HOLY CROSS COLLEGE
Life to the Full

Western Australian Certificate of Education
ATAR course examination, 2018

Question/Answer Booklet

11 PHYSICS

Test 1 - Motion

Name SOLUTIONS

Student Number: In figures | | | | | | | | |

Mark: $\frac{\quad}{39}$ 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	39	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***.

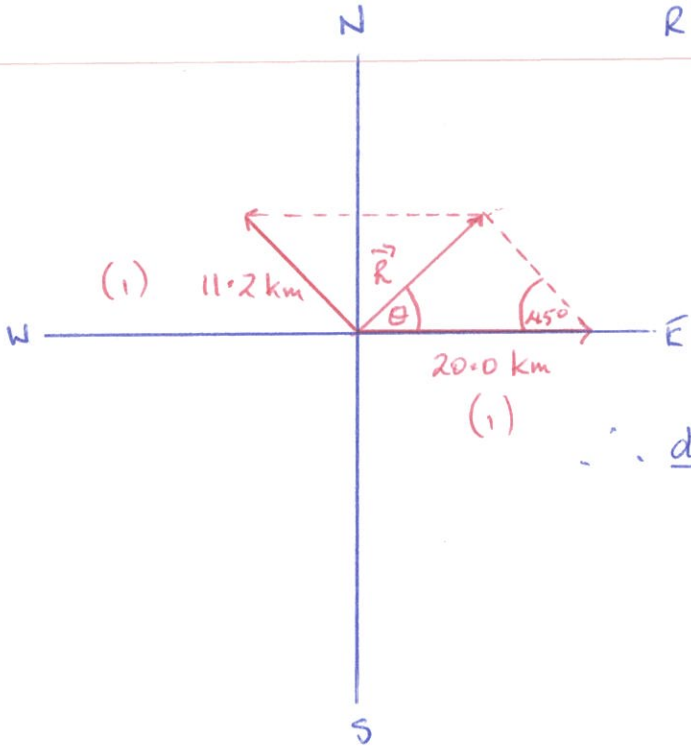
7. Questions containing the instruction "estimate" may give insufficient numerical data for their solution. Students should provide appropriate figures to enable an approximate solution to be obtained. Give final answers to a maximum of two significant figures and include appropriate units where applicable.

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 yacht sails due east at 10.0 kmh^{-1} for 2.00 hours before changing course around a marker and sailing northwest at 8.00 kmh^{-1} for 1.40 hours to reach a second marker. Calculate:

(a) the yacht's displacement in kilometres. (5 marks)



$\vec{R} = \sqrt{(20.0)^2 + (11.2)^2 - 2(20.0)(11.2)\cos 45.0^\circ}$

$= 14.4$ km (1)

$\frac{14.4}{\sin 45.0^\circ} = \frac{11.2}{\sin \theta}$

$\Rightarrow \theta = 33.4^\circ$ (1)

(1) (1)

$\therefore$ displacement = 14.4 km E 33.4° N (1)

(b) the yacht's average velocity in kmh^{-1}. (3 marks)

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

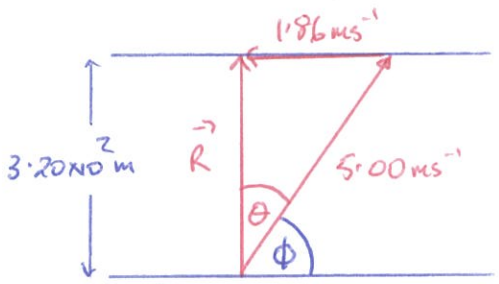
$= \frac{14.4}{3.40}$ (1)

$= 4.23\ kmh^{-1}$ E 33.4° N

(1) (1)

2. A man in a small boat that can maintain a velocity of 5.00 ms^{-1} in still water wants to reach a point directly across a river that flows at 1.86 ms^{-1}. Given that the river is 3.20 x 10^2 m wide, calculate:

