OCR
RECOGNISING ACHIEVEMENT

Wednesday 5 June 2013 – Morning

AS GCE PHYSICS B (ADVANCING PHYSICS)

G492/01 Understanding Processes/Experimentation and Data Handling

ADVANCE NOTICE **questions**

These questions should be attempted after reading the advance notice article.

Simple measurements using a temperature sensor

The data displayed in Fig. 1 shows the variation of p.d. V with celsius temperature θ obtained using two different temperature sensors **A** and **B**.

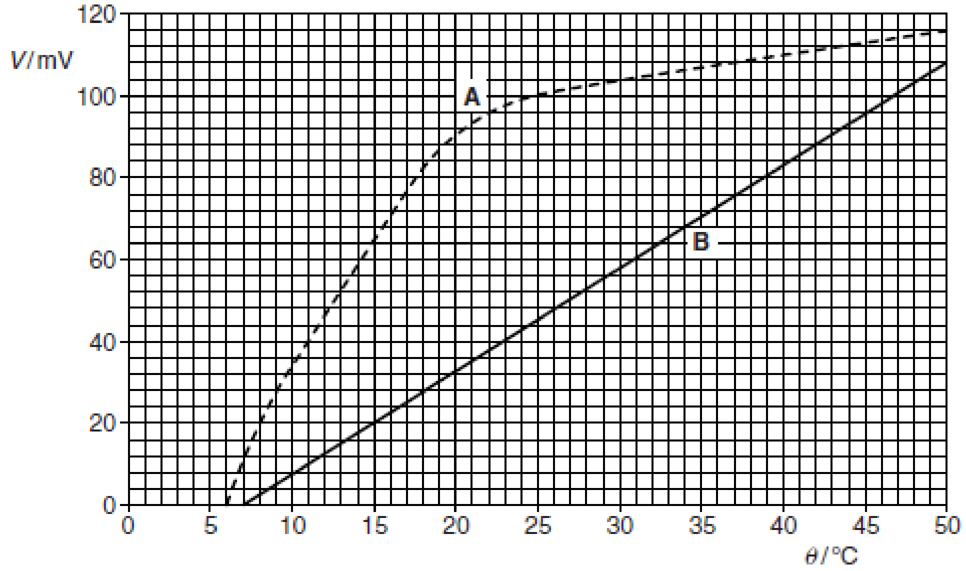

Fig. 1

Q1 Define these terms which describe the performance of a sensor:

RANGE ……………………………………………………………………………………

……………………………………………………………………………………...

RESOLUTION ……………………………………………………………………………………

……………………………………………………………………………………

SENSITIVITY ……………………………………………………………………………………..

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Q2 Calculate the sensitivity of sensor B from the information on the graph [Fig 1]. Show your working below and annotate Fig. 1 to make your method clear

Q3 Calculate the sensitivity of sensor A at temperatures of 15°C and 35°C from the information on the graph [Fig 1]. Show your working below and annotate Fig. 1 to make your method clear.

Q4 Estimate the temperature at which the sensitivity of sensor A is equal to the sensitivity of sensor B.

temperature = ………………………………

Explain how you arrived at your answer.

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Q5 Calculate the temperature resolution of sensor B if the voltmeter used can only read 5mV increments. Use the value of sensitivity the you calculated in Q2. Show your working below.

Q6 Explain why a student might choose to use sensor A for measuring a temperature of around 15°C but would choose sensor B for measuring a temperature of 35°C.

Trolley down a ramp

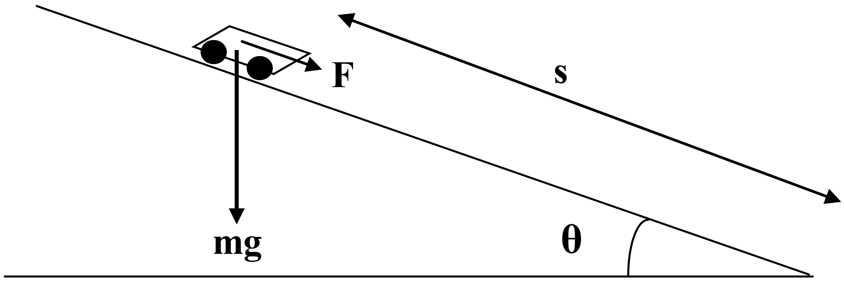

Fig.2

Q1 Explain why the force F accelerating the trolley down the ramp is less than the weight [mg].

