Year 11 HSC Physics
Assessment Task March 2014

Vehicle Safety

(This assessment is worth 25% of your Assessment Mark for Year 11)
Rationale
This assessment task is completed over several weeks. As such it forms both an assessment and part of your learning. As it is a compilation of work, it presents an opportunity for those who work methodically to achieve a very good mark, regardless of their aptitude in test-style assessments.

It is really useful to know something about cars. Most of you will be learning to drive at the moment or very soon, and will be buying your first car in the not too distant future. I hope that this project, as well as fulfilling all the requirements of a Preliminary Course Physics Assessment Task, will give you a little more information about the care needed when choosing and maintaining a car.

AD, Feb 2014

This assessment involves 5 activities:

1. Internet research of crash testing and vehicle safety
2. Research into vehicle advertising
3. Experimental testing of ‘crumple zones’ on dynamics carts
4. Research into fitment of safety equipment in vehicles of different ages
5. A conclusion for the project

This task has been issued to you in the week beginning 10 March 2014. You will have lesson times allocated (not necessarily consecutively) in the following three weeks to complete the following parts of the report:

Part 1: Internet research (1 lesson, 13 March)
Part 2: Vehicle advertising research (to be completed at home)
Part 3: Collisions experiment (2 lessons, 20/21 March)
Part 4: Car inspections (1 lesson 24 March p5)
Part 5: Conclusion (to be completed at home)

The completed report, including this booklet, is to be handed in during class on Friday 28 March p1.
Part 1: Internet Research

The safety of vehicles has become big news. There is a lot of information on vehicle safety and how they are tested on the internet. Use the links below to answer the questions. Use your work from your year 10 assessment task too. Remember to refer to the correct physics principles when explaining your answers. For example, use the terms force/acceleration/momentum appropriately.
Your report should be no more than 2 pages of A4, Typed

A) ANCAP crash tests

Use the information to answer the following:
1. How are the cars crashed? Describe each way using a sketch, and justify why each test is undertaken.
2. How are these crashes scored? How are these scores transferred into a star rating?
3. Find a crash test which scores poorly, which has a video of the test available. Watch the test. Identify the vehicle and date of manufacture. Describe WHY the test received a poor result – what happened????

B) NRMA new and used car safety ratings

Have a look through the different types of cars listed on this page. Compare the range of safety ratings with their type.

Use the information on this site to answer the following questions:
4. Compare the safety ratings of different sizes of cars. Is there generally a difference? Justify this statement by referring to the data. Why do you think this is?
5. Are more expensive cars generally safer than cheaper cars? What evidence do you have for this?
6. How does your family car rate when compared with similar vehicles in its class and age range?
Part 2: Vehicle Advertising and Safety

Advertisements for vehicles are often worded in a specific way to appeal to a certain target group. They try to show the vehicle in a certain light which is considered appealing to these people.

You are to find at least five printed advertisements for vehicles and for each one:

- Cut out the advertisements and stick each onto a sheet of paper. Attach these to your assessment. If it is a TV or radio ad, describe what happens during the advert.
- List any safety features shown in the advertisement.
- Describe the likely target audience for this advertisement.
- If the main emphasis is not safety in the advertisement, what is it?

Use the information you have gathered from the advertisement to answer the following questions on a separate sheet:

1. From your study of advertisements, what is the main emphasis of vehicle advertising?

2. Does the emphasis on safety vary for each style of vehicle? In what way?

3. Does the level of safety equipment vary with price of vehicle?

4. What effects will a vehicle’s top speed, power and acceleration likely to have on safety? Is this considered in the advertisements?

5. How does the information presented in the advertisement relate to the safety ratings you found in Part 2?
Part 3: Car Crumple Zone Experiment

One of the major developments in car safety has been the development of the crumple zone. This easily crushed area at the front of the car greatly reduces the risk of serious injury to the driver.

How does a crumple zone work?

• You are to design and construct a crumple zone for the front of a dynamics cart. You must test this for effectiveness. This can be done by observing the effects of a crash on a seated, unrestrained ‘passenger’ dummy made from Plasticine.

• Your crumple zone must be attached to the front of the cart.

• The cart must roll down a ramp and crash into a solid object (a brick or the wall), both with and without the crumple zone, and the results compared.

• You must list the variables in your report.

• Include a photo or diagram of your crumple zone.

• Your discussion must include an explanation of the physics principles that allow the crumple zone to work.

• Your report is to be presented as an experimental report included as part of this project.

• You may want to test several different styles of crumple zone if you wish. Crumple zones which work correctly don’t work more than once.

• You will be provided with the following equipment:

1. Dynamics cart
2. Sticky tape
3. Card
4. Paper
5. Scissors
6. Ramp
7. Plasticine
8. Talc (to powder the dummy and avoid sticking)
The Physics of car crashes and crumple zones

Some of the principles that you have studied are listed below. You will need to use some of these principles in the conclusion for this part of the experiment and also in the car inspections section for part 4.

