3.9 Physics Required Practicals and Uncertainties: 30-minute Pack

Total Marks

AQA 8464 · Calculator allowed · about 30 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Ben investigates the acceleration of a trolley on a ramp. Two light gates are set up along the ramp, connected to a data logger, and an interrupt card of known width is attached to the trolley. The equation linking acceleration, change in velocity and time is: acceleration = (final velocity - initial velocity) / time

(a) The interrupt card has a width of 5.0 cm. State the equation used to calculate the trolley's velocity as it passes through a light gate. **(1)**

(b) The trolley's velocity at the first light gate is 0.20 m/s and at the second light gate is 0.80 m/s. The time taken to travel between the gates is 0.40 s. Calculate the acceleration of the trolley. **(3)**

.....

(c) State one variable that should be controlled when investigating the effect of the mass of the trolley on its acceleration. **(1)**

(d) The interrupt card's width (5.0 cm) is measured using a ruler with a resolution of 0.1 cm. Calculate the percentage uncertainty in this measurement. **(2)**

.....

© Revision Library | revisionlibrary.co.uk

(e) Explain why using light gates gives a more precise measurement of the trolley's velocity than a student using a stopwatch and metre rule. **(2)**

(Total for Question 1 is 9 marks)

---

2 Aaliyah sets up a stationary (standing) wave on a stretched string, using a signal generator connected to a vibration transducer at one end, with the string passing over a pulley and a hanging weight at the other end to keep the tension constant. The frequency is adjusted until a clear stationary wave pattern with well-defined nodes and antinodes forms along the string.

(a) State how Aaliyah knows the string is vibrating at one of its resonant (natural) frequencies. **(1)**

(b) Define the term node, as used to describe a stationary wave. **(1)**

(c) The string forms 3 complete loops between the transducer and the pulley, over a total length of 90 cm. Calculate the wavelength of the stationary wave. **(2)**

(d) The frequency of the signal generator is 50 Hz. Calculate the speed of the wave on the string. **(3)**

(e) Suggest why a stroboscope is sometimes used to help view the vibrating string safely and clearly. **(1)**

(Total for Question 2 is 8 marks)

© Revision Library | revisionlibrary.co.uk

3 A student measures the mass and volume of a small alloy sample in order to calculate its density.

Mass = 24.0 g, measured with an uncertainty of plus or minus 0.1 g
Volume = 8.00 cm^3, measured with an uncertainty of plus or minus 0.16 cm^3

(a) Calculate the percentage uncertainty in the mass measurement. **(1)**

.....

(b) Calculate the percentage uncertainty in the volume measurement. **(1)**

.....

(c) When two measured quantities are multiplied or divided to find a derived quantity, the percentage uncertainties of each measurement are added together to find the total percentage uncertainty. Calculate the total percentage uncertainty in the calculated density. **(2)**

.....

(d) Calculate the density of the sample, and use your answer to part (c) to express this with its absolute uncertainty, in the form (density plus or minus uncertainty) g/cm^3. **(3)**

.....

(Total for Question 3 is 7 marks)

© Revision Library | revisionlibrary.co.uk

Mark scheme · 3.9 Physics Required Practicals and Uncertainties: 30-minute Pack

Question 1

(a) velocity = distance / time (width of card / time the card blocks the light gate), oe **B1**

(a) Answer: Velocity = distance / time.

(b) (0.80 - 0.20) / 0.40, oe **M1**

(b) = 0.60 / 0.40, oe **M1**

(b) 1.5 m/s^2 cao **A1**

(b) Answer: 1.5 m/s^2

(c) the angle/height of the ramp (or the force accelerating the trolley), oe **B1**

(c) Answer: The angle (height) of the ramp.

(d) absolute uncertainty = plus or minus 0.05 cm (half the smallest scale division), then (0.05 / 5.0) x 100, oe **M1**

(d) 1.0% cao **A1**

(d) Answer: 1.0%

(e) light gates time electronically with a very small resolution, removing human reaction-time error, oe **B1**

(e) human reaction time (typically 0.2-0.3 s) is significant compared with the short time intervals involved, so a stopwatch gives a much larger percentage uncertainty than a light gate, oe **B1**

(e) Answer: Light gates record time electronically, removing human reaction-time error; a stopwatch's reaction-time error is large compared with the short time intervals involved, giving it a much bigger percentage uncertainty.

Question 2

(a) a stable, clear stationary wave pattern forms, with well-defined nodes and antinodes (rather than a small, blurred vibration), oe **B1**

(a) Answer: A stable, large-amplitude stationary wave pattern forms, with clear nodes and antinodes.

(b) a point on the wave with (approximately) zero amplitude, which does not oscillate, oe **B1**

(b) Answer: A point on a stationary wave that does not oscillate (zero amplitude).

(c) wavelength = 2 * 90 / 3, oe **M1**

(c) 60 cm = 0.60 m cao **A1**

(c) Answer: 0.60 m

(d) uses wavelength in metres (0.60 m) from part (c), ft **M1**

(d) speed = 50 * 0.60, oe **M1**

(d) 30 m/s cao **A1**

(d) Answer: 30 m/s

(e) it flashes at (or near) the vibration frequency, making the fast-moving string appear to move slowly or appear stationary, so its shape can be seen clearly and safely, oe **B1**

(e) Answer: The strobe flashes near the vibration frequency, making the fast-moving string appear to move slowly, so it can be observed clearly and safely.

Question 3

(a) 0.4% cao (from (0.1/24.0) x 100 = 0.417%, awrt 0.4) **B1**

(a) Answer: 0.4%

(b) 2.0% cao (from (0.16/8.00) x 100) **B1**

(b) Answer: 2.0%

(c) adds the answers to (a) and (b), ft **M1**

(c) 2.4% cao (awrt 2.4), ft **A1**

(c) Answer: 2.4%

(d) density = 24.0 / 8.00, oe **M1**

(d) absolute uncertainty = 2.4% of the density (ft from part c), oe **dM1**

(d) 3.00 plus or minus 0.07 g/cm^3 cao (allow appropriate rounding), ft **A1**

(d) Answer: 3.00 plus or minus 0.07 g/cm^3

© Revision Library | revisionlibrary.co.uk