BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI (RAJ)

Physics Laboratory (PHY F110): Mid Term Test (2017 - 2018)

Date : 7 Oct 2017 **A**

Max. Marks : 24 **Duration : 30 mins**

Name : **ID. :** **Section:**

- ✓ Questions on Error Analysis are compulsory to attempt.
- ✓ Answer 12 questions (including 2 questions from Error Analysis).
- ✓ Only first 12 attempted questions will be evaluated.
- ✓ Each question carries 2 marks.
- ✓ Any overwriting would be considered as Not Attempted

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Answer																						

For Evaluation Purpose Correct Answers: Marks Obtained:

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1. (Error Analysis) The radius and height of a right circular cylinder are measured to be 3 and 2 centimeters (respectively) with errors of 5% each (standard deviation). The percentage error in its volume is given by :
   (A) 10.00% (B) 6.71% (C) 11.18% ✓ (D) 5.59%

2. (Error Analysis) The parameters y and x are expected to follow a linear relation. The experimental measurements yield the data (x_i, y_i) where i ranges from 1 to n. Let $< x >$ and $< y >$ be the average of x_i and y_i respectively. The best fit line $y = m\,x + c$
   (A) passes through the point $(< x >, < y >)$ and at least one of the data points
   (B) need not necessarily pass through $(< x >, < y >)$ or any of the data points but minimizes the sum $\Sigma(y_i - m\,x_i - c)^2$
   (C) passes through at least two data points
   (D) passes through the point $(< x >, < y >)$ but not necessarily through any of the data points (x_i, y_i) ✓

3. (Diffraction Grating) If the grating constant is 1250 lines/cm, what is the slit separation (in μm)
   (A) 12 μm (B) 20 μm (C) 4 μm (D) 8 μm ✓

4. (Diffraction Grating) In a diffraction grating experiment using a purely monochromatic source and a given grating element, if the 7^{th} order diffraction maximum appears at θ=30°, what will be the value of θ for the 5^{th} order diffraction maximum?
   (A) 17.2° (B) 20.9° ✓ (C) 22.8° (D) 28.5°

5. (Planck's Constant) In high frequency region where $h\nu/kT \gg 1$, Planck's law of radiation from a black body is reduced to
   (A) $(8\pi h\nu^3/c^3)\exp(h\nu/kT)$ (B) $(8\pi h\nu^3/c^3)\exp(-h\nu/kT)$ ✓ (C) $(8\pi h\nu^3/c^3)\exp(-kT/h\nu)$ (D) $(8\pi h\nu^3/c^3)\exp(kT/h\nu)$

6. (Planck's Constant) In Planck's constant experiment, at the temperatures of the filament which you reach in lab, which statement is correct ?
   (A) $I_{ph}^{red} > I_{ph}^{blue} > I_{ph}^{green}$ (B) $I_{ph}^{green} > I_{ph}^{red} > I_{ph}^{blue}$ (C) $I_{ph}^{red} > I_{ph}^{green} > I_{ph}^{blue}$ ✓ (D) $I_{ph}^{blue} > I_{ph}^{red} > I_{ph}^{green}$

7. (Newton's Rings) In the Newton's Rings experiment, the zeroth order ring is dark. This is because, the path difference is
   (A) λ (B) $\lambda/2$ (C) 0 ✓ (D) $\lambda/4$

8. (Newton's Rings) Which of the following factors does not affect the radii of the rings in the Newton's ring experiment
   (A) Wavelength of the light used
   (B) Refractive index of the enclosed film
   (C) Intensity of the light source ✓
   (D) Radius of curvature of the convex lens

9. (e/m) You can see the circular/helical path of the electrons in the e/m experiment. This is due to
   (A) radiation from the continuously accelerating electrons
   (B) Bremsstrahlung radiation when the electrons are suddenly stopped on striking the glass tube
   (C) fluorescent radiation from the material coating the glass tube
   (D) ionization and subsequent recombination of the helium atoms on the path of the electrons ✓

10. (e/m) The magnetic field in the e/m experiment is produced by

    (A) a solenoid (B) a pair of circular coils ✓ (C) an electromagnet (D) permanent magnets

11. (Young's Modulus) Find out the depression z at the midpoint of the bar due to load M. Given: $M = 100.0\ gm$, length between knife edges $\ell = 7.0\ cm$, distance between scale and optical lever $D = 55.0\ cm$, length between Laser pointer leg and its pivot $x = 5.3\ cm$, thickness $d = 0.2\ cm$, breadth $b = 2.0\ cm$, mean shift $y = 11.5cm$.

