 \times 100 = 68\%$. Pattern: each bounce keeps roughly two-thirds of the previous height, so the bounce height shrinks each time as energy is lost to heat, sound, and deformation.
3. Rubric: every action force has an equal and opposite reaction force. Examples (any two): walking (foot pushes ground back, ground pushes foot forward), swimming, rowing a boat, a rocket launch, jumping off a skateboard. Full marks for a correct statement plus two valid, distinct examples.
4. Method: fill a measuring cylinder partway, record start level, lower in the rock, record new level; difference = volume. Rock A: $90/30 = 3.0 \text{ g/cm}^3$. Rock B: $45/30 = 1.5 \text{ g/cm}^3$. Rock A is denser.
5. Rubric: hypothesis (longer string $\rightarrow$ lower pitch); IV = string length, DV = pitch, controls = same string, same tension/pluck, same listener; pitch measured with a tuner app or by matching to a known note; 3 lengths x 3 repeats.
6. Any sensible ordered sequence, e.g.: 1) Check the switch is closed. 2) Check the bulb is not blown (try a known-good bulb). 3) Check battery is not flat (try a new battery). 4) Check all wires/connections are tight and touching metal. Each check rules out one break in the loop.
7. X nearly stops (about 0 cm/s); Y moves off at about 20 cm/s. Total momentum before (one marble moving) equals total after (the other marble moving), so momentum is conserved.
8. Rubric: IV = surface, DV = slide distance or time; controls = same block, same ramp, same release; table with Surface / Trial 1 / Trial 2 / Trial 3 / Average; 3 trials per surface.
9. Rubric: table with Design / Flight 1 / 2 / 3 / Average; averages computed correctly; conclusion names the farthest design and links it to a feature (e.g. longer wings = more lift, or a sharp nose = less drag).
10. Rubric: paragraph states energy is conserved but changes form; cites two experiments (e.g. bouncing ball: motion $\rightarrow$ heat/sound; pendulum: potential $\rightarrow$ kinetic and back; balloon rocket: stored air pressure $\rightarrow$ motion). Full marks for the claim plus two accurate pieces of evidence.