Centre Number						Candidate Number				
Surname						Other Names				

Notice to Candidate. The work you submit for assessment must be your own. If you copy from someone else or allow another candidate to copy from you, or if you cheat in any other way, you may be disqualified.

Candidate Declaration. I have read and understood the Notice to Candidate and can confirm that I have produced the attached work without assistance other than that which is acceptable under the scheme of assessment.

Candidate Signature		Date	

For Teacher's Use	
Section	Mark
PSA	
Stage 1	
Section A	
Section B	
TOTAL (max 50)	

General Certificate of Education
Advanced Subsidiary Examination
June 2015

Physics (Specification A & B) PHY3T/P15/test

Unit 3T AS Investigative Skills Assignment (ISA) P

For submission by 15 May 2015

For this paper you must have:	**Time allowed**
• your documentation from Stage 1 • a 30 cm ruler with millimetre measurement • a protractor • a calculator.	• 1 hour
Instructions:	**Information**
• Use black ink or black ball-point pen. • Fill in the boxes at the top of this page. • Answer **all** questions. • You must answer the questions in the space provided. Do not write outside the box around each page or on blank pages. • Do all rough work in this book. Cross through any work you do not want to be marked. • Show all your working.	• The marks for questions are shown in brackets. • The maximum mark for this paper and Stage 1 is 41.

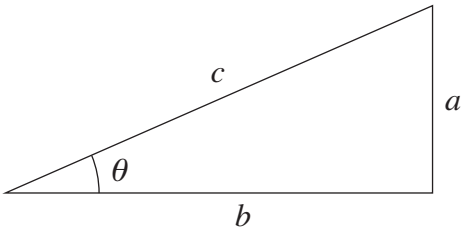
Details of additional assistance (if any). Did the candidate receive any help or information in the production of this work? If you answer yes give the details below or on a separate page.

Yes ☐ No ☐

Teacher Declaration:
I confirm that the candidate's work was conducted under the conditions laid out by the specification. I have authenticated the candidate's work and am satisfied that to the best of my knowledge the work produced is solely that of the candidate.

Signature of teacher ..... Date .....

USEFUL FORMULAE



$$\sin\theta = \frac{a}{c}$$

$$\cos\theta = \frac{b}{c}$$

$$\tan\theta = \frac{a}{b}$$

$$c^2 = a^2 + b^2$$

Section A

Answer **all** questions in the spaces provided.
You should refer to your documentation from Stage 1 as necessary.
The formulae on page 2 may be useful when answering questions in this section.

1 (a) State the independent variable in your experiment.

[1 mark]

.....

1 (b) (i) Determine the percentage uncertainty in your value of L.

[1 mark]

percentage uncertainty = ... %

1 (b) (ii) State the value of d that has the largest percentage uncertainty.
Calculate the percentage uncertainty in this value of d.

[1 mark]

value of d = ...

percentage uncertainty = ... %

1 (b) (iii) Using your answers from 1(b)(i) and 1(b)(ii), calculate the percentage uncertainty in $\frac{L}{d}$.

[1 mark]

percentage uncertainty = ... %

1 (c) (i) Describe the relationship between $\left(1 - \frac{L}{d}\right) h$ and m shown by your graph from Stage 1.

[1 mark]

.....

.....

.....

1 (c) (ii) Suggest an equation for this relationship.

[1 mark]

1 (d) Explain how you adjusted the beam to be horizontal, stating any assumptions you made.

[3 marks]

.....

.....

.....

.....

.....

.....

1 (e) State **two** possible sources of systematic error in your experiment.

[2 marks]

1 .....

2 .....

1 (f) State **one** possible source of random error in your experiment. Explain your answer.

[2 marks]

source of random error .....

explanation .....

.....

.....

