



VCE PHYSICS UNITS 3&4 [2020]

Unit 4 AOS 3 - Practical investigation - Topic Exam 1

YOUR NAME: Vishnu Prasad Sivakumar

STRUCTURE OF EXAM

Section A - Short Answer

7 questions

46 marks

46 marks

WHEN YOU FINISH

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

edrolo.com.au/e2818

SECTION A – SHORT ANSWER

Question 1 (5 marks)

Students set up the apparatus shown in Figure 2 to study the photoelectric effect.

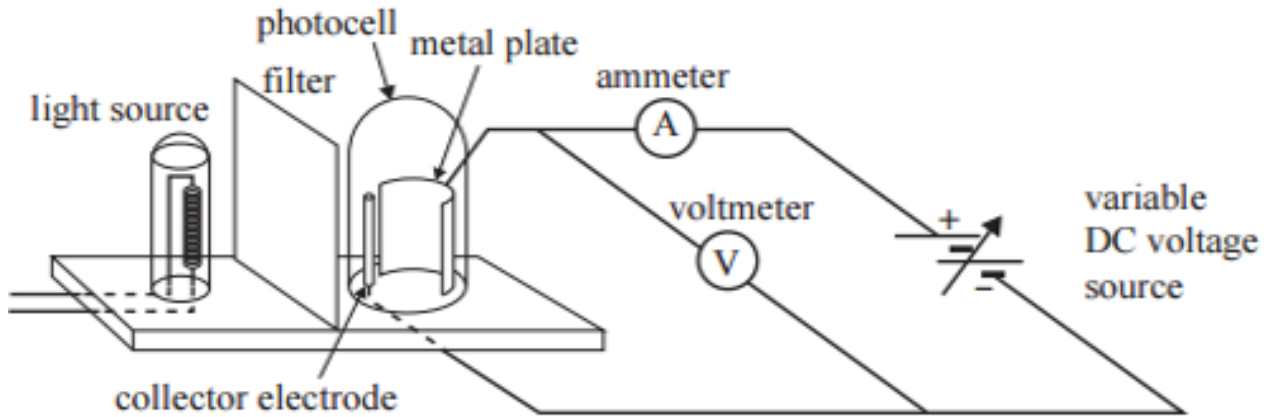


Figure 2

The apparatus consists of

- a source of white light
- a set of filters that only allow light of selected wavelengths to pass through
- a metal plate and a collector electrode enclosed in an evacuated (no air) glass case.
- a voltmeter (V), ammeter (A) and variable DC voltage source in a circuit, as shown in Figure 2.

With a particular filter in place, the students gradually increase the voltage as measured by the voltmeter, V, from zero.

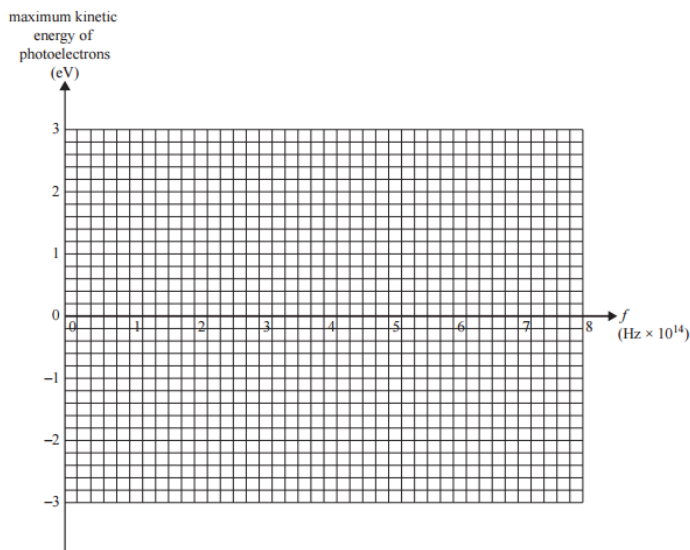
The students now use five different filters to give five frequencies of light falling on the plate, and measure the stopping voltage on the voltmeter for each frequency. Their data is shown below.

Frequency (Hz)	Stopping voltage(Vs)
4.5×10^{14}	1.3
5.0×10^{14}	1.5
6.1×10^{14}	2.0
6.9×10^{14}	2.5
7.6×10^{14}	2.8

Question 1.a

3 marks

From this data, plot these points on the axes below and hence draw a line of best fit to show the maximum kinetic energy of the emitted electrons versus frequency falling on the metal plate.

**Question 1.b**

2 marks

From your graph, what value of h , Planck's constant (in eV s), would the students have obtained? Show your working.

