TOPIC: GRAVITATION & MECHANICAL PROPERTIES OF SOLIDS

TOTAL = 20 MARKS DATE: 1-11-14

DURATION = 45 MIN.

UNIT TEST –XI (SET- A)

1. Draw and discuss stress versus strain graph, explaining clearly the terms Elastic limit, permanent set, proportionality limit, elastic hysteresis, tensile Strength. **(5)**

2. Derive expression for the orbital velocity of a satellite and its time period. What is a geostationary satellite? Obtain the expression for the height of the geostationary satellite. **(5)**

3. In a two stage launch of a satellite, the first stage brings the satellite to a height of 150 km and the 2nd stage gives it the necessary critical speed to put it in a circular orbit. Which stage requires more expenditure of fuel? Given mass of earth = 6.0 × 10^{24} kg, radius of earth = 6400 km. **(3)**

4. An aluminum wire 1m in length and radius 1mm is loaded with a mass of 40 kg hanging vertically. Young's modulus of Al is 7.0 × 10^{10} N/m^2 Calculate (a) Tensile stress (b) change in length (c) tensile strain and (d) The force Constant of such a wire. **(3)**

5. State Hooke's law. Deduce expression for young's modulus of material of a wire of length 'l', radius of crossection 'r' loaded with a body of mass M Producing an extension Δl in it. **(2)**

6. Prove that the elastic potential energy per unit volume is equal to $\frac{1}{2}$ Stress × strain **(2)**

Designed by: Md. Wasim Iqbal
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UNIT TEST –XI (SET- A) DATE: 1-11-14

MARKING SCHEME

1.

Diagram & Showing points in the graph = 1 + 1 =2 marks **Explanation: (Definition & Nature) ½ x 6 = 3 marks** **Elastic Limit = ½, Permanent Set =1/2 Proportionality Limit=1/2** **Elastic hysteresis= ½, Tensile Strength = 1/2**
Refer to S. l. Arora Book Page no.= 9.4 Quest.no= 10

2.

For Orbital velocity= 3 marks (Diagram= 1, Derivation=2 marks (O.V =1 +Time Period=1) **For Geostationary Satellite= 2 marks (Definition = 1 mark, Derivation of height = 1**
Refer to S. l. Arora Book Page no.= 8.31 & 8.34 Quest.no=41 & 8.25

3.

(1+1+1/2+1/2= 3 marks)

Work done on satellite in first stage = W1 = PE at 150 km – PE at the surface

$W_1 = \frac{-GMm}{R+h}$ - $(\frac{-GMm}{R+h})$= $\frac{GMmh}{R(R+h)}$ 1

Work done on satellite in 2nd stage = W2 = energy required to give orbital Velocity,

v_0 =1/2 m v_0^2 =$\frac{1}{2}\frac{GMm}{R+h}$ 1

$\frac{W_1}{W_2}$= $\frac{2h}{R}$ =$\frac{2\ X\ 150}{6400}$ =$\frac{3}{64}$ < 1 1/2

∴ **W2 > W1 so second stage requires more energy.** ½

4.

Formula used:1$\frac{1}{1/2}$ **Calculation(with final answer)= 1**$\frac{1}{1/2}$

a) Stress= F/A= mg/$\pi\ r^2$ = $\frac{40\ X\ 10}{\pi\ (1\ X10\ )^{-3}}$ =

b) $\Delta l = FL/AY$ =

c) Strain = $\frac{\Delta l}{l}$

d) F = kx = kΔl **, Force constant , k= F/**Δl =

5.

Defination= 1 , Derivation= 1	
Refer to S. l. Arora Book	**Page no.= 9.3, 9.4 Quest.no= 7, 9**

6.

Formula used = 1 Derivation = 1		
Refer to S. l. Arora Book	**Page no.=9.20**	**Quest.no=27**

TOPIC: GRAVITATION & MECHANICAL PROPERTIES OF SOLIDS

UNSOLVED SET FOR PRACTICE

UNIT TEST –XI **(SET- B)**

1. Define the term gravitational potential energy. Is it a scalar or vector? Derive an expression for the gravitational potential energy at a point in the Gravitational field of earth. . (5 Mrks.)

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2. a) A wire of length l area of crossection A and young's modulus Y is stretched by an amount x. What is the work done? . (5 Mrks.)

b) Define shear modulus. With the help of a diagram explain how shear Modulus can be calculated. .

c) How are we able to break a wire by repeated bending?

3. Three mass points each of mass m are placed at the vertices of an equilateral triangle of side l. What is the gravitational field and potential the centroid of the triangle due to the three masses. . (3 Mrks.)

4. How is the knowledge of elasticity useful in selecting metal ropes used in cranes for lifting heavy loads. . (3 Mrks.)

5. If the radius of the earth were to decrease by 1%, keeping its mass same, how will the acceleration due to gravity change? . (2 Mrks.)

6. Which is more elastic steel or rubber? Explain. (2Mrks.)

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