Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2019

Physics

Unit 3 Practical Skills

Booklet B

Higher Tier

[GPY34]

GPY34

TUESDAY 18 JUNE, MORNING

TIME

1 hour 15 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
You must answer the questions in the spaces provided.
Do not write outside the boxed area on each page or on blank pages.
Complete in black ink only. **Do not write with a gel pen.**
Answer **all** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 70.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Quality of written communication will be assessed in Question **3(a)**.
You should have a ruler and a protractor.

11845

1 A student is given a uniform metre rule and some weights.
The apparatus is used to investigate moments.

The metre rule is placed on a triangular block of wood (pivot) as shown above.

(a) Where should the triangular block be placed to balance the metre rule?

Position _____

Explain your answer.

_____

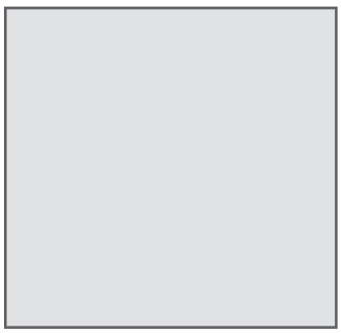
_____ [2]

(b) State how you calculate the moment of a force.

_____

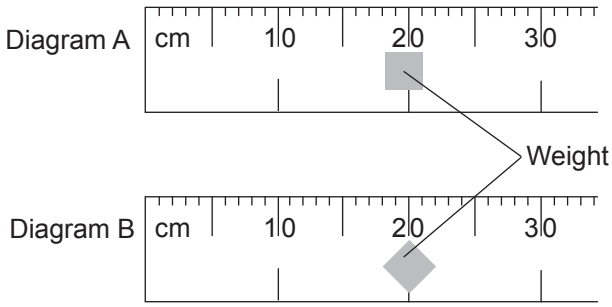
_____ [1]

(c) The weights used were in the form of a metal square as shown in the diagram below. Mark with the letter **X** the centre of gravity of the metal square.
Show clearly on the diagram how you get your answer.



[2]

(d) Diagrams A and B show two attempts by the student to place a weight on the metre rule at the 20 cm mark.



Explain the advantage of placing the weight as shown in Diagram B.

_____

_____

_____

_____ [1]

[Turn over

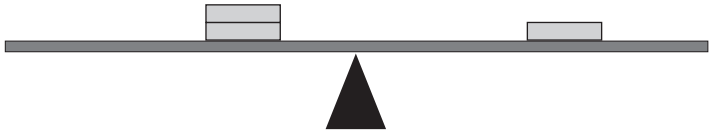
(e) State in words the Principle of Moments.

_____

_____

_____ [3]

(f) The student carried out the investigation by placing known weights on opposite sides of the pivot.
The weights were adjusted until the metre rule was **balanced**.



The results of the investigation are shown in the **incomplete** table opposite.

- Use the Principle of Moments to complete the table.
- Include the unit for moment in the column headings.
- Use the space below for calculations.

Calculations

NOTE the position on the metre rule is **not** the same as the distance from the pivot.

Position on the metre rule	Weight/N	Anti-clockwise moment/ _____	**Position** on the metre rule	Weight/N	Clockwise moment/ _____
20 cm mark	1		60 cm mark		
40 cm mark			75 cm mark	2	
25 cm mark	4		70 cm mark		

[6]

(g) The student placed a 5 N weight 40 cm to the left of the pivot.
Explain, with the help of a suitable calculation, why the student was unable to balance the metre rule using a 3 N weight on the right of the pivot.

