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# Examiners' Report
# January 2011

# GCSE Physics 6PH07 01

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## Introduction

Although this is a written paper testing practical skills, it was pleasing to see that many candidates had clearly carried out relevant practicals and were able to relate their experience to the questions asked.

The best answers were well orgainised and concise and generally used scientific terms correctly. Answers to the first five questions showed a good awarenes of practical measurements. However, it was clear, for example from answers to question 8(a), that some candidates did not know the meaning of terms such as 'linear relationship' and 'inversely proportional'.

## Question 6

Almost all candidates answered this question. Marks were awarded for relevant points explained in context up to a maximum of four. Candidates who commented on reaction time effects with stop watches gained a mark, but no credit was given for simply saying there were 'human errors'.

**6** An experiment involves measuring the time taken for a ball to fall through different distances. The maximum distance is 1.5 m.

One student says that it is better to use light gates or sensors and a datalogger. Another student says that just using a stopwatch is better.

Discuss the advantages and disadvantages of each method.

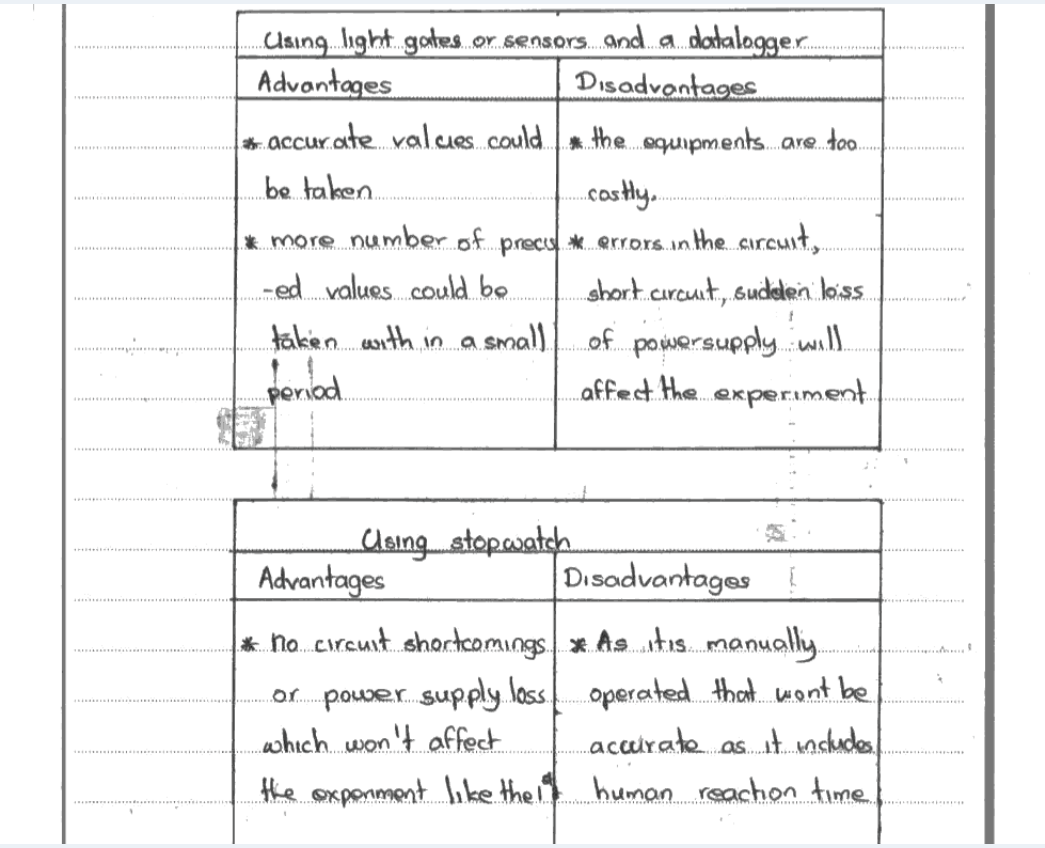
Light gates and datalogger are better than stopwatch because systematic error such as reaction time is reduced significantly. ~~unc~~ uncertainty can be reduced. Parallax error can also be reduced if light gates and datalogger is used. If a stopwatch is used, the observer has to keep eye level with the reading to be taken. A graph can be plotted immediately using light gates and datalogger. Readings taken using light gates and datalogger ~~or~~ have higher precision as stopwatch can only measure up to 0.01s only. measurements can also be taken between short time intervals.

