**EASTERN GOLDFIELDS COLLEGE**

**GENERAL 12 INTEGRATED SCIENCE**

**Task 8 Motion Investigation**

**NAME: MARKING KEY MARKS\_\_\_\_\_\_\_\_\_\_/60**

**DATE \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ WEIGHTING: 9%**

*Equipment required:* ruler, pencil, pen, eraser, timer, scales, measuring tape and calculator

In this assessment you are going to investigate various forms of motion.

**PART 1: Reaction Time**

The reaction time is the time it takes your brain to respond after receiving a stimulus (seeing, hearing, smelling or touching something)

We can work out the reaction time by dropping and catching a ruler. The reaction time is affected by many things.

Working in pairs, drop a metre rule, without warning, and let your partner catch it. Make sure to drop the ruler from the **same** height each time by having the ruler hanging just above your partner’s fingers. Record how far the ruler fell, in centimetres, and then complete a total of 5 trials so you can get an averaged result.

Swap your roles and repeat the experiment. Record yours and your partner’s results using an appropriate scientific table in the space below.

**Tables 1. (*3 marks)***

|  |  |
| --- | --- |
| 1 | Table Title |
| 1 | Units |
| 1 | Trials with an average calculated |

Eg. How far a 1m ruler fell when being caught by two year 12 students

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Participant | Trial 1 (cm) | Trial 2 (cm) | Trial 3 (cm) | Trial 4 (cm) | Trial 5 (cm) | Average |
| 1 |  |  |  |  |  |  |
| 2 |  |  |  |  |  |  |

**Question 1.** Using this formula for reaction time, **t =**  calculate the reaction times for you and your partner. H = height and g = gravity on Earth ***(4 marks)***

*\*NOTE: gravity is measured in m/s/s, and your current reaction is recorded in cm. You will need to convert the cm to m before you complete the calculation.*

**My reaction time My partner’s reaction time**

|  |  |
| --- | --- |
| 1 | Each instance of correct formula use (correct conversion from cm to m included) |
| 1 | Each correct answer |

E.g., t = SQRT(2(0.3m)/9.88m/s/s)

**Question 2.** Who has a better reaction time? Explain your answer. ***(2 marks)***

1 mark for correctly stating who has the better reaction time

1 mark for referring to their data to explain their choice

**Question 3.** Describe two reasons why a person may react unusually slowly. ***(2 marks)***

1 mark per reason.

Could be: distracted, intoxication of some kind, tired, etc.

**Question 4.** Explain why five trials were conducted for both you and your partner. ***(1 marks)***

To collect more reliable/accurate results (1)

**Question 5**. Imagine that you have placed a large, strong fan under your partner, so that it is blowing up towards the ceiling all around them and the ruler. The force it exerts is **less** than that of gravity.

**a)** Describe how this would change the motion of the ruler after you drop it. ***(2 marks)***

It would cause the ruler to fall at a slower rate (1) because it would increase air resistance (1)

Also possible..

Upwards force would counter gravity (1 mark)

Gravity still stronger so it will still fall (1 mark)

Ruler could fall sideways (1 mark)

**b)** Explain the impact that this would this appear to have on your reaction time. ***(1 mark)***

It would appear to increase reaction time/decrease time it takes to react (1)

**PART 2: Hanging Weights**

Measure and record the weight and mass of the weights you have been provided with. Your weights will be less than 1kg, so ensure that you record your measurement correctly.  ***(2 marks)***

Weight on Earth = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ N Mass = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ kg

Attach the weights to a string and hang them on the clamp stand. The clamp must be at the highest point. Measure and record the height from the bottom of the weights to the bench. ***(1 mark)***

H = roughly accurate measurement depending on set-up on the day.

While the weights are hanging steadily on the string, cut the string with a pair of scissors so that the weights fall down. **Be careful not to crush your fingers**.

**Question 1.** Using **t = ,** calculate the time it takes for the weights to hit the ground. ***(2 marks)***

|  |  |
| --- | --- |
| 1 | Correct formula use (correct conversion from cm to m included) |
| 1 | Correct answer |

**Question 2.** Calculate the average speed of the weights as they fall. ***(2 marks)***

*NOTE: remember any conversions that you may need to do. What is speed normally measured in?*

|  |  |
| --- | --- |
| 1 | Uses correct formula use (speed = distance/time) |
| 1 | Correct answer |

e.g. speed = 0.68m/0.2s

speed = 3.4m/s

**Question 3.** If you were to determine the average velocity of the weights as they fell, you would need to determine a direction of motion. Name a direction that these weights are moving in. ***(1 mark)***

1 mark for correct direction. E.g. – down, away from the stand, away from string, etc

**Question 4**. Explain why the weights stop moving when they land on the bench. ***(2 mark)***

Because the weights land on the bench/ground (1) and the normal force provided by this is stronger than the force of gravity pushing the weights down (1)

**Question 5.** Discuss what would happen to the motion of the weights if they were dropped from a greater height. ***(2 marks)***

1 mark/correct response:

* The weights would accelerate more
* The weights would have a high velocity
* The weights would have a greater speed

- The weights would cover a greater distance

* - The weights would have greater displacement.
* - The weights would hit the ground with a greater force
* The weights would take longer to fall