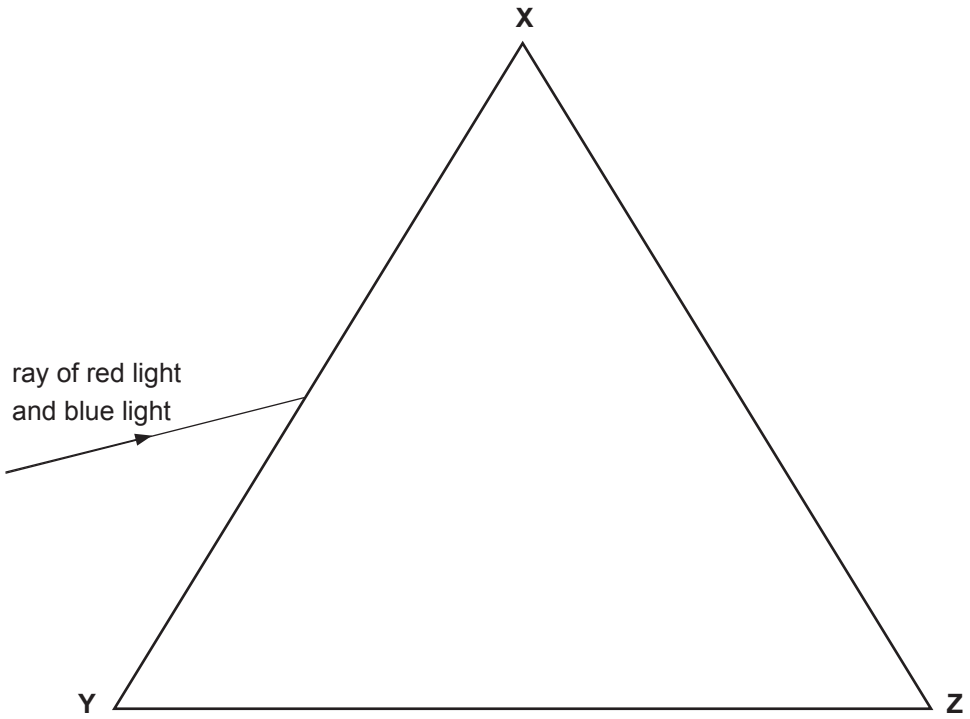
_____

_____

_____ [2]

[Turn over

2 The diagram shows a ray of light incident on a triangular glass prism.
The light is composed of two colours, red and blue.



(a) (i) **With a protractor and a ruler**, draw a normal at the point where the light enters the glass. [1]

(ii) **Carefully** mark on the diagram the angle of incidence of the ray of light.
Label the angle with the letter **i**. [1]

(iii) **Using a ruler**, mark the passage of both colours in the glass, until they both strike the side **XZ**.
Label the red ray in the glass **R** and the blue ray **B**. [2]

(iv) Carefully mark the angle of refraction of the **blue** ray in the glass with the letter **r**. [1]

(v) Choose the sentence below which best explains why the red and blue rays of light behave differently when they enter the glass.
Tick (✓) only the correct sentence.

Red light travels at the same speed as blue light in air but red light travels faster than blue light in glass.	
Red light travels at a faster speed than blue light in both air and glass.	
Red light travels slower than blue light in both air and glass.	
Red light travels at the same speed as blue light in air but travels slower than blue light in glass.	

[1]

(vi) Which colour, if any, has the larger angle of incidence **in the glass** at the side **XZ**?
Tick (✓) only the correct sentence.

Both have the same angle of incidence.	
Red light has the larger angle of incidence.	
Blue light has the larger angle of incidence.	

[1]

(vii) When **white light** enters a glass prism it breaks up into many different colours. When these colours are shown on a screen a spectrum is observed.
List the colours seen in order of **increasing** wavelength.

_____ [2]

(viii) What is this effect called?

_____ [1]

[Turn over

(b) (i) The wavelength of orange light in glass is 4.00×10^{-7} m and its frequency is 5.00×10^{14} Hz.
Calculate the speed of orange light in glass.
Show clearly how you get your answer, starting with the equation you plan to use.

Speed = _____ m/s [3]

(ii) The speed of all colours of light in air is 3.00×10^{8} m/s.
Using your answer to part **(i)**, calculate the change of speed for orange light when it enters glass.
Show clearly how you get your answer.

