New Specification

Rewarding Learning

Centre Number

Candidate Number

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2017

Physics

Assessment Unit AS 3B
(Theory)

assessing

Practical Techniques and Data Analysis

[SPH32]

SPH32

THURSDAY 15 JUNE, MORNING

TIME

1 hour.

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 six** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 50.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

1 In devices such as X-ray tubes and CROs electrons need to be accelerated up to high speeds. **Table 1.1** provides data on the kinetic energy acquired by an electron when accelerated through a potential difference.

Table 1.1

Potential difference / V	120	568	1274	1686	2540
Kinetic energy / fJ	1.92×10^{-2}	9.09×10^{-2}	2.04×10^{-1}	2.70×10^{-1}	4.06×10^{-1}

On **Fig. 1.1**, plot a graph of potential difference against kinetic energy and draw the best fit line.

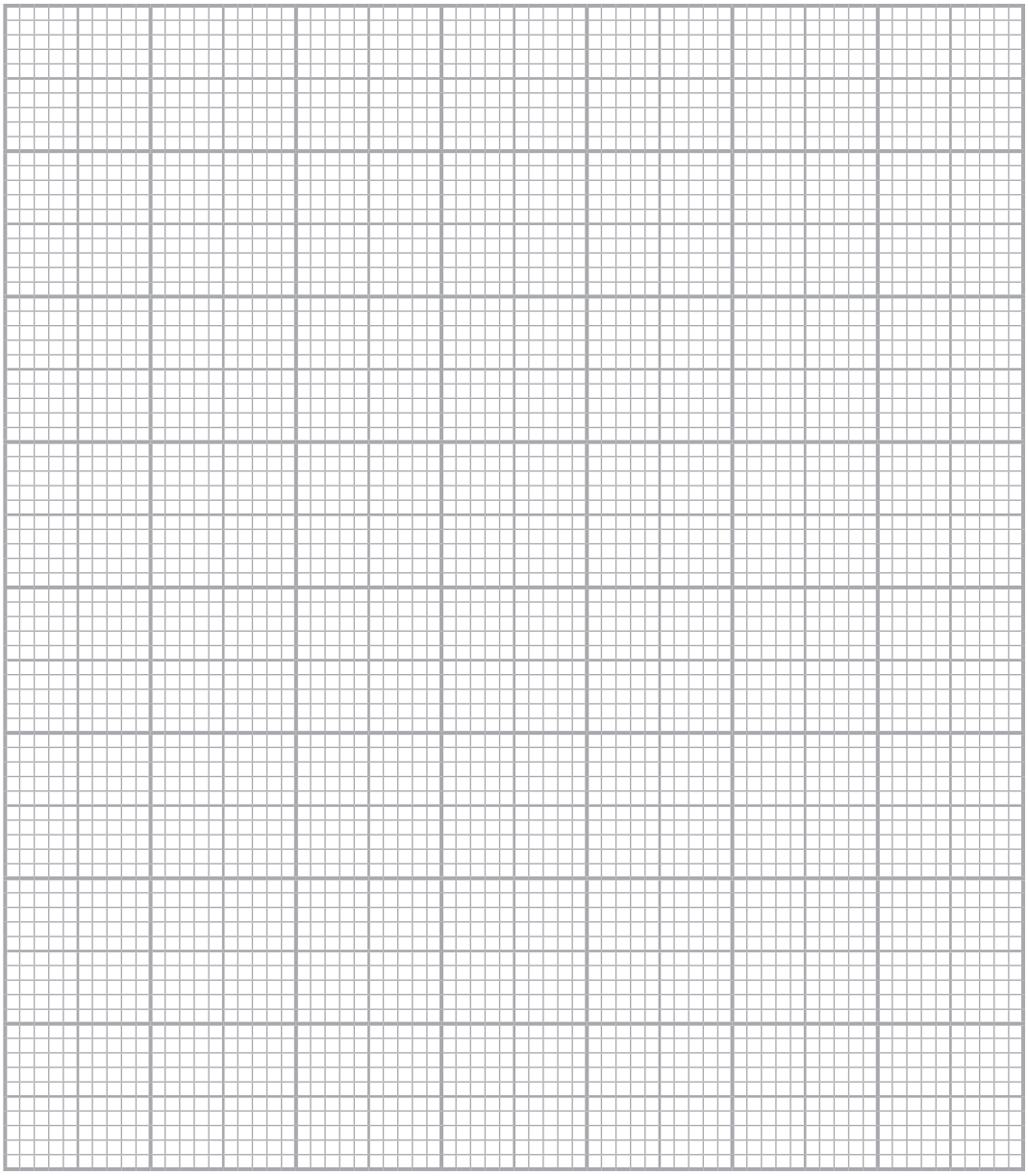

Fig. 1.1

[8]

2 The graph drawn in **Fig. 2.1** shows the relationship between the gas pressure measured in Pa and the temperature of a gas measured in °C.

