Name: _____ ( ) Class: 24 /____

ANDERSON SERANGOON JUNIOR COLLEGE

2024 JC2 Preliminary Examination

PHYSICS Higher 2 9749/04

Paper 4 Practical **Monday 26 August 2024**

2 hours 30 minutes

Candidates answer on the Question Paper.
Additional Materials: As listed on the Confidential Instructions

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READ THESE INSTRUCTIONS FIRST

Write your name, class index number and class in the spaces provided above.
Write in dark blue or black pen on both sides of the paper.
You may use an HB pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, glue or correction fluid.

Answer **all** questions.

Write your answers in the spaces provided on the question paper.
The use of an approved scientific calculator is expected, where appropriate.
You may lose mark if you do not show your working or if you do not use appropriate units.

Give details of the practical shift and laboratory where appropriate in the boxes provided.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

Shift
Laboratory

For Examiner's Use	
Paper 4 (55 marks)	
1	
2	
3	
4	
Total (55 marks)	

This document consists of **16** printed pages and **0** blank page.

For Examiner's Use

1 In this experiment, you will investigate the motion of a sphere launched from a ramp.

(a) Set up the apparatus as shown in Fig. 1.1. Adjust the height of the clamp so that the launch angle ϕ is approximately 15°. **Do not bend the ramp throughout the experiment**.

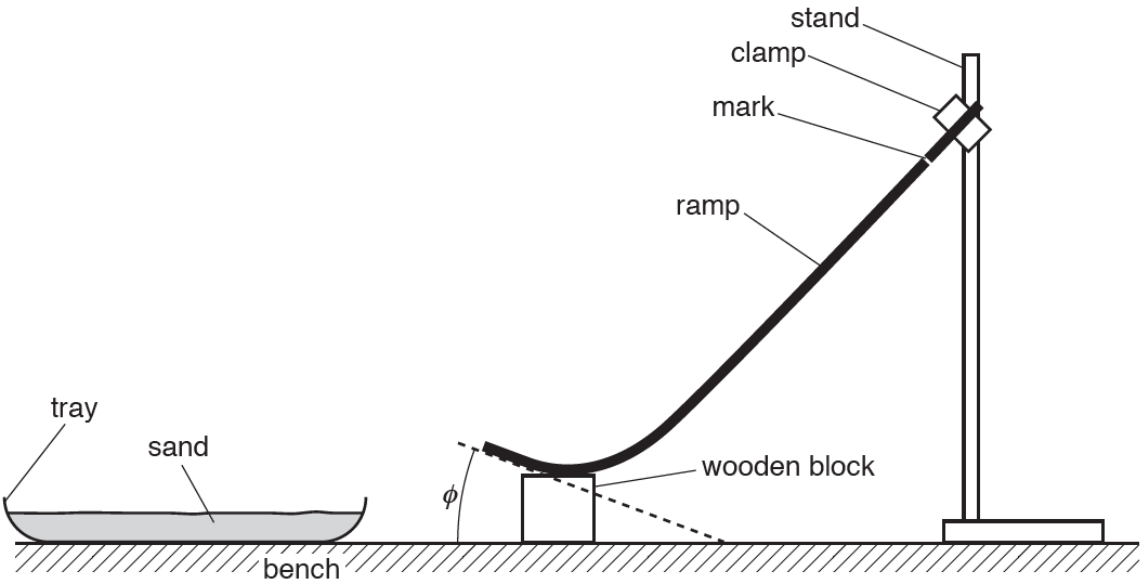

Fig. 1.1 (not to scale)

(b) **(i)** Measure and record ϕ, as shown in Fig. 1.1.

ϕ = ……..…… [1]

M1

(ii) Measure and record the height h_1 of the mark above the bench, as shown in Fig. 1.2.

