15/15

PHY 111

Homework 1sec # 3

Student name: Student ID:

1. Write the number of the significant figures in the following numbers:

   a. 0.098050 — 5
   b. 24300 ± 20 — 4
   c. 12.02021 — 7
   d. 0.00021015 — 5
   e. 3.10278×10^6 — 6
   f. 4109.0051 ± 0.0006 — 8

2. A student measured the radius of a sphere (r) 8 times as follows : 3.31 , 3.41 , 3.26 , 3.20, 3.44 , 3.35, 3.25 and 3.43 in cm. Find:

   a. The best estimate value of the radius of the sphere. $= 3.33125$

   b. The sample standard deviation in the radius of sphere. $\sigma = 0.09$

   c. The radius of sphere in correct form ($r \pm \Delta r$). $\sigma_m = \frac{\sigma}{\sqrt{N}} = \frac{0.090622}{\sqrt{8}} = 0.03$

   ~~$r = 3.33 \pm 0.09$~~ $\Rightarrow$ $r = 3.33 \pm 0.03$ cm

3. The radius of circle is measured to be $(5.337 \pm 0.005)\ cm$. Find the area of circle.

$A = \pi r^2 \Rightarrow \Delta A = 2\pi r \Delta r$

$A = \pi r^2 = \pi \times (5.337)^2 = 89.4384\ cm^2$

$\Delta A = 2\pi \times 5.337 \times 0.005 = 0.167 \Rightarrow 0.17$

$A = 89.44 \pm 0.17$ cm^2

4. Find the uncertainty (ΔR) expression for the following calculated values :

   a. $R(x,y,z) = \sin(x^3 - yz)$

$\Delta R = \frac{\partial R}{\partial x}\Delta x + \frac{\partial R}{\partial y}\Delta y + \frac{\partial R}{\partial z}\Delta z = \cos(x^3 - yz) \cdot 3x^2 \Delta x + \cos(x^3 - yz) \cdot z \Delta y + \cos(x^3 - yz) \cdot y \Delta z$

$\Delta R = 3x^2 \cos(x^3 - yz)\Delta x + z\cos(x^3 - yz)\Delta y + y\cos(x^3 - yz)\Delta z$

   b. $R(x,y,z) = \frac{z^4 y^{\frac{1}{2}}}{x^5}$

(a) $\Delta R = 3x^2 \cos(x^3 - yz)\Delta x + 2\cos(x^3 - yz)\Delta y + y\cos(x^3 - yz)\Delta z$

(b) General Rule $\Delta R = \frac{\partial R}{\partial x}\Delta x + \frac{\partial R}{\partial y}\Delta y + \frac{\partial R}{\partial z}\Delta z \Rightarrow \left(\frac{\Delta R}{R} = \left(4\frac{\Delta z}{z} + \frac{1}{2}\frac{\Delta y}{y} + 5\frac{\Delta x}{x}\right) \times R\right)$

$\Delta R = 4\frac{\Delta z}{z} \cdot \frac{z^4 y^{\frac{1}{2}}}{x^5} + \frac{1}{2}\frac{\Delta y}{y} \cdot \frac{z^4 y^{\frac{1}{2}}}{x^5} + 5\frac{\Delta x}{x} \cdot \frac{z^4 y^{\frac{1}{2}}}{x^5} \Rightarrow \Delta R = \frac{4z^3 y^{\frac{1}{2}}}{x^5}\Delta z + \frac{z^4}{2y^{\frac{1}{2}}x^5}\Delta y + \frac{5z^4 y^{\frac{1}{2}}}{x^6}\Delta x$ (b)

PHY 111

Quiz 1 sec # 3

12.5/15

Student name: Student ID:

1. Write the number of the significant figures in the following numbers:

   a. 0.09050 — 4
   b. 243000 ± 200 — 4
   c. 12.020210 — 8
   d. 0.0002115 — 4
   e. 3.102780×10^{-5} — 7
   f. 4109.051 ± 0.006 — 7

~~2.43×10~~ $2430 \times 10^2 \pm 2 \times 10^2$

2. The radius (r) of right cylinder (اسطوانة قائمة) is measured to be $(3.27 \pm 0.05)\ cm$, and its hight(L) is founded $(8.41 \pm 0.03) cm$ Find the surface area of the cylinder $(A \pm \Delta A)$.

