BS192 : USL

Physics End Sem Examination

Q1: Measurements given in Table 1 were entered by a student who performed the ultrasonic diffraction experiment. The velocity of the ultrasonic wave in the medium of these observations is: (Following values may be useful: wavelength of the laser, $\lambda = 650$ nm; distance between the crystal and the detector, L = 1 m; frequency of the crystal, f = 5 MHz.)

(a) 1083 m/s
(b) 1480 m/s
(c) 1523 m/s
(d) 1830 m/s

Table 1: Measurements corresponding to ultrasonic diffraction experiment in Q1

Micrometer reading (mm)	Detector Output (μA)
16.5	1.8
16	5.6
15.5	12.4
15	500
14	100
13.5	22
13	33.8
12.5	165
12	4600
11	2400
10.5	200
10	21.6
9.5	17.3
9	86.3
8	12.71
7.5	11.6
7	1.8
6.5	2
6	1.7

Q2: An ultrasonic wave travels through water at 1480 m/s. The diffraction grazing has a slit spacing (d) of 2cm, and the first-order maximum occurs at 30°. What is the frequency (f) of the ultrasonic wave?

(a) 148 kHz
(b) 1480 kHz
(c) 14.8 kHz

(d) 1.48 kHz

Q3: In an ultrasonic diffraction grazing experiment, what happens to the diffraction angle (θ) of the first-order maximum if the frequency (f) of the ultrasonic wave is increased (while keeping the slit spacing (d) and wave speed (v) constant)?

(a) θ increases because wavelength decreases
(b) θ decreases because wavelength increases
(c) θ remains unchanged because it depends only on slit spacing
(d) θ becomes zero because high-frequency waves don't diffract

Q4: A Kundt's tube experiment is conducted where a steel rod clamped at its centre is vibrated longitudinally, producing sound waves in the air column inside the tube. The length of the rod is 1.2 m, and the frequency of vibration is 2000 Hz. The distance between consecutive node in the air column is measured to be 8.5 cm. Calculate the speed of sound in air.

(a) 340 m/s
(b) 420 m/s
(c) 300 m/s
(d) 290 m/s

Q5: In Kundt's tube experiment, what does the distance between two consecutive nodes represent?

(a) Full wavelength (λ) of the sound wave.
(b) Half the wavelength ($\lambda/2$)
(c) Quarter wavelength ($\lambda/4$)
(d) Twice the wavelength (2λ)

Q6: If the Kundt's tube experiment is conducted in a warmer room, how does the node spacing change?

(a) Increases
(b) Decreases
(c) Stays the same
(d) Depends on humidity

Q7: In Newton's ring experiment, the wavelength of monochromatic light (λ) used was 589 nm. If the diameter of the 10th dark ring was 4.2 mm. Find the radius of curvature of the plano-convex lens.

(a) 75 cm
(b) 95 cm
(c) 45 cm
(d) 105 cm

Q8: In a Newton's ring experiment, the diameter of the 4th and 12th dark ring is 0.400 cm and 0.700 cm respectively. The diameter of the 20th dark ring is:

(a) 0.908 cm
(b) 0.215 cm
(c) 0.609 cm
(d) 0.512 cm

O9: If monochromatic light is replaced with white light in Newton's rings experiment, what happens?

(a) Rings disappear
(b) Rings become coloured
(c) Only bright rings appear
(d) Only dark rings appear

Q10: In the photoelectric effect experiment, light of wavelength 500 nm is incident on a metal surface. The work function of the metal is 2 eV. What would be the measured stopping potential (in V)?

(a) 0.48
(b) 0.58
(c) 0.60
(d) 0.40

Q11: In the photoelectric effect experiment. a student calculated the stopping potential using three different filters. The stopping potential was found to be 0.37 V, 0.75 V and 1.04 V, corresponding to the filters labelled 453 THz, 529 and 615 THz (1 THz = 10^{12} Hz). The student was later informed that the frequency label for one of these filters was likely wrong. Can you point out which filter is labelled wrong?