(a) the direction the man must head the boat (relative to the bank). Include a vector diagram. (3 marks)



(1)

$\sin\theta = \frac{1.86}{5.00}$

$\Rightarrow \theta = 21.8^\circ$ (1)

$\therefore \phi = 68.2^\circ$ to the bank upstream. (1)

(b) the time taken to reach his destination. (4 marks)

$\vec{R} = 5.00 \cos 21.8^\circ$ (1)

$= 4.64\ ms^{-1}$. (1)

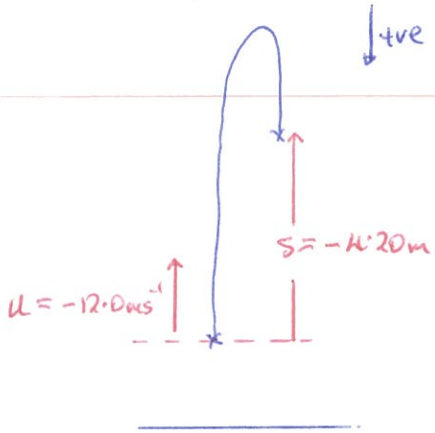
$V_{across} = \frac{s_{across}}{t}$

$\Rightarrow t = \frac{3.20 \times 10^2}{4.64}$ (1)

$= 69.0\ s$ (1)