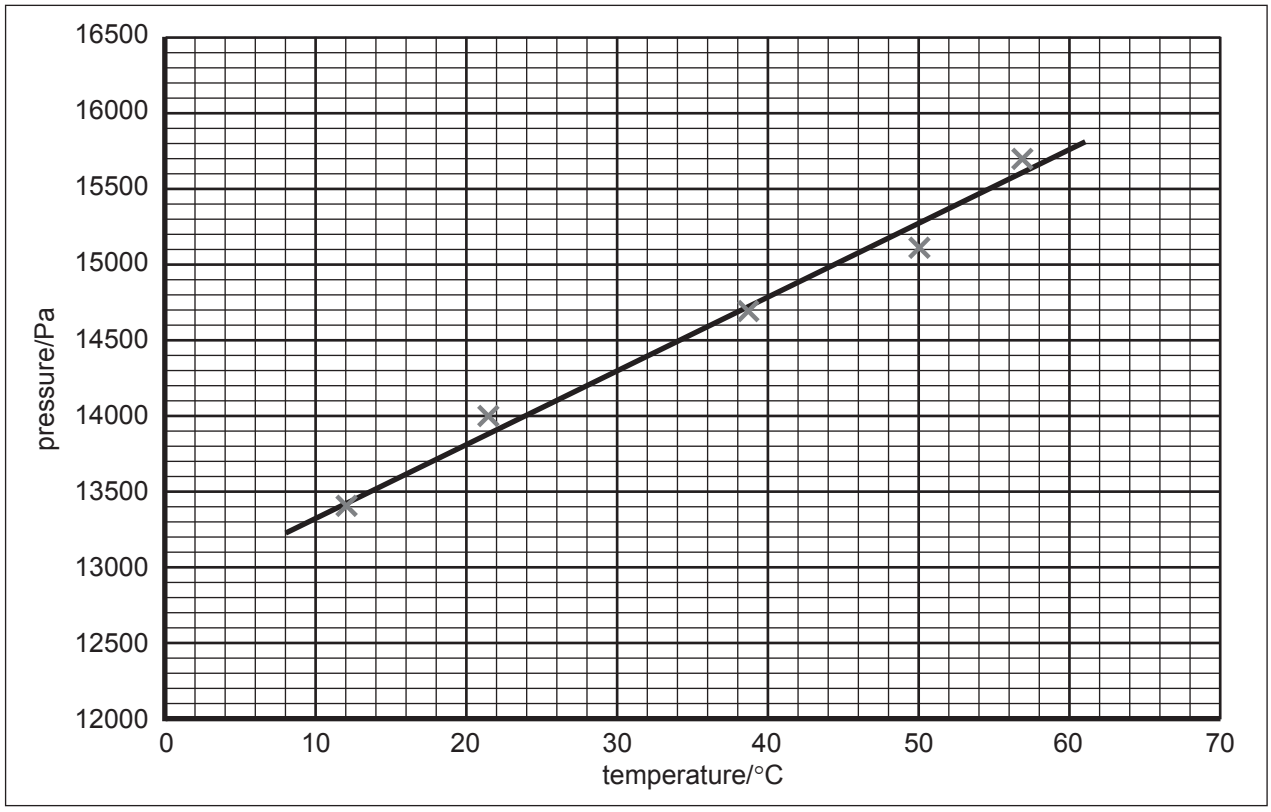

Fig. 2.1

(a) Determine the gradient of the best fit line shown in **Fig. 2.1**.

Gradient = _____ [3]

Unit = _____ [1]

(b) (i) Draw an extreme fit line for the points shown in **Fig. 2.1**. [1]

(ii) Use the extreme fit line to determine the percentage uncertainty in the gradient of the best fit line in **Fig. 2.1**.

Percentage uncertainty = _____ % [3]

[Turn over

3 The graph in **Fig. 3.1** shows how the **square root** of the **electronvolt energy** of a characteristic X-ray photon depends on the atomic number of the element from which it is emitted.

The software package used to produce the graph in **Fig. 3.1** has provided the equation of the best fit (trend) line.