**Question 6**. Using this equipment set-up, there are a number of motion experiments that you could conduct. Imagine that you are testing how quickly the weights drop when you increase their mass. The table below contains the data for such an experiment.

|  |  |  |
| --- | --- | --- |
| **Mass (kilograms)** | **Height (metres)** | **Time (seconds)** |
| 0.1 | 0.4 | 0.5 |
| 0.2 | 0.4 | 0.45 |
| 0.3 | 0.4 | 0.4 |
| 0.4 | 0.4 | 0.35 |
| 0.5 | 0.4 | 0.3 |

**a)** What is the dependent variable for this experiment? Mass ***(1 mark)***

**b)** State one controlled variable for this experiment: Height ***(1 mark)***

**c)** Explain why height is not the independent variable for this experiment. ***(2 mark)***

1 mark for each correct response:

* The independent variable is the variable is the variable that changes
* height is staying the same
* height is a controlled variable
* Independent = mass in kilograms

**d)** Propose another **motion** experiment that could be conducted using this equipment ***(1 marks)***

*(Hint: motion is looking at speed, velocity, acceleration, distance, displacement and force)*

Suggested experiment must be different to the two conducted already, and must directly relate to motion (1)

**PART 3 :Trolley on Inclined Plane**

In this activity, you are going to allow a trolley to roll down a slope. Set up the equipment as shown below starting with a height of h=5cm.

**100cm**

**Trolley**

**Stopping Distance**

**Height , h**

**Method.**

1. Allow the trolley to roll along the plane.
2. Measure and record the time, t, it takes to cover the 100cm inclined plane
3. Measure and record the stopping distance, x
4. Determine the average speed of the trolley over the 100cm
5. Change the height by supporting the plane on a pile of books
6. Repeat the above for 6 *increasing* values of h.

**Table of Results *(4 marks)***

|  |  |  |  |
| --- | --- | --- | --- |
| **Height (m)** | **Time on plane (s)** | **Stopping distance (m)** | **Average speed**  **(m/s)** |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

**Choose two of the columns above to create a graph with, and then graph those results in the space below**. You will be marked on using the correct type of graph, an appropriate scale and axis, and an accurate title. ***(5 marks)***

Title:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1 mark for title

1 mark for x axis labelled/ units/ scale

1 mark for y axis labelled/ units/ scale

1 marks for plotting graph

1 mark for appropriate graph (line)

**Use the results in the table above to answer the questions below**.

**Question 1.** What is the dependent variable(s)? ***(2 marks)***

1 – Time on the inclined plane

1 – Stopping distance

**Question 2.** Explain how you made the experiment a fair test. ***(1 mark)***

By keeping the controlled variables the same between trials.

**Question 3.** Describe what happened to time on the inclined plane as the height increased. ***(1 mark)***

Time on the inclined plane decreased as height increased (1), or other summary of their results if somehow different

Place a book at the bottom of the ramp, and release the cart from one of the heights listed in your table. The cart will crash into the book.

**Question 4.** Calculate the acceleration of the cart as it moves down the inclined plane.

*(Hint:* ***a = ∆v/t****, and the motion cart is beginning at rest).* ***(2 marks)***

|  |  |
| --- | --- |
| 1 | Uses correct formula use (a = final velocity – 0/time (seconds)) |
| 1 | Correct answer with unit (m/s/s) |

**Question 5.** Calculate the force with which the cart is crashing into the book.

*(Hint:* ***f=m.a****, and there are scales available for you to weigh the cart with)* ***(2marks)***

|  |  |
| --- | --- |
| 1 | Uses correct formula use (a = final velocity – 0/time (seconds)) |
| 1 | Correct answer with unit (m/s/s) |

**Question 6.** Describe the observed relationship between stopping distance and speed***. (1 mark)***

Stopping distance increases a speed increases (or some variation of this)

If their results are somehow different, then a relationship for their results.

**Question 7.** Explain why you did not push the trolley down the ramp. (***2 marks)***

It is difficult to apply the exact same amount of force for each test (1)

Results would therefore not be accurate / would not be a fair test (1)

**Question 8.** State one piece of advice you would give a fellow year 12 school mate about speeding and driver safety based upon your results. ***(1 mark)***

1 mark for appropriate advice.

For e.g: if you drive faster, it will take you longer to break so give yourself more room/break earlier. Or, if a car behind you is speeding, try to change lanes.

**Question 9**. In a car, we burn fuel to supply energy for motion. Explain how you made the trolley move ***(1 mark)***

Some variation of: by placing it at the top of the ramp, gravity caused the trolley to accelerate down (1)

**Question 10.** A driver normally applies brakes to stop a car. Explain what caused the trolley to slow down to rest in your experiment.  ***(1 mark)***

The force of friction supplied by the carpet (1)

**Question 11.** In the space below, draw a free body diagram of the cart if you had pushed it down the inclined place, ensuring that you include all of the forces that would be acting upon it during its motion. ***(5 marks)***

1 mark/force

**Gravity**

**Applied Force**

**Air Resistance**

**Trolley**

**Friction**

**Normal Force**

**The end ☺**