HOLY CROSS COLLEGE

Life to the Full

Western Australian Certificate of Education
ATAR course examination, 2020

Question/Answer Booklet

11 PHYSICS

Test 1 - Motion

Name SOLUTIONS

Student Number: In figures

Mark: $\frac{}{37}$ In words

Time allowed for this paper
Reading time before commencing work: five minutes
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

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	4	4	50	37	100
Section Three: Comprehension					
				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***.

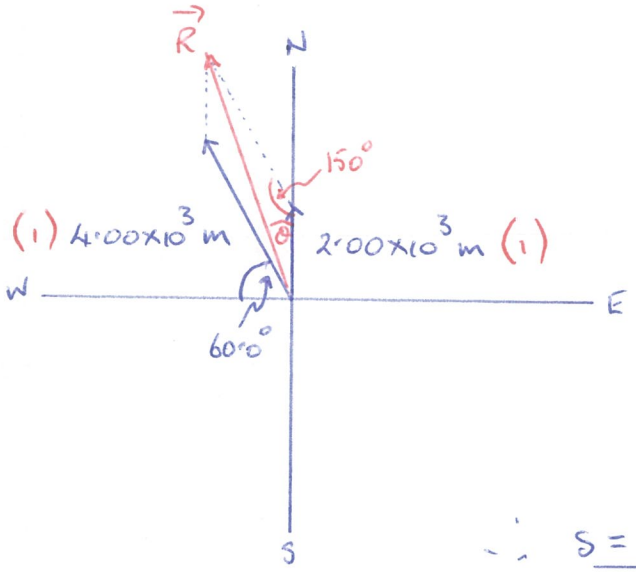
7. Questions containing the instruction "estimate" may give insufficient numerical data for their solution. Students should provide appropriate figures to enable an approximate solution to be obtained. Give final answers to a maximum of two significant figures and include appropriate units where applicable.

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.

1. A boat head N30.0°W at 8.00 kmh^{-1} from a jetty for 30.0 minutes before changing course to head due north at 6.00 kmh^{-1} for 20.0 minutes before arriving at a small island.

(a) Calculate the displacement of the boat (in metres) after 50.0 minutes. Include a vector diagram in your working. (5 marks)



$$\vec{R} = \sqrt{(2.00\times10^3)^2 + (4.00\times10^3)^2 - 2(2.00\times10^3)(4.00\times10^3)\cos 150^\circ}$$

$$= 5.82\times10^3 \text{ m} \quad (1)$$

$$\frac{5.82\times10^3}{\sin 150^\circ} = \frac{4.00\times10^3}{\sin\theta}$$

$$\Rightarrow \theta = 20.1^\circ \quad (1)$$

$$\therefore S = 5.82\times10^3 \text{ m } N\,20.1^\circ W \quad (1)$$

(b) Determine the average velocity of the boat for the journey. (3 marks)

$$v_{ave} = \frac{s}{t}$$

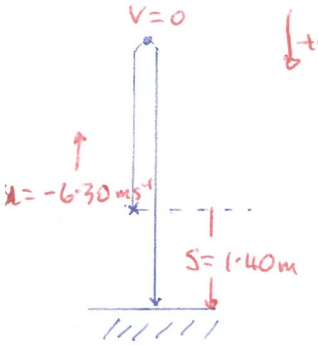
$$= \frac{5.82\times10^3}{(50.0\times60.0)} \quad (1)$$

$$= 1.94 \text{ ms}^{-1} \; N\,20.1^\circ W$$

(1) (1)

2. A primary school student designed the coin for the Australia-New Zealand day-night test at Optus Stadium. He was allowed to toss the coin for the start of the match and flipped it upwards at 6.30 ms^{-1} from 1.40 m above the pitch. It fell onto the pitch and the captain of New Zealand won the toss.

(a) How high did the coin rise above the pitch? (5 marks)



+ve ↓

$v = 0\ ms^{-1}$

$u = -6.30\ ms^{-1}$ (1)

$a = 9.80\ ms^{-2}$

$t = ?$

$s = ?$

Consider movement to the top.

$v^2 = u^2 + 2as$

$\Rightarrow s = \frac{v^2 - u^2}{2a}$ (1)

$= \frac{0 - (-6.30)^2}{2(9.80)}$ (1)

$= -2.02m$ (1)

$\therefore$ Height = 3.42 m above the pitch (1)

(b) What was the impact velocity of the coin onto the pitch? (3 marks)

Consider the whole motion.

