**Summer work for incoming Year 12**

Instructions - Choose at least one task from **each row** of the table and one task from each column of the table.

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| **Topic** | **Option A basics** | **Option B calculations** | **Option C Thinking hard** |
| **Waves** | **Task**:  Create a labeled diagram of a transverse wave and a longitudinal wave. Then, define and give an example for each of the following terms:   * Amplitude * Wavelength * Frequency * Period * Wave speed * Compression * Rarefaction   **Extension**:  Explain the difference between mechanical and electromagnetic waves and give three examples of each. | **Task**:  Use the wave equation:  *v=fλ* to calculate:   1. The wavelength of BBC Radio one FM and BBC talk sport medium wave 2. A sound wave in air travels at 340 m/s. What is the wavelength of the highest sound people can hear   **Extension**:  Design a simple experiment (or describe one) to measure the speed of sound in air using a stopwatch and two people. | **Task**:  Explain the principle of superposition in your own words. Then describe (with diagrams if possible):   * Constructive interference * Destructive interference * Stationary waves (including nodes and antinodes)   **Challenge**:  Research and explain how noise-cancelling headphones use the principle of superposition to reduce unwanted sound. |
| **Electricity** | **Task**:  Define the following terms and state their standard units:   * Charge (Q) * Current (I) * Voltage (V) * Resistance (R)   Then, explain what is meant by the statement:  **"1 ampere is 1 coulomb per second."**  **Extension**:  Convert 1.2 mA into amperes and calculate how much charge flows in 3 minutes. | **Task**:   1. Use Ohm’s Law *(V=IR)(V = IR)*(V=IR) to calculate:    1. The current through a 12 Ω resistor when 6 V is applied.    2. The voltage across a 4 Ω resistor with a current of 0.5 A. 2. In a **series circuit** with three resistors (2 Ω, 3 Ω, and 5 Ω) and a 10 V battery:    1. What is the total resistance?    2. What is the total current? 3. In a **parallel circuit** with two resistors (6 Ω and 3 Ω) connected across a 6 V supply:    1. What is the total resistance?    2. What is the current through each resistor?   **Extension**:  Compare how current and voltage behave differently in series and parallel circuits. | **Task**:  Plan an experiment to investigate **how the resistance of a wire depends on its length**.  Include in your plan:   * A clear hypothesis * A diagram of the circuit * List of equipment * Method (step-by-step) * How to make it a fair test * Safety considerations * How you would calculate resistance from your measurements   **Extension**:  Suggest how you could reduce sources of error in this investigation. |
| **Forces and motion** | **Task**:  Define the following terms, including units where appropriate:   * Displacement * Velocity * Acceleration * Force * Mass * Weight * Resultant force   Then, write out **Newton’s three laws of motion** in your own words and give a real-life example of each.  **Extension**:  Explain how mass and weight are different, and calculate the weight of a 60 kg person on Earth. | **Task**:  Use the **SUVAT equations** to solve these problems (assume constant acceleration):   1. A car accelerates from rest at 2.5 m/s² for 6 seconds.    1. What is its final velocity?    2. How far does it travel? 2. A ball is thrown upwards at 12 m/s.    1. How long until it reaches the top of its path?    2. What is its displacement at that point?   Also, draw:   * A velocity-time graph for an object accelerating and then decelerating. * A displacement-time graph for a stationary object, then a steadily moving object.   **Extension**:  Rearrange the SUVAT equations to make each variable the subject. | **Objective**: Plan an experiment to explore Newton’s Second Law.  **Task**:  Design a practical investigation to explore how **force affects acceleration** using a trolley, pulley, and weights.  Your plan should include:   * A clear hypothesis * Diagram of the setup * Equipment list * Method (step-by-step) * Variables (independent, dependent, control) * How you will calculate acceleration * Safety considerations   **Extension**:  Explain how friction might affect your results and how you could reduce its impact. |
| **Materials** | Choose **one** of the following products:   * A bridge cable * A prosthetic limb * A heat shield for a space capsule   For your chosen product:   1. List **3 key properties** the material must have. 2. Suggest **one suitable material** and explain why it’s a good choice. 3. Give a brief **scientific reason** (e.g. structure, bonding, strength, heat resistance).   **Extension**:  Pick a high-tech material (e.g. Kevlar, graphene, or memory alloy) and explain one use. | **Task**:   1. Calculate:    1. The density of a 300 g block of aluminium with volume 111 cm³    2. The mass of a 0.5 m³ block of iron (density = 7,870 kg/m³) 2. Hooke’s Law: *F=kx*  A spring stretches 5 cm when a 2 N force is applied. What is the spring constant? 3. Describe the meaning of these material properties and give examples of materials that show them:    1. Brittle    2. Ductile    3. Elastic    4. Plastic    5. Stiff    6. Tough   **Extension**:  Convert 5 cm into metres and recalculate extension in SI units. Why is this important in physics? | **Springs**  Plan an investigation to determine the spring constant of a spring using different weights.  Your plan should include:   * Equipment list * Method (step-by-step) * Diagram * Variables (independent, dependent, control) * How you’ll calculate the result * How to reduce error and improve accuracy   **Extension**:  Explain how repeat measurements and graph plotting could help improve your results. |
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