**Task 13 : Physics 11 Car Safety Investigation Marking Grid: Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

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| **A PRELAB THEORY** | Part marks | Max  Mark | Mark | Comments |
| 1. **Crumple zone**   *Car deliberately crumples on impact to reduce force as car rapidly goes from speed v to zero velocity(1)*  *From W=Fs= Change in KE=1/2mv2 - 0 increases the distance until the car stops reduces F (2)*  *From I=Change in momentum mv-0 = Ft increasing the time for collision reduces F (2)* |  | **5** |  |  |
| 1. **Seatbelts**   *From Newtons first law a body will continue in motion until a Force is applied. (1)*  *When car stops suddenly and unrestrained person will continue to travel forward (1)*  *Seatbelt applies a force in the opposite direction to the cars travel to stop the person moving forward (1)*  *Seatbelts are also flexible to slightly increase the time and distance before the person is stopped thus reducing the force of the seatbelt on the person (1)*  *The standard sash seatbelt spreads the force of impact over a larger surface area reducing the force at any one point. (1)*  *A lap seatbelt applies all the force to one point of the body the pelvis with significantly increased risk of damage to the area (1)* |  | **5** |  |  |
| 1. **Air bags**   *On impact a chemical reaction produces a gas to rapidly inflate the bag. (1)*  *The bag is already deflating as the person hits the bag. (1)*  *This stops the person hitting the steering wheel or dash board. (1)*  *Since W=Fs= change in kinetic energy the airbag increases the distance to impact for the person and reduces the force (1)*  *Since I =Ft = change in momentum, the airbag reduces time until the person impacts reducing the force (1)* |  | **5** |  |  |
| 1. **Seat belts and Air bags**   *Having a seat belt only means there is still a force applied to the person (1)*  *Using an airbag and seatbelt reduces the force of the seatbelt on the person. (1)*  *Using an airbag only means the person could be knocked sideways in a side-on collision (1)*  *Young children sitting in the front of the car are too short and the airbag would hit them in the face rather than the chest as they are designed to do. (1)* |  | **4** |  |  |
| 1. **Speed and Reaction Time**   *In the event of an emergency, the person will still continue travelling until they have reacted to the emergency (1)*  *For a typical reaction time of 0.25sec and travelling at a speed of 50km/h. The person will travel s=vt =3.5m before putting the brakes on. (Student explains relation reaction time and distance travelled) (2)*  *The faster the speed of the person the further they will travel (1).*  *If they are distracted this distance will be much longer(1)* |  | **5** |  |  |
| **TOTAL PRELAB** |  | **24** |  |  |
| **PART B. DESIGN OF EXPERIMENT** |  |  |  |  |
| **Hypothesis**  *Clearly states principle being tested and includes the Physics* |  | **2** |  |  |
| **Aim**  *Purpose of experiment is clear* |  | **1** |  |  |
| **Method** |  | **11** |  |  |
| Clearly labelled diagram (3) |  |  |  |  |
| Detailed steps (6)  (3, basic idea, 6 detailed) |  |  |  |  |
| List of materials/ Equipment (2) |  |  |  |  |
| **Independent variable** |  | **1** |  |  |
| **Dependent variable** |  | **1** |  |  |
| **Control variables (2)** |  | **2** |  |  |
| **Valid**  *Experiment relates to hypothesis* |  | **2** |  |  |
| **Reliable**  *– includes repeat trials* |  | **1** |  |  |
| **TOTAL DESIGN OF EXPERIMENT** |  | **21** |  |  |

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| **C. CONDUCTING** |  |  |  |  |
| **Conducting experiment**  *Independently carries out experiment and problem solves difficulties (10)*  *Carries out independently, some guidance with problem solving (7)*  *Carries out effectively with some assistance (5)* |  | **10** |  |  |
| **Presentation of results**  *(Suitable tables/graphs from Sparkvue/ photos )* |  | **10** |  |  |
| **TOTAL CONDUCTING** |  | **20** |  |  |
| **D. ANALYSIS/ CONCLUSION** |  |  |  |  |
| **Analysis of results**  Includes calculations and graphs |  | **10** |  |  |
| **Errors/Uncertainties**/ how to improve experiment |  | **3** |  |  |
| **Discussion** of effectiveness of Experiment  *Significant detail of experiment with detailed Physics (10)*  *Detailed experiment with some Physics (7)*  *Discusses outcome of experiment with limited Physics (5)* |  | **10** |  |  |
| **Conclusion**  Summarises experiment (2)  Summarises main results and analysis (2)  States whether result supports analysis (1) |  | **5** |  |  |
| **TOTAL ANALYSIS/ CONCLUSION** |  | **28** |  |  |
| **E . REAL LIFE** |  |  |  |  |
| Describes how experiment relates to real –life in terms non-physicists can understand  *States experiment (2)*  *States results (2)*  *States how this relates to car safety in real-life (2)*  *Uses appropriate language (1)* |  | **7** |  |  |
| **TOTAL REAL-LIFE** |  | **7** |  |  |
| **TOTAL INVESTIGATION** |  | **100** |  |  |