13

Turn over for the next question

There are no questions printed on this page

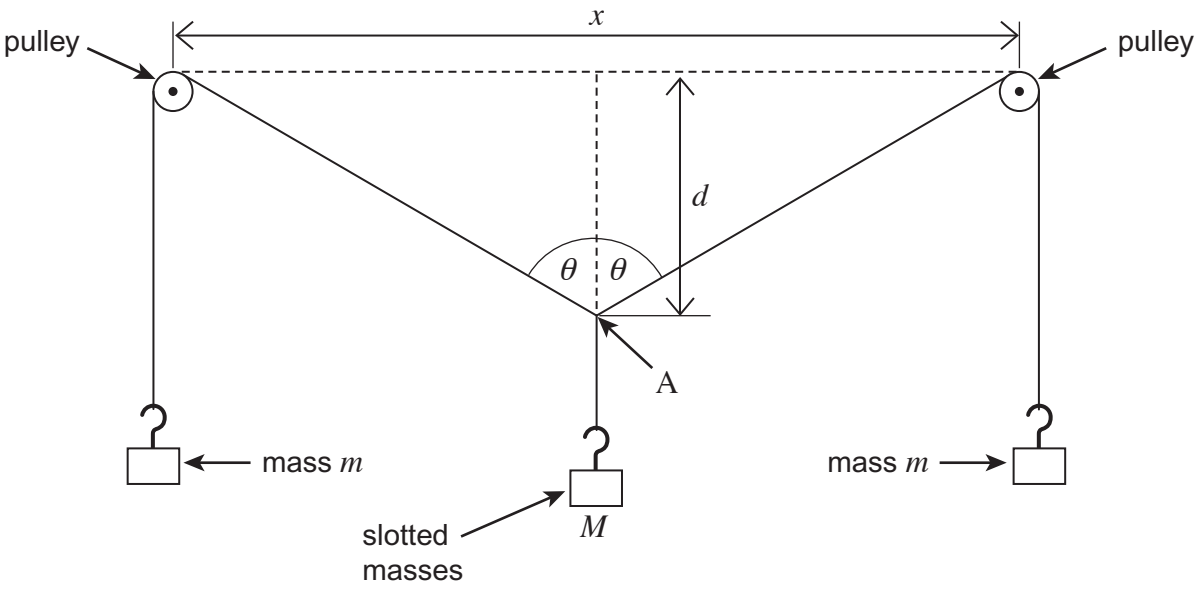
DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Section B

Answer **all** the questions in the spaces provided.

2 **Figure 1** shows the arrangement of apparatus in an experiment to investigate the equilibrium of three forces.

Figure 1



The two pulleys are secured in a fixed position at the same height. The centres of the pulleys are separated by a horizontal distance x. Identical masses m are suspended by a continuous string which passes over both pulleys. A third mass M is suspended from the string at point A, equidistant from the pulleys. The strings that pass over the pulleys each make an angle θ to the vertical at point A, as shown in **Figure 1**.

When the forces are in equilibrium the vertical distance d is measured. Mass M is varied and the system is allowed to come into equilibrium. For each M, the corresponding distance d is measured.

The results are shown in **Table 1**.

Question 2 continues on the next page

Table 1

M/kg	d/m	$\frac{d}{\sqrt{d^2 + \frac{x^2}{4}}}$
0.100	0.035	0.087
0.200	0.066	0.163
0.300	0.105	0.254
0.400	0.139	0.328
0.500	0.183	
0.600	0.228	

2 (a) Given that $x = 0.800$ m, complete **Table 1**.

[1 mark]

2 (b) Complete the graph in **Figure 2** on page 9 by plotting the two remaining points and drawing a best fit straight line.

[2 marks]

2 (c) Determine the gradient of the graph in **Figure 2**.

