**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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