$v = ?$

$u = -6.30\ ms^{-1}$

$a = 9.80\ ms^{-2}$

$t =$

$s = 1.40m$

$v^2 = u^2 + 2as$

$= (-6.30)^2 + 2(9.80)(1.40)$ (1)

$\Rightarrow v = 8.19\ ms^{-1}$ down (1) (1)

(c) How long was the coin in the air? (3 marks)

$v = u + at$

$\Rightarrow t = \frac{v - u}{a}$ (1)

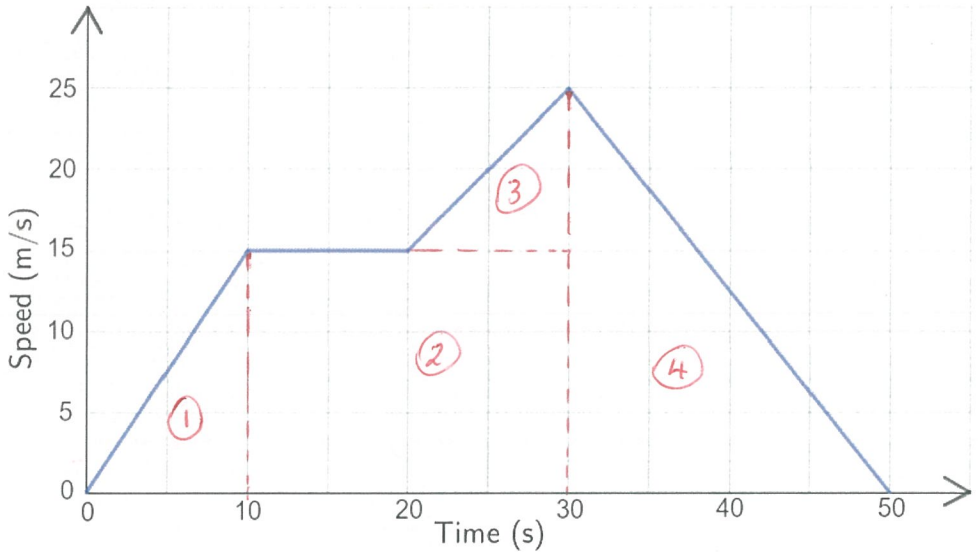
$= \frac{8.19 - (-6.30)}{9.80}$ (1)

$= 1.48\ s$ (1)

(d) The student made the coin spin. In reality, how would this affect your calculations for (a) - (c)? Explain your answer. (2 marks)

- The height, velocity and time would all be less. (1)
- Air resistance would slow the coin, moving up and down. (1)

