Alpha School

Physics

Homework Assignment

Name: _____ Date: _____ Grade: _____

Homework: apply physics to motion, energy, and circuits, plus a pendulum experiment. Answer in complete sentences where asked.

1. A car accelerates from 10 m/s to 30 m/s over 100 m. Find its acceleration using v^2 = u^2 + 2as.

2. A ball is thrown horizontally at 20 m/s from a cliff 45 m high. Using g = 10 m/s^2, how long until it hits the ground, and how far from the base does it land?

3. A 1,000 kg car moving at 20 m/s brakes to a stop in 50 m. Find the average braking force (work-energy method).

4. Two carts collide: cart A (2 kg, 3 m/s) hits cart B (3 kg, at rest) and they stick together. Find their common velocity.

5. A string vibrates with a standing wave of 3 loops. If the string length is 1.2 m, what is the wavelength?

6. A convex lens has focal length 10 cm. An object is placed 30 cm away. Use 1/f = 1/do + 1/di to find the image distance. Is the image real or virtual?

7. A wire carries 2 A through a 6-ohm resistor for 10 s. How much heat energy is produced (P

= I^2 R, E = Pt)?

8. A satellite orbits Earth. Explain in your own words why it does not fall straight down even though gravity pulls it.

9. EXPLAIN IN YOUR OWN WORDS: How does a transformer change voltage, and why is high voltage used for long-distance power transmission?

10. PROJECT: Build a simple pendulum (string + weight). Measure the period for 3 different lengths (keep the mass and swing angle the same). Record a data table and state how period depends on length.

ANSWER KEY - For Teacher/Parent Use

1. a = (900 - 100)/(2 x 100) = 800/200 = 4 m/s^2.

2. Time: 45 = (1/2)(10)t^2 -> t^2 = 9 -> t = 3 s. Horizontal distance: 20 x 3 = 60 m.

3. Work = change in KE: F x 50 = (1/2)(1000)(20^2) = 200,000 J -> F = 4,000 N (opposing motion).

4. Momentum: 2 x 3 = 6 kg m/s. Common mass 5 kg -> v = 6/5 = 1.2 m/s.

5. 3 loops = 3 half-wavelengths: 3(lambda/2) = 1.2 -> lambda = 0.8 m.

6. 1/di = 1/10 - 1/30 = 1/15 -> di = 15 cm. The image is real (positive image distance, on the opposite side).

7. P = 4 x 6 = 24 W. E = 24 x 10 = 240 J.

8. Accept any correct explanation: the satellite is in continuous free fall, but its sideways velocity keeps it falling around Earth instead of into it.

9. Accept any correct explanation: a transformer uses changing magnetic flux in coils with different turn counts to step voltage up or down; high voltage means lower current for the same power, which reduces I^2 R heating losses in wires.

10. Project: grade on a complete data table, a correct method (same mass and angle, only length varied), and a correct conclusion: period increases with length (roughly with sqrt(length)).

Note: For show-your-work and explain-in-your-own-words items, accept any correct reasoning that reaches the stated result. Partial credit is encouraged.