Surname	Centre Number	Candidate Number
Other Names		2

GCE A LEVEL

1420U50-1E

S19-1420U50-1E

PHYSICS – A2 unit 5
Practical Examination

Practical Analysis Task

FRIDAY, 29 MARCH 2019 – MORNING

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**5**	
2.	**20**	
Total	**25**	

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ADDITIONAL MATERIALS

In addition to this examination paper, you will require a calculator and a **Data Booklet**.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Pencil may be used to draw tables and graphs.
Answer **all** questions.
Write your name, centre number and candidate number in the spaces at the top of the page.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The total number of marks available for this task is 25.
The number of marks is given in brackets at the end of each question or part-question.
You are reminded of the necessity for good English and orderly presentation in your answers.

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Answer **all** *questions.*

1. When carrying out an investigation to determine the density of paper Sally counted out 50 identical sheets of A4. She found these sheets had a total mass of (234.5 ± 0.1) g and a total thickness of (0.25 ± 0.01) cm. She measured the length, l, and the width, w, using a ruler of resolution ± 1 cm, these she found to be l = 30 cm and w = 21 cm. Determine the density of the paper along with its **absolute** uncertainty. [5]

2. Richard decided to investigate the relationship between the impact velocity of an object and the diameter of the crater it leaves. The impact velocity can be calculated using the equation

$$v = \sqrt{2gh}$$

where v = impact velocity
g = acceleration due to gravity
h = drop height

He set up the apparatus shown on the following page.

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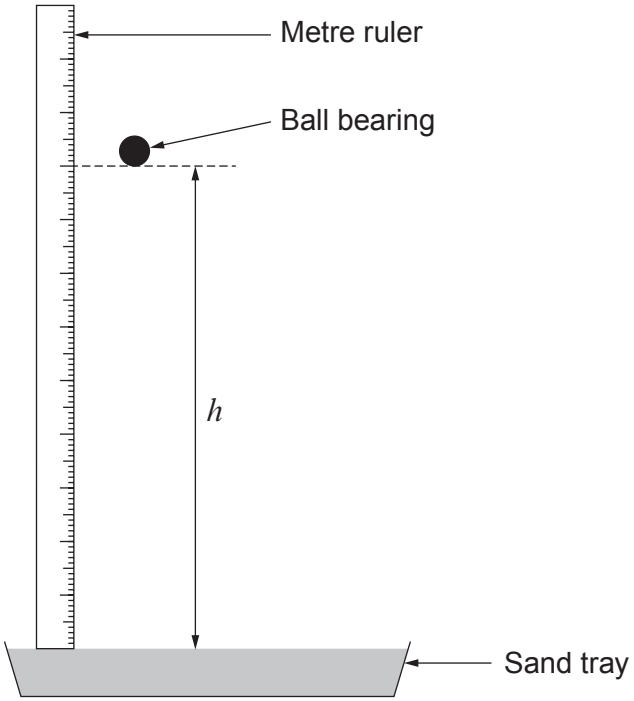

Richard dropped the ball bearing and measured the diameter, d, of the crater it left in the sand. He repeated this for a series of different heights, h. To ensure his results were repeatable he carried out the experiment three times from each height and obtained the following results.

Drop height h / m ± 5%	Diameter, d / cm				(Mean diameter)^2 d^2 / cm^2	Uncertainty in (mean diameter)^2 / cm^2	Impact velocity $v = \sqrt{2gh}$ / m s^{-1}	Uncertainty in impact velocity / m s^{-1}
	Reading 1	Reading 2	Reading 3	Mean				
0.100	2.9	2.7	2.7	2.8	7.7	0.6	1.40	
0.200	3.2	3.2	3.4	3.3	10.7	0.7	1.98	
0.300	3.5	3.7	3.6				2.43	
0.400	3.9	4.1	3.8				2.80	
0.500	4.2	4.2	4.0	4.1	17.1	0.8	3.13	
0.600	4.4	4.3	4.1				3.43	

(a) Complete the four columns in the table above. Space has been left for any calculations if needed. [6]