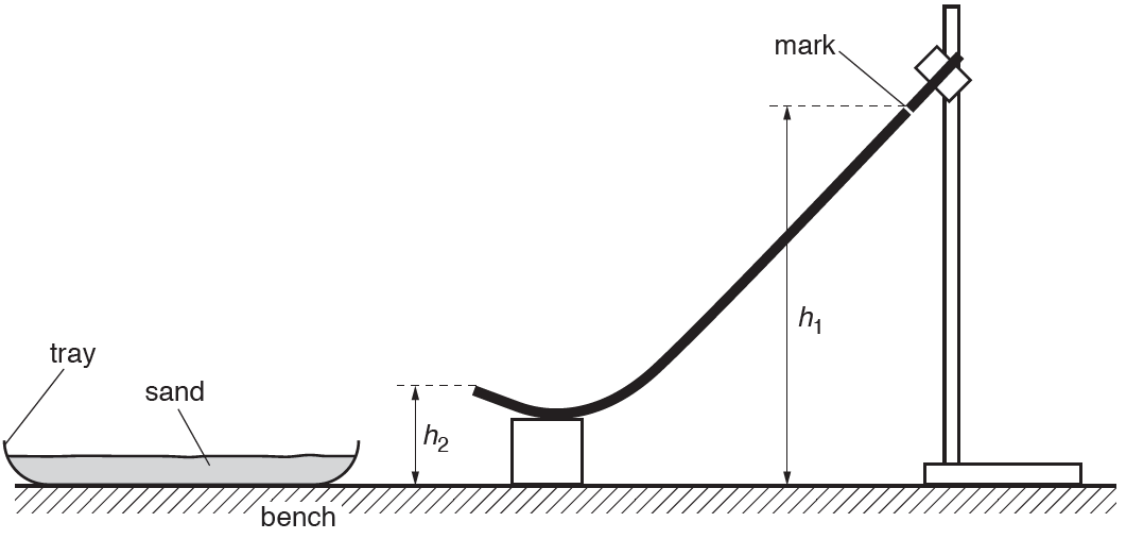

Fig. 1.2 (not to scale)

h_1 = ……..……

(iii) Measure and record the height h_2 of the end of the ramp, as shown in Fig. 1.2.

h_2 = ……..…….…… [1]

For Examiner's Use

M2

(iv) Calculate the speed v of the sphere when it leaves the ramp using the expression

$$v = \sqrt{2g(h_1 - h_2)}$$

where g = 9.81 m s^{-2}.

v = ……..…….…… [1]

A1

(c) Justify the number of significant figures you have given for your value of v.

……..…

……..... [1]

P1

(d) **(i)** Place the sphere on the ramp at the mark. Release the sphere.

(ii) Measure and record the horizontal distance R from the end of the ramp to the landing position of the sphere, as shown in Fig. 1.3.

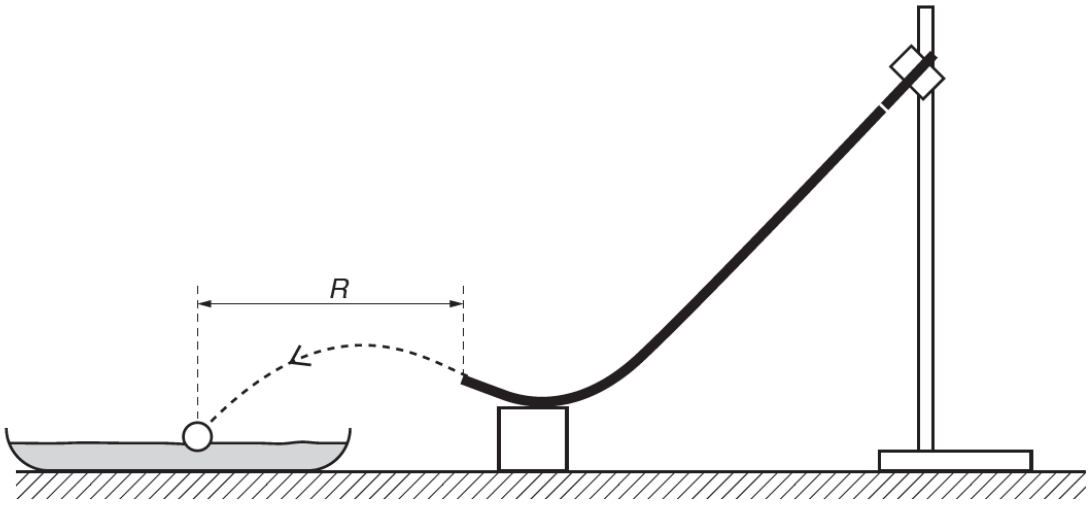

Fig. 1.3 (not to scale)

M3

M4

R = ……..…….. [2]

[Turn Over

(e) Estimate the percentage uncertainty in your value of R.

For Examiner's Use

percentage uncertainty = ... [1] A2

(f) By lowering the clamp, increase the launch angle ϕ to approximately 25°. Repeat **(b)** and **(d)** using the sphere.

ϕ = ……..……..……

h_1 = ...

h_2 = ...

v = ...

M5

M6

R = ...[2]

For Examiner's Use

(g) It is suggested that the relationship between R, v and ϕ is

$$R = k\,v\cos\phi$$

where k is a constant.

(i) Using your data, calculate two values of k.

first value of k = ...

second value of k = ... [1] A3

(ii) State whether your results support the suggested relationship.

Justify your conclusion by referring to your value in **(e)**.

……

……

……..[1] A4

(iii) It is not accurate to draw a conclusion based on only two readings as in **g(ii)**. Suggest a way the method can be changed.

……

……

……..[1] A5

(h) **(i)** State one significant source of error in this experiment.

……

……

……[1]

For Examiner's Use

A6

(ii) Suggest an improvement that could be made to the experiment to address the source of error identified in **(h)(i)**. You may suggest the use of other apparatus or a different procedure.

……

……

……[1]

A7

(i) A student is investigating the motion of a sphere launched horizontally from the ramp with a range of different speeds *v*.

It is suggested that the square of the horizontal distance *R* from the end of the ramp to the landing position of the sphere is directly proportional to *v*.

Plan an investigation on this relationship using the **same apparatus**.

Your account should include your experimental procedure, control of variables, and how you would use your results to test the relationship.

……

……

……

……

……

……

……

……

……

……

……[4]

PL1

PL2

PL3

PL4

[Total: 18]

2 In this experiment, you will investigate the oscillation of a rod.

For Examiner's Use

(a) Assemble the apparatus as shown in Fig. 2.1. Set the distance x between the supporting strings to about 8 cm. Each spring should be vertical and the metal rod should be parallel to the bench.

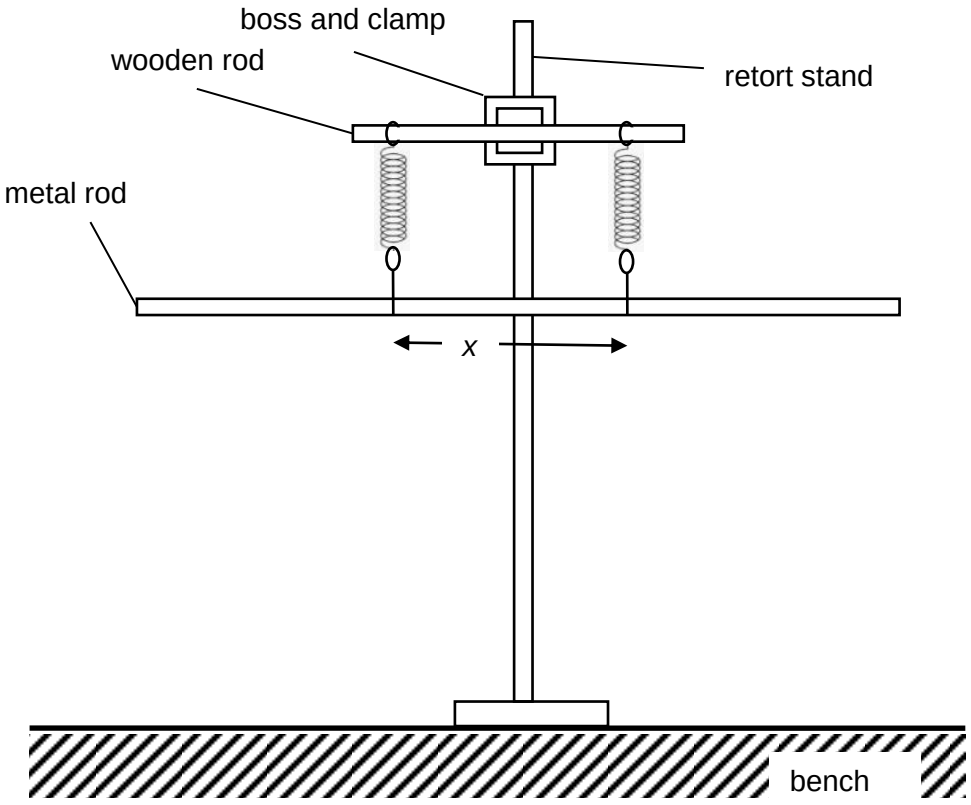

Fig. 2.1

Measure and record x.

x = ... [1]

M1

(b) Lift one end of the metal rod a short distance and push the other end of the metal rod down a short distance. Release the rod so that it oscillates with a rocking motion, as shown in Fig. 2.2.

For Examiner's Use

Fig. 2.2

(c) Take measurements to determine the period T of the oscillation.

T = ... [2]

M2	
A1	

(d) The equation that relates T and x for this oscillator is

$$T = \frac{k}{x}$$

where k is a constant.