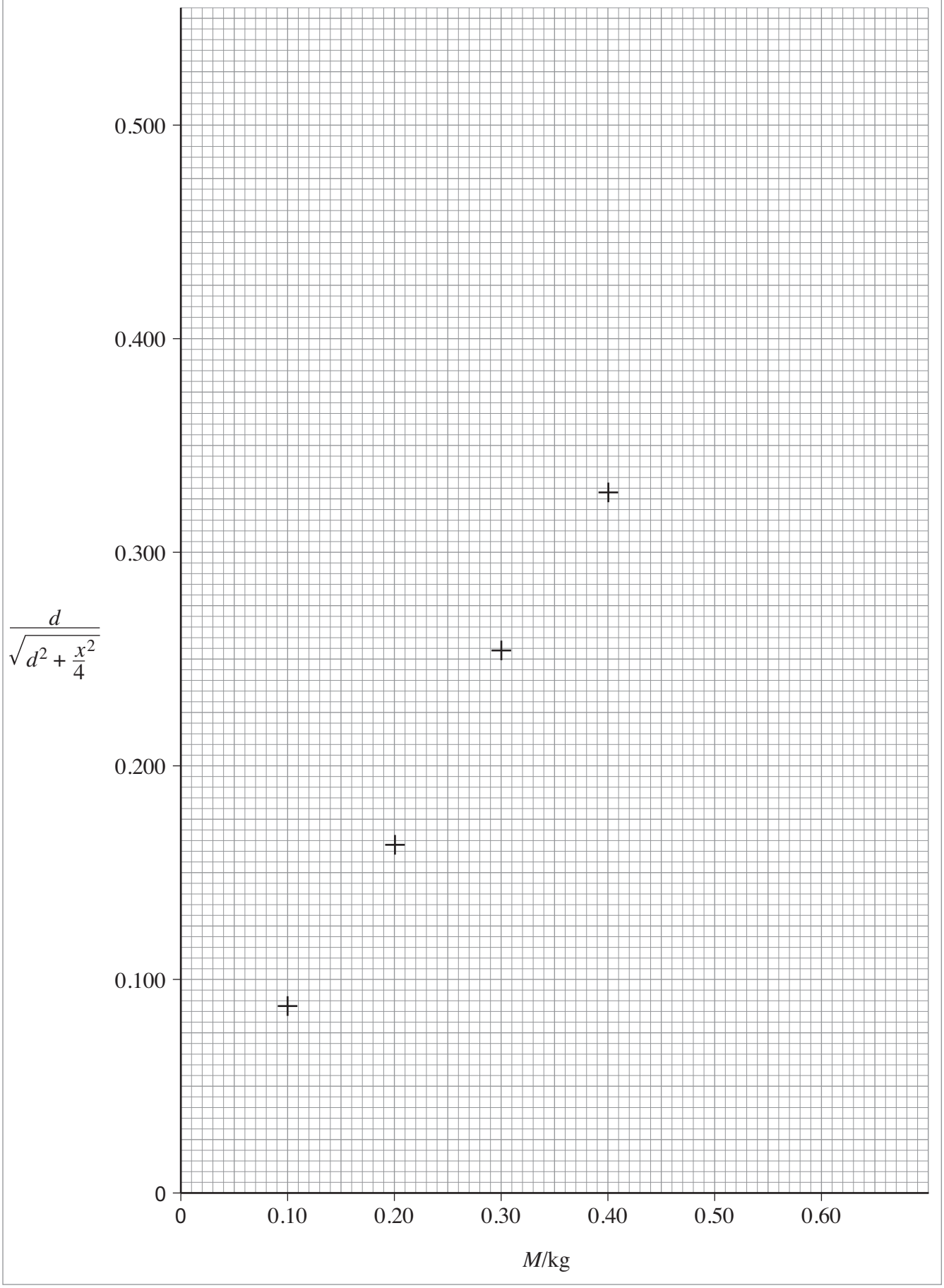
[3 marks]

gradient = ...

2 (d) (i) Consider the forces that act at point A in **Figure 1**. By resolving these forces vertically, show that $M = 2m\cos\theta$.

[1 mark]

Figure 2



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2 (d) (ii) Express $\cos\theta$ in terms of d and x and hence show that the gradient of the graph is equal to $\frac{1}{2m}$.

[2 marks]

2 (d) (iii) Determine the value of m using your value for the gradient from 2(c).

[2 marks]

$m =$ .....

2 (e) A student obtains different results for d when M is increased compared with those obtained when M is decreased.

2 (e) (i) Suggest why these two sets of results do not agree.

[1 mark]

.....

.....

2 (e) (ii) State what the student should do with the results to take account of this problem.