3. A man on a building site throws a 2.00 kg hammer vertically up to a workmate on the first floor. If the hammer's initial velocity is 12.0 ms^{-1} upwards and the second man catches it 4.20 m above its release point as it is falling downwards.

(a) Calculate the velocity of the hammer when it is caught. (3 marks)



$v = ?$
$u = -12.0\ ms^{-1}$
$a = 9.80\ ms^{-2}$
$t = ?$
$s = -4.20m$
Sign convention (1)

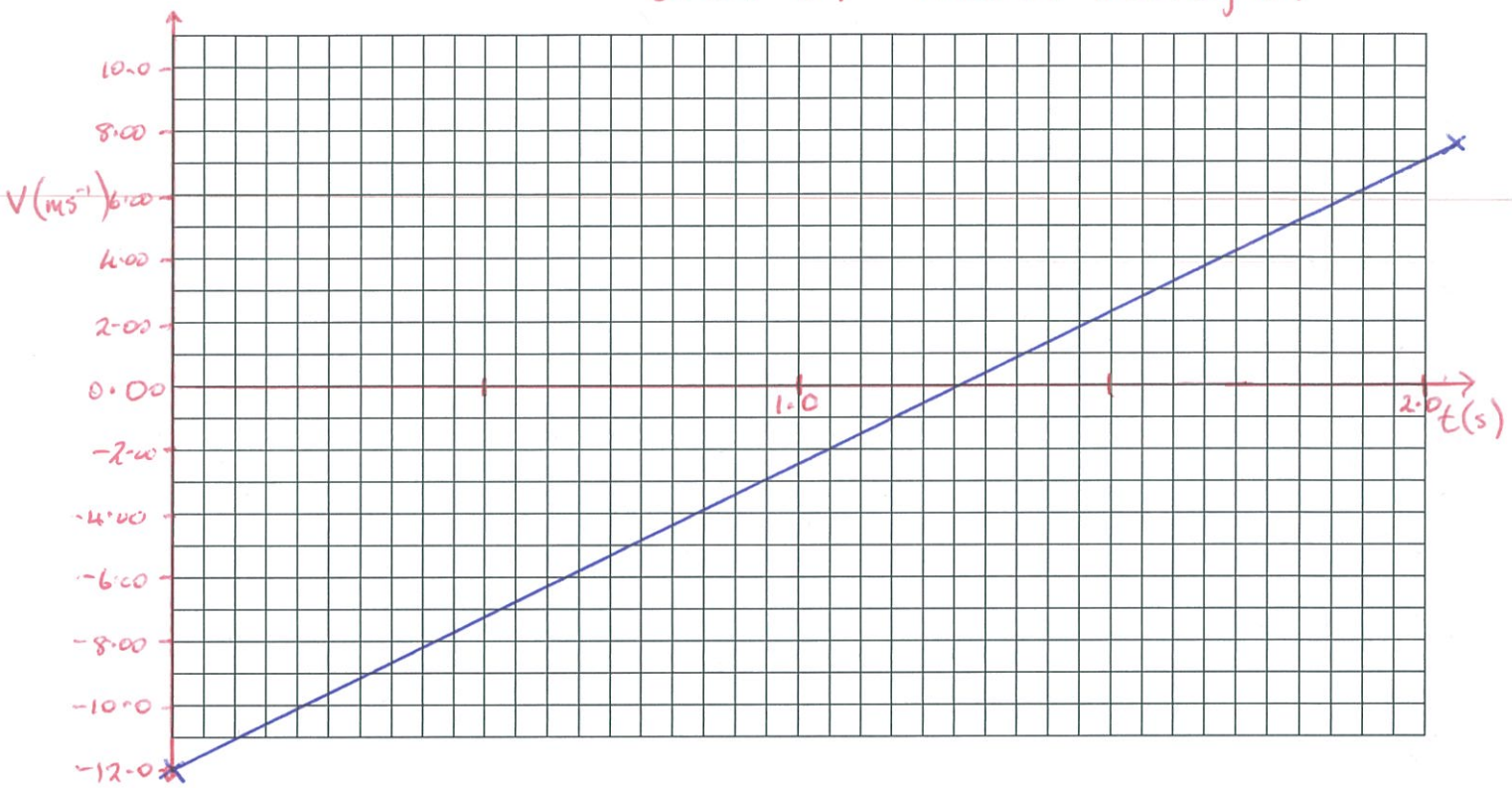
$v^2 = u^2 + 2as$
$= (-12.0)^2 + 2(9.80)(-4.20)$ (1)
$\Rightarrow v = 7.85\ ms^{-1}$ down (1)