Calculate k.

k = ... [2]

A2	
A3	

[Total: 5]

3 In this experiment, you will investigate how the current through a milliammeter varies as the resistance of a resistor is changed.

For Examiner's Use

(a) Set up the circuit as shown in Fig. 3.1.

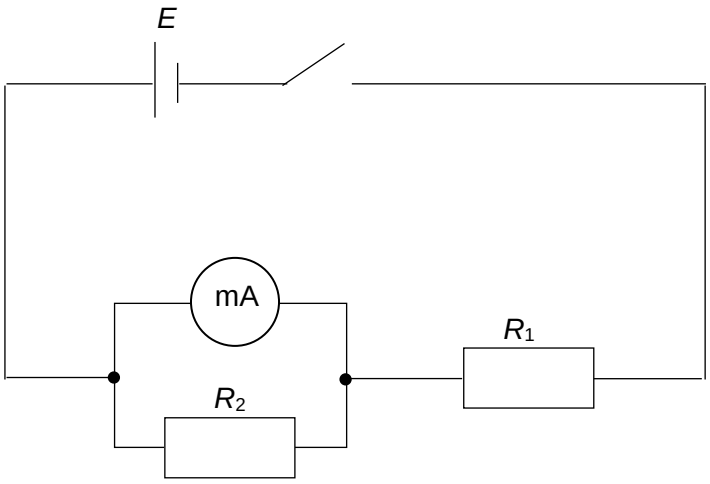

Fig. 3.1

(b) The resistor of resistance R_2 can be made using any combination of the resistors provided. The resistance of each resistor is 100 Ω.

(c) Set the value of R_2 to 100 Ω and close the switch. Record the current I through the digital milliammeter.

I = ……A [1]

M1

(d) Change the value of R_2 and repeat step **(c)** to obtain further sets of values for R_2, and the corresponding values of I.

For Examiner's Use

M2	
M3	
P1	
P2	
P3	
A1	

[7]

(e) It is suggested that I and R_2 are related by the equation,

$$\frac{1}{I} = \frac{k}{R_2} + C$$

where k and C are constants.

Plot a suitable graph to determine values of k and C.

A2	
A3	
A4	
A5	

k = ...

C = ...

[7]

For Examiner's Use

P4	
P5	
P6	

(f) **(i)** Comment on any anomalous data or results you may have obtained. Explain your answer.

For Examiner's Use

…….

……[1] M4

(ii) Measure and record a value of the e.m.f. E of the power supply using the digital voltmeter.

E = ……[1] M5

(g) Theory suggests that $k = \frac{R_1 S}{E}$

where S is the resistance of the digital milliammeter.

Given that R_1 = 470 Ω, together with your answers to **(e)** and **(f)(ii)**, determine a value for S.

A6

S = ……[1]

(h) C is inversely proportional to E.

On the graph grid on page 11, sketch a second graph to represent the results if E is increased. Label this graph Z. A7

[2] A8

[Total: 20]

Question 4 begins on the next page.

4 Springs can be made from metal wires of thickness t, with cross-sectional area A, as shown in Fig. 4.1.

For Examiner's Use

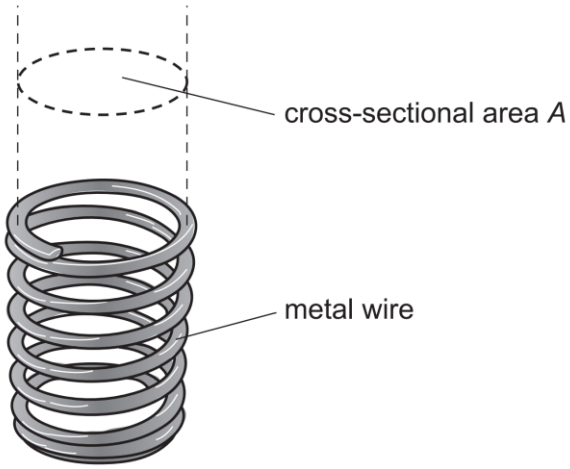

Fig. 4.1

The spring constant k is given by the equation:

$$k = \frac{Ct^P}{A^Q}$$

where C, P and Q are constants.

You are given springs of different A and t.

Design a laboratory experiment to determine the constants P and Q.

Draw a diagram to show the arrangement of your apparatus. You should pay particular attention to:

(a) the equipment you would use
(b) the procedure to be followed
(c) how k would be determined
(d) the control of variables
(e) any precautions that should be taken to improve the accuracy of the experiment.

Diagram

For Examiner's Use

For Examiner's Use

[12]

[Total: 12]