



VCE PHYSICS UNITS 3&4 [2020]

Unit 4 AOS 3 - Practical investigation - Topic Exam 2

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STRUCTURE OF EXAM

Section A - Short Answer

8 questions

47 marks

47 marks

WHEN YOU FINISH

Get your marks, and view solution videos that explain the answer to each question at:

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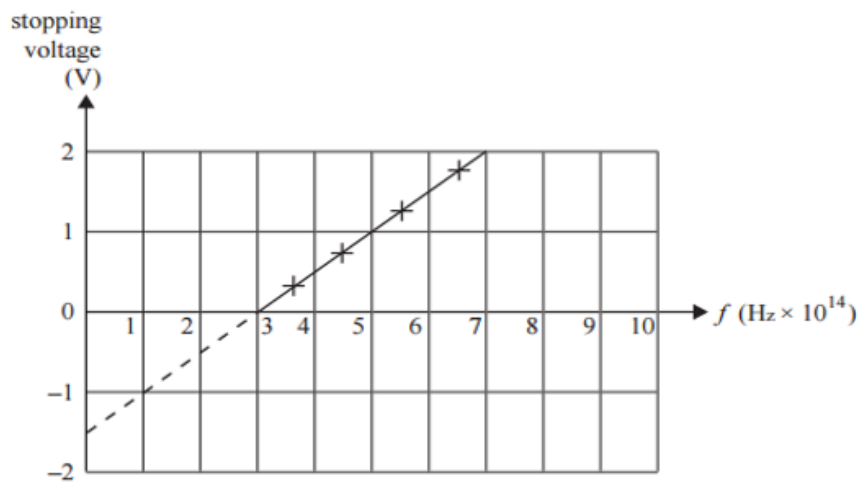
SECTION A – SHORT ANSWER**Question 1**

3 marks

Two students have studied the photoelectric effect and the graph in Figure 4 shows the results of their experiment, specifically how the stopping voltage varies as a function of the frequency.

From the data on the graph (Figure 4), determine the values Kristy and Adrian would obtain for Planck's constant, h .

Show your working and provide a correct unit for your answer.

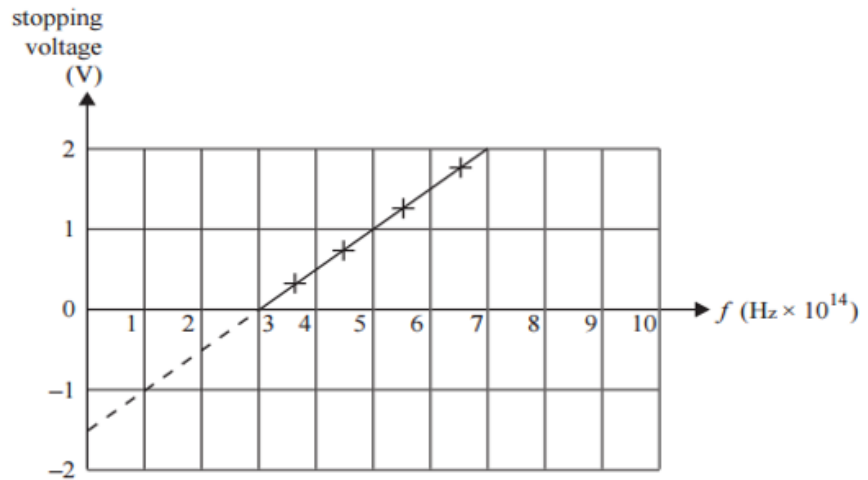
**Figure 4**

Question 2

2 marks

Two students have studied the photoelectric effect and know that the energy of a photon is proportional to its frequency. Also, that the stopping voltage is proportional to the maximum kinetic energy of the photoelectron. The graph in Figure 4 shows the stopping voltage as a function of the frequency.

From the data on the graph (Figure 4), determine the values Kristy and Adrian would obtain for the work function of the metal.

**Figure 4**

Provide a correct unit for your answer.

