**Physics IA – Individual Investigation**

**1. What is the Individual Investigation?**

The task you are being asked to complete is to design and carry out an individual investigation on a physics concept related to or extending on from the physics topics studied. The individual investigation is the internal assessment for Group 4 Science courses. It is worth 20% of your final IB grade in Physics. It will be marked and graded internally by your teacher, and then externally moderated by the IB.

This task is marked against assessment criteria with a total mark out of 24:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Personal engagement | Exploration | Analysis | Evaluation | Communication | **Total** |
| 2 | 6 | 6 | 6 | 4 | 24 |

It will consist of one scientific investigation taking about 10 hours, and the **report should be a maximum of 12 sides (A4 paper, font size Arial 11 or similar).**

**But first**, you will need to discuss your proposal with your teacher. An investigation plan, an equipment requisition form and a risk assessment form MUST be submitted before commencing work. (Forms to be used for this are attached).

**2. What kind of investigations are you allowed to do?**

You should choose a research question and carry out an investigation that you are genuinely interested in. You do not have to do an experiment in the lab, there are a number of possible tasks to choose from, including:

* A hands-on laboratory investigation
* Using a simulation (as long as it is open-ended and interactive)
* Extracting data from a database and analyzing it graphically
* Using a spreadsheet for analysis and modeling
* Producing a hybrid of a spreadsheet/database work with a hands-on investigation

**Your investigation must be unique in the cohort** – in both focus and methodology. It cannot be the same as the previous investigations that we have conducted in class, but it could be an extension or a variation of any of those. It is preferred that your investigation is open-ended.

You must carefully consider and address safety, ethical and environmental issues.

1. **What are the timelines for this task?**

* Planning, research and discussion: Aug 13- Sept 3rd, (2 in class periods)
  + Investigation proposal sheet: due: Sept 3rd
  + Risk assessment form: Sept 3rd
  + Equipment requisition sheet due: due: Sept 3rd
* Investigation carried out: Sept 17-28,
* First draft of investigation report due: Nov 5th,
* Feedback on first draft: Nov 19th - 23rd
* Final draft of investigation report due: Feb 28th

**4. What are possible topics for investigation?**

* Adhesive properties of blu-tak
* Descent of various types of golf balls along an incline
* Stopping distances
* Apex vents in parachutes
* Air resistance and cones / shuttlecocks
* Investigating sails, helicopter wings
* String tension in tennis/badminton racquets
* Vibrating strings
* Water rockets (you will need to provide this yourself)
* Power output / efficiency of solar cells – factors that affect it
* Simulating greenhouse effect
* Resistance/resistivity of ionic solutions/different types of graphite
* Temperature and strength of chocolates
* Investigate the Leidenfrost phenomenon
* Temperature and bounciness of a squash ball
* Magnetic strength and temperature
* Magnetic braking down an incline plane
* Magnetic damping of oscillations
* Eddy currents (Electromagnetism)
* Bifilar pendulums, compound pendulums
* Coupled pendulum / Energy transfer between oscillators
* Comparison of timbre of different musical instruments
* Comparison of musical instruments – effect of temperature
* Sound absorption by different densities/thicknesses of Styrofoam
* Polarisation of light in sugar solution
* Light absorption of liquids
* Refraction through different densities/concentrations of transparent liquids
* Singing wine glass/ resonance
* Resonant frequency of tower blocks
* Resolution of the human eye
* Simulating hot air balloons
* Newton’s law of cooling
* Cooling rate inside the freezer
* Half-life of the bounce of a ball
* Half-life of damped oscillations

**5. The process**

**5.1 PHASE ONE (Aug 13th - Sept 3rd)**

• Decide on a research topic; either a problem to be solved or a hypothesis to be tested.