    (A) $5.358\ cm$ (B) $1.732\ cm$ (C) $1.108\ cm$ ✓ (D) $1.528\ cm$

12. (Young's Modulus) A metallic wire of length L, cross-sectional area A and Young's modulus Y has weight W. It is hanging vertically downward. The final length of the wire due to its own weight is given by

    (A) $L(\frac{2W}{AY}+1)$ (B) $L(\frac{W}{2AY}+1)$ ✓ (C) $L(\frac{W}{AY}+1)$ (D) $L(\frac{W}{4AY}+1)$

13. (Velocity of Sound) In the velocity of sound experiment, locations of nodes are recorded as 8.7 cm, 16.9 cm, 26 cm,and 34.5 cm when the frequency fed from the audio frequency generator is 2 KHz. The calculated velocity of sound from this data is

    (A) 340 m/s (B) 350 m/s (C) 344 m/s ✓ (D) 348 m/s (E) 354 m/s

14. (Velocity of Sound) Which of the following statements is false for the velocity of sound experiment (assume that symbols have their usual meaning).

    (A) The general solution for amplitude of oscillations as a function of position is given by $f(x) = A\cos kx + B\sin kx$

    (B) Energy is transported with velocity of sound ✓

    (C) Condition for positions of nodes is: $\omega x/\upsilon = n\pi$

    (D) Distance between two anti-nodes is $\lambda/2$ where λ is the wavelength of sound waves.

15. (Slit) The intensity distribution in Double Slit diffraction pattern will be of the form $I = 4I_0(\sin^2\beta/\beta^2)\cos^2\gamma$. Here, the second term $\cos^2\gamma$ is due to

    (A) Diffraction produced by each slit.

    (B) Interference of the light diffracted from each slit. ✓

    (C) The interference of two waves each of certain amplitude and differing in frequency.

    (D) An extra factor related to the geometry of the setup.

16. (Slit) Suppose in the double-slit arrangement, $d = 0.150\ mm$, $L = 120\ cm$, $\lambda = 640\ nm$, and $y = 2.0\ cm$. What is the path difference for the rays from the two slits arriving at point P ? (Assume that the distance between the slits is much greater than the wavelength of the monochromatic light, $d \gg \lambda$. Find the closest answer.)

    (A) $2.0\mu m$ (B) $1.5\mu m$ (C) $2.5\mu m$ ✓ (D) $4.5\mu m$

17. (LCR) At very low frequencies, i.e. $\omega \to 0$, which component of the LCR circuit has the minimum impedance ?

    (A) the capacitor (B) the inductor ✓ (C) the resistor (D) depends on whether the circuit is in series or parallel

18. (LCR) In LCR experiment, assume you have determined the resonant frequency ν_0 for a particular set of inductance L, capacitance C and resistance R. Now, if each of these values is made twice of its earlier value, what will be the new resonant frequency ?

    (A) $\nu_0/2$ ✓ (B) $\nu_0/4$ (C) ν_0 (D) $4\nu_0$

19. (EMI) In the ideal EMI experiment, the charge delivered to the capacitor in the n^{th} swing,

    (A) is an increasing function of n

    (B) depends neither on RC nor on n

    (C) depends on RC but not on n

    (D) is a decreasing function of n ✓

20. (EMI) Which of the following is a false statement about the experiment of electromagnetic induction

    (A) The maximum value of induced emf scales linearly with maximum angular speed.

    (B) In the absence of all frictious damping (damping due to friction), the oscillations would go on for ever. ✓

    (C) The maximum value of induced emf scales approximately linearly with the angle of release of the metal arc.

    (D) The maximum value of the induced emf is a function of the geometry of the apparatus as far as it performs SHM.

21. (Coupled Pendulum) For in phase mode of oscillations, the time period of the coupled pendulums

    (A) Changes exponentially with the distance of the spring from the pivot

    (B) Is directly proportional to the distance of the spring from the pivot

    (C) Is inversely proportional to the distance of the spring from the pivot

    (D) Doesn't change with change in the distance of the spring from the pivot ✓

22. (Coupled Pendulum) The phase difference between motion of two pendulums in the normal modes with frequencies ω_1 and ω_2 ($\omega_2 > \omega_1$), are respectively,

    (A) π and 0 (B) 0 and π ✓ (C) 0 and $\pi/2$ (D) $\pi/2$ and 0

BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI (RAJ)

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2. (Error Analysis) The radius and height of a right circular cylinder are measured to be 3 and 2 centimeters (respectively) with errors of 3% each (standard deviation). The percentage error in its volume is given by :
   (A) 9.24% (B) 8.53% (C) 11.18% (D) 6.71% ✓

3. (Slit) The intensity distribution in Double Slit diffraction pattern will be of the form $I = 4I_0(\sin^2\beta/\beta^2)\cos^2\gamma$. Here, the second term $\cos^2\gamma$ is due to
   (A) Diffraction produced by each slit.
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