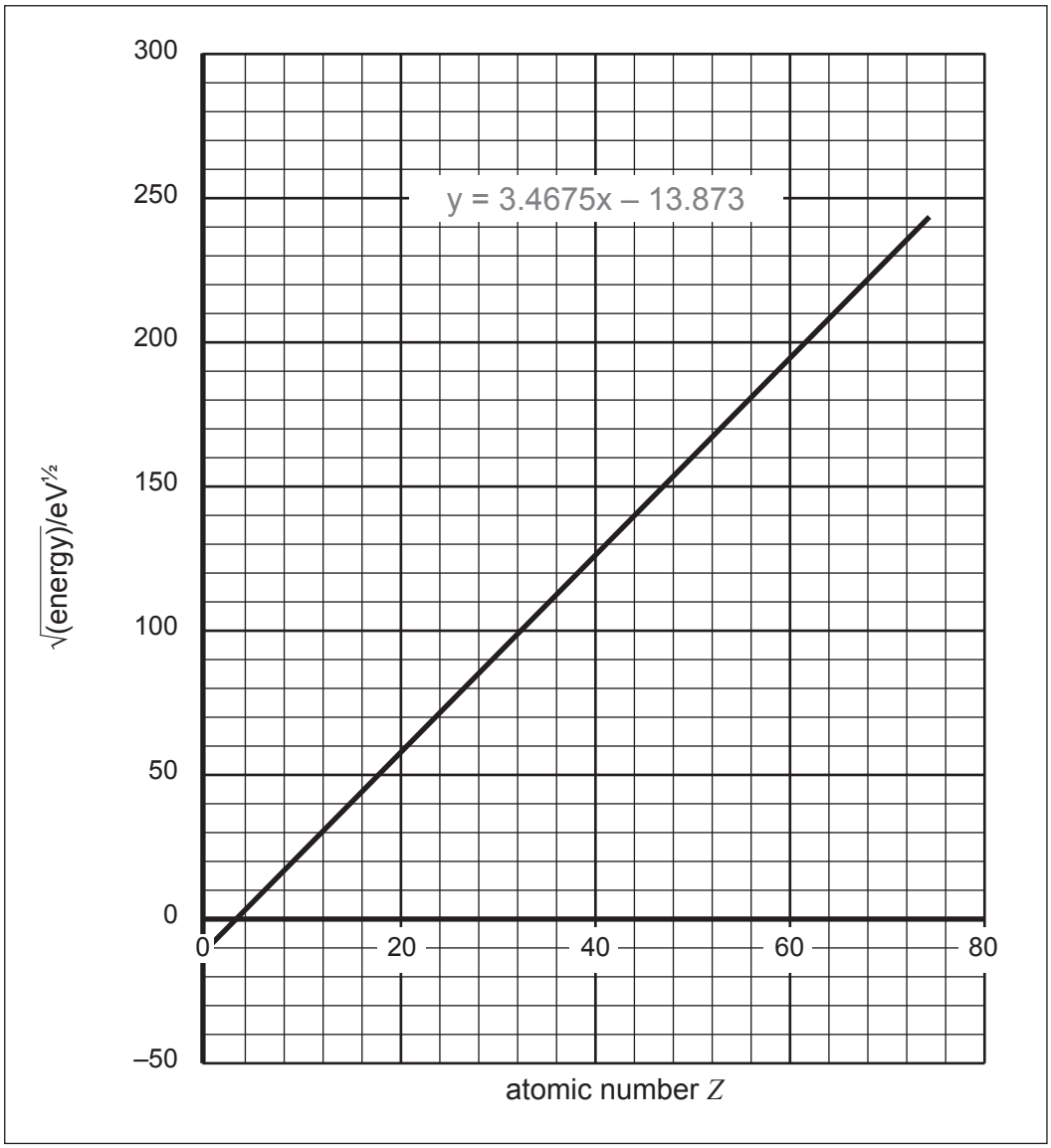

Fig. 3.1

The relationship between the X-ray photon energy E and element atomic number Z is given by **Equation 3.1**

$$E = a(Z - b)^2 \qquad \textbf{Equation 3.1}$$

where a and b are constants.

(a) Determine values for constants a and b.

a = _____

b = _____ [3]

(b) State the units for constants a and b. If there is no unit, state 'NONE'.

Unit of a = _____

Unit of b = _____ [2]

[Turn over

4 **Table 4.1** provides data about the length of a simple pendulum and the periodic time of that pendulum. All lengths were measured using a standard metre rule and all times were measured using a standard stopwatch/clock.