Change of speed = _____ m/s [2]

(iii) A different colour of light travels in the same glass at a speed of 1.98×10^{8} m/s. Using your answers to parts **(i)** and **(ii)**, will this colour of light be refracted more, less or the same as the orange light?
Circle your response and explain your answer.

refracted more refracted less refracted the same

Explanation _____

_____

_____ [3]

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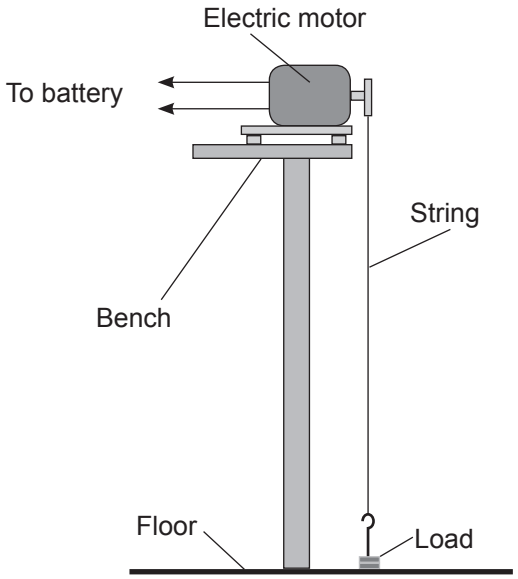
(Questions continue overleaf)

[Turn over

3 (a) The aim of an experiment is to measure the power of a small electric motor. The diagram below shows the apparatus assembled to do this.



Describe in detail how this experiment should be carried out.
In your answer, you should state the following:

- the measurements you would make and the apparatus you would use to make the measurements;
- the measurement which should be repeated and why;
- the calculations needed to determine the power of the motor.

In this question, you will be assessed on your written communication skills including the use of specialist science terms.

Measurements and apparatus _____

_____

_____

_____

_____

_____

Measurement to be repeated and why _____

_____

_____

Calculations _____

_____

_____ [6]

(b) (i) Name and define the unit of power.

_____

_____

_____ [3]

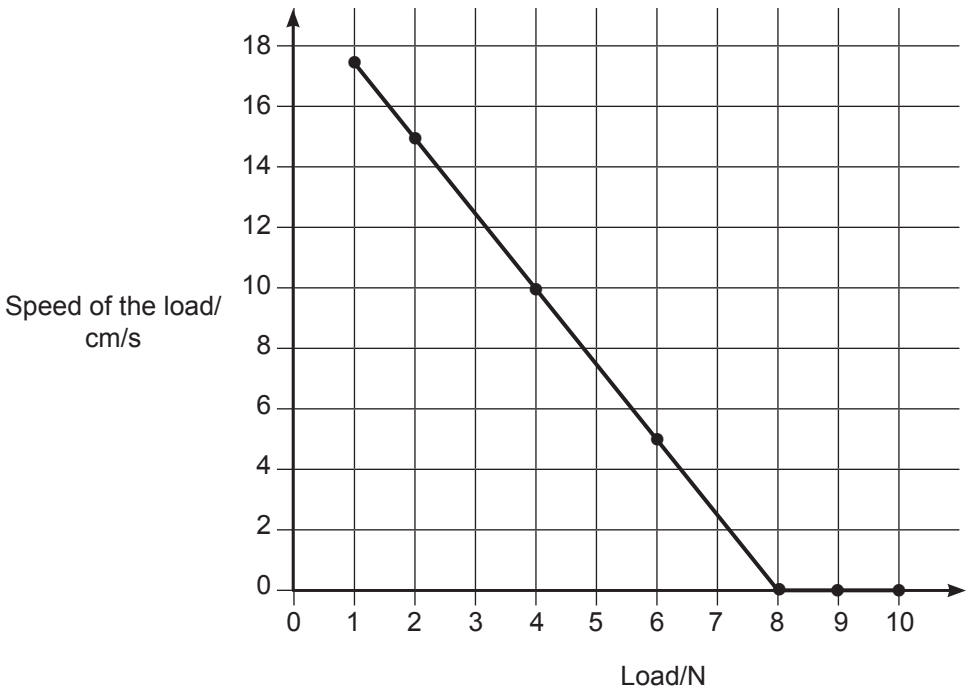
(ii) The load moves upwards at a **constant speed**.
Complete the table to show the energy of the load as it moves upwards from the ground. Place a tick (✓) in the appropriate box.

	Decreases	**Remains constant**	**Increases**
Kinetic energy			
Potential energy			
Total energy			

[3]

[Turn over

(c) In another experiment, the motor was used to lift different loads.
The speed at which the load was lifted was measured for each load.
The results are shown in the graph below.



