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| **Instrument Number 8** | | | **Term 4 2021** | |
| **Student Name** |  | **Handout Date** (Week Beginning) | | 16/11/2021 |
| **Teacher Name** | TURNGA | **Interim Check Date** | | 23/11/2021 |
| **Class** | SCI082N | **Rough Draft Date** | |  |
| **Unit Number/Name** | 4. Energy | **Due Date** | | 30/11/2021 |

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| **Assessment Technique** | Student experiment | | | |
| **Time/Length** | 2 weeks | | | |
| **Assessment Conditions** | Summative | | | |
| **Seen/Unseen** | Seen and unseen elements | | | |
| Materials handed out prior to assessment? | No | Yes | **Conditions** |
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| **Criterion** | **Marks** |  |
| **Science Inquiry** | /65 |  |

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| **Differentiation: If assessment conditions have been adjusted details are provided below** |
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| **Acknowledgement of assessment responsibility** |  |
| I understand the consequences of plagiarism/cheating and confirm this is my own work. | |
| **Student Signature:** | **Date:** ……………………………… |

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| B:\Common\_NEW MSHS LOGO\NEW LOGO - B&W\BW-Shield Only white outline.png | **Maroochydore State High School**  **Standards Matrix for Year** 8 **Science Term 4 Energy** |

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| Assessable Elements | | A | B | C | D | E |
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| Science Inquiry Skills | Questioning and predicting | Identification and construction of questions and problems that can be investigated scientifically and the making of justified predictions | Identification and construction of questions and problems that can be investigated scientifically and the making of plausible predictions | Identification and construction of questions and problems that can be investigated scientifically | Guided identification and guided construction of questions and problems for investigation | Directed identification and directed construction of questions and problems for investigation |
| Planning and conducting | * Planning of investigations that: * - Describe how to manage safety and ethical considerations * - identify and describe how variables are changed, measured and controlled   Accurate collection of reliable data | * Planning of investigations that: * Describe the implications of safety and ethics considerations * identify and describe how variables are changed, measured and controlled   Accurate collection of data | * Planning of investigations that: * Consider safety and ethics   Identify variables to be changed, measured and controlled | * Partial planning of investigations that: * Consider safety and ethics   Identify variables to be changed, measured and controlled | * Use of provided investigations methods * Identification of safety considerations |
| Processing and analysing data and information | * Following of conventions to construct accurate representations of data to reveal and analyse patterns and trends   Use of these patterns and trends when explaining relationships to justify conclusions | * Following of conventions to construct representations of data to reveal and analyse patterns and trends   Use of these patterns and trends when describing relationships when justifying conclusions | * Construction of representations of data to reveal and analyse patterns and trends   Use of these patterns and trends when justifying conclusions | * Partial construction of representations of data to partially reveal patterns and trends   Drawing of conclusions | * Partial construction of representations of data   Statements about data |
| Evaluating | * Evaluation of the quality of data to justify the explanation of how effective modifications to methods could improve the quality of their data   Application of scientific knowledge and investigation findings to critically evaluate claims made by others | * Explanation of how effective modifications to methods could improve the quality of their data   Application of scientific knowledge and investigation findings to make informed evaluations of claims made by others | * Explanation of how modifications to methods could improve the quality of their data   Application of scientific knowledge and investigation findings to evaluate claims made by others | * Description of modifications to methods * Description of claims made by others | Statements about:   * Modifications   Claims |
| Communicating | Concise and coherent use of appropriate language and accurate representations to communicate science ideas, methods and findings in a range of text types | Coherent use of appropriate language and accurate representations to communicate science ideas, methods and findings in a range of text types | Use of appropriate language and representations to communicate science ideas, methods and findings in a range of text types | Use of everyday language and representations to communicate science ideas, methods and findings | Fragmented use of language and representations to communicate science ideas, methods and findings |
| Score | Max  **65** | **A+≥ 61**  **A≥ 55**  **A-≥ 52** | **B+≥ 49**  **B≥ 46**  **B-≥ 42** | **C+≥ 39**  **C≥ 33**  **C-≥ 30** | **D+≥ 26**  **D≥ 19**  **D-≥ 16** | **E+≥ 13½**  **E≥ 6½**  **E-≥ 0** |