Question 2

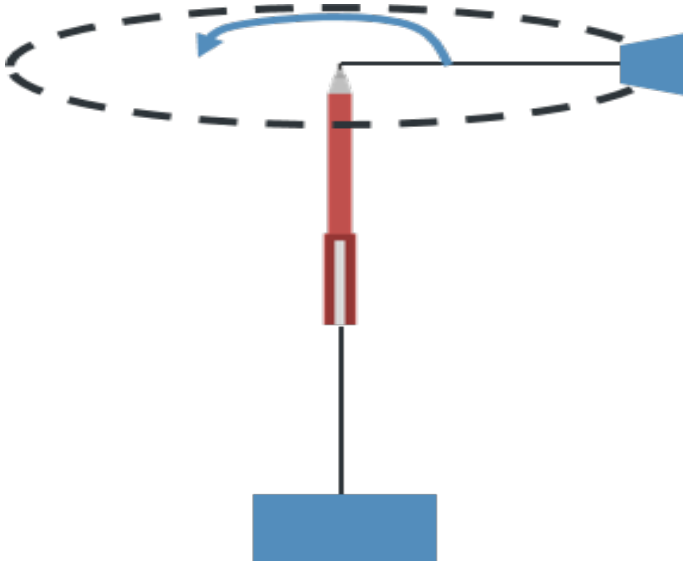
2 marks

What is an appropriate number of significant figures that your value of Planck's constant should be quoted to? Justify your answer

Question 3 (15 marks)

The data in the table was measured by a group of VCE Physics students as part of their investigation into circular motion. The students theorised that there should be a relationship between the tension in the string and the speed of the object squared. Plot tension vs speed² on graph paper and ensure that you include a suitable line of best fit.

The rotating object had a mass of 150 g and the radius of rotation was 25 cm.



Time for 50 rotations (s) **Time (s)** **Radius (m)** **Speed (m/s)** **speed squared (m^2/s^2)** **Tension (N)**

12	0.24	0.25	9	43	28.0
16	0.32	0.25	7	24	15.0
22	0.44	0.25	5	13	8.0
26	0.52	0.25	4	9	6.0
31	0.62	0.25	4	7	5.0
48	0.74	0.25	2	4	3.0
50	1.00	0.25	2	3	2.0
67	1.34	0.25	2	2	1.0

Question 3.a

4 marks

Plot tension (y -axis) vs speed² (x -axis) on graph paper and ensure that you include a suitable line of best fit.

Question 3.b

2 marks

Calculate the gradient of this line and include sufficient working.

Question 3.c

2 marks

The device used to measure the tension was marked in increments of 2 Newtons. The confidence in the measurement of tension was deemed to be to the nearest 2 Newtons. Add bars to your graph to represent the uncertainty in the measurement of the tension.

Question 3.d

3 marks

Find the uncertainty in the gradient measurement from this data.

Question 3.e

3 marks

The students have researched the fact that $F_{Net} = mv^2/r$ for circular motion. Knowing this, calculate what the gradient of the graph be? Your answer should be provided with a correct unit.

Recall, The rotating object had a mass of 150 g and the radius of rotation was 25 cm

Question 3.f

1 mark

Reflecting on this activity, suggest one way to increase the precision of the data collected.

Question 4

4 marks

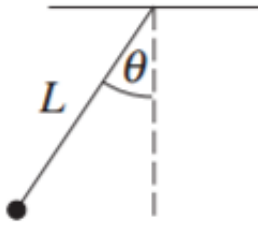
A group of students have sourced some data collected from an experiment which investigated the behaviour of charged particles moving in a uniform magnetic field. In the experiment electrons were fired horizontally into a vertical magnetic field and the electrons was observed to move in a circular path.

They intend to calculate the strength of the magnetic field by using measurements made of the electrons' motion. Take the mass of the electron to be $9.1 \times 10^{-31} \text{ kg}$ and the charge on an electron to be $-1.6 \times 10^{-19} \text{ C}$.

State what measurements they require and how these could be used to calculate the magnetic field strength.

Question 5 (8 marks)

Two students, Kim and Ali, performed an experiment to determine the acceleration due to gravity (g) using a simple pendulum consisting of a small mass hanging from a light string.