(i) Describe what the graph tells you about the motor when the load **exceeds** 8 N.

_____

_____ [1]

(ii) For loads up to 8 N the speed of the load and the load are related by the equation below.

$$\text{Speed of load} = 20 - K \times \text{Load}$$

Use the graph to find the value of K.
Show clearly how you get your answer.

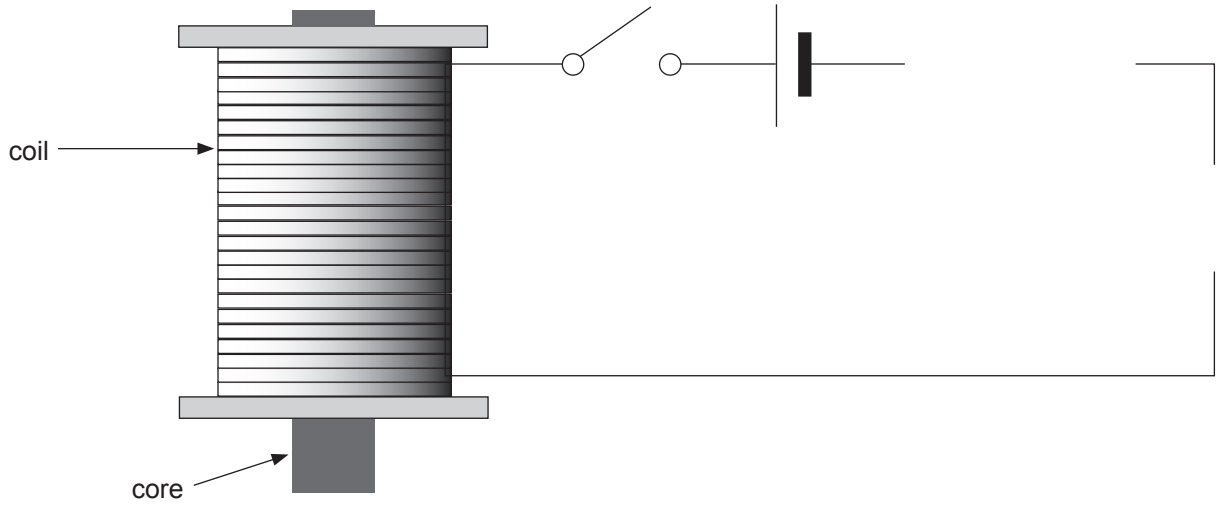
K = _____ [3]

(iii) What is the unit of K?

_____ [1]

[Turn over

4 **(a)** The diagram below shows a coil of wire with a metal core.



When an electric current flows through the coil the metal core becomes an electromagnet.

(i) From what metal should the core be made?

_____ [1]

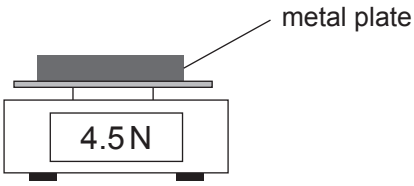
(ii) What additional components are needed to vary the current in the coil and measure it? Write your answers in the boxes below.

To vary the current in the coil	
To measure the current in the coil	

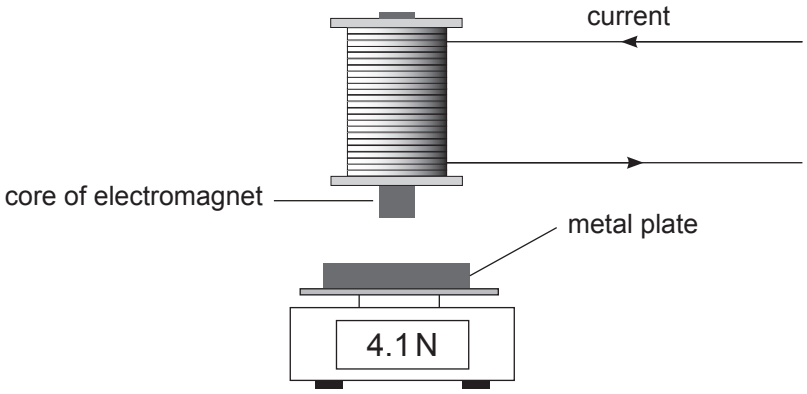
[2]

(iii) Complete the circuit above by adding these additional components in the appropriate spaces. **You must use the correct electrical symbols.** [2]

(b) To measure the strength of the electromagnet a metal plate was placed on an electronic balance as shown in the diagram below.
The electronic balance was adjusted to give force readings in newtons (N).
The weight of the metal plate was 4.5 N as shown in the diagram.