(b) Determine the time of flight of the hammer. (2 marks)

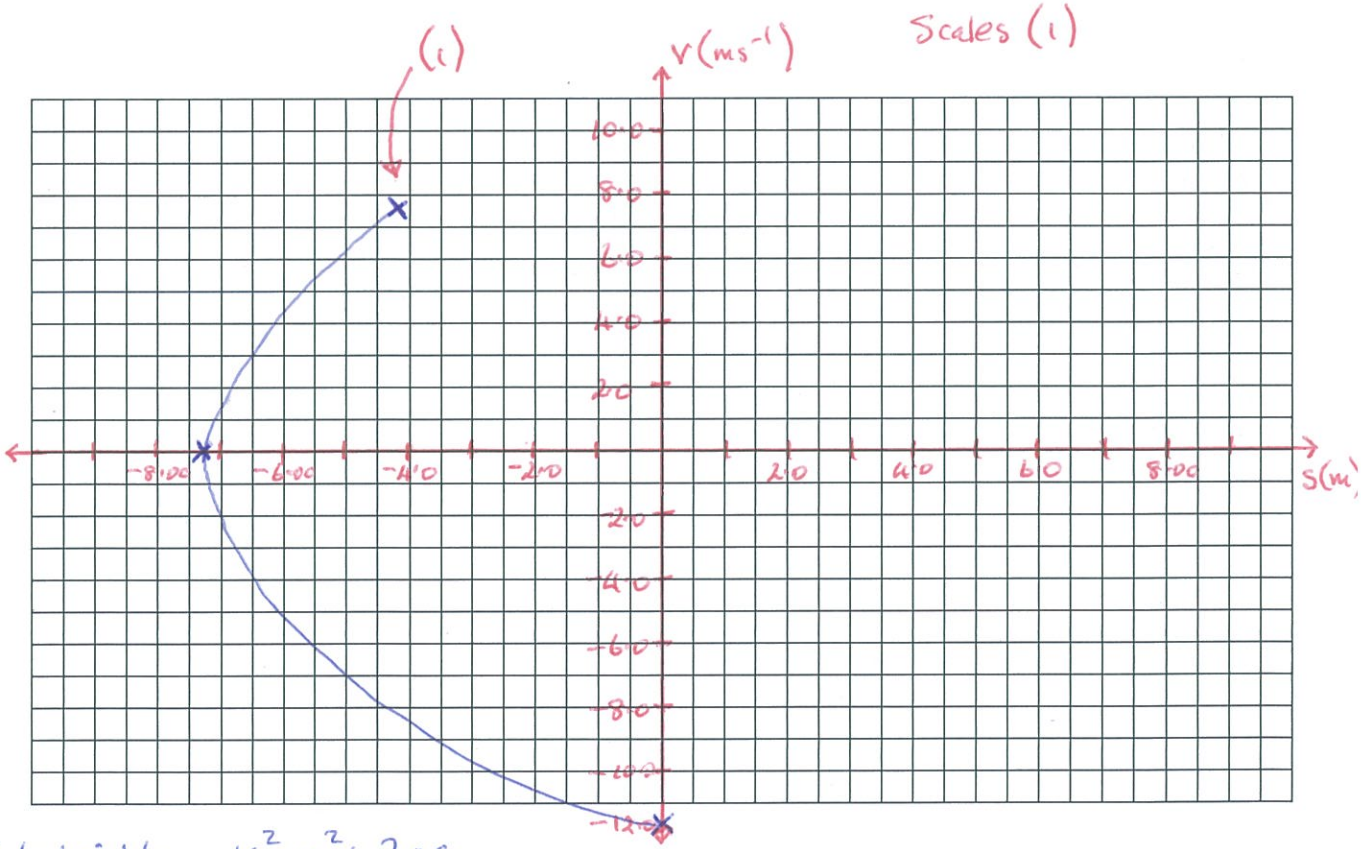
$v = u + at$
$\Rightarrow 7.85 = -12.0 + 9.80t$ (1)
$\Rightarrow t = 2.03s$ (1)

(c) Draw a velocity - time graph for the motion. Include accurate scales. (3 marks)

Scales - (1) Linear (1) Accuracy (1)



(d) Draw a velocity - displacement graph for the motion. Include accurate scales.
(3 marks)