[1 mark]

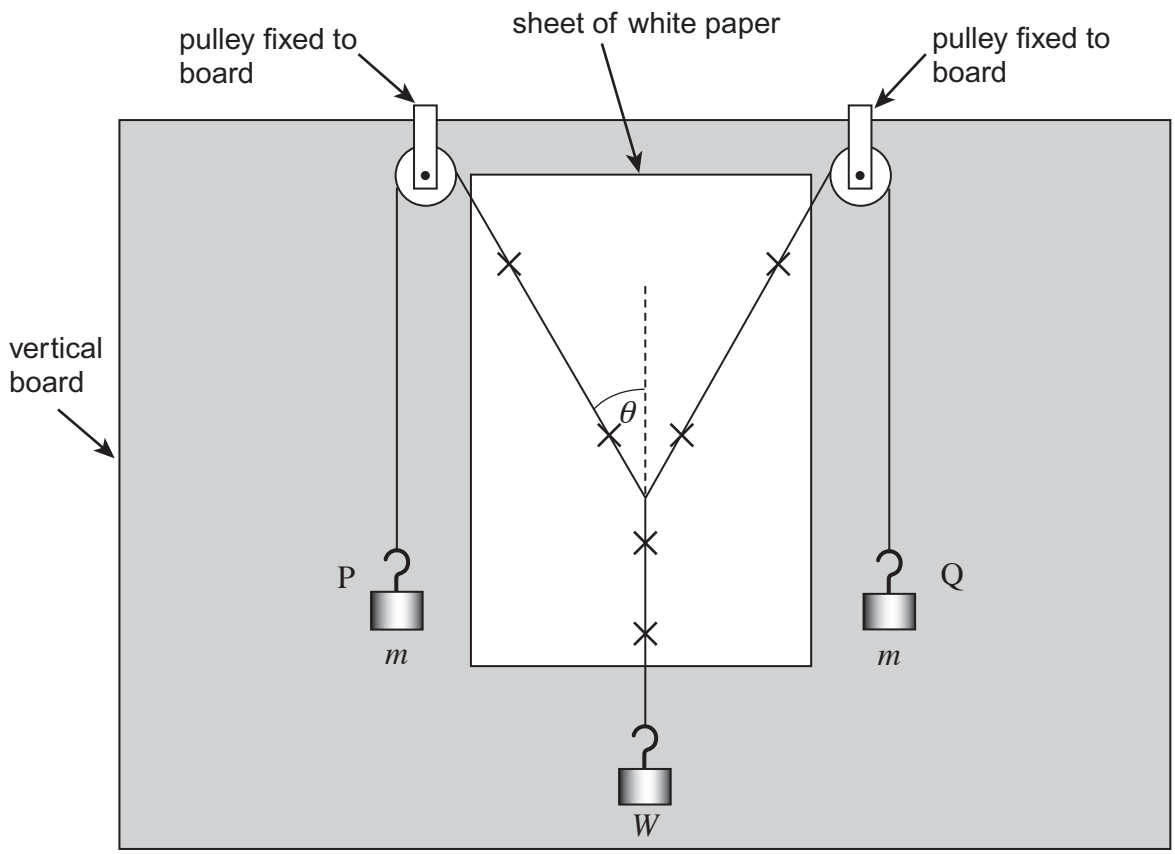
.....

.....

13

3 An arrangement for investigating the equilibrium of forces is shown in **Figure 3**.

Figure 3



In the arrangement shown in **Figure 3**, P and Q are identical masses of mass m.
A student uses this arrangement to investigate the relationship between m and θ when the system of forces is in equilibrium. Weight W is constant.
The student performs the investigation by marking the position of the strings when the forces are in equilibrium for different values of m. He does this by marking crosses on the sheet of white paper.

3 (a) The string is about 10 mm from the paper. Describe and explain a technique to mark accurately the string positions on the paper.

[2 marks]

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Turn over ▶

3 (b) The crosses on the paper are used to determine the directions of the strings.
The results are shown full scale in **Figure 4** on page 13.

3 (b) (i) Use **Figure 4** and your protractor to measure θ as accurately as possible and calculate the percentage uncertainty in your answer. State the precision of the protractor you used.

[3 marks]

precision of protractor = ...

θ = ...

percentage uncertainty = ... %

3 (b) (ii) Use **Figure 4** and a ruler to determine θ using trigonometry. Show on **Figure 4** the measurements you make.

[2 marks]

θ = ...