* A list of stimulus topics has been provided above to give you an idea of some of the possible areas for investigation.
* It might be possible to introduce a degree of complexity to a simple investigation that you have encountered in class time. For example, we have measured the specific heat capacity of water. You can then turn this into an IA investigation by looking at the effect of different concentrations of salt solution and/or different types of chemical salt solutions to the specific heat capacity.
* You can conduct a web search on Physics investigations.

**5.2 PHASE TWO (Aug 13th – Sept 3rd)**

**What you will be provided with.**

1. To make this investigation manageable you will be provided with basic science equipment, including data loggers and laptops as needed. If you need specialised equipment then you will have to supply this yourself.
2. Technical assistance regarding other requirements can be obtained from your teacher.

**STEP 1: Research the topic.**

1. You will need to develop an understanding of the principles of your chosen topic. By use of the library, internet, textbooks or other source of information (parent, expert) you should clarify the
2. The physics principles
3. Measurement techniques.

**STEP 2: Choose a factor that you would like to investigate.**

1. So that you have sufficient time for the experiment you may chose to investigate only one factor (variable) to alter. However, depending on the complexity of the task, you may find it necessary to investigate more than one variable so as to allow a depth of analysis. Notes should be taken for your journal.
2. The research question (RQ) is a critical component of the investigation. Defining the aims of your study clearly will help determine all other aspects of your investigation.
3. Hence, the RQ can certainly make or unmake your investigation. If your RQ is weak, it would be too difficult to make up for it in the other aspects of the study; and the whole investigative process is unlikely to be successful. Remember, it is hard to formulate a good answer to a bad question.
4. **The RQ encourages a complex answer**. It is **not** answerable by a simple ‘yes or no’; the answer to it is **not immediately obvious**. It is capable of generating multiple insights and possible surprises.
5. **The answer to the RQ transcends the raw data**. It is expected that the analysis and interpretation you implemented to answer the RQ goes beyond the raw data. It involves variables that can be determined from raw data and includes cause and effect relationships. It allows for a reasonable amount of data processing that shall include some calculations and graphing of processed data (not just raw data) and a meaningful interpretation of the graphs (including gradients and intercepts) and charts.

**STEP 3: Design your investigation**

1. Define your variables. What is your:
2. Dependent variable/s (what you will measure);
3. Manipulated variable/s (what you will change);
4. Controlled variables (what you will keep constant).
5. Develop an “Aim” for your investigation. The Aim should be in the form of an explicit statement relating to your variables, eg: “I investigated the effect of (manipulated variable) on (dependent variable) when (controlled variables) are kept constant. I will do this by…
6. Plan your approach (see below for materials).
7. Decide what equipment will be necessary.

**STEP 4: Complete the following forms and hand in to your teacher:**

1. **Investigation Proposal Sheet** by the due date for your teacher to review and give approval.
2. **Materials Requisition Sheet**
3. **Risk Assessment Sheet** for your teacher to review and give approval.

**5.3 PHASE THREE – Performing the experiment (Sept 17th - 28th)**

**STEP 5a: Preliminary Trials -** You should record all observations, measurements, problems, changes in approach and modifications to your initial plans and procedure in your journal.

**STEP 5b: Final experiment** - You should record all observations, measurements, problems in your journal.

**5.4 PHASE FOUR – Report Writing (Sept 28th – Feb 28th). First Draft due November 5th.**

**STEP 6: Write the investigation Report.** Report writing involves collating all you’ve done into a report of your investigation. The report will be a more detailed version of a standard laboratory report. Other people’s ideas, statements, diagrams, photos and so on should be correctly referenced. Your work must not contain plagiarised material.

**Feedback on your report draft:** will be given by your teacher. You are required to submit a draft of your report write-up to your teacher for comment (once). Feedback will be in the form of a *feedback checklist*. You can also seek help during the planning and performing of the experiment.