- Speed = distance/time
- Acceleration = change in speed/time
- Reaction time = time taken to react to stimuli
- Reaction distance = distance traveled while reacting
- Stopping distance = reaction distance + braking distance
- Newton’s first law of motion (Inertia)
- Newton’s second law of motion (F = ma)
- Newton’s third law (action reaction pairs of forces)
- Increasing the time taken for a change in speed decreases the force (F=ma, a=change in speed/time therefore F = m(change in speed/time)

Table of times during a collision that may help your explanations in this part of the assessment
All values of time are assuming a change in velocity of 30km/h (8.3 m/s) to zero

<table>
<thead>
<tr>
<th>Description</th>
<th>Time (s)</th>
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<tbody>
<tr>
<td>Impact with hard object (eg, steering wheel)</td>
<td>0.03s</td>
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<tr>
<td>Restraint by seatbelt</td>
<td>0.1s</td>
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<tr>
<td>Restraint by Seatbelt + Airbag</td>
<td>0.3s</td>
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<tr>
<td>Car without crumple zone</td>
<td>0.02s</td>
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<tr>
<td>Car with crumple zone</td>
<td>0.08s</td>
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</table>

The Report

Include in your report the following:

- Aim
- Diagram of equipment setup
- Photo or diagram of crumple zone
- Results table showing the qualitative results of the experiment
- A discussion assessing the effectiveness of the experiment and explaining the physics concepts behind the results
- Conclusion – did you answer the aim?
Part 4: Vehicle Inspections

Passenger safety depends on many factors, driver skill and behavior, vehicle age and design, road conditions and other road users. This part of your project involves the inspection of various vehicles of differing ages and styles to identify the elements of design which are safety oriented.

**Things to do:**

1. You will be presented with a range of different cars to inspect, with build dates from the 1920’s to the present day.

2. You are to inspect each of these different vehicles and draw on a sketch devices which **reduce the likelihood** of an accident (example: indicators) in **blue** and those which **reduce the risk of harm** to the passengers in an accident (example: seatbelts) in **red**. You may use the vehicle outlines in appendix 1 or draw your own. *(NB the vehicle’s manufacture date, make and model is usually stamped on a plate attached to the ‘fire wall’ under the bonnet behind the engine.)*

Your study will be concentrating on comparing the variety and number of each of the devices on the different ages of vehicle.

*Be aware – some vehicles have been modified since they were originally built to make them safer for modern driving. Ask the owner if you are not sure if the car has been modified.*

3. List each of the blue collision avoidance devices in the table. Describe how each reduces the chance of an accident in a separate table. You only need to describe each device once. A table outline is in appendix 2, you may use your own design of table.

4. List each of the red safety devices in the table and briefly describe how each reduces the risk of injury. Use the terms **speed, acceleration, force, friction, and inertia** where appropriate. A table outline is in appendix 3, you may use this or devise your own.
Part 5: Conclusion

To complete your project, you are to write a conclusion. This is to be no more than one side of typed text.
The idea of a conclusion for a project like this is to tie it all together.
  • How does the internet research reflect your findings in the car inspections?
  • How did your car inspections relate to your understanding of crumple zone design?
These are the sort of things you need to think of.

You must also include a list of references used for each of the parts of this assessment task. Check your diary for the correct presentation of references.
Appendix 1: Inspection diagrams

(You will need at least three of these for different vehicles, choose the shapes that are the most suitable and feel free to alter them or use photos of the vehicles instead.)

Vehicle 1

Vehicle Make and Model:

Vehicle year of manufacture:

Vehicle 2

Vehicle Make and Model:

Vehicle year of manufacture:
Vehicle 3

Vehicle Make and Model:

Vehicle year of manufacture:

Vehicle 4

Vehicle Make and Model:
Vehicle year of manufacture:
## Appendix 2

### Vehicle Collision Avoidance Devices

<table>
<thead>
<tr>
<th>Collision Avoidance Device</th>
<th>Vehicles fitted with this device</th>
<th>How this device reduces the risk of an accident</th>
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Appendix 3

Vehicle Safety Devices

List the items in or on the car designed to protect the occupants in the event of an accident and explain how they work. Try to use the terms force, inertia, impulse, momentum, acceleration and mass where appropriate.