The surface area = 2x area of circle + circumference x height

$= 2\times\pi r^2 + 2\pi rh = 2\pi\times(3.27)^2 + 2\pi\times(3.27)(8.41) = 239.8558$

$\frac{\Delta A}{A} = \frac{\Delta r}{r} + \frac{\Delta L}{L} \Rightarrow \frac{\Delta A}{239.8558} = \frac{0.05}{3.27} + \frac{0.03}{8.41} \Rightarrow \Delta A = 4.52$

$\frac{\Delta A}{A} = \frac{\Delta r}{r} + \frac{\Delta L}{L}$

$A \mp \Delta A$

$240 \mp 5\ cm^2$

3. Find the uncertainty (ΔR) expression for the following calculated values :

   a. $R(x, y, z) = y^2 + 5\ln(2x - z^3)$

$\frac{\Delta R}{R} = \frac{dR}{dx}\Delta x + \frac{dR}{dy}\Delta y + \frac{dR}{dz}\Delta z = 5\ln(2x-z^3)\times 2\,\Delta x + 2y\,\Delta y + 5\ln(2x-z^3)\times 3z^2\,\Delta z$

$\frac{\Delta R}{R} = 10\ln(2x-z^3)\Delta x + 2y\,\Delta y - 15\ln(2x-z^3)z^2\,\Delta z \Rightarrow \Delta R = (y^2 + 5\ln(2x-z^3)\left[10\ln(2x-z^3)\Delta x + 2y\Delta y - 15\ln(2x-z^3)z^2\Delta z\right]$

   b. $R(x, y, z) = \frac{z^6 y^{\frac{1}{3}}}{x^3}$

$\frac{\Delta R}{R} = 6\frac{dR}{dz}\Delta z + \frac{1}{3}\frac{dR}{dy}\Delta y + 3\frac{dR}{dx}\Delta x$

4. Answer the two following question about today's experiment :

   a) What is meaning of "conservation of linear momentum ", write the law and explain all symbols in it ? it means that the linear momentum is consered before and after

   b) What are the physical quantity you will measure it today? $P_i = P_f$

mass, velocity (speed)

$m_i v_i = m v_f$

m: mass, v_i: initial speed, v_f: final speed

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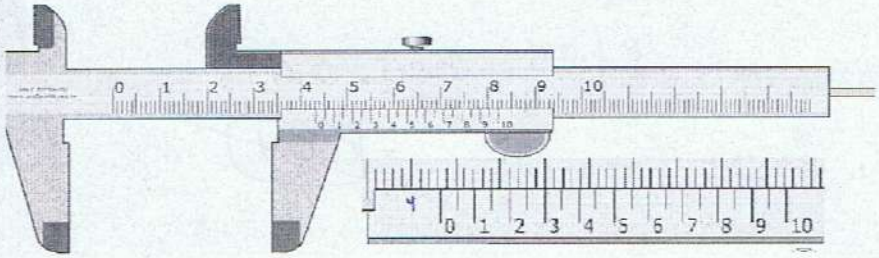
Quiz 2 sec # 3

Student name: Student ID:

10.5/11

1. Write the reading of the Vernier caliper and Micrometer in **mm** unit

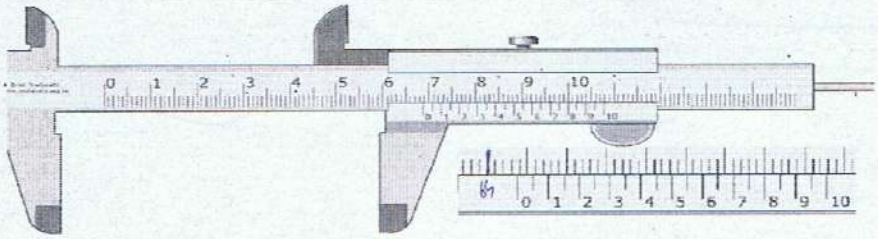
a.



~~44~~. 43.30

43.30 mm

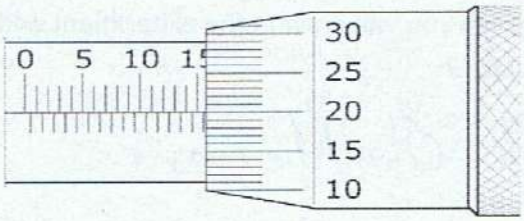
b.



68.65

68.65 m

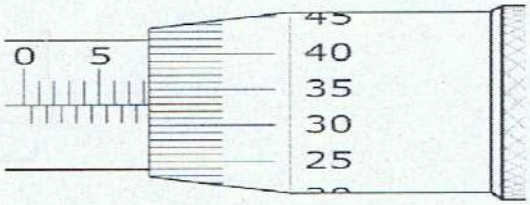
c.



~~15~~. 15.50 mm + 0.20 = 15.70 mm

15.70 mm

d. 4



80 + 0.33

8.33 mm

8.33 mm

$\Delta L_1 = \Delta_2 + \Delta_3 = 0.4$ cm

$\Delta L_2 = \Delta_2 + \Delta_1 = 0.5$ cm

2. In the density of liquid experiment, one of students measured $L_1 = 15.8\ cm$, $L_2 = 18.9\ cm$, also he estimated the quantities $\Delta_1 = 0.2\ cm$, $\Delta_2 = 0.3\ cm$, and $\Delta_3 = 0.1\ cm$, assuming the density of water $\rho_1 = 1.04\ gm/cm^3$, Find the density of liquid ρ_2 (with uncertainty)

$$\frac{\rho_1 L_1}{L_2} = \frac{\rho_2 L_2}{L_2} \Rightarrow \rho_2 = \rho_1 \frac{L_1}{L_2} = 1.04 \frac{gm}{cm^3} \times \frac{15.8\ cm}{18.9\ cm}$$

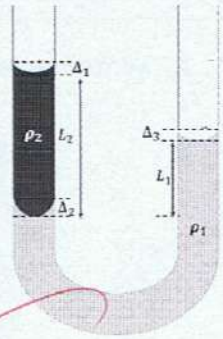
$\rho_2 = 0.8694$ gm/cm³

$$\frac{\Delta\rho_2}{\rho_2} = \frac{\Delta L_1}{L_1} + \frac{\Delta L_2}{L_2} \Rightarrow \Delta\rho_2 = \rho_2 \left(\frac{0.4}{15.8} + \frac{0.5}{18.9}\right) = 0.045$$

$= \boxed{0.04}$

$\rho_2 \mp \Delta\rho_2$

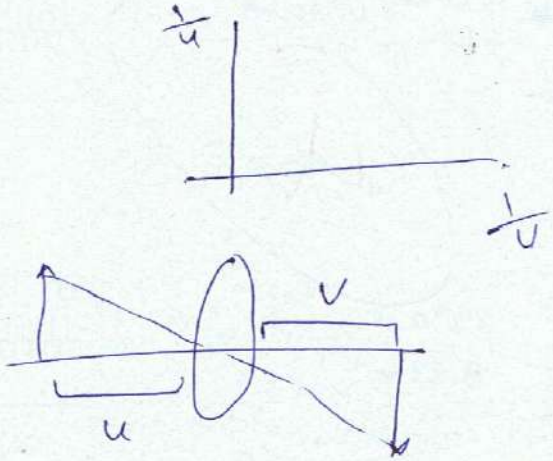
$= \boxed{0.87 \mp 0.04}$ gm/cm³



4.5

3. In the todays experiment:
   a) What is the aim of the experiment? calculate the focal length and convex length of a lens
   b) What is the graph you will draw in the experiment and what are the quantity will you calculate ?

$\frac{1}{u}$ vs $\frac{1}{v}$, the Quantities are u, v



2

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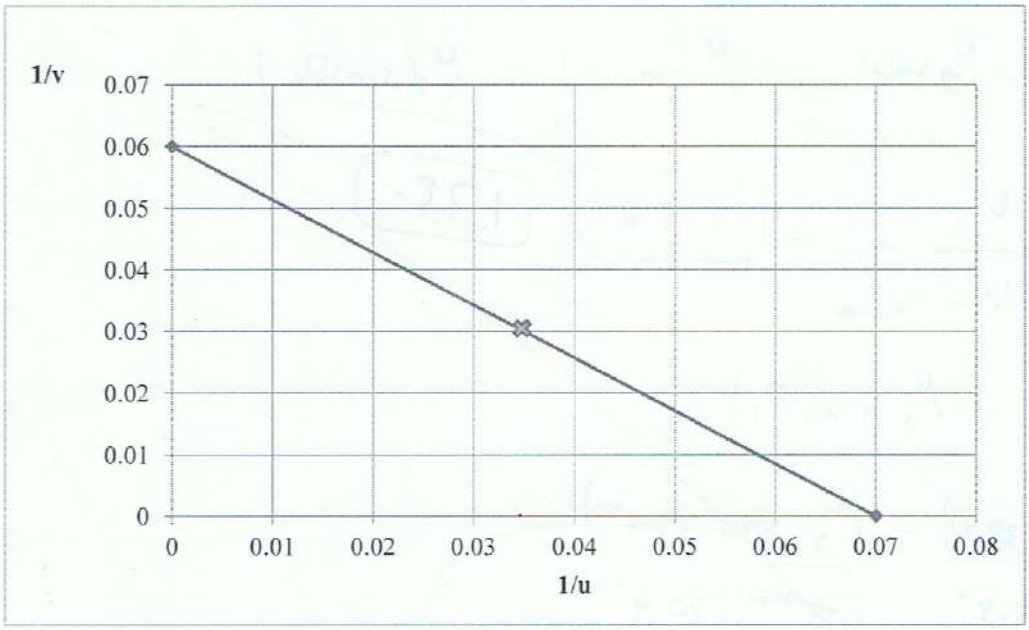
PHY 111

Quiz 3 sec # 3

Student name: Student ID:

1. Consider the following graph of $\frac{1}{v}$ vs $\frac{1}{u}$ from the focal length of convex lens experiment, and let $\Delta v = \Delta u = 0.16\ cm$, what is the focal length of the lens ($f \pm \Delta f$)?



$\Delta v = \Delta u = 0.16\ cm$

take the x-intercept $\Rightarrow \frac{1}{f} = \frac{1}{u} + \frac{1}{\infty} \Rightarrow \frac{1}{f} = 0.07\ cm \Rightarrow f = 14.286\ cm$

take the y-intercept $\Rightarrow \frac{1}{f} = \frac{1}{\infty} + \frac{1}{V} \Rightarrow \frac{1}{f} = 0.06\ cm = 16.666\ cm$

$\overline{f} = \frac{f_1 + f_2}{2} = 15.476\ cm$

$\left(\frac{\overline{1}}{u}, \frac{\overline{1}}{v}\right) = (0.035, 0.03)\ cm$

$(\overline{u}, \overline{v}) = (28.57, 33.33)\ cm$

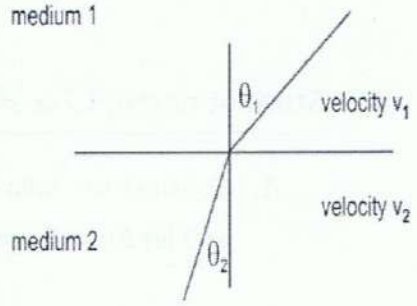
$\frac{\Delta f}{f^2} = \frac{\Delta u}{u^2} + \frac{\Delta v}{v^2} \Rightarrow \frac{\Delta f}{(\overline{f})^2} = \frac{0.16}{u^2} + \frac{0.16}{v^2}$

$\Rightarrow \Delta f = 0.0814 \approx 0.08\ cm$

$f \pm \Delta f \Rightarrow 15.48 \pm 0.08\ cm$

2. The speed of light in medium 1 (v_1) is 225000 km/sec , let $\theta_1 = 38.7°$, $\theta_2 = 20.4°$ and using the speed of light in vacuum $c = 300000\ km/sec$, Find

   a) The refraction indices of medium1 and medium 2?
   b) The speed of light in medium 2 (v_2) in km/sec unit?



$U_{\text{in medium}} = 225000\ km/sec$ $\quad \theta_1 = 38.7°$

$U_{\text{in vacuum}} = 300000\ km/sec$ $\quad \theta_2 = 20.4°$

$M_1 \sin(i) = M_2 \sin(\theta) = M_1 \sin(\theta_1) = M_2 (\sin\theta_2)$

$M_{\text{medium}_1} = \dfrac{U_{\text{in medium}}}{U_{\text{in vaccum}}} = 0.75$ $\quad 1.33$

$M_1 (\sin\theta_1) = M_2 \sin(\theta_2)$

$0.75\,(\sin(38.7)) = M_2\,\sin(20.4°)$

$\sin(20.4°)$ $\quad \sin(20.4°)$

$M_2 = 1.345 = 2.385$

$M_{\text{medium}_2} = \dfrac{U_{\text{in medium}_2}}{U_{\text{in vaccim}}} \Rightarrow U = M\, U_{\text{vaccum}}$

$403588.20\ km/sec$

125751.615