(a) Filter labelled 453 THz
(b) Filter labelled 529 THz

(c) Filter labelled 615 THz
(d) Cannot be determined

Q12: A light of frequency 400 THz was incident on a metal surface. The work function of the metal is 2.0 V. How would the number of electrons emitted change if the intensity of the light is now doubled?

(a) It will increase
(b) It will decrease
(c) No electrons will be emitted
(d) Cannot be determined

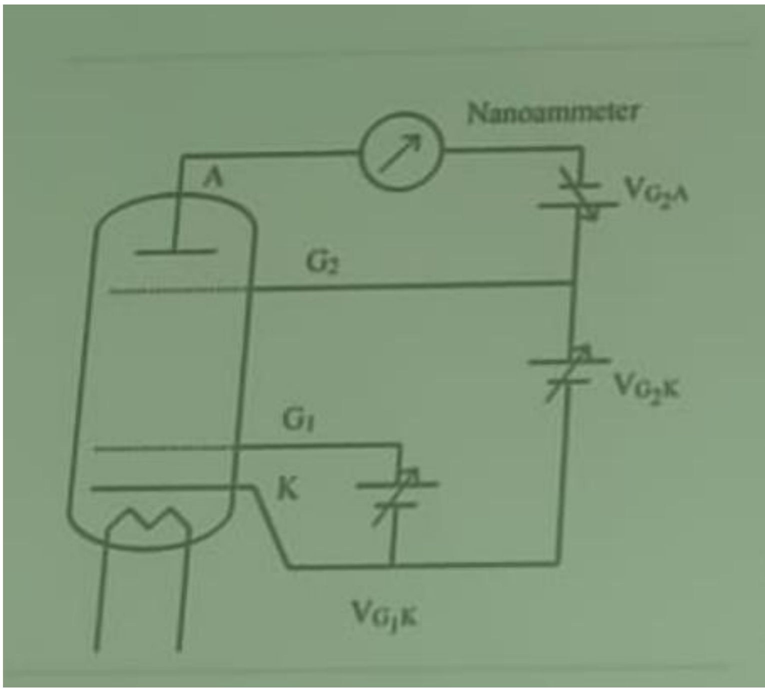

Figure. 2: Schematic of Franck-Hertz experiment

Q13: Identify the correct operation conditions for the setup shown in Fig. 2 when a third dip in current is observed with Argon atoms present in the tube (known excitation potential is V_{ex})

(a) $V_{G1K} < V_{G2K}$ and $V_{G2K} < V_{G2A}$
(b) $V_{G1K} > V_{G2K}$ and $V_{G2K} = 3V_{G2A}$
(c) $V_{G1K} < V_{G2K}$ and $V_{G2K} > V_{G2A}$
(d) $V_{G1K} > V_{G2K}$ and $V_{G2K} > V_{G2A}$

Q14: In the Frank-Hertz experiment, an accelerating voltage of V_{G2K} =18 V is being applied. Assume that V_{G1K} is exactly enough to counteract the space-charge effects. If the excitation potential of the atom under investigation is 7 V, what will be the kinetic energy of most of the electrons when they reach the plate G2?

(a) 11 eV
(b) 14 eV
(c) 4 eV
(d) 21 eV

Q15: During the Frank-Hertz experiment, the voltage was varied linearly from 0V to 5V and then back to 0V. What is the expected trend for current corresponding to this measurement if the excitation potential is to be 6 V?

(a) Current will remain zero throughout the measurement
(b) Gradual increase in current followed by a gradual decrease in current
(c) Current will remain constant throughout the measurement
(d) Gradual increase in current followed by a sudden drop in current and then again a gradual increase in current

Answer Key

1. A	2. A	3. ABCD	4. A	5. B
6. A	7. A	8. A	9. B	10. A
11. B	12. C	13. C	14. C	15. B