Their procedure was as follows:

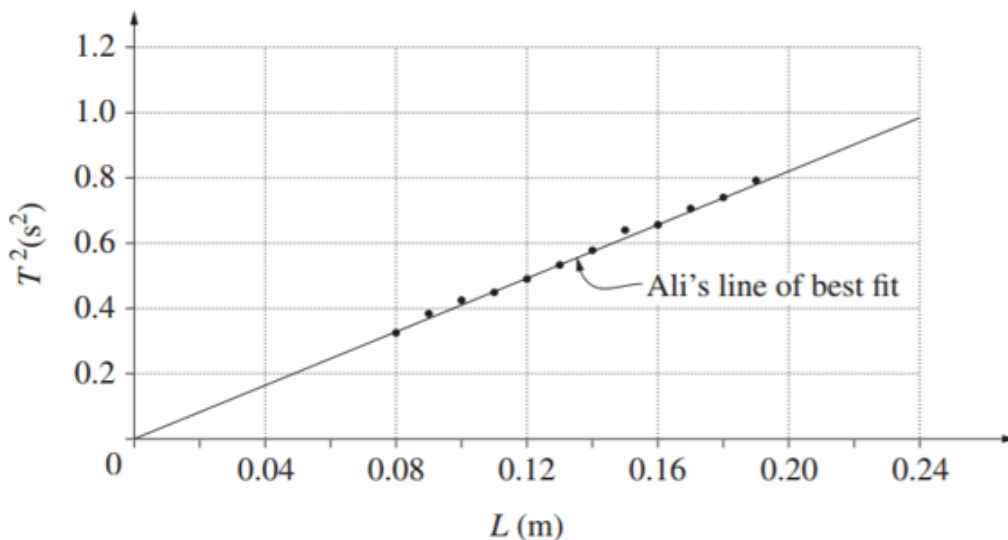
1. Adjust the length of the string (L) to measure 0.08m .
2. Hold the mass to the side to give a small angular displacement, θ .
3. Release the mass and measure the time for one period (T).
4. Record the result in a table.
5. Repeat using a string length (L) of 0.09m and continue until the string length is 0.19m (going up in 0.01m increments, using the same initial angular displacement each time).

6. Calculate g using the relationship $T = 2\pi\sqrt{\frac{L}{g}}$

The results are shown in the table:

$L(\text{m})$	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.16	0.17	0.18	0.19
$T(\text{s})$	0.57	0.62	0.65	0.67	0.70	0.73	0.76	0.80	0.81	0.84	0.86	0.89

Kim used the data in the table to obtain a mean value for g . Kim's result was $g = 9.3\text{ms}^{-2}$. Ali used the results to produce the following graph. Ali's line of best fit was used to calculate g .



Question 5.a

2 marks

Outline TWO changes that could be made to the experimental procedure that would improve its accuracy.

Question 5.b

3 marks

Compare Kim's and Ali's methods of calculating g and identify the better approach.

Question 5.c

3 marks

Calculate the value of g from the line of best fit on Ali's graph.

Question 6 (10 marks)

Students are running short of time when recording data as part of an investigation. They are required to find the resistance of an unknown device using an ammeter and a voltmeter. They choose to take 3 readings using 3 different voltages, calculate the corresponding resistances for each trial and find the average of this value.

Question 6.a

2 marks

Trial	Voltage (V)	% Uncertainty	Current (A)	% Uncertainty	Resistance (Ω)	% Uncertainty
1	2.8		0.45			
2	4.6		0.64			
3	5.4		0.72			

Calculate the corresponding values for the resistance and add these to the table above. You should provide these values to an appropriate number of significant figures.

Question 6.b

3 marks

Trial	Voltage (V)	% Uncertainty	Current (A)	% Uncertainty	Resistance (Ω)	% Uncertainty
1	2.8	1.8	0.45	1.1	6.2	2.9(3.2)
2	4.6		0.64			
3	5.4		0.72			

The precision of the ammeter and voltmeter was limited and the values recorded were only confident to the nearest 0.1 Volt and 0.01 Ampere. Use this information to state the % uncertainty for all three quantities for Trial 1 .

Question 6.c

3 marks

Trial	Voltage%	Current%	Resistance%
	(V) Uncertainty(A)	Uncertainty(Ω)	Uncertainty
1	2.8	0.45	
2	4.6	0.64	
3	5.4	0.72	

There was an observed trend in the value of the calculated resistance. State this trend, suggest a reason for this and propose an improvement to the method to control this.

Question 6.d

2 marks

Trial	Voltage%	Current%	Resistance%
	(V) Uncertainty(A)	Uncertainty(Ω)	Uncertainty
1	2.8	0.45	
2	4.6	0.64	
3	5.4	0.72	

Suggest a better way to use the collected data to obtain a more accurate value for the resistance.

Question 7

2 marks

A Year 7 student, Eloise, is measuring the height of sunflowers that have been growing under different conditions as part of her experiment. She uses a ruler that is marked in cm intervals. Her friend Carmel suggests that she use a different ruler that is marked in mm as this will give a more accurate reading for her measurements of height.

Is Carmel's advice correct? Justify your response.
