



## Western Australian Certificate of Education ATAR course examination, 2017

### Question/Answer Booklet

# 11 PHYSICS

Name

## Evaluation 1 - Airbags

Student Number: In figures

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Mark: 18 In words

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### Time allowed for this paper

Reading time before commencing work: nil  
Working time for paper: fifty minutes

### Materials required/recommended for this paper

#### ***To be provided by the supervisor***

This Question/Answer Booklet  
Formulae and Data Booklet

#### ***To be provided by the candidate***

Standard items: pens, (blue/black preferred), pencils (including coloured), sharpener, correction fluid/tape, eraser, ruler, highlighters

Special items: non-programmable calculators satisfying the conditions set by the School Curriculum and Standards Authority for this course  
one A4 page of notes - handwritten

### Important note to candidates

No other items may be taken into the examination room. It is **your** responsibility to ensure that you do not have any unauthorised notes or other items of a non-personal nature in the examination room. If you have any unauthorised material with you, hand it to the supervisor **before** reading any further.

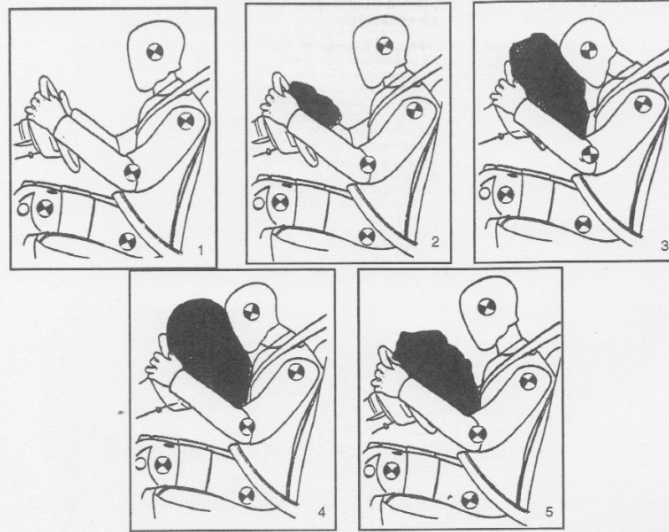
## Structure of this paper

Section	Number of questions available	Number of questions to be answered	Suggested working time (minutes)	Marks available	Percentage of exam
Section One: Short Answers	-	-	-	-	-
Section Two: Problem-solving	-	-	-	-	-
Section Three: Comprehension	6	6	50	18	100
Total					100

## Instructions to candidates

1. The rules for the conduct of examinations at Holy Cross College are detailed in the College Examination Policy. Sitting this examination implies that you agree to abide by these rules.
2. Write your answers in this Question/Answer Booklet.
3. Working or reasoning should be clearly shown when calculating or estimating answers.
4. You must be careful to confine your responses to the specific questions asked and to follow any instructions that are specific to a particular question.
5. Spare pages are included at the end of this booklet. They can be used for planning your responses and/or as additional space if required to continue an answer.
  - Planning: If you use the spare pages for planning, indicate this clearly at the top of the page.
  - Continuing an answer: If you need to use the space to continue an answer, indicate in the original answer space where the answer is continued, i.e. give the page number. Fill in the number of the question(s) that you are continuing to answer at the top of the page.
6. Answers to questions involving calculations should be **evaluated and given in decimal form**. It is suggested that you quote all answers to **three significant figures**, with the exception of questions for which estimates are required. Despite an incorrect final result, credit may be obtained for method and working, providing these are **clearly and legibly set out**.
7. Questions containing the instruction "estimate" may give insufficient numerical data for their solution. Students should provide appropriate figures to enable an approximate solution to be obtained. Give final answers to a maximum of two significant figures and include appropriate units where applicable.
8. Note that when an answer is a vector quantity, it must be given with magnitude and direction.
9. In all calculations, units must be consistent throughout your working.

## 5 Air Bags; Myths and facts.



**The supplemental air-bag restraints system.** In a serious frontal crash, the air-bag inflates in less than the blink of an eye. And begins to deflate very quickly. Yet in that brief time, it can help cushion you from forces that might otherwise cause severe injuries. Of course, whether your car is equipped with a supplemental air-bag system or not, you should always buckle your safety belt every time you go anywhere.

This sequence of drawings simulates how the Ford driver-side supplemental air-bag would help provide additional protection for the driver during moderate to severe frontal collisions. The nylon air-bag is stored in the centre of the steering wheel. The vehicle may also have a passenger side air-bag stored in the instrument panel above the glove box area.

The supplemental air-bag restraint system is activated in a frontal collision equivalent to hitting a solid barrier at about 23 kilometres per hour or more, or hitting a parked car of similar size at 47 kilometres per hour or more.