However, stopwatch is better than light gates and data logger because it is cheaper than the letter. No power supply is required for the stopwatch method. Experiment will not be affected by a sudden ~~flux~~ fluctuation in power supply, that might affect datalogger's readings. Experiment set-up using the stopwatch is simpler.

**(Total for Question 6 = 4 marks)**

### ResultsPlus
### Examiner Comments

This is a very comprehensive answer which gained full marks. The candidate clearly understood the advantages and disadvantages of both light gates and stop watches.



Using light gates or sensors and a datalogger

| Advantages | Disadvantages |
|---|---|
| * accurate values could be taken<br>* more number of precised values could be taken with in a small period | * the equipments are too costly.<br>* errors in the circuit, short circuit, sudden loss of powersupply will affect the experiment |

Using stopwatch

| Advantages | Disadvantages |
|---|---|
| * no circuit shortcomings or power supply loss which won't affect the experiment like the | * As it is manually operated that wont be accurate as it includes human reaction time |

**ResultsPlus**
**Examiner Comments**

This canddidate has made good use of a table and has gained 3 marks for comments on cost, power supply, reaction time.

**ResultsPlus**
**Examiner Tip**

Always make sure that you check the details of the question. Although it is true that a data logger can take many readings this was not considered relevant in the situation described in the question.

## Question 7

This was a planning exercise using similar criteria to those with which home candidates work as laid out in the specification. The best candidates set out their work following the prompts given in the question, although marks were awarded wherever an appropriate point was made.

A 'method' for the experiment was not required but those candidates who wrote one were awarded relevant marks. However these answers sometimes did not address sections of the question such as justifying the choice of an instrument.

This was a well organised answer in which the candidate had drawn a clear labelled diagram using a ruler.

7 You are to plan an experiment to determine the Young modulus of a material in the form of a long wire. You are to use a graphical method. Assume that standard laboratory apparatus is available.

Your answer should include:

(a) a labelled diagram of the apparatus to be used, (1)

(b) a list of any additional apparatus required that is not shown in the diagram, (1)

(c) the quantities to be measured, (1)

(d) an explanation of your choice of measuring instrument for two of these quantities, (4)

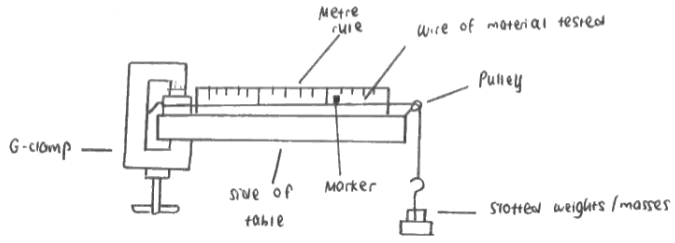
(e) which is the independent and which is the dependent variable, (1)

(f) how the data collected will be used to determine the Young modulus, (2)

(g) the main source of uncertainty and/or systematic error, (1)

(h) a comment on safety. (1)

a)




b) Micrometer screw gauge

c) i. The force applied by recording mass of weights / slotted masses x g

ii. Cross-sectional area of long wire tested, find diameter and then area = $\pi r^2$

iii. Extension of the long wire

iv. Original length of the wire

d) i. Micrometer screw gauge used to measure the diameter of the wire. It has a precision of 0.01 mm suitable for measuring the diameter of the thin wire. Area = $\pi r^2$, $r = \frac{\text{diameter}}{2}$.

ii. Metre rule used to measure the original length and the extension of the wire. Has precision of 0.1 cm. Suitable for measuring lengths as well as difference in lengths. Other apparatus do not have suitable precision.