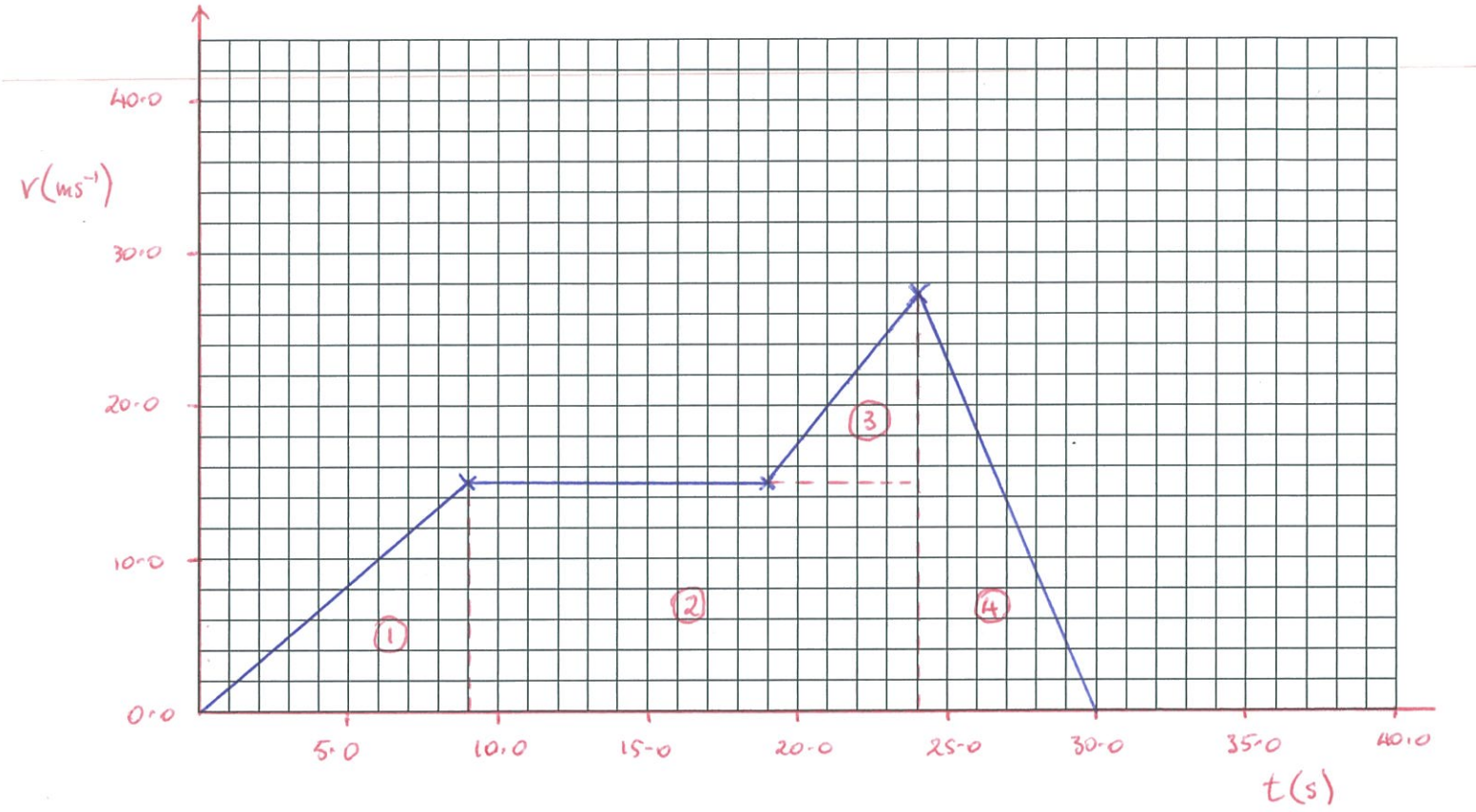


To calculate height: $v^2 = u^2 + 2as$

$\Rightarrow s = \frac{v^2 - u^2}{2a} = \frac{0 - (-12.0)^2}{2(9.80)} = -7.35\,m.$ (1)

4. A car accelerates uniformly from rest and reaches 15.0 ms^{-1} after 9.00 s. It then continues with constant velocity for another 10.0 s before accelerating at 2.50 ms^{-2} for 5.00 s. It then brakes uniformly to a halt in 6.00 s. Assume the motion occurs in a straight line.

(a) Draw a velocity - time graph for the motion. Include accurate scales. (5 marks)



$v = u + at$

$= 15.0 + (2.50)(5.00)$

$= 27.5\ ms^{-1}$ (1)

Scales (2)

Plotting (1)

Accuracy (1).

(b) Use the graph to determine the displacement of the car for the motion. (4 marks)

