جامعة بنها　　　　　　　　　　　　　الفرقة الأولي

كلية العلوم　　　　　　　　　　　　　مادة (فيزياء عامة ١)

دور يناير ٢٠١٧　　　نظام ساعات معتمدة　　　الزمن 2 ساعات

د./ صلاح عيد إبراهيم حمزة　　　　　تاريخ الامتحان: ١٤ /٠١/٢٠١٧

الاجابة باللون الأحمر

B) Properties of Matter

Answer the following Questions (40 markets)

A)Choose the correct answer (each item 2markets)

17- The Bulk modulus of elasticity is

a- $\dfrac{normal\,stress}{volume\ strain}$　　b- $\dfrac{normal\ stress}{longtudinal\ strain}$　　c – $\dfrac{\tan gential\ stress}{shearing\ strain}$

18-The stress in stretching a uniform metallic wire of area cross section 10^{-6} m^2 and length ٢m through $4x10^{-3}$ m and its Young's modulus is $2x10^{11}$ N/m^2 is

a- ٤x10^{8} N/m^2　　b-٥x$10^{٨}$ N/m^2　　c – 6.33x$10^{٨}$ N/m^2

19-The moment of inertia of a uniform Ring of mass m and radius R about an axis passing through its center perpendicular to its plane is .

a- $\frac{1}{2}mR^2$　　b- mR^2　　c- $\frac{3}{2}mR^2$

20-The equation of motion of simple harmonic motion for LC circuit is

a- $\ddot{I} = -LC^2 I$　　b- $\ddot{I} = -\dfrac{L}{C} I$　　c- $\ddot{I} = -\dfrac{1}{LC} I$

21- The Filter pump is used to ……….the process of filtration of liquids

a- slow　　b-quicken　　c – stop

22- The work done in stretching a uniform metallic wire ,is

a- $\frac{1}{2}\,stress x\,strain$　　b-2x $strainxstrain$　　c – $\dfrac{stress}{2\ strain}$

23- Using the dimensional theory the relation between the excess pressure inside a soap bubble P and surface tension γ and radius of bubble R and dimensionless constant k is

a- $P = k\dfrac{\gamma}{R^2}$　　b- $P = k\dfrac{\gamma}{R}$　　c- $P = k\dfrac{\gamma^3}{R^2}$

24-The Bernouli equation of fluids where,p is the pressure of fluid, h is the height of fluid,g the gravity , ρ the density of fluid and v is velocity of fluid is a- $P + h\rho g + \frac{1}{2}\rho V^2 = constant$ b- $P^2 + h\rho g + \frac{1}{2}\rho V^2 = constant$ c- $P + h\rho^2 g + \frac{1}{2}\rho V = \text{constant}$

25-The resultant equation of standing wave of two waves $y_1 = ASin(kx - \omega t)$ and $y_2 = ASin(kx + \omega t)$ is

a- $y = 2ASin(2kx - 2\omega t)$ b- $y = 2ASin(kx)\cos(\omega t)$ c- $y = 2A\cos(kx)\sin(\omega t)$

26- In S.H.M. the acceleration is directly proportional to……..

(a) Area   (b) volume   (c) displacement

27- Sound waves in a gas are……… waves.

(a) Longitudinal   (b) standing   (c) transverse

28-The wave equation is a differential equation in second order with respect to………and ………

(a) Time, force   (b) time, area   (c) time, displacement

29-The region in which stress and strain are proportional is called……

(a) Young's region   (b) Hook's region   (c) bulk region

30- The SI unit of stress is………

(a) N.m   (b) N/ m   (c) N/m^2

31-The fluid is nonviscous, this means that there is no internal………

(a) Motion   (b) force   (c) friction

(B)Answer the following questions:

1-Prove that The equation of continuity in fluid flowing through a pipe of non uniform size where A is cross sectional area of tube and v is velocity of fluid is $Av = consant$ (3markets)

2-prove that the maximum possible value of poisson's ratio is 1/2   (3markets)

3- Deduce the resultant wave of the two waves $y_1 = ASin(kx - \omega t)$ and $y_1 = ASin(kx - \omega t + \varphi)$ and discuss the case of constructive interference   (4markets)

1-Prove that The equation of continuity in fluid flowing through a pipe of non uniform size where A is cross sectional area of tube and v is velocity of fluid is $Av = consant$ (3markets)

------------------------------ **Solution** --

Consider an ideal fluid flowing through a pipe of non uniform size, as illustrated in Fig. (1). The fluid is assumed to be in

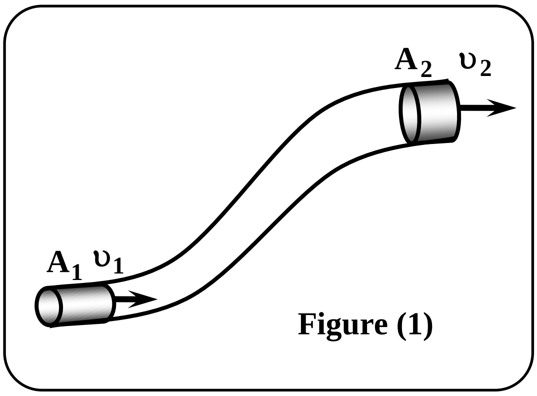

Figure (1)

stream line motion. As there is no accumulation of the fluid at any point, the amount of fluid flowing per second is the same at all cross sections of the tube. Mass of fluid that crosses the area A_1 at time interval Δt is

$$m_1 = \rho V_1 = \rho A_1 d_1 \quad , \quad d_1 = \upsilon_1 \Delta t$$

$$m_1 = \rho A_1 \upsilon_1 \Delta t$$

The mass of fluid that crosses the area A_2 at the same time interval is

$$m_2 = \rho A_2 \upsilon_2 \Delta t$$

Because the fluid is incompressible and because the flow is steady, the mass crosses A_1 in a time interval Δt must equal the mass that crosses A_2 in the same time interval. That is,

$$A_1 \upsilon_1 = A_2 \upsilon_2$$

$$A\upsilon = const.$$

This equation is called the equation of continuity.

