Started on	Thursday, 17 February 2022, 8:00 AM
State	Finished
Completed on	Thursday, 17 February 2022, 8:37 AM
Time taken	37 mins 1 sec
Grade	**25.00** out of 30.00 (**83**%)

Question **1**

Correct

Mark 2.50 out of 2.50

Heights of air columns (in a one-end-closed cylinder) for the fundamental mode were measured as 30 cm, 28 cm, 25 cm, 22 cm and 20 cm, respectively for the tuning fork frequencies 300 Hz, 325 Hz, 340 Hz, 400 Hz, and 420 Hz. Which of the following options will be the closest value for the measured velocity of sound in air (in units of metres/second) stated as **value** $\pm$ **standard deviation**, for the given data.

a. 350 ± 5

b. 351 ± 5

c. 350 ± 12 ✔

d. 351 ± 7

The correct answer is: 350 ± 12

Question **2**

Incorrect

Mark 0.00 out of 2.50

The least count of the micrometer screw in a Michelson set-up is 0.001 mm and the measured minimum displacement of the movable mirror is 0.020 mm. We count 100 fringe collapses. The maximum proportional error in the measurement of the wavelength of the source, expressed as a percentage, is (write a number for your answer).

Answer: 10 ✖

The correct answer is: 11

Question **3**

Correct

Mark 2.50 out of 2.50

A stretched string of length 90 cm is vibrating in the second overtone (third harmonic). At an instant of the time, when the transverse velocity of all the particles on the string is zero, it is observed that the transverse displacement of the point on the string at the 15 cm mark is approximately 2 cm. At this instant, estimate the **square of the displacement** (in units cm^2) of the point on the string at the 70 cm mark. Write an integer for your answer.

Answer: 3 ✔

The correct answer is: 3

Question **4**

Correct

Mark 2.50 out of 2.50

A student is given two different Fresnel biprisms A and B. The student uses them successively in the Michelson interferometer arm, in the experiment on measurement of the base angle of a Fresnel biprism. Adjusting the translation stage position for a displacement of 0.005 mm the student observes 20 fringe collapses for both prisms A and B. The lab instructor tells the student that the prisms are made of glass with different refractive indices: $n_A = 1.5$ and $n_B = 1.6$. What can the student conclude about the base angles ϕ_A and ϕ_B of prisms A and B? Choose the right answer.

- a. none of the above
- b. \(\phi_A< \phi_B \)
- c. \(\phi_A>\phi_B \) ✔
- d. \(\phi_A= \phi_B \)

The correct answer is: \(\phi_A>\phi_B \)

Question **5**

Correct

Mark 2.50 out of 2.50

For observables \(x \) and \(y \) in an experiment, a small data set
of four points are given as : \((x,y) = (1,3) ; (2,5) ; (3,7) ; (4,10) \). Which of the following is the straight line obtained using the **method of least squares**?

- a. \(y = 0.5 - 2.3 \ x \)
- b. \(y = -0.5 \ + 2.3 \ x \)
- c. \(y = 2.3 + 0.5 \ x \)
- d. \(y = 0.5 + 2.3 \ x \) ✔

The correct answer is: \(y = 0.5 + 2.3 \ x \)

Question **6**

Correct

Mark 2.50 out of 2.50

A simple experiment is performed to measure the area of a thin elliptical disc. The major (a) and minor (b) axes are measured with scales of different least counts \(\Delta a \) and \(\Delta b \). If \(a=\mu b \) (\(\mu>1 \)) and \(\Delta a = \nu \Delta b \) (\(\nu\) <1) then, for a fixed \(\mu \), the error is reduced for,

- a. larger \(\nu \).
- b. none of these answers.
- c. \(\mu = \nu \)
- d. smaller \(\nu \). ✔

The correct answer is: smaller \(\nu \).