Table 4.1

Length / cm	Time for 20 oscillations / s					Periodic time / s
	t_1	t_2	t_3	t_4	mean	
13.5	14.35	14.89	15.26	14.78	14.82	0.74
35.9	25.05	23.30	24.10	24.04	24.12	
54.2	29.58	25.66	29.20	29.86		
78.3	35.77	35.74	35.68	35.56	35.69	1.78
95	39.07	39.16	39.29	39.26	39.20	1.96

(a) (i) Calculate the periodic time of the pendulum of length 35.9 cm.

Periodic time = _____ s [2]

(ii) Calculate the mean time for 20 oscillations for the pendulum of length 54.2 cm.

Mean time = _____ s [2]

(iii) The pendulum length 95 cm is accurately measured but is recorded incorrectly. Write down how it should be recorded and explain why your suggestion is correct.

_____

_____

_____

_____ [2]

(b) (i) Explain why 20 oscillations were timed.

_____

_____ [2]

(ii) Explain why the timing for 20 oscillations was repeated 4 times.

_____

_____ [2]

[Turn over

5 A potential difference is applied across two resistors in series. **Fig. 5.1** shows the arrangement.

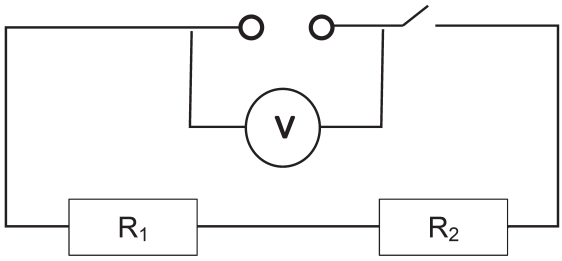

Fig. 5.1

- When the switch is closed the voltmeter records a potential difference of 14.5 V. The voltmeter reading has an uncertainty of ± 0.1 V.
- Resistor R1 has a value of 470 Ω ± 10 %.
- Resistor R2 has a value of 320 Ω ± 5 %.

(a) (i) Calculate the percentage uncertainty in the potential difference.

Percentage uncertainty = ± _____ % [2]

(ii) Calculate the percentage uncertainty in the total external resistance of the circuit.

Percentage uncertainty = ± _____ % [3]

(b) When the switch is closed, use $P = \frac{V^2}{R}$ to determine the absolute uncertainty in the power dissipated in the external circuit.

Absolute uncertainty = ± _____ W [4]

6 A student is verifying that the acceleration experienced by an object of constant mass is proportional to the resultant force acting on the object. **Fig. 6.1** illustrates the experimental arrangement used by the student.

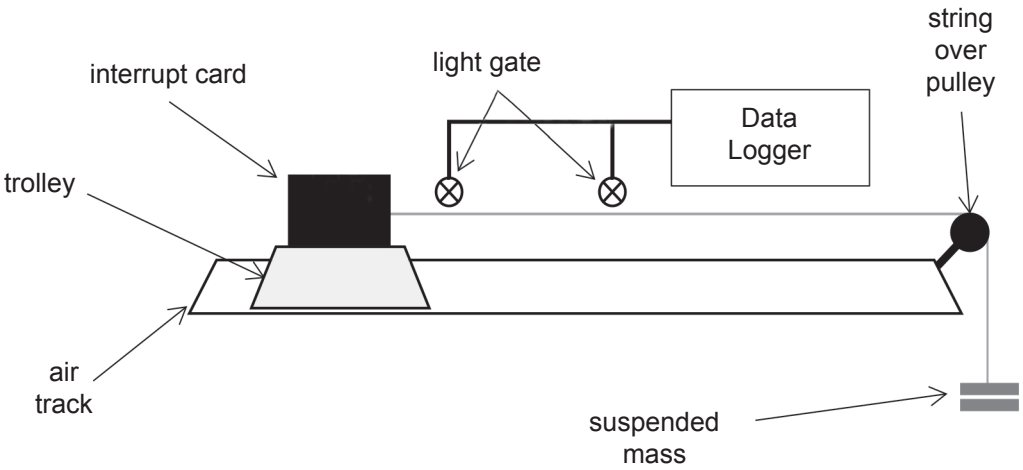

Fig. 6.1

(a) State any data that has to be input to the Data Logger so that the acceleration of the trolley can be determined.

_____

_____ [1]

(b) Explain, fully, how the apparatus shown in **Fig. 6.1** facilitates the determination of an accurate value for the resultant force.

_____

_____

_____

_____

_____

_____ [3]

[Turn over

(c) The force is increased by adding further slotted masses to those suspended above the ground. Explain why this is a problem and outline a procedure for overcoming this problem.

[3]

(d) Where would you position the light gates if you were performing the experiment using a 2 m long air track sitting on a bench 0.76 m high? Explain your answer.

[3]

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

Examiner Number