QCE Unit 3 Physics Data Test IA1 – Practice Questions

Data Set 1

Question 1 (2 marks)

Calculate the average centripetal acceleration for the tangential velocity of 6ms^{-1} to two decimal places.

→ $Average = \frac{36.4+36.25+35.80}{3} = 36.15$

→ 1 mark for correct answer, 1 mark for working

Question 2 (2 marks)

Calculate the centripetal acceleration measured during the second trial for the tangential velocity of 10ms^{-1}.

→ $Average = 98.20 = \frac{98+x+99.6}{3}$

→ Rearrange equation for x to achieve the answer of 97.00

→ 1 mark for correct answer, 1 mark for working

Question 3 (2 marks)

Making reference to Table 1, deduce the relationship between the eraser's tangential velocity *v* and its centripetal acceleration a_c.

→ Centripetal acceleration is proportional to the square of the tangential velocity, can use any two values of *v* and *a* on Table 1 to show this.

→ 1 mark for correct relationship determined, 1 mark for using values from the table

Question 4 (4 marks)

Using the average centripetal accelerations from Table 1, determine the length of the string that is tied to the eraser, including the uncertainty in this length.

→ Using the formula for centripetal acceleration from formula sheet, can be rearranged as follows:

$$r = \frac{v^2}{a_c}$$

→ Apply this equation to each of the average centripetal acceleration values. From this the mean value for the radius can be found as approximately 1 and the maximum and minimum values can be used to determine the absolute uncertainty in this length which is found to be approximately $\pm\ 1.3\ *\ 10^{-2}$

Data Set 2

Question 1 (2 marks)

Determine the nature of the relationship between the Electric Field Strength produced by the positive charge and the radius of the negative charge from said field. Refer to Table 2.

→ Electric field strength is proportional to the inverse square of the distance between the two charges. Can show using Table 2 that as the radius is doubled, the force between the two charges decreases by a factor of 4.

→ 1 mark for correct relationship identified, 1 mark for using Table 2

Question 2 (2 marks)

Using the relationship determined in Question 1, predict what the radius *r* will be for the final row of Table 2.

→ Can be seen that the average electric field strength for the required radius is approximately 4 times smaller than the average electric field strength for a radius of 10cm. For this reason, it can be predicted that the radius in the final row of Table 2 will be approximately 20cm.

→ 1 mark for correct answer, 1 mark for explanation using relationship established in Question 1 (if student identified incorrect relationship in Question 1 but used it correctly in Question 2 then they still get this mark)

Question 3 (3 marks)

Calculate the magnitude of the negative charge, including the relative uncertainty in the final answer.

→ Using the formula

$$E = \frac{1}{4\pi\epsilon_0}\frac{q}{r^2}$$

→ The charge *q* can be determined for all average values of *E* and *r* found in Table 2, from this, the average charge can be determined as the magnitude and the maximum and minimum charges can be used to find an absolute uncertainty in the charge. This absolute uncertainty can then be converted to a relative uncertainty by dividing the absolute uncertainty by the average *E* value determined. Should give the following answers.

Magnitude:$\approx 3.02 * 10^{-11}$

Relative Uncertainty:$\approx 200\%$

→ 1 mark for correct magnitude, 1 mark for correct relative uncertainty, 1 mark for working.

Question 4 (2 marks)

The actual magnitude for the negative charge is $3 * 10^{-11} C$ (note that this is a magnitude hence why it is positive). With this in mind, what percentage error is present within the experiment?
→ Using the formula for percentage error from the formula sheet and the charge magnitude determined in Question 3, an answer of 0.65% should be obtained.
→ 1 mark for correct value, 1 mark for working.

Question 5 (3 marks)

What is the magnitude of the positive charge? (No uncertainty calculations needed)
→ Using any of the average electric field values from Table 2 and the magnitude of the negative charge given in Question 4 can calculate force using $F = qE$, can then equate this to $F = \frac{1}{4\pi\epsilon_0} \frac{Qq}{r^2}$ where *r* is the corresponding radius to whichever electric field value was chosen. → Can then solve for *Q* to achieve an answer of approximately $3.0 * 10^{-7}$ (answers will vary here depending on which value of *E* and *r* used but should be in the same ballpark)
→ 1 mark for correct answer, 1 mark for working of Force calculation, 1 mark for remainder of working.

Question 6 (2 marks)

While at a distance of 6cm from the positive charge, the negative charge experiences an acceleration of $2.4 * 10^{10} ms^{-2}$. What is the mass of the negative charge?
→ Using the corresponding *E* value for *r* = 6cm, can calculate force experienced by the negative charge using $F = qE$.
→ This can then be equated to $F = ma$ where both *F* and *a* are now known. Use this to solve for m to give an answer of approximately $9.4 * 10^{-20}$.
→ 1 mark for correct answer, 1 mark for working

Data Set 3

Question 1 (4 marks)

Identify any trends in the results making reference to Table 3 and Graph 2 and furthermore, determine a relationship between the angle of the current carrying wire to the magnetic field (θ) and the Force experienced by said wire (F).

→ Can identify a trend from Graph 2, not one specific answer to this but could be something like "as the angle between the current carrying wire and the magnetic field increases, so does the force experienced by the wire at a non-linear rate".
→ More specifically, the relationship should be identified as Magnetic force being proportional to the sine of the angle. This can be shown by using values from Table 3 where the magnetic force increases at the same rate as sin(θ)
→ 1 mark for identifying a trend in the data, 1 mark for identifying the relationship, 1 mark for referring to Table 3, 1 mark for referring to Graph 2.

Question 2 (3 marks)

A charge of 35 Coulombs takes 5 seconds to travel through the wire. From this, determine both the current travelling through the wire and the magnetic field strength that the wire is suspended in.

→ Can calculate current using the formula $I = \frac{q}{t}$ where q = 35 and t = 5 to determine a current of 7A.
→ Can then use the formula $F = BILsin(\theta)$ where *F* and theta are taken from Table 3, solve for B. Should achieve an answer of 0.08T.
→ 1 mark for correct answer, 1 mark for calculating current, 1 mark for rest of working.

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