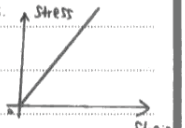
e) Independant : Force applied per unit area / the mass of slotted weights

Dependant : The extension of the long wire once force is applied

f) The force applied in order to obtain a given extension is divided by the area of the wire to get the value of stress, $\sigma = \frac{F}{A}$. (A: cross-sectional)

The extension of the wire from the force is divided / ratio by the original length of wire. This is the stress, $\varepsilon = \frac{\Delta x}{x}$.

Young Modulus = $\frac{\text{Stress}}{\text{Strain}} = \frac{F/A}{\Delta x / x} = \frac{Fx}{A \Delta x}$. Graph of stress against strain is plotted. Gradient of graph represents the value of the Young Modulus.




g) Zero error of micrometer screw gauge

h) Shoes should be worn to protect feet from falling masses.

Eye goggles for protection against snapped wire

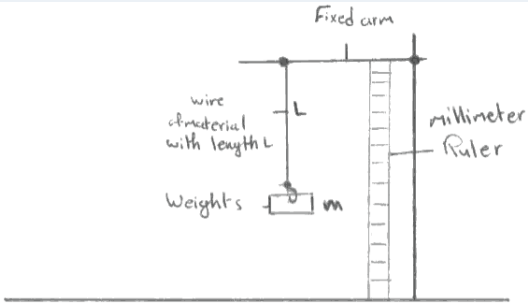
## ResultsPlus
### Examiner Comments

This candidate has stated that force has to be measured and that a micrometer measures a diameter from which an area has to be calculated. All steps in the use of the data have been detailed.

## ResultsPlus
### Examiner Tip

Remember to justify the choice of an instrument by including a comment on the precision and the size of the measurement to be taken as this candidate has. Although the candidate has said that there might be a zero error in reading the micrometer in answering section (g) they have not said that the measurement of the diameter is the main source of uncertainty in the experiment so did not gain this mark.

This answer shows a different, but equally valid, method.




b) digital calipers, balance

c) Cross-sectional area, original length, extension, ~~mass~~ Weight of weights added.

d) Use of digital calipers to determine the diameter of the cross-section, then calculating it's Area by ( $4\pi(\frac{d}{2})^2$ ), use of balance to determine the mass of the weights before hanging them, and then we can calculate it's force applied on the wire by ( $F = W = mg$ ) ( g → gravitional field)

e) Independant variable → extension

Dependant variable → Force applied

f) young modulus = $\frac{\text{stress}}{\text{strain}} = \frac{fL}{A\Delta L}$ = gradient

g) ~~The material not b~~ Calculation of the stress and strain.

h) It's recommended to wear safety goggles, in case the wire is broken, and get a distance between your feet and the weight.

**ResultsPlus**
**Examiner Comments**

Candidates such as this one did not understand how to identify the independent variable.

**ResultsPlus**
**Examiner Tip**

Learn the equation for finding an area. Check your understanding of independent variables.

## Question 8(b)

While most candidates managed to rearrange the equation into the form $y = mx + c$, less able candidates then copied the stem of the question rather than explaining the links.

(b) The equation relating $f$, $u$ and $v$ is

$$1/f = 1/u + 1/v$$

Rearrange this equation to show that:

- the gradient of the graph should be –1
- the intercept with the y axis is $1/f$.

(3)

• ✱ $1/f = 1/u + 1/v \Rightarrow 1/v = -1/u + 1/f$.

The equation close to the equation $y = ax + b$. and $a = -1$, so the gradient of the graph should be -1.

• When $1/u = 0$.

~~$1/f = 0 + 1/v \Rightarrow 1/v = 1/f$~~.

So the intercept with y axis is $1/f$.

**ResultsPlus**
**Examiner Comments**

This candidate has clearly explained the use of the intercept and identified the gradient as 'a'.

**ResultsPlus**
**Examiner Tip**

Learn how to rearrange equations and explain your answers.