Q2 The force $F = mg\sin\theta$ Using Newton's second law $F = ma$ show that the acceleration down the slope is equal to $g\sin\theta$

Q3 If the trolley starts from rest then $V^2 = 2as$ Rearrange this formula to make **a** the subject. What measurements would need to be made to obtain a value of a?

Q4 The value of a could be measured for a range of slope angles θ. Suggest a suitable graph that could be drawn to obtain a value of g and explain how the value of g could be calculated.

Q5 The table below contains experimental data. Use this to find a value of g using a suitable graph.

θ^o	V/ms^{-1}	s/m			
10.0	1.35	0.800			
15.0	2.01	0.800			
20.0	2.32	0.800			
25.0	2.58	0.800			
30.0	2.92	0.800			
35.0	3.00	0.800			
40.0	3.18	0.800			

The data is not perfect.

Show your working on the graph.

Q6 The value of g obtained by this method can be affected by systematic errors in the experiment.

Explain what is meant by the term "systematic error".

Q7 Explain how the factors listed below could affect the final calculated result for g . State whether the value of g is likely to be high, or low, with reasons.

1. Frictional forces due to rolling resistance of the trolley wheels.

2. Energy losses due to the viscosity of air.

Q8 An electronic timer and light gate give a reading of $2.32 \pm 0.01\ ms^{-1}$ when $\theta = 20.0^{o}$ and S= 0.80m.

Calculate the maximum and minimum values of g indicated by this data and so express a final answer as an average value of g with a % uncertainty.

Measuring the speed of light

Q1 Calculate the approximate time taken for light to travel one mile. [1 mile = 1.609km]

Q2 Explain why Galileo's method failed given that the best human reaction time is around 0.1s.

Q3 Using the *minimum* value that Michelson measured, calculate the percentage error compared with the modern accepted value for c quoted in the article.

Q5 A microwave oven is made with a rectangular metal cavity inside as shown below [Fig.3]

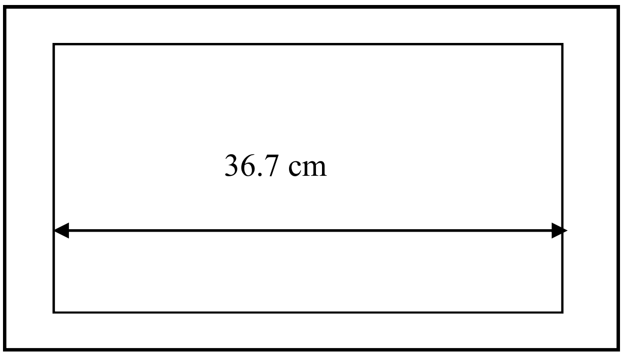

Fig.3

Draw inside the box the likely linear horizontal standing wave pattern that could be set up if 2.45GHz microwaves are fed into the oven. Assume that there is a node at each metal wall.

On the wave pattern indicate with an H where the "chocolate hotspots" are going to be located.

Q7 A student measures the distance between hotspots to be 5.9cm ± 0.5cm. What are the minimum and maximum values of the speed of light indicated by this data?

Q8 A microwave oven contains a device called a magnetron which produces high energy microwave oscillations. These can be fed into the oven cavity from the side as shown in Fig.4

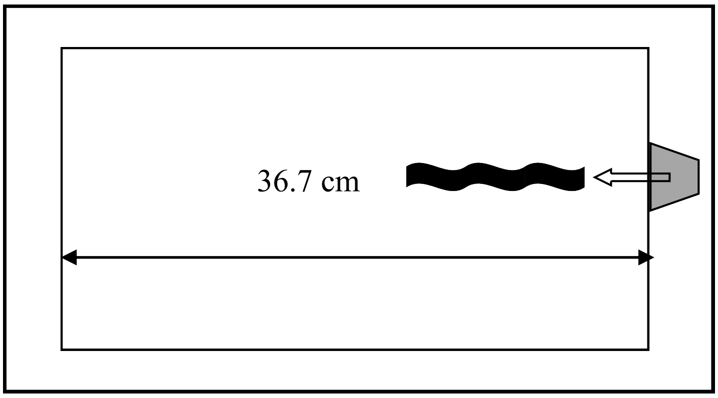

Fig.4

Explain how standing waves can be set up in the microwave cavity.