Question 3 (3 marks)

With the filter for a particular frequency ($8.0 \times 10^{14} \text{ Hz}$), Kristy and Adrian now double the intensity of the light from the light source.

Question 3.a

1 mark

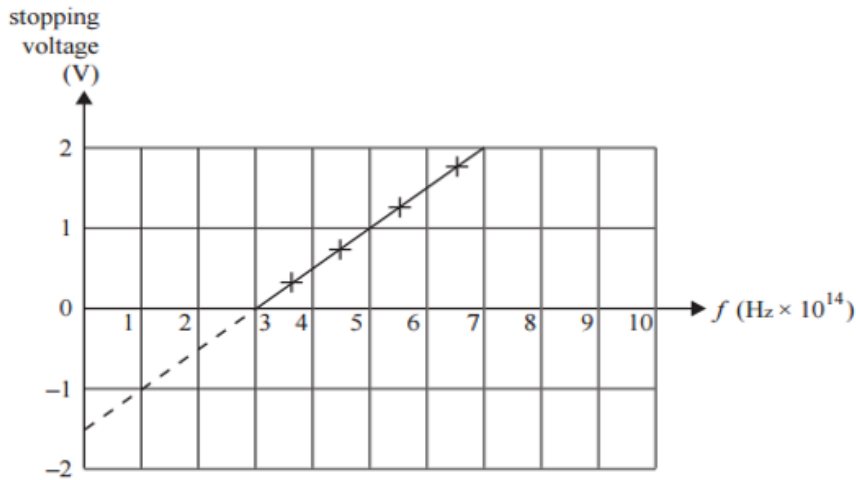
State what effect this will have on the maximum kinetic energy of the emitted electrons.

Question 3.b

2 marks

Kirsty and Adrian run this experiment using two different filters. The first allows light of frequency 5×10^{14} Hz to pass through and the second allows a frequency of 7×10^{14} Hz to pass through.

From the data in the graph, what can you conclude about the energy of the photoelectrons released.

**Figure 4****Question 4** (14 marks)

In an experiment investigating the function of transformers, data was collected for Primary (V_{in}) and secondary (V_{out}) voltages for a particular transformer when a range of voltages were applied to the primary coil. When performing this experiment the currents used were relatively small. This data is provided in the table below.

$V_{in}(V)$ $V_{out}(V)$

240.4 30

212.5 27

178.2 22

156.8 20

143.2 18

121.0 15

98.5 12

67.7 8

43.9 5

Question 4.a

4 marks

Plot a graph of V_{in} vs V_{out} and draw a line of best fit for your data.

Question 4.b

2 marks

Use your graph to estimate the turns ratio of this transformer.

Question 4.c

1 mark

State whether this is a step up or step down transformer.

Question 4.d

2 marks

Looking at the recorded data, are the values for V_{in} or V_{out} recorded more precisely? Explain your answer.

Question 4.e

2 marks

Identify the independent and dependent variables in this experiment.

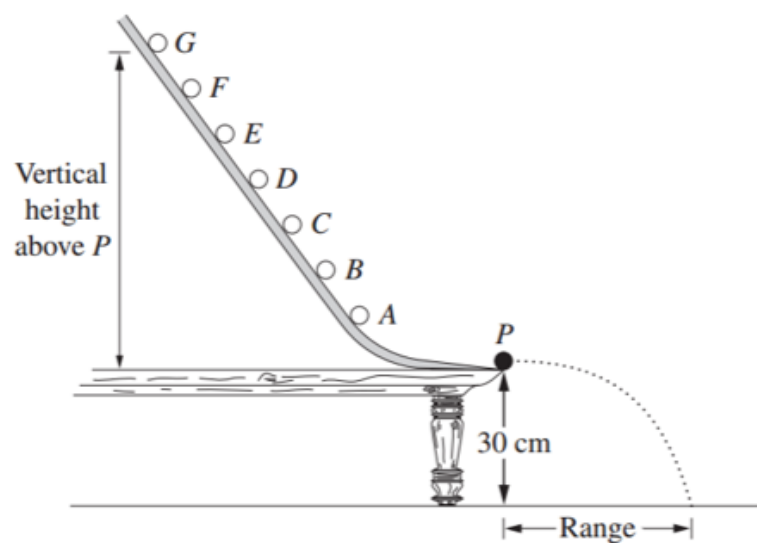
Question 4.f

3 marks

One of the experimenters completed further experiments with higher currents. She found that the efficiency of the transformer changed when greater currents were involved. Explain why this observation may have occurred.