2-prove that the maximum possible value of poisson's ratio is 1/2

(3markets)

------------------------------ **Solution** --

Whenever a body is subjected to a force in a particular direction, there is change in dimensions of the body in the other two perpendicular directions. This is called secondary strain. ***Poisson's ratio*** is defined as ***the ratio of secondary strain per unit stress to the longitudinal strain per unit stress***.

Consider a wire of length ℓ and radius r. The wire is fixed at one end and a force is applied at the other end. Consequently, the length of the wire increases and its radius decreases, see Fig. (7). If increase in length is $d\ell$, and decrease in radius is dr, then

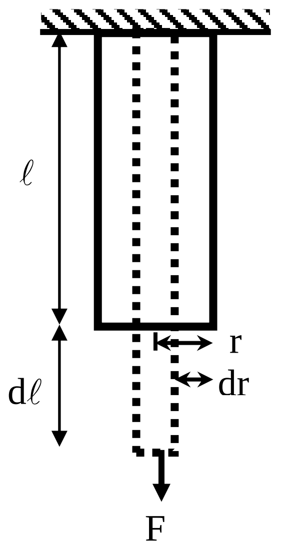

Figure (7)

$$\text{Longitudinal strain } = \frac{d\ell}{\ell}$$

$$\text{Secondary strain } = -\frac{dr}{r}$$

Since Poisson's ratio σ is the ratio of secondary strain to the longitudinal strain, then

$$\sigma = \frac{-dr/r}{d\ell/\ell}$$

Prove that $(\sigma = \frac{1}{2})$

The initial volume of the wire is

$$V = \pi r^2 \ell$$

If the volume of the wire remains unchanged $(dV = 0)$ after the force has been applied, then

$$dV = 0$$

$$0 = \pi(r^2\, d\ell + 2r\, dr\, \ell)$$

$$r\, d\ell = -2\ell\, dr$$

$$\therefore\ \sigma = \frac{-dr/r}{d\ell/\ell} = \frac{1}{2}$$

This is the maximum possible value of Poisson's ratio.

3- Deduce the resultant wave of the two waves $y_1 = ASin(kx - \omega t)$ **and** $y_1 = ASin(kx - \omega t + \varphi)$ **and discuss the case of constructive interference (4markets)**

------------------------------- **Solution** --

Let us consider two waves of equal frequency and amplitude traveling with the same speed in the same direction but with a phase difference φ between them. The equations of the two waves will be:

$$y_1 = A\sin(kx - \omega t)$$

and

$$y_2 = A\sin(kx - \omega t + \varphi)$$

Now let us find the resultant wave

$$y = y_1 + y_2 = A[\sin(kx - \omega t) + \sin(kx - \omega t + \varphi)]$$

From the trigonometric relations

$$\sin a + \sin b = 2\sin\tfrac{1}{2}(a+b)\,\cos\tfrac{1}{2}(a-b)$$

We obtain

$$\therefore\ y = 2A\,\cos\frac{\varphi}{2}\,\sin(kx - \omega t + \frac{\varphi}{2})$$

The resultant wave represents a new wave having the same frequency but with an amplitude $2A\cos\frac{\varphi}{2}$

Special cases

- **Constructive interference**: If $\varphi = 0$ then $\cos 0 = 1$ and

  $y = 2A\,\sin(kx - \omega t)$

  The crest of one corresponds to the crest of the other and likewise for the troughs. The resultant amplitude is twice that of either waves alone, Fig, (3a).

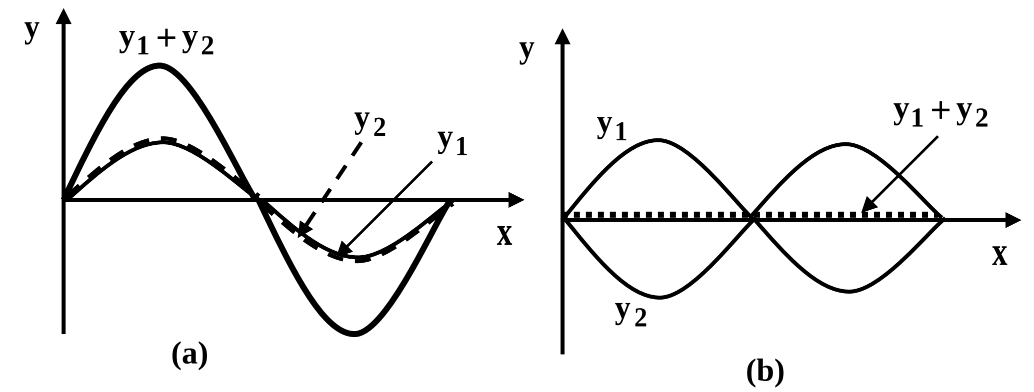

Figure (3)