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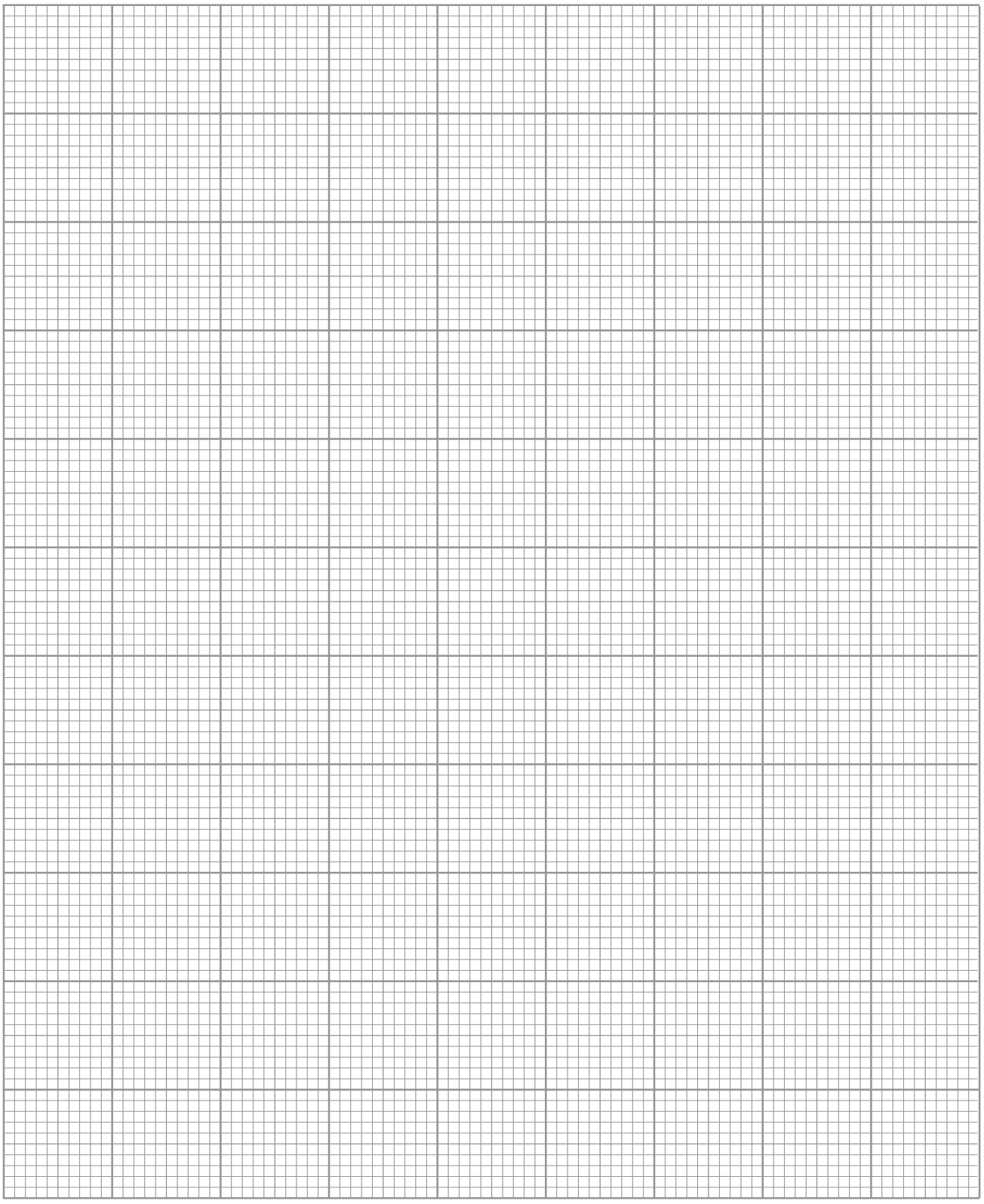
(b) By studying craters on the moon scientists believe that the impact velocity of a meteor is directly proportional to the diameter of the crater squared.

$$v \propto d^2 \quad \text{or} \quad v = kd^2$$

where k is a constant.
Using Richard's results, keeping the diameter squared in cm^2 and impact velocity in $m\,s^{-1}$, plot a graph to see if this is true. Include error bars on both axes **where possible**, and draw a line of maximum gradient and a line of minimum gradient. [5]



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(c) (i) Calculate the maximum and minimum gradients for your graph. [3]

(ii) Hence, determine the mean gradient and its **percentage** uncertainty. [2]

(iii) Use the data to determine if it supports the scientists' theory that the impact velocity is directly proportional to the diameter squared. Explain your reasoning. [2]

(d) Predict how, if at all, the diameter of the crater would be affected if Richard had carried out his experiment on the moon (g_{moon} = 1.6 m s^{-2}). [2]

END OF PAPER

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