Question 5 (7 marks)

A group of students conducted an investigation in which ball bearings were released from various points on a ramp. The ball bearings rolled down the ramp to the edge of a table at point P as shown. Their ranges were measured.



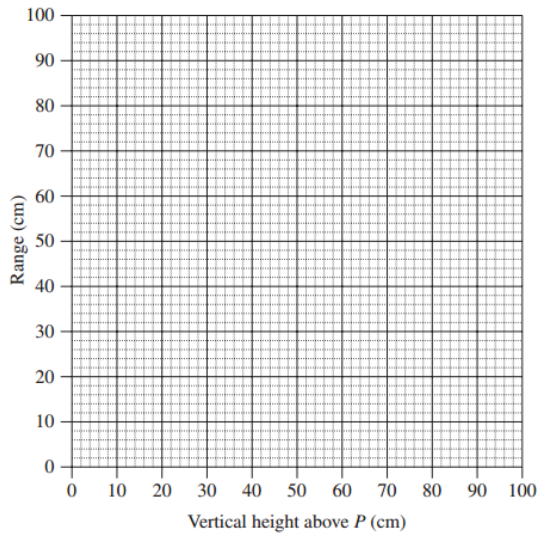
The results are shown in the table.

Point of release	Vertical height above P (cm)	Range (cm)
A	10	32
B	20	44
C	30	58
D	40	50
E	50	76
F	60	82
G	70	87

Question 5.a

2 marks

Plot the data from the table and draw a line of best fit.

**Question 5.b**

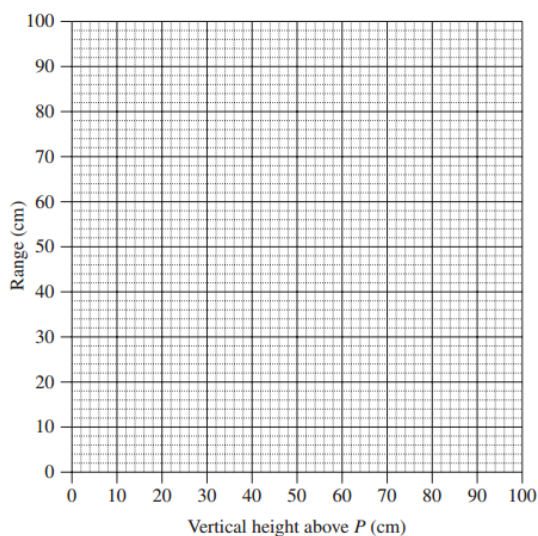
1 mark

Using your graph, predict the range of a ball bearing released from a height of 80 cm above point P.

Question 5.c

2 marks

The distances were recorded to the nearest 2 cm for both height and range. Add bars to the data point corresponding to a release height of 40 cm to represent this uncertainty.



Question 5.d

2 marks

Recalling that the distances were recorded to the nearest 2cm for both height and range, calculate the percentage uncertainty of the range measurement for the vertical height of release of 70cm.

Question 6

3 marks

Two students are discussing their understanding of errors and uncertainty and how best to manage these in their investigation of the time taken for a pendulum to swing through 10 oscillations. Cameron states that if they include repeated measurements of the time for this to happen and take an average they will reduce the systematic errors in their experiment. Eloise disagrees, saying that by repeating measurements they will reduce the random uncertainties in their measurements and not the systematic errors.

State and explain whether one, both or neither of these students are correct.