$\frac{1}{V} = \frac{1}{F} - \frac{1}{U}$ $\quad y = \frac{1}{V}$, $u = -1$

$\frac{1}{V} = -1 \cdot \frac{1}{U} + \frac{1}{F}$ $\quad x = \frac{1}{U}$, $c = \frac{1}{F}$

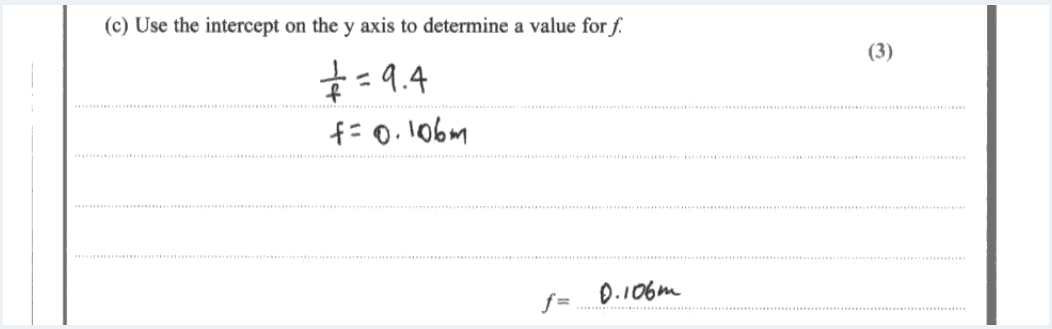
$y = m x + c$

**ResultsPlus**
**Examiner Comments**

This candidate has used arrows to demonstrate the links and also gains 3 marks.

## Question 8(c)

Most candidates read the intercept correctly but fewer gave an answer to the expected two significant figures as determined by the data provided.


(c) Use the intercept on the y axis to determine a value for $f$.

(3)

$\frac{1}{f} = 9.4$

$f = 0.106\text{m}$

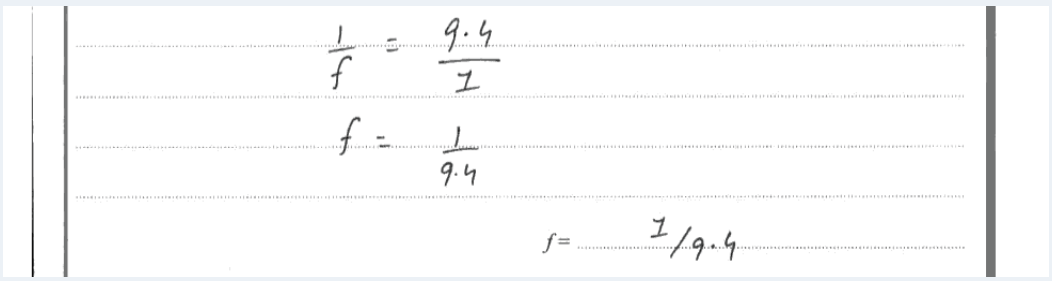
$f =$ 0.106m

**ResultsPlus**
**Examiner Comments**

This is a good answer but to the wrong number of significant figures and so does not gain the last mark.

**ResultsPlus**
**Examiner Tip**

In 'practical' papers you must get the number of significant figures correct.


$\frac{1}{f} = \frac{9.4}{1}$

$f = \frac{1}{9.4}$

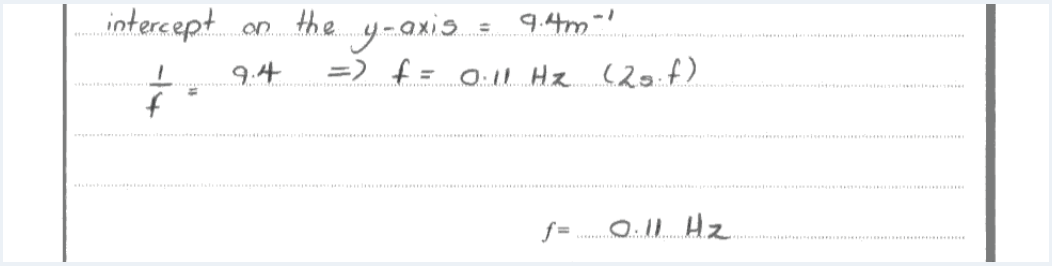
$f =$ 1/9.4

**ResultsPlus**
**Examiner Comments**

Answers must be given as decimals, not fractions.

**ResultsPlus**
**Examiner Tip**

You must work answers out not leave them as fractions.


intercept on the y-axis = $9.4\text{m}^{-1}$

$\frac{1}{f} = 9.4 \Rightarrow f = 0.11\text{ Hz}$ (2 s.f)

$f =$ 0.11 Hz

**ResultsPlus**
**Examiner Comments**

This has the right number of significant figures but the wrong unit.

**ResultsPlus**
**Examiner Tip**

You must learn the units for each quantity

## Question 9(a)

This was generally answered well but a few answers lacked clarity. Some tried to draw a conclusion or trend rather than criticising the results.

(a) Criticise the set of results.

(2)

- Only 4 sets of data, instead of 6.
- Inconsistent percision with the diameter
- Inconsistent number of significant figures for the average time.

**ResultsPlus**
**Examiner Comments**

This is a good clear answer which gained full marks.

Inconsistent decimal places of diameter readings.
Inconsistent deimel places of average time readings

**ResultsPlus**
**Examiner Comments**

It is better to comment on significant figures rather than decimal places. Only one mark was available for a comment on significant figures.

**ResultsPlus**
**Examiner Tip**

Look for more than one criticism for two marks.

## Question 9(b)

A large number of candidates did not provide a unit for velocity but generally the question was answered well.

(b) The ball bearings were timed falling a distance of 68 mm. Complete the table below.

(4)

| Diameter/mm | Radius/mm | Radius²/mm² | Average time/s | Velocity/ mms⁻¹ |
|---|---|---|---|---|
| 3 | 1.5 | 2.3 | 28 | 2.4 |
| 4 | 2.0 | 4.0 | 8.08 | 8.4 |
| 6.01 | 3.0 | 9.0 | 4.25 | 16.0 |
| 12.03 | 6.0 | 36.0 | 2.32 | 29.3 |

**ResultsPlus**
**Examiner Comments**

This answer gains all 4 marks.

| Diameter/mm | Radius/mm | Radius²/mm² | Average time/s | Velocity/ |
|---|---|---|---|---|
| 3 | 1.5 | 2.3 | 28 | 2.4 |
| 4 | 2.0 | 4.0 | 8.08 | 8.4 |
| 6.01 | 6.01 | 9.03 | 4.25 | 16 |
| 12.03 | 6.0 | 36.0 | 2.32 | 29.3 |

**ResultsPlus**
**Examiner Comments**

This candidate has forgotten the unit and not rounded the radius and radius² to two significant figures. It would be better to give the missing velocity as 16.0 but the candidatate has not lost a mark for this.

**ResultsPlus**
**Examiner Tip**

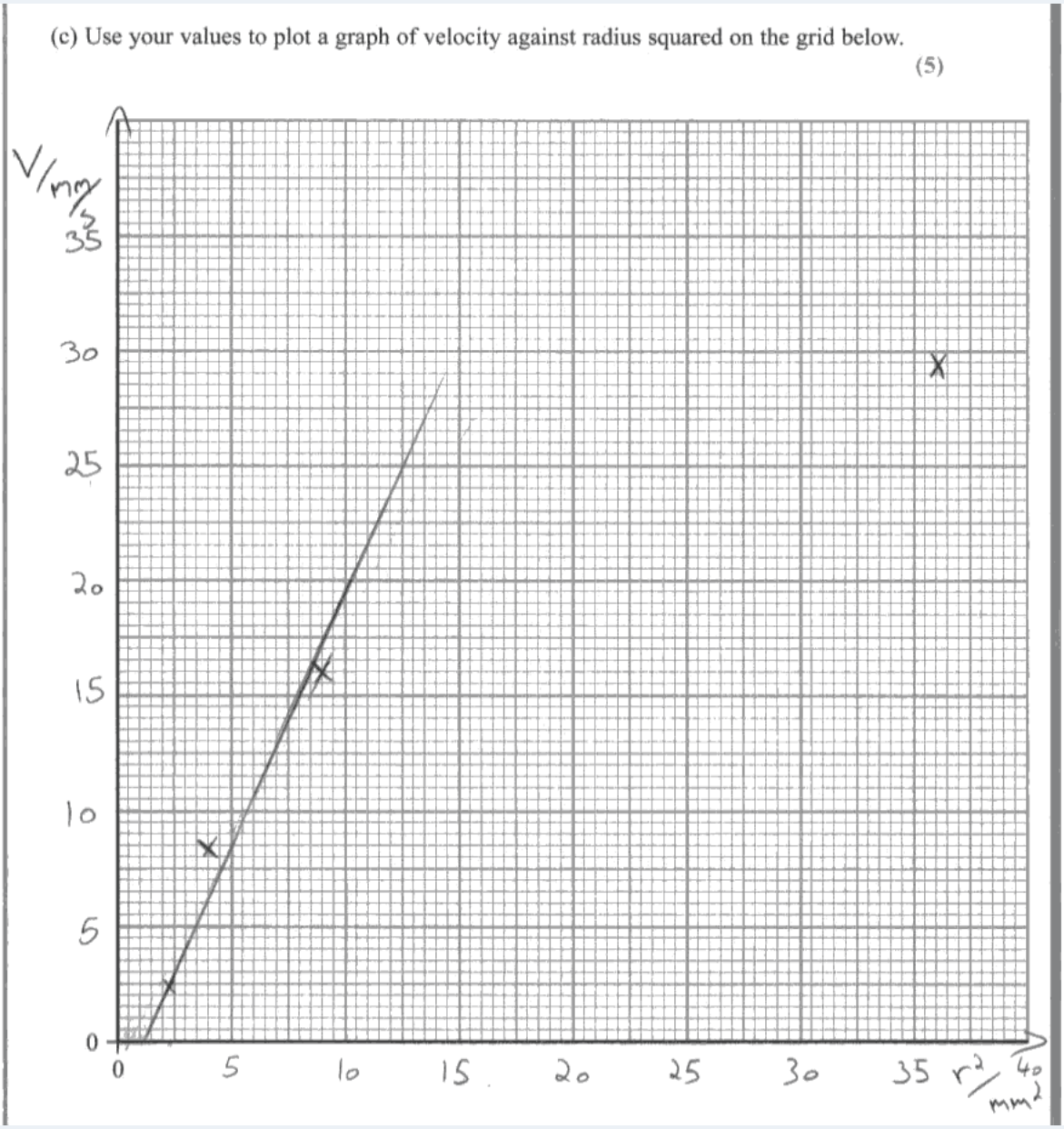
Remember to check units and significant figures in a practical paper.

## Question 9(c)

Although the examiners were surprised by the number of candidates who did not draw good or complete graphs, many displayed good learning and sound teaching with good thin curves through all points. Candidates should be warned to avoid the use of scales such as 3 $mm^2$/10 squares as this usually causes plotting errors.

(c) Use your values to plot a graph of velocity against radius squared on the grid below.

(5)




**ResultsPlus**
**Examiner Comments**

The scale and labels are good as is the plotting, but the candidate has drawn a straight line instead of a curve and so has lost two marks.

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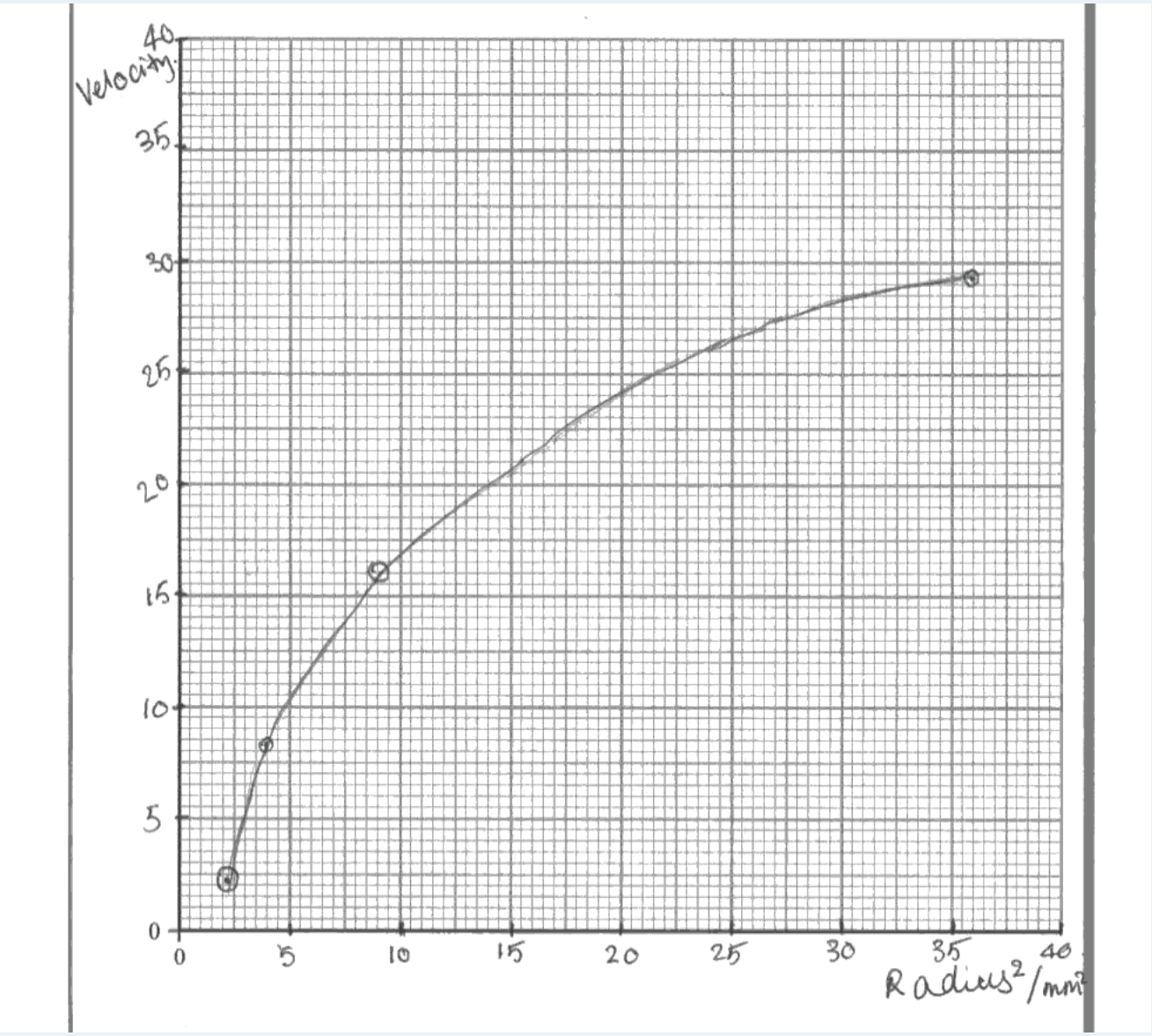
**Examiner Tip**

Don't draw a straight line if the data show a curve.




**ResultsPlus**
**Examiner Comments**

These are sensible scales and the labels are clear, however the unit for velocity is missing. The curve goes through all the points although it could have continued to the *x*-axis.

**ResultsPlus**
**Examiner Tip**

Remember that labels on axes should include units.

## Question 9(d)

Canddidates seemed to consider measurements rather than the context of the experiment. Many mentioned parallax error which would be unlikely to cause this amount of difference. Very few thought about the times or distances necessary for the balls to reach terminal velocity.

(d) The student expected to obtain a straight line graph.

Suggest **one** possible reason for the apparent error in her measurements.

(1)

The ball bearing has not reached its terminal velocity.

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**Examiner Comments**

This answer gained full marks.

The final bearing was too big for the tube length used & so it didn't reach terminal velocity, therefore it looks like an anomaly.

**ResultsPlus**
**Examiner Comments**

This answer also considers terminal velocity and in addition has thought about the effect of the size of the ball bearing.

## Paper Summary

The paper attracted the full range of marks. Some excellent papers were seen and very few unanswered questions.

## Grade Boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:

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