<table>
<thead>
<tr>
<th>Safety Device</th>
<th>Vehicles fitted with this device</th>
<th>How this device reduces the risks of injury in an accident</th>
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# Moving About Assessment Task 2014
## Marking Scheme

### Part 1 – Internet Research

<table>
<thead>
<tr>
<th>Activity</th>
<th>Outcome</th>
<th>Mark</th>
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<tbody>
<tr>
<td>Used car safety ratings</td>
<td><strong>P14. draws valid conclusions from gathered data and information</strong></td>
<td></td>
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<td></td>
<td><strong>14.1 analyse information to:</strong></td>
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<tr>
<td></td>
<td>a) identify trends, patterns and relationships as well as contradictions</td>
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<td></td>
<td>e) make and justify generalisations</td>
<td>/6</td>
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<tr>
<td>ANCAP testing</td>
<td>• evaluate the effectiveness of some safety features of motor vehicles</td>
<td>/4</td>
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<td></td>
<td>• identify data sources, gather, process, analyse, present secondary</td>
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<td></td>
<td>information and use the available evidence to assess benefits of</td>
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<td></td>
<td>technologies for avoiding or reducing the effect of a collision</td>
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</table>

### Part 2 – Vehicle Advertising

<table>
<thead>
<tr>
<th>Activity</th>
<th>Outcome</th>
<th>Mark</th>
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<tbody>
<tr>
<td>Collecting adverts/Collating</td>
<td><strong>12.3 gather information from secondary sources by:</strong></td>
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<td>a) accessing information from a range of resources, including popular</td>
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<td></td>
<td>scientific journals, digital technologies and the Internet</td>
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<tr>
<td>Answers to questions</td>
<td><strong>12.4 process information to:</strong></td>
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<td></td>
<td>e) assess the reliability of first-hand and secondary information and</td>
<td>/2</td>
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<td></td>
<td>data by considering information from various sources</td>
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<tr>
<td>Answers to questions</td>
<td>f) assess the accuracy of scientific information presented in</td>
<td>/3</td>
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<td></td>
<td>mass media by comparison with similar information presented in</td>
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<tr>
<td></td>
<td>scientific journals</td>
<td></td>
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</tbody>
</table>

Total /10
### Part 3 – Experiment

<table>
<thead>
<tr>
<th>Activity</th>
<th>Outcome</th>
<th>Mark</th>
</tr>
</thead>
</table>
| Method, Variables and their control | **11.2 plan first-hand investigations to:**  
   a) demonstrate the use of the terms ‘dependent’ and ‘independent’ to describe variables involved in the investigation  
   b) identify variables that need to be kept constant, develop strategies to ensure that these variables are kept constant,                         | /3   |
| Method, procedure | **11.2 plan first-hand investigations to:**  
   c) design investigations that allow valid and reliable data and information to be collected  
**11.3 choose equipment or resources by:**  
   a) identifying and/or setting up the most appropriate equipment or combination of equipment needed to undertake the investigation | /3   |
| Results | **12.2 gather first-hand information by:**  
   b) measuring, observing and recording results in accessible and recognisable forms, carrying out repeat trials as appropriate                     | /4   |
| Discussion | **12.4 process information to:**  
   a) assess the accuracy of any measurements and calculations and the relative importance of the data and information gathered  
   c) best illustrate trends and patterns by selecting and using appropriate methods, including computer assisted analysis  
   d) evaluate the validity of first-hand and secondary information and data in relation to the area of investigation  
5. Safety devices are utilised to reduce the effects of changing momentum  
   • assess the reasons for the introduction of air bags and crumple zones to vehicles with respect to the concepts of impulse and momentum | /5   |
| Conclusion | **12.4 process information to:**  
   e) assess the reliability of first-hand information and data by considering information from various sources | /2   |

Total: /17
# Part 4 – Car Inspections

<table>
<thead>
<tr>
<th>Activity</th>
<th>Outcome</th>
<th>Mark</th>
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</thead>
</table>
| Car inspections/diagrams              | **5. Safety devices are utilised to reduce the effects of changing momentum**  
  - identify data sources, gather, process, analyse, present secondary information and use the available evidence to assess benefits of technologies for avoiding or reducing the effect of a collision | /5   |
| Table of collision avoidance devices   | **5. Safety devices are utilised to reduce the effects of changing momentum**  
  - identify data sources, gather, process, analyse, present secondary information and use the available evidence to assess benefits of technologies for avoiding or reducing the effect of a collision | /4   |
| Table of vehicle safety devices        | **5. Safety devices are utilised to reduce the effects of changing momentum**  
  - assess the reasons for the addition of air bags and crumple zones to vehicles with respect to the concepts of impulse and momentum                                                                 | /6   |

/15
## Part 5 – Conclusion

<table>
<thead>
<tr>
<th>Activity</th>
<th>Outcome</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conclusion</td>
<td>14.3 use available evidence to: b) propose ideas that demonstrate coherence and logical progression and include correct use of scientific principles and ideas</td>
<td>/5</td>
</tr>
<tr>
<td>References</td>
<td>13.1 present information by: c) selecting and using appropriate methods to acknowledge sources of information</td>
<td>/3</td>
</tr>
</tbody>
</table>

/8

Overall Mark /60

Comments: