Pearson Edexcel

Additional Assessment Materials

Summer 2021

Pearson Edexcel GCE A Level Physics

Topic 1: Working as a Physicist

Test 1

(Public release version)

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Additional Assessment Materials, Summer 2021

General guidance to Additional Assessment Materials for use in 2021

Context

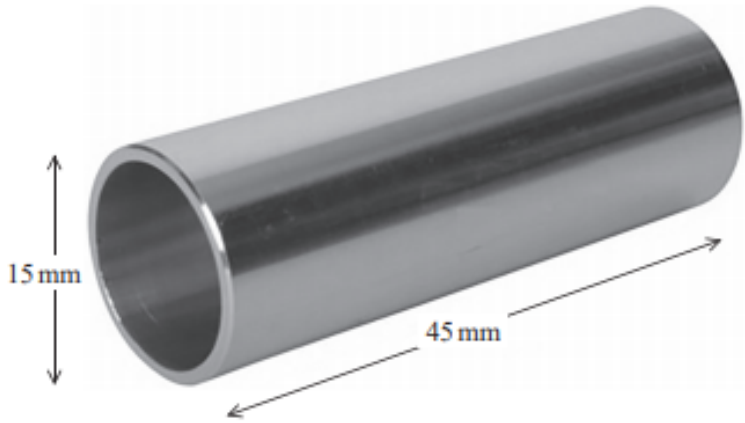
- Additional Assessment Materials are being produced for GCSE, AS and A levels (with the exception of Art and Design).
- The Additional Assessment Materials presented in this booklet are an **optional** part of the range of evidence teachers may use when deciding on a candidate's grade.
- 2021 Additional Assessment Materials have been drawn from previous examination materials, namely past papers.
- Additional Assessment Materials have come from past papers both published (those materials available publicly) and unpublished (those currently under padlock to our centres) presented in a different format to allow teachers to adapt them for use with candidate.

Purpose

- The purpose of this resource to provide qualification-specific sets/groups of questions covering the knowledge, skills and understanding relevant to this Pearson qualification.
- This document should be used in conjunction with the mapping guidance which will map content and/or skills covered within each set of questions.
- These materials are only intended to support the summer 2021 series.

1

1 An engineer was checking the dimensions of a steel tube. The tube had a length of about 45 mm and an external diameter of about 15 mm as shown.



She used a digital micrometer to measure the diameter of the tube. Before taking the reading she closed the jaws of the micrometer to check for a zero error.

(a) State the type of error she avoided by doing this.

(1)

(b) Describe the procedure she should follow to determine an accurate value for the external diameter of the tube.

(3)

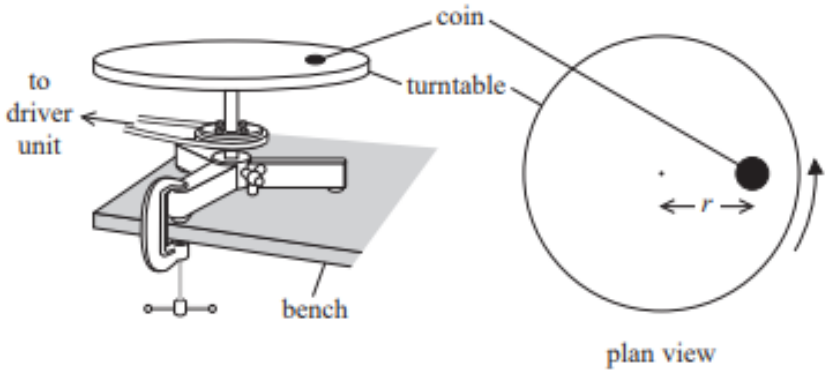
(c) The engineer determined the length of the tube using the micrometer. The reading on the micrometer scale was 45.043 mm. She recorded the reading as 45.0 mm.
State why recording a reading of 45.043 mm could not be justified.

(1)

(Total for Question 1 = 5 marks)

3 A student was investigating the forces involved in circular motion.

He placed a small coin on a horizontal turntable as shown. The turntable was connected to a driver unit so that it could be rotated at a constant rate.



(a) The student measured the distance r between the centre of the turntable and the centre of the coin, with a metre rule as shown.

Explain why the percentage uncertainty in the value of r is about 1%.
Your answer should include a calculation.

(3)

(b) The student switched on the driver unit and increased the rate of rotation until the coin slid off the turntable. He read the angular velocity ω of the turntable from a digital display on the driver unit. He then replaced the coin in the original position on the turntable and repeated the procedure.

His results are shown.

ω / rads^{-1}				
0.125	0.112	0.118	0.123	0.116

(i) The student used the results to calculate a mean value of ω.

State the purpose of calculating a mean.

(1)

(ii) Calculate the percentage uncertainty in the mean value of ω.

(3)

Percentage uncertainty = ...

(iii) The student used ω and r to calculate the centripetal acceleration of the coin at the instant it started to slide.

Calculate the percentage uncertainty in this centripetal acceleration.

(3)

Percentage uncertainty = ...

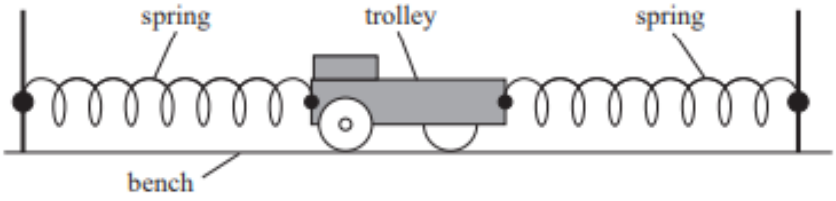
(c) The student repeated the procedure with different values of r.

Explain how the value of ω at which the coin started to slide varied as r increased.

(3)

(Total for Question 3 = 13 marks)

7 A trolley is attached to the ends of two springs as shown. When displaced from its equilibrium position, the trolley moves with simple harmonic motion.



(a) A student has a stopwatch and metre rule available.

(i) Explain the procedure that the student should follow to make an accurate determination of the time period T of the trolley.

(6)

(ii) Describe how the student should use her value of T to determine the maximum speed of the trolley.

(3)

(b) Another student suggests that a more accurate value for T could be obtained by using a position sensor and data logger.

Comment on this suggestion.

(1)

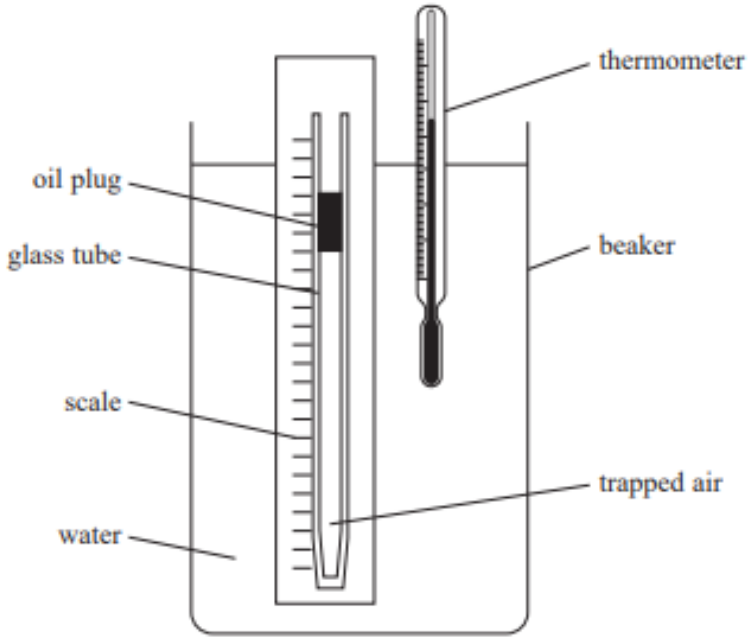
(c) The student displaces the trolley a greater distance from the equilibrium position, so the amplitude of oscillation is doubled. The trolley still moves with simple harmonic motion.

Explain how the maximum kinetic energy of the trolley will change.

(3)

(Total for Question 7 = 13 marks)

11 A student investigated how the volume of a fixed mass of air varies with the temperature of the air. She used the apparatus shown.



A glass tube was sealed at one end. A plug of oil trapped a length l of air in the tube. The water in the beaker was heated to a temperature θ. The corresponding value of l was measured. This was repeated for a range of temperatures.

The thermometer had a resolution of 0.5 °C. The scale had mm divisions.

The student's results are shown in the table.

θ / °C	l / cm
24	8.8
60	9.8
78.5	10.3
95.5	10.9

(a) (i) Criticise the student's results.

(3)

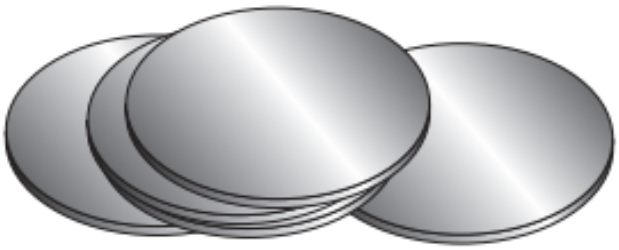
(ii) Explain two possible sources of error in this investigation.

(4)

(iii) Describe two improvements that would increase the accuracy of measurements obtained in this investigation.

(2)

3 A student is investigating the properties of steel. He has fifty steel discs available.



Each disc has a diameter $d \approx 1.3$ cm and a thickness $t \approx 2$ mm.

(a) State a suitable measuring instrument that could be used with a single disc to measure t.

(1)

(b) A balance which can measure mass with a resolution of 0.2 g is available.

Determine the minimum number of discs that should be placed on the balance together if the percentage uncertainty in the measurement of the mass is to be less than 0.5%.

(4)

density of steel = 7900 kg m^{-3}

Minimum number of discs = ...

(c) The measured uncertainty in d is ± 0.1 mm and the measured uncertainty for t is ± 0.05 mm.

Determine the percentage uncertainty in the calculated volume of the disc.

(3)

Percentage uncertainty in volume = ...

(Total for Question 3 = 8 marks)

5 A student is using a simple pendulum to determine a value for the acceleration of free fall g.

(a) She measures the length l of the pendulum four times with a metre rule and records the following values.

l / cm			
l_1	l_2	l_3	l_4
85.5	86.0	87.5	85.5

She calculates the mean length l_m of the pendulum using the following method:

$$l_m = \frac{85.5 + 86.0 + 87.5 + 85.5}{4} = 86.1\,\text{cm}$$

(i) Calculate a more accurate value for l_m.

(2)

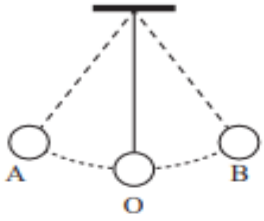
l_m = ...

(ii) Determine the time period of the oscillations of this pendulum, using your calculated value for l_m.

(2)

Time period of oscillations = ...

(b) She sets the pendulum into oscillations with small amplitude and uses a stopwatch to determine the time period.



The student releases the pendulum at A and simultaneously starts the stopwatch. She measures the time taken for 5 oscillations and divides the value by 5. She repeats the procedure twice and calculates a mean time period.

Explain two modifications to the student's method that would improve the value obtained for the time period.

(4)

(Total for Question 5 = 8 marks)

TOTAL FOR PAPER IS 56 MARKS