When activated, the nylon air-bag emerges very rapidly from its storage area as it fills with nitrogen, a harmless gas that is part of the air we breathe. This process takes place in approximately 55 milliseconds (1/20 of a second). Following inflation, the nitrogen gas is released almost immediately through vents in the back of the bag. The spent air-bag module can be removed and replaced relatively quickly by a qualified technician—it cannot be reused. However, significant vehicle damage will result in a crash severe enough to activate the air-bag and other parts of the supplemental air-bag restraint system also may have to be

replaced or repaired.

When coupled with the use of safety belts, the supplemental air-bag, which helps provide additional face, head, neck and chest protection in certain higher energy frontal crashes, has been demonstrated to be an effective supplement to the safety belt.

The system consists of crash sensors, an air-bag module, the necessary wiring, and an electronic diagnostic device. The high technology sensors are designed to initiate inflation of the supplemental air-bag during moderate to severe frontal collisions while preventing accidental inflation during lower speed collisions and bumps, such as may occur in minor accidents or hitting 'potholes.' In these situations, the safety belts alone help provide protection.

In a moderate to severe frontal collision, the sensors, mounted in the front of the vehicle send an electrical signal which, almost instantly, causes inflation of the supplemental air-bag.

The system constantly monitors its own condition and state of readiness through an electronic diagnostic module. When the ignition switch is turned on, the module determines if the system is operating properly and is ready to function. If the diagnostic module detects a fault, it will provide a warning

signal indicating that service is needed.

Ford has spent many years and millions of dollars developing and testing supplemental air-bags. Ford now has millions of kilometres of on-the-road experience with supplemental air-bags and the system has been demonstrated to be safe, reliable, and effective.

Myths	Facts
You don't need to wear seat belts if your car has air-bags.	Seat belts must still be worn. Air-bags inflate only in moderate to severe frontal crashes. Safety belts help restrain the occupant and help direct the occupant into the air-bag during a frontal collision. In addition safety belts help protect the occupant in other impacts such as side, rear, and rollover for which air-bags were not designed to inflate.
Air-bags cause high repair costs because the inflate in minor accidents.	Air-bags are designed to inflate only in certain frontal accidents more severe than hitting a car of similar size at approximately 47 kilometres per hour.
Air-bags can cause you to lose control of your car when they inflate inadvertently.	In actual consumer service since 1985 the supplemental air-bag system has been demonstrated to be safe, reliable and effective.

The first inflatable device for crash landings was created for an aeroplane during the Second World War. Airbags began to appear in cars in the 1980s.

1. Airbags work by increasing the time it takes to absorb the shock of an impact. Use Physics principles to explain why this is beneficial for the occupant of a car in a collision.

(4 marks)

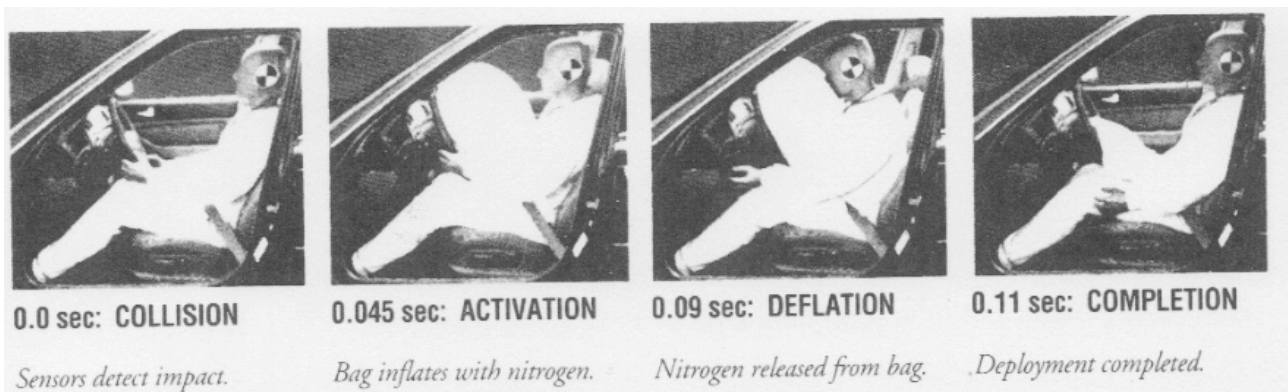
2. How does the air bag assist in minimising injury to the driver?

(3 marks)

3. Why is the airbag stored in the centre of the steering wheel? (2 marks)

4. With airbags now standard in motor vehicles, do you still need to wear a seat belt? In your answer, disregard the road rules in place. Explain using Physics principles whether it is necessary. (3 marks)

5. Air bags require sensors to deploy them. Where are these sensors located, and what do they measure? (2 marks)



6. In these photographs provided by the Honda Motor Company, it appears that the air bag is deflated just about the same time that the driver's head comes in contact with the bag. Why is this an important safety design? (3 marks)