**Teacher feedback:**

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| TREBUCHET- An investigation into Energy Efficiency | | |
| **Rationale**  This part of the assignment has been done for you. Yaaaa!!  Except the last sentence.  **/1**  **Research Question:**  Complete this question by naming the independent variable you will investigate (listed in rationale) **and** the range in which it will be varied..  **/2** | **Rationale:**  A trebuchet is a siege engine that was invented in the Middle Ages, either to smash down masonry walls, or to throw projectiles over them. Large (5 metre high) trebuchets were capable of throwing projectiles with a mass of hundreds of kilograms. While such weapons were expensive to build they were invaluable in the 12th to 15th centuries for armies laying siege to heavily fortified castles. A simplified diagram of the trebuchet is shown in diagram 1.  Diagram 1:  PProjectile or Load  The trebuchet still represents an important physics problem that has affected human life day in and day out for thousands of years. For example, the motion of the trebuchet duplicates human throwing, chopping, digging, cultivating, and reaping motions.  In the modern world, the movement of a trebuchet offers an excellent analogy for swing actions in sports such as baseball, golf and tennis. These sports have millions of dollars invested in the pursuit of efficiency of action. Physicists using the analysis of trebuchet motion have made important contributions to the understanding of the physics of these sports and making the movement more energy efficient.  The efficiency of the trebuchet can be measured by a comparison of the Gravitational Potential Energy (EGP) put into the trebuchet (as the counterweight falls), and the Kinetic Energy (EK) that comes out of the trebuchet (in the projectile when it is released).  Determining the EGP put in as the counter weight falls is calculated using the equation for Gravitational Potential Energy (EGP):  Determining the EK of the projectile as it is released is done in two mathematical steps:  Firstly, the velocity of the projectile when it is released is calculated by combining the horizontal velocity (d/t) with the vertical velocity (½x9.8xt), using the formula:  Secondly, the Kinetic Energy (KE) is calculated from this velocity using the formula:  The *efficiency* can then be calculated by directly comparing the EGP put into the trebuchet and the EK which came out using the formula:  There are three factors which can alter the output (EK) of a trebuchet. These are;   * the mass of the counterweight, * the length of the string attaching the load, and * the ratio of the length of the counterweight beam to the length of the load beam.   This investigation will use a small trebuchet to investigate the effect of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ on the efficiency of the trebuchet.  **Research Question:**  What effect does changing the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ have on the efficiency of a trebuchet. | |
| **Hypothesis/Prediction**  Traditionally a hypothesis is only two sentences, but you need to write more than this here. Make a prediction regarding the effect of increasing your independent variable on the efficiency of the trebuchet. Justify this prediction using a logical argument and some of the prior knowledge of the trebuchet. Your prediction and justification does not need to be “right”, but it does need to be logical, and well argued.  **/4** | |  | | --- | | **Hypothesis/Prediction** | |  | |  | |  | |  | |  | |  | | |
| **RISK ASSESSMENT**    **Describe** the possible risks in the experiments by completingthe table      **/3** | |  |  |  |  | | --- | --- | --- | --- | | Source of risk | What harm could it cause? (circle) | Safety precautions taken | If an incident occurred what should I do? | |  | Minor  Significant  major |  |  | |  | Minor  Significant  major |  |  | |  | Minor  Significant  major |  |  |   **Risk assessment:**  Table 1 – Possible risks in the trebuchet Extended Experimental Investigation: | |
| **METHODOLOGY**  In this section you do not have to provide a method, which is traditionally a list of steps.  You do have to provide an explanation of the experimental idea behind your investigation (an experiment your investigation is based on) – this is the “previous investigation” and has been done for you.  You also have to explain how the previous experiment has been modified to suit your investigation.  **/1**  **/2**  Use the word “trend” here  **/3**  Use the word “uncertainty” here  **/2**  **/1**  **/2**  **Identify** the variables.  **Independent** **variable** is the one that is changed deliberately.  **Dependent variable** is the one that is measured.  **Controlled** **variables** are those that must be kept the same all the time.  **/4**  Here you should clearly describe how each of your controlled variables was managed by the group so that these variables did not affect the result.  **/4** | **Methodology:**  Previous Investigation:  The previous investigation was an experiment using a small catapult constructed out of wood and rubber bands and a plastic lid. An experiment was done to investigate the relationship between the distance the load arm of the catapult was pulled back, and the Kinetic Energy (EK) released when the load was propelled forward.  Modifications:   * The appliance used in the investigation was changed from a catapult to a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. * The independent variable was changed from the distance the load arm was   pulled back, to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.  The reason for this is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_   * There were \_\_\_\_\_\_\_\_ variations of the independent variable, and these   ranged from \_\_\_\_\_\_\_\_\_\_\_\_\_\_ to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. This should be  sufficient data to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_   * There were \_\_\_\_\_\_\_\_\_ trials for each variation of the independent variable. This should be sufficient trials to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_   \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_   * The distance the projectile travelled was measured from the centre of the trebuchet. It was measured with a tape measure, which created an uncertainty in each distance measurement of \_\_\_\_\_\_ metres. * The time the projectile was in the air was measured with a stopwatch. While the stopwatch is very accurate, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_   \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. For this reason, it was assumed the measurement of time would have an uncertainty of \_\_\_\_\_\_\_\_\_\_ seconds.  Independent Variable: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Dependent Variable: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Controlled Variables: (at least 4) - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Description of how controlled variables were managed:   |  | | --- | |  | |  | |  | |  | | |
| **RESULTS**  **Complete** the measurements that will be needed for the experiment and the calculations.  There are two other variables of the trebuchet which you do not vary (see bulleted list earlier). List the values of these variables  **/4**  Use the table on the right to **record** the primary data.  List your independent variable in the heading for the first column  There is room for 7 variations of the independent variable you are investigating, although you do not have to complete this many variations.  **/3**  Use the averages you calculated in table 2 (a) AND the formulas on page 4, to calculate and complete table 2(b).  **/3** | **Results:**   * Mass of Projectile = \_\_\_\_\_\_ g = \_\_\_\_\_\_\_\_\_\_ kg   Distance the counterweight falls vertically = \_\_\_\_\_\_\_\_\_\_ cm = \_\_\_\_\_\_\_\_\_\_ m   * \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ = \_\_\_\_\_\_\_\_\_\_ \_\_\_ * \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ = \_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_   **Table 2– Changing to measure efficiency:**   1. Measured data – time and horizontal distance (with uncertainty)  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | \_\_\_\_\_\_\_\_\_\_  \_\_\_\_\_\_\_\_\_\_  \_\_\_\_\_\_ ( ) | **Time** projectile was in the air, **t** (seconds) | | | | | Horizontal **distance** travelled by projectile, **d** (metres) | | | | | | T 1 | T 2 | T 3 | Avg | Uncert in time | T 1 | T 2 | T 3 | Avg | Uncert in dist | |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  1. Overall results – velocity, EGP, EK, and Efficiency  |  |  |  |  |  | | --- | --- | --- | --- | --- | | \_\_\_\_\_\_\_\_\_\_  \_\_\_\_\_\_\_\_\_\_  \_\_\_\_\_\_ ( ) | Velocity of projectile  (m/s) | EGP put into trebuchet  (Joules) | EK out of trebuchet  (Joules) | Efficiency  (%) | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | | |
| Here you should show one example of each of the calculations. Choose a data set and list this at the top by stating the independent variable and the variation you are using for your example.  Make sure you include a formula, correct substitution of values and answers with units.  **/6**  **Construct** a scatter graph (crosses for each data point) of*Efficiency versus your independent variable*  Choose your scale carefully to maximise the size of the graph.  **Draw the trend line** where you think the “trend” or “pattern” of the points is.  The trend line may be a straight line, or it may be a curve. If it is a curve draw it as a smooth curve. The trend line does not have to go through all, or even any of the points.  **/ 5**  **Identifying trends, Patterns, and Relationships:**  There are two trends to discuss. First para discuss the most important trend, which is the efficiency. Identify the trend in efficiency and the independent variable increases. Go thru the four steps ( in the data book).  2nd para, identify the trend in the distance the projectile travelled as the independent variable increased. Only three steps as there is no need for a math relationship for this one.  Both paras – remember to follow the four-step pattern – **Check your data analysis book for a more detailed guide to what to write.**  **/3**  **Identifying Uncertainty and Validity:**  Describe the amount of uncertainty and limitations in your results. Do uncertainty first in one paragraph, then limitations in a second paragraph.  Remember there are three ways to judge the uncertainty, so use as many of these ways as you can.  Limitations are harder to judge, but definitely identify at least one factor which limits your ability to interpret or use the data to make predictions. Also, if you believe (and can justify) that the efficiency data is not accurate (there is **error**, not just uncertainty), this is a limitation.  **Check your data analysis book for a more detailed guide to what to write.**  **/3**  **Conclusion:**  Start with the most important decision (finding) you can make about your results. Sum it up in one short and simple topic sentence. Then justify/explain this sentence in the rest of the para. At the end of the para, explain the real-life implications of the finding.  Repeat for any other decisions you make about the results.  **Check your data analysis book for a more detailed guide to what to write.**  **/3**  **Evaluating Reliability and Validity:**  Do this in two parts – Reliability in the first para, and Validity in the second.  For Reliability, rely heavily on the amount of uncertainty you identified. Use it to argue whether the investigations is reliable.  For Validity, rely on the limitations you identified and any other additional factors you believe make the findings not valid to apply to real life.  **Check your data analysis book for a more detailed guide to what to write.**  **/3**  **Improvements and extensions:**  Do this in two parts – Suggest improvements in the first para, and Extensions in the second.  For Improvements, rely heavily on two things.  First - if the results are not reliable suggest things which would improve the reliability and/or accuracy in the experiment.  Secondly - If you have decided that the validity is low, then also suggest ways to improve the validity.  For Extensions you have to suggest what alternative investigation needs to be done. This is harder, and you have to think about this quite a bit.  **We did not do a lot of this in our data analysis book, so we will discuss this part a little in class.**  **/3** | | **Example calculations** - for a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of \_\_\_\_\_\_\_\_\_ (value & units)   |  |  | | --- | --- | | **Average** **time**: | **Average distance:** | |  |  | | **Velocity of Projectile:** | **EGP:** | |  |  | | **EK:** | **Efficiency:** | |  |  |   Graph 1: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_and its effect on efficiency  Efficiency ( % )   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |   \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (\_\_\_\_\_)  **Identifying trends, Patterns, and Relationships**   |  | | --- | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  |   **Identifying Uncertainty and Limitations**   |  | | --- | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  |   **Conclusion**   |  | | --- | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  |   **Evaluating Reliability and Validity**   |  | | --- | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  |   **Improvements and Extensions**   |  | | --- | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | |