Physics 2019 v1.3

IA1: Sample assessment instrument

Data test (10%)

This sample has been compiled by the QCAA to assist and support teachers in planning and developing assessment instruments for individual school settings.

Student name

Student number

Teacher

Exam date

Marking summary

Criterion	Marks allocated	Provisional marks
Data test	10	
Overall	**10**	

Conditions

Technique	Data test
Unit	Unit 3: Gravity and electromagnetism
Topic/s	Topic 1: Gravity and motion Topic 2: Electromagnetism
Time	60 minutes + 10 minutes perusal
Seen/Unseen	Unseen questions and datasets
Other	QCAA-approved graphics calculator permitted Physics formula and data booklet permitted

Instructions

Use the datasets to respond to the associated questions in the spaces provided. Each question is associated with the dataset that immediately precedes it.

Data test summary

Dataset	Question	Objective			
		Apply understanding	Analyse evidence	Interpret evidence	
1	1	2			
	2	1			
	3		2		
	4			2	
2	5	1			
	6	2			
	7		1		
	8			2	
3	9		3		
	10			4	
Total		**6**	**6**	**8**	**20**
Percentage		**30%**	**30%**	**40%**	**100%**

Dataset 1

A student set up the apparatus shown in Figure 1 to conduct an experiment to address the following research question:

What is the relationship between the force exerted by a bar magnet on another identical bar magnet when separated by distances (r) between $0.005\ \text{m} \leq r \leq 0.05\ \text{m}$*?*

The raw data from this experiment is presented in Table 1.

Figure 1: Apparatus for magnetic force experiment

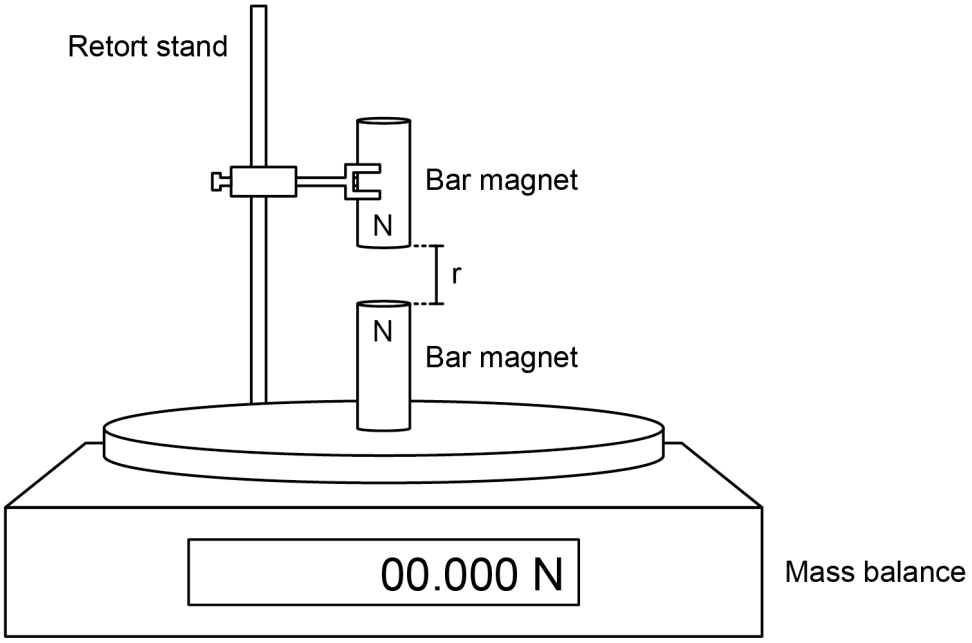

Table 1: Results from magnetic force experiment

Distance r (m) ±0.0005 m	Force F (N) ±0.001 N			Average force F (N)
	Trial 1	Trial 2	Trial 3	
0.010	1.000	1.000	1.020	1.007
0.020	0.255	0.245	0.250	0.250
0.025	0.156	0.156	0.156	0.156
0.030	0.103	0.103	0.107	0.104
0.040	0.060	0.060	0.062	
0.050	0.042	0.038	0.040	0.040

Question 1 (2 marks)

Calculate the average force (N) for the distance $r = 0.040$ m.

Answer: N (3 d.p.)

Question 2 (1 mark)

Determine the absolute uncertainty of the mean for the force, F, between the magnets when separated by a distance $r = 0.040$ m. Use the formula $\pm \frac{x_{max} - x_{min}}{2}$.

Answer: ± N (3 d.p.)

Question 3 (2 marks)

Identify the relationship between the distance, r, between two magnets and the force, F, exerted by one magnet on the other. Use evidence from Table 1 to support your answer.

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Question 4 (2 marks)

Predict the magnitude of the force between the two magnets when they are 0.080 m apart. Show your working.

Answer: N (3 d.p.)

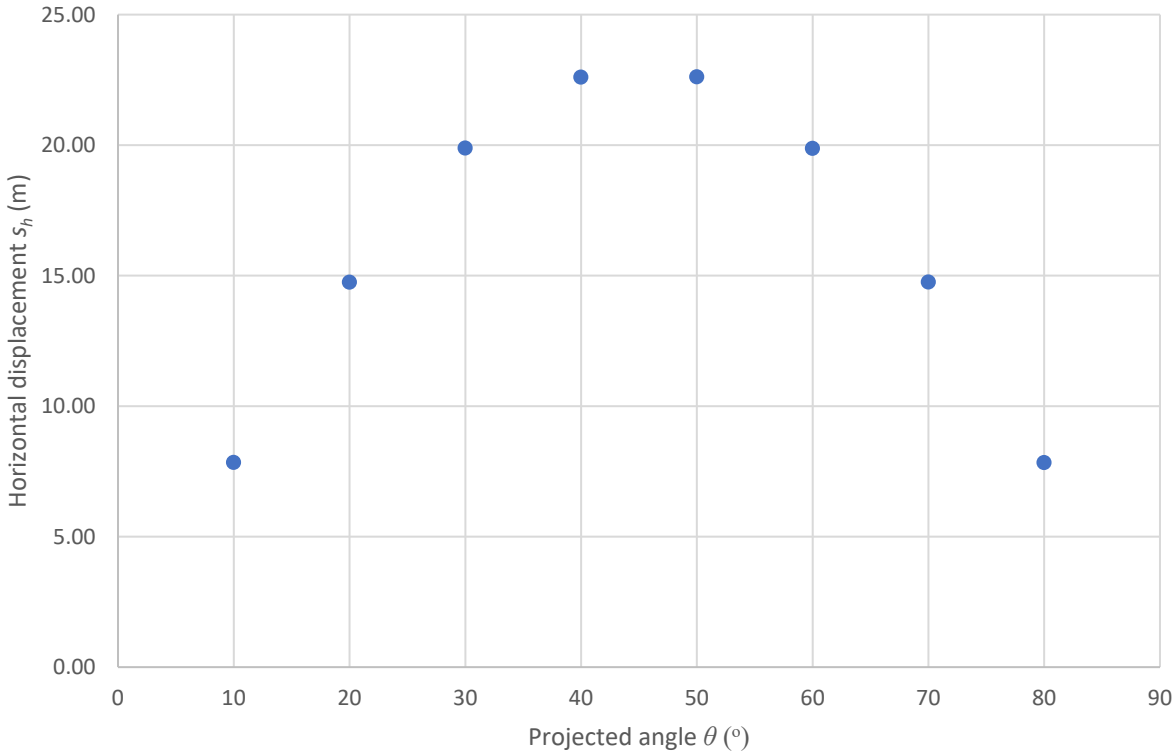
Dataset 2

An experiment was conducted to address the following research question:

What is the relationship between the projected angle ($10° \leq \theta \leq 80°$) of a golf ball and its horizontal displacement (range) when launched from ground level with a constant initial velocity of 15.0 m/s?

The experimental data was collected and processed, and is presented in Graph 1.

Graph 1: Horizontal displacement of golf ball projected at various angles



Question 5 (1 mark)

Identify the two projected angles that produced a horizontal displacement of 20 m.

Projected angles: ° and °

Question 6 (2 marks)

Calculate the initial horizontal component of the velocity of the golf ball when it was projected at an angle of 20°.

Horizontal component of velocity = m s^{-1} (1 d.p.)

Question 7 (1 mark)

Identify the trend between the projected angle θ and the horizontal displacement s_h of the golf ball.

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Question 8 (2 marks)

Infer which projected angle would result in the largest horizontal displacement. Give a reason for your response.

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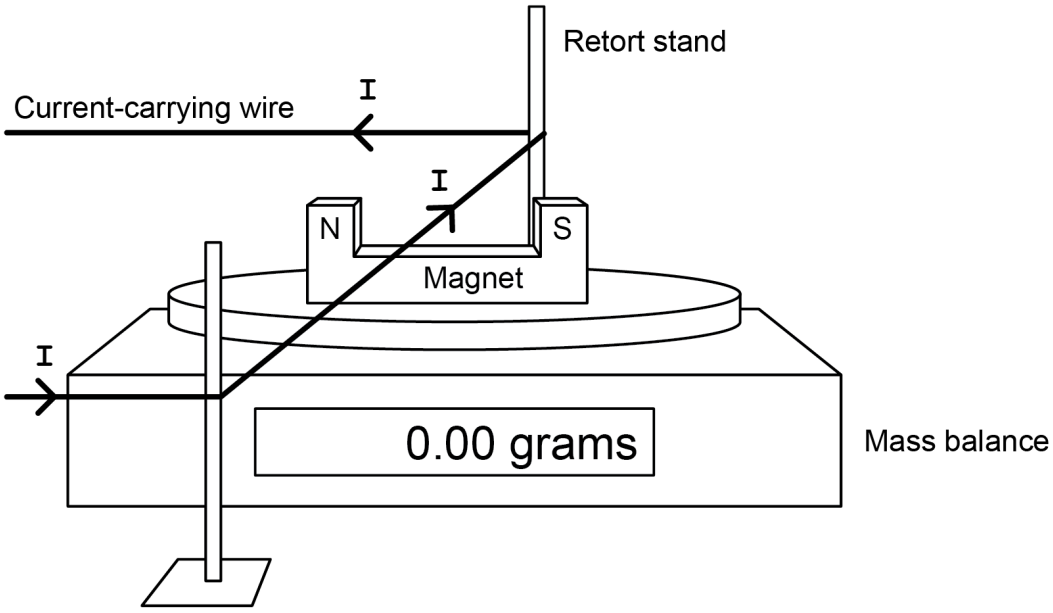
Answer: °

Dataset 3

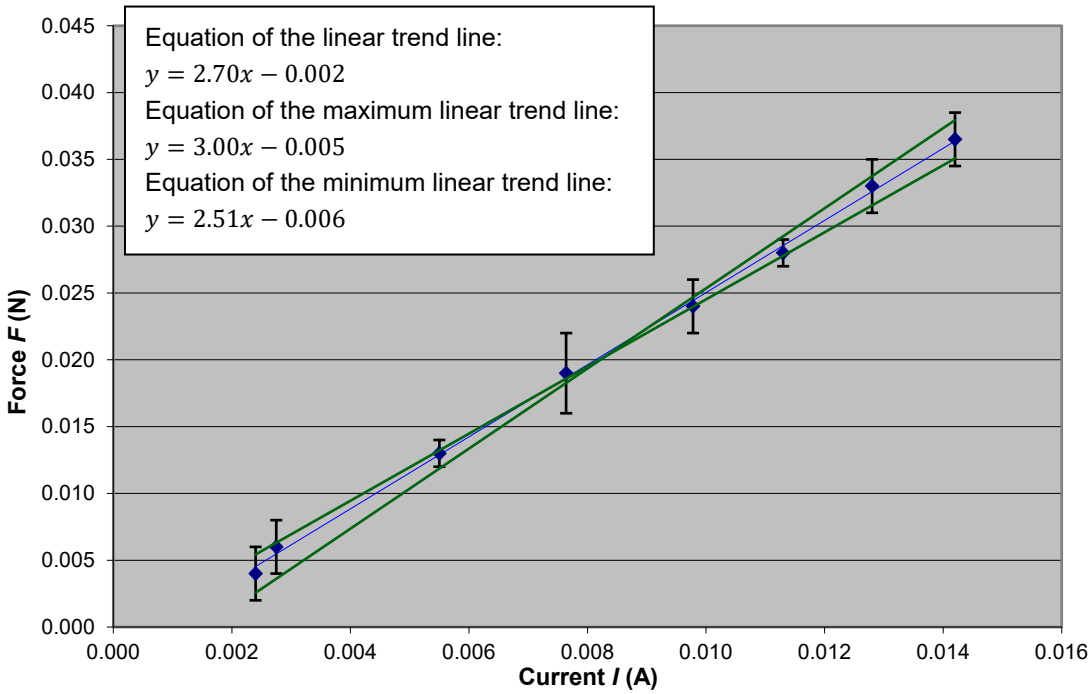
A student set up the apparatus shown in Figure 2 to conduct an experiment to investigate the force acting on a conductor in a magnetic field. The student varied the current through the conductor and measured the tared mass reading on the mass balance. The data was processed and plotted in Graph 2.

The effective length of the wire in the magnetic field was 2 cm. The wire was orientated at 90° to the magnetic field.

Figure 2: Apparatus to measure the force on a current-carrying conductor in a magnetic field



Graph 2: Force on a current-carrying conductor in a magnetic field



Question 9 (3 marks)

Identify a mathematical relationship between the force acting on the conductor and the current passing through the conductor, including the uncertainty of the gradient and *y*-intercept.

Question 10 (4 marks)

Draw a conclusion that quantifies the magnitude of the magnetic field through which the wire is passing, including the absolute or percentage uncertainty in the value you determine. Show your reasoning.

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Instrument-specific marking guide (ISMG)

Criterion: Data test

Assessment objectives

2. apply understanding of gravity and motion, or electromagnetism to given algebraic, visual or graphical representations of scientific relationships and data to determine unknown scientific quantities or features
3. analyse evidence about gravity and motion, or electromagnetism to identify trends, patterns, relationships, limitations or uncertainty in datasets
4. interpret evidence about gravity and motion, or electromagnetism to draw conclusions based on analysis of datasets

The student work has the following characteristics:	Cut-off	Mark
• consistent demonstration, across a range of scenarios about gravity and motion, or electromagnetism, of – selection and correct application of scientific concepts, theories, models and systems to predict outcome/s, behaviours and implications – correct calculation of quantities through the use of algebraic, visual and graphical representations of scientific relationships and data – correct and appropriate use of analytical techniques to correctly identify trends, patterns, relationships, limitations and uncertainty – correct interpretation of evidence to draw valid conclusions.	> 90%	10
	> 80%	9
• consistent demonstration, in scenarios about gravity and motion, or electromagnetism, of – selection and correct application of scientific concepts, theories, models and systems to predict outcome/s, behaviours and implications – correct calculation of quantities through the use of algebraic, visual and graphical representations of scientific relationships and data – correct use of analytical techniques to correctly identify trends, patterns, relationships, limitations and uncertainty – correct interpretation of evidence to draw valid conclusions.	> 70%	8
	> 60%	7
• adequate demonstration, in scenarios about gravity and motion, or electromagnetism, of – selection and correct application of scientific concepts, theories, models and systems to predict outcome/s, behaviours and implications – correct calculation of quantities through the use of algebraic, visual and graphical representations of scientific relationships and data – correct use of analytical techniques to correctly identify trends, patterns, relationships, limitations and uncertainty – correct interpretation of evidence to draw valid conclusions.	> 50%	6
	> 40%	5

The student work has the following characteristics:	Cut-off	Mark
• demonstration, in scenarios about gravity and motion, or electromagnetism, of elements of – selection and correct application of scientific concepts, theories, models and systems to predict outcome/s, behaviours and implications – correct calculation of quantities through the use of algebraic, visual or graphical representations of scientific relationships or data – correct use of analytical techniques to correctly identify trends, patterns, relationships, limitations or uncertainty – correct interpretation of evidence to draw valid conclusions.	> 30%	4
	> 20%	3
• demonstration, in scenarios about gravity and motion, or electromagnetism, of elements of – application of scientific concepts, theories, models or systems to predict outcome/s, behaviours or implications – calculation of quantities through the use of algebraic or graphical representations of scientific relationships and data – use of analytical techniques to identify trends, patterns, relationships, limitations or uncertainty – interpretation of evidence to draw conclusions.	> 10%	2
	> 1%	1
• does not satisfy any of the descriptors above.	≤ 1%	0