**Investigation proposal sheet - Physics IA**

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| --- |
| Hanzhuo Zhang |

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| --- |
| Amplitude of ripples at impact of free-falling mass. |

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| --- | --- | --- |
| *Research Question/ Aim/ Hypothesis to be investigated* | |  |
|  | RQ: How does the height from which a free-falling mass is released influence the amplitude of ripples created at impact with a water surface? |  |
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|  | Hypothesis: There will be a squared relationship between the amplitude of ripples and the height from which the mass is released, as E∝A2, where G.P.E.= m g h. |  |
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| *Brief description of method/ experimental design/ You may draw a labeled diagram of set-up at the back page.* | |  |
|  | 1. A tank of water will be dyed, and paper rulers are placed into the stationary water body to measure the depth (equilibrium position of the water) from the stain mark. |  |
|  |  |  |
|  | 1. A clamp stand is used as the pivot of a pulley system for suspending a mass above water, and releasing the mass into the body of water from different heights. |  |
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|  | 1. The amplitude of the ripple will be measured by the difference in height of the stain mark. |  |
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Investigation approval ……………………………………………

*(teacher signature and date)*

**Equipment Request Form – Physics IA**

**Full name (print) Hanzhuo Zhang**

**Title of Experiment:** Amplitude of ripples at impact of free-falling mass.

|  |  |  |
| --- | --- | --- |
| **List ALL materials and equipment to be used:** | | |
| **Item** | **Item** | **Item** |
| **Clamp stand** | **Vernier Caliper** |  |
| **A big enough water tank** |  |  |
| **Brass mass** |  |  |
| **String** |  |  |
| **Paper** |  |  |
| **Food dye** |  |  |

|  |  |
| --- | --- |
| **EQUIPMENT requested from Science Department:**  **(Be specific. Eg Beaker: 250ml etc.)** | |
| **Item** | **Details (eg. Size, number, length etc)** |
| **Food dye (any color)** |  |
| **A big water tank** |  |
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| **CHEMICALS requested from the Science Department:**  **(Be specific. Eg HCl: 1M, 50 mL etc.)** | |
| **Item** | **Details (eg. Amount, Molarity etc)** |
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Requisition approval ……………………………………………

*(teacher signature and date)*

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**Risk Assessment Form – Physics IA**

**Full name (print) ………………………………………………………………………………**

A. IDENTIFY THE CHEMICAL HAZARDS IN THIS INVESTIGATION.

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| --- | --- | --- | --- |
| LIST THE CHEMICALS | *Conc %* | LIST SPECIFIC HAZARD INFORMATION  (ie Toxic, irritant, corrosive, carcinogen, flammable oxidising, explosive) | POSSIBLE EXPOSURE ROUTES  Inhalation, absorption, ingestion. |
| REACTANTS |  |  |  |
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| PRODUCTS |  |  |  |
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B. IDENTIFY HAZARDS OTHER THAN CHEMICALS THAT MAY EXIST IN THIS INVESTIGATION.

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| --- | --- | --- | --- |
| Hazard Category | Tick.  If exists | Hazard Details.  *Give brief description.* | Precautions taken  *Give brief description* |
| Pathogenic microorganisms (known or unknown) |  |  |  |
| Animal tissue or fluids. |  |
| Cuts. (eg scalpels, knives, glass tube), |  |
| Eye Damage non- chemical. (eg dusts, fumes, lasers) |  |
| Slips / trips. (eg possible wet floor, leads etc) |  |
| Falling objects (eg: tall apparatus, projectiles, masses) | ✓ |  |  |
| Ignition source (eg bunsens, candles, matches). |  |
| Moving parts (eg blender, centrifuge) |  |
| Heat, (eg: ovens, hot plates, water). |  |
| Cold. (eg: Liquid N). |  |
| Pressure or vacuum. |  |
| Noise |  |  |  |
| Electricity. (any ac electrical equipment). |  |
| Ionising radiation. (eg: radio isotopes). |  |
| Non- ionising radiation. (eg Laser, UV and EMR) |  |
| Chemical |  |
| No Hazards Identified |  |

Noted by teacher ……………………………………………

*(teacher signature and date)*