Question **7**

Correct

Mark 2.50 out of 2.50

In a Michelson interferometer experiment, the displacement \(d\) of the movable mirror from the zero phase difference (between the two arms) position, is measured as \(1.2\) cm. If the wavelength of light is \(600\) nanometers, then the order number of the central dark fringe is (write an integer for your answer; eg. for an answer like \(2000\), write \(2000\) and **not** \(2\times {10}^{3} \)):

Answer: 40000 ✔

The correct answer is: 40000

Question **8**

Incorrect

Mark 0.00 out of 2.50

The proportional error in wavelength measurement using a Michelson interferometer is \(10\) percent. The least count of the translation stage used for measuring the base angle of a Fresnel biprism is \(0.01\) mm. The minimum measured value of the quantity \(\ell\) (displacement of prism, as defined in the manual) is \(0.10\) mm. We observe a minumum of \(10\) fringe collapses. The maximum proportional error (expressed as a percentage) in base angle measurement is (write an integer for your answer):

Answer: 30 ✖

The correct answer is: 40

Question **9**

Correct

Mark 2.50 out of 2.50

Velocity of sound wave in air is measured by using tuning forks of known frequencies and adjustable height of the air-column in a one-end-closed pipe. When height of the air column is gradually **increased** from zero value, first resonant sound (fundamental) was heard when the height of the air column was \(30\) cm for a tuning fork of \(300\) Hz. The tuning fork is thereafter replaced with another tuning fork of frequency \(600\) Hz while the height of the air column is **increased** slowly. What will be the expected height of the air column, in centimeters, for which the next resonant sound (first overtone) may be heard? Write an integer for your answer.

Answer: 45 ✔

The correct answer is: 45

Question **10**

Correct

Mark 2.50 out of 2.50

We adjust the movable mirror position in a Michelson interferometer set-up to obtain a fringe pattern of concentric circles, using light of wavelength \(500\) nm. How far must the movable arm be displaced (in millimeters) for \(1000\) fringes to emerge at the center of the pattern? Write a number for your answer (two decimal places; eg. for an answer like \(0.56\) write \(0.56\) and **not** \(.56\))

Answer: 0.25 ✔

The correct answer is: 0.25

Question **11**

Correct

Mark 2.50 out of 2.50

For a string of fixed length \(L\) and a fixed frequency \(\nu \) of the vibrator, the second harmonic (\(n=2\)) was observed for a pan of mass 50 gm attached to string. The fundamental (\(n=1\)) is observed at the same \(\nu \), when an additional ball of mass \(m \) is placed on the pan. What is the value of \(m \) in grams?

- a. 15
- b. 150 ✔
- c. 1500
- d. 1.5

The correct answer is: 150

Question **12**

Correct

Mark 2.50 out of 2.50

The transverse wave experiment is performed with two different pieces of the same string (i.e. same mass per unit length \(\mu\)) which are of lengths \(\ell_1\) and \(\ell_2 \), respectively. For \(\ell_1 \) and \(\ell_2 \), successive experiments are performed but with the same weight on the pan. It is observed that the fundamental frequency for \(\ell_1 \) is \(\nu_1 \) while that of the first overtone for \(\ell_2 \) is \(\nu_2 \). Now the experiment is repeated once more with the same weight in the pan but with another string (same \(\mu \)) of length \(L = \ell_1 + \ell_2 \). If the fundamental frequency for this third string of length \(L \) is \(\nu \), then which of the following is correct?

- \(\frac{1}{\nu} = \frac{1}{\nu_1} + \frac{2}{\nu_2} \) ✔
- \(\nu = \nu_1 + \frac{\nu_2}{2} \)
- \(\frac{1}{\nu} = \frac{1}{\nu_1} + \frac{1}{2\nu_2} \)
- \(\nu = \nu_1 + 2 \nu_2 \)

The correct answer is: \(\frac{1}{\nu} = \frac{1}{\nu_1} + \frac{2}{\nu_2} \)

◄ Compensatory Test - 1

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