3. The speed-time graph below describes a 50-second car journey, assumed to be in a straight line.



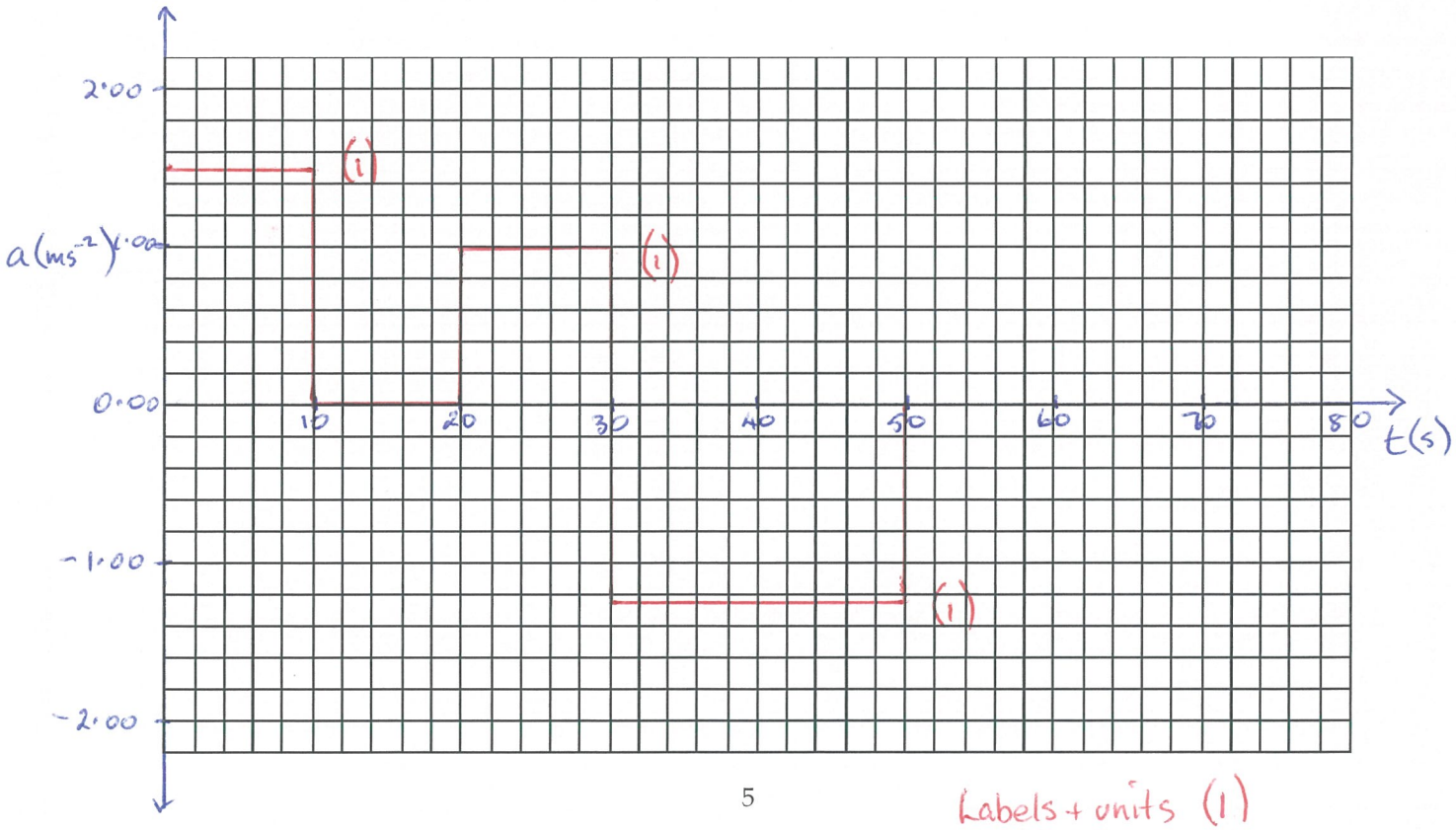
(a) Determine the displacement of the car using the graph. (4 marks)

s = area under graph

$= \frac{1}{2}(10.0)(15.0) + (20.0)(15.0) + \frac{1}{2}(10.0)(10.0) + \frac{1}{2}(20.0)(25.0)$ (3)

= 675 m forwards (1)

(b) Draw an acceleration - time graph for the motion with clearly-marked axes. (5 marks)

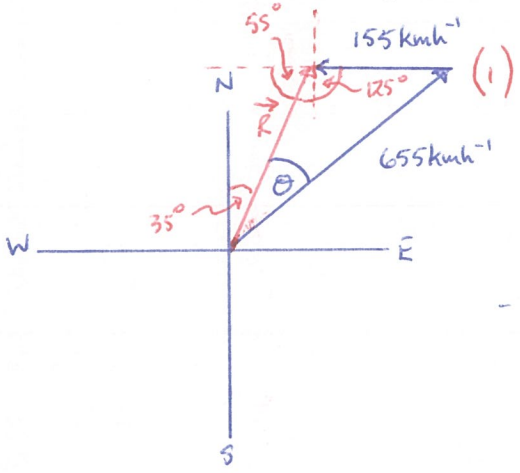


Labels + units (1)

Shape (1)

4. A plane is flying at 655 kmh^{-1} in level flight. It needs to set a heading from this point to land at an airport 1.10×10^3 km away on heading N35.0°E. A wind is blowing at 155 kmh^{-1} from the east.

(a) Determine the heading that the plane must take in order to reach the airport. Drawing a vector diagram is recommended. (4 marks)



(1)

$\frac{655}{\sin 125^\circ} = \frac{155}{\sin\theta}$ (1)

$\Rightarrow \theta = 11.2^\circ$ (1)

$\therefore$ Heading is N46.2°E (1)

(b) How long will it take the plane to reach the airport? Ignore any change in altitude as the plane descends to land. (3 marks)

$V = \frac{s}{t}$

$\Rightarrow t = \frac{s}{V}$ (1)

$= \frac{1.10 \times 10^3}{655 \cos 11.2^\circ}$ (1)

$= 1.71$ hours (1)