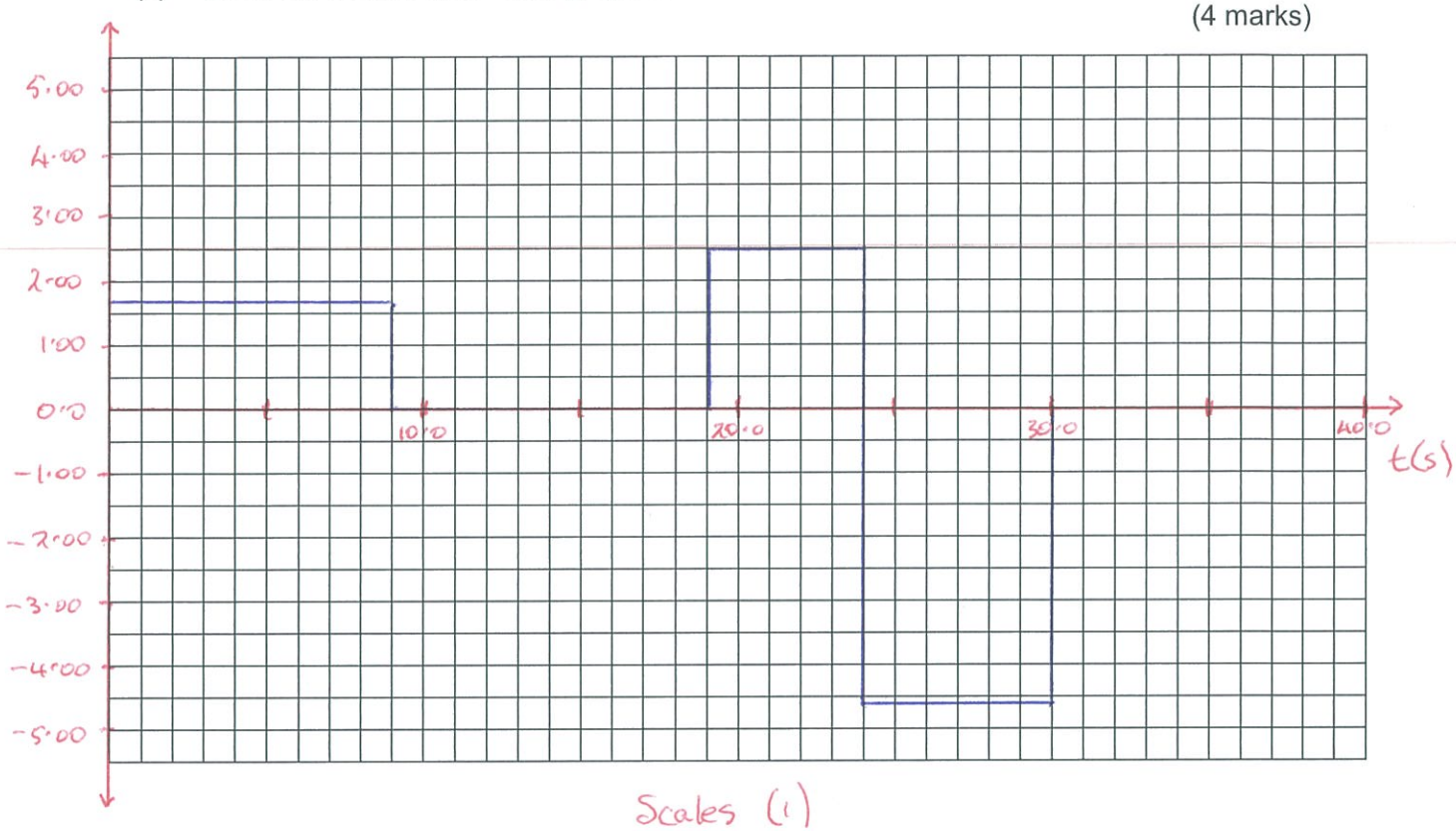
s = area under graph

$= \frac{1}{2}(9.00)(15.0) + (15.0)(15.0) + \frac{1}{2}(5.00)(12.5) + \frac{1}{2}(6.00)(27.5)$ (3)

$= \underline{406\ m}$ (1)

(c) Draw an acceleration - time graph for the motion. Include accurate scales.

(4 marks)



Scales (1)

Shape (1)

$a_1 = \frac{v-u}{t}$ $\quad a_2 = 0$ $\quad a_3 = 2{\cdot}50\ ms^{-2}$ $\quad a_4 = \frac{v-u}{t}$

$= \frac{15{\cdot}0-0{\cdot}0}{9{\cdot}00}$ $\qquad = \frac{0-27{\cdot}5}{6{\cdot}00}$

$= 1{\cdot}67\ ms^{-2}$ (1) $\qquad = -4{\cdot}58\ ms^{-2}$ (1)