3 (c) Theory suggests that $W = 2mg\cos\theta$.
The student produces a set of results for different values of m and the corresponding values of θ.
Suggest and explain a graphical way of testing this relationship between m and θ.

[1 mark]

.....

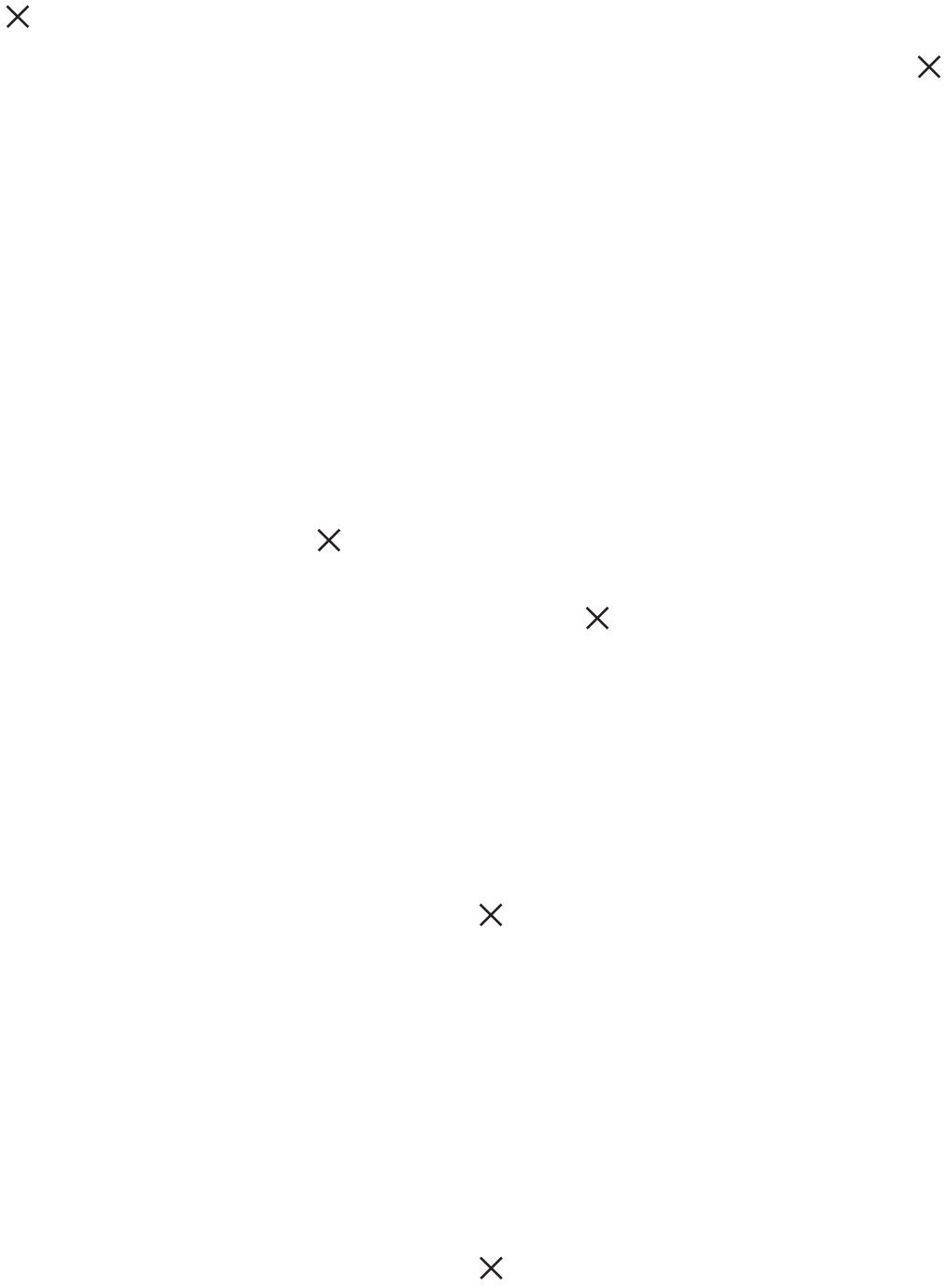
.....

.....

.....

8

Figure 4



END OF QUESTIONS