The electromagnet is placed above the metal plate as shown below.
When the electromagnet was energised by passing a current through the coil an upward force was exerted on the metal plate. This reduced the reading on the electronic balance.



An experiment is carried out to investigate how the strength of the electromagnet depends on the current in the coil.

(i) When carrying out this experiment the core and coil of the electromagnet were not changed. Only the size of the electric current was changed.
Looking at the diagram of the apparatus, what other quantity should be kept the same throughout the experiment?

_____

_____ [1]

[Turn over

The results of this experiment are shown in the table below.

Current/A	0	0.5	1.0	1.5	2.0	2.5
Balance reading/N	4.5	4.1	3.7	3.3	2.9	2.5
Upward force on metal plate/N	0					2.0

(ii) Complete the table by calculating the upward force on the metal plate.
Write your answers in the spaces provided. [2]

To test if the upward force on the metal plate was proportional to the current in the coil of the electromagnet, a graph showing the relationship between the two quantities is needed.

(iii) On the grid opposite plot a graph of current on the x-axis and upward force on the y-axis.
Add an appropriate label with units to both axes.
Plot the points using the values from the table above. [6]

(iv) **Using a ruler**, draw the line of best fit through the points. [1]

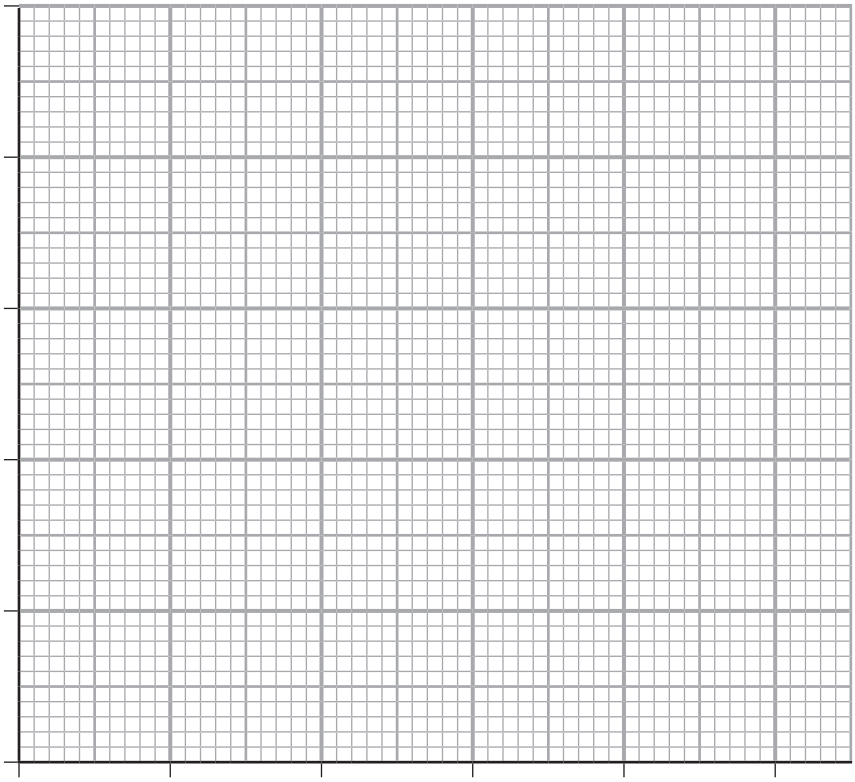
(v) What is the relationship between the upward force on the metal plate and the current in the coil of the electromagnet?

_____

What two features of the graph support this relationship?

1. _____

2. _____ [3]



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For Examiner's use only	
Question Number	**Marks**
1	
2	
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Total Marks	

Examiner Number