Question 7 (9 marks)

A rectangular coil is inserted into an uniform field of unknown strength at a constant velocity of 0.2 ms^{-1} . The coil have dimensions of 60 cm by 60 cm and is inserted into a field running perpendicularly to the coil.

The flux within the coils was recorded against time by a data logger and is presented below. The coil was initially outside the field when the time was started, with the leading edge 20 cm from the start of the field.

Time (s)	Flux (Wb)
0	0.0
1	0.0
2	9.0×10^{-4}
3	1.8×10^{-3}
4	2.7×10^{-3}
5	2.7×10^{-3}
6	2.7×10^{-3}
7	1.8×10^{-3}
8	9.0×10^{-4}
9	0.0
10	0.0

Question 7.a

4 marks

Plot flux against time for this data on graph paper, ensuring that axes are appropriately labelled and a trend line is added if required.

Question 7.b

2 marks

Use the data collected to calculate the strength of the uniform magnetic field.

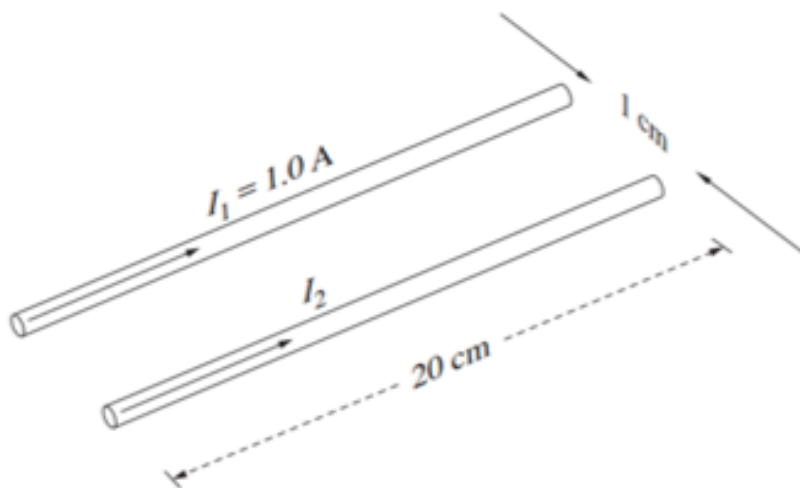
Question 7.c

3 marks

Plot a second graph to show how the voltage varies with time for this experiment.

Question 8 (6 marks)

The diagram shows part of an experiment designed to measure the force between two parallel current-carrying conductors.



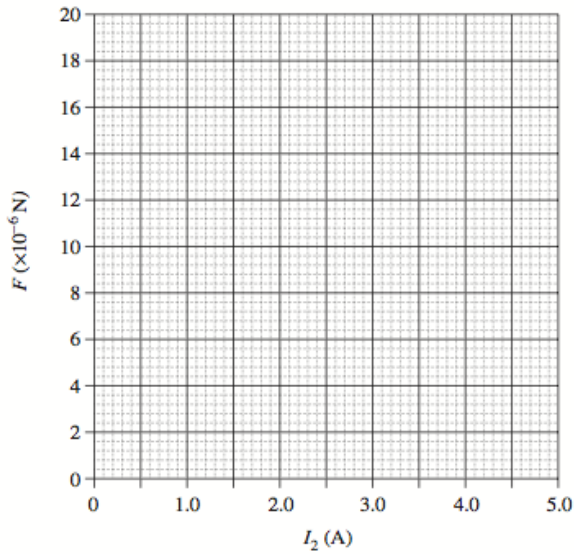
The experimental results are tabulated below.

$I_2 (\text{A})$	Force ($\times 10^{-6} \text{ N}$)
0	0
2.0	7
3.0	11
4.0	14
5.0	18

Question 8.a

3 marks

Plot the data and draw the line of best fit.

**Question 8.b**

2 marks

Calculate the gradient of the line of best fit from the graph.

Question 8.c

1 mark

State a possible unit for the gradient value.