PHYSOL-3 EXAMINATION SERIES

Exam-3 CHAPTERS 8,9,10 & 11

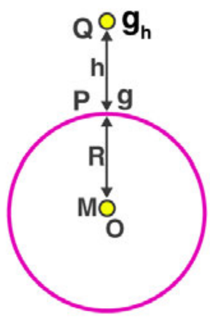
SUNDAY 15-05-2022 @ 7.00pm

Answerkey

Answer any 3 questions from 1 to 5. Each carries 1 score

1	Mass of body	**1**
2	Young’s modulus	**1**
3	Hydraulic Lift	**1**
4	increases / decreases.	**1**
5	conduction, convection and radiation	**1**

Answer any 5 questions from 6 to 13. Each carries 2 score

6	Let g--> acceleration due to gravity on the surface of earth. **g_h**--> acceleration due to gravity at a height ‘h’. h--> height from the surface of earth. R--> Radius of earth. M--> Mass of earth. We have $g=\frac{GM}{R^2}$ and $g_h=\frac{GM}{(R+h)^2}$ Therefore $g_h=\frac{GM}{R^2(1+\frac{h}{R})^2}=g(1+\frac{h}{R})^{-2}$ For $\frac{h}{R}$ << 1 , using binomial expression, $g_h=g[1-\frac{2h}{R}]$ Thus the acceleration due to gravity decreases with height from the surface of earth.  	**2**
7	“The square of the time period of revolution of the planet around the sun is proportional to the cube of the semi-major axis of the elliptical orbit” $T^2 \alpha a^3$	**2**
8	Steel. Because for a given stress , strain is small for steel.	**2**
9	‘A’. Small strain for large stress. or Slop(Young’s Modulus) is higher for A	**2**
10	According to pressure depth relationship P = hρg, h–depth, ρ–density and g–acceleration due to gravity. As per the above equation blood pressure in humans will be greater at the feet than at the brain.	**2**
11	a) Hot soup is more tasteful than the cold one because the surface tension of the hot soup is less than that of the cold and so spreads over a larger area of the tongue. b) Warm water has lower surface tension comparing with cold water and can wet the dirty	**2**

clothes in better way and achieves greater cleaning action.

12

Graph	Process	State
i) BC	a) Melting	r)Partially Solid and liquid
ii) DE	d) Vaporisation	s) Partially liquid and vapour

2

13

$$\frac{98.6-32}{180}=\frac{C}{100}$$

$$C = \frac{100(98.6-32)}{180} = 37\ ^0C$$

2

Answer any 3 questions from 14 to 17. Each carries 3 score

14

At a height

$$g' = g\left(1-\frac{2h}{R}\right)$$

At a depth $g' = g\left(1-\frac{d}{R}\right)$

Both are equal.

$$g\left(1-\frac{2h}{R}\right) = g\left(1-\frac{d}{R}\right)$$

$$\left(1-\frac{2h}{R}\right) = \left(1-\frac{d}{R}\right)$$

2h=d

h=d/2

h=600/2=300Km

3

15

a) Materials for which stress-strain graph is not a straight line within elastic limit. **2**

Do not obey Hooke's law.

The elastic region is very large.

No plastic region.

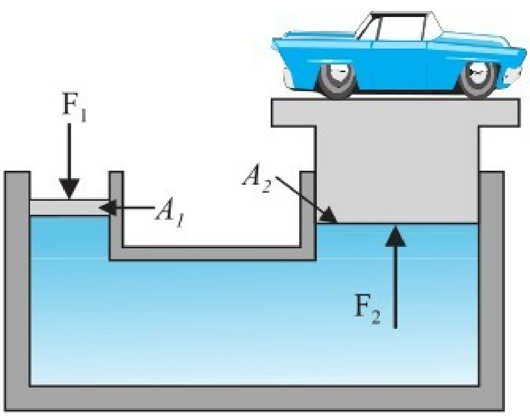
Examples: Rubber, the elastic tissue of aorta.

b) Compressibility **1**

16

Pascal's law

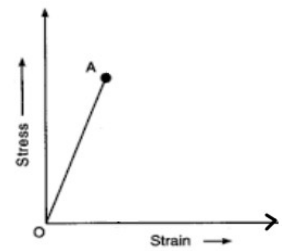
When force is applied on a liquids the pressure is transmitted equally in all directions inside the liquids there fore the hydrostatic pressure has no fixed direction and hence it is a scalar quantity



3

	Let, F_1 --> force on smaller piston. F_2 -->force developed on larger piston. A_1 --> area of smaller piston, A_2 --> area of larger piston. According to Pascal's law, the pressure applied on smaller piston is transmitted with out change at all points in the liquid. Thus $\frac{F_1}{A_1}=\frac{F_2}{A_2}$ Therefore $F_2=\frac{F_1}{A_1}A_2$ as $A_2 >> A_1$, $F_2 >> F_1$ This shows that the small force applied on the smaller piston will be appearing as a very large force on the large piston. As a result of which a heavy load placed on the larger piston is easily lifted upwards.	
17	a) 1:2:3 b) Invar has extremely small coefficient of linear expansion. Therefore the length of the clock pendulum doesn't change appreciably with the change of season so the clock keeps correct time.	**1** **2**

Answer any 2 questions from 18 to 20. Each carries 4 score

18	a) While a satellite is revolving around earth, the necessary centripetal force is provided by the gravitational force of attraction. No other force is required for the satellite to keep in orbital motion. That is why a satellite needs no fuel to go around a planet in its fixed orbit. b) Consider a satellite of mass m moving round in a closed orbit of radius r with orbital velocity v_o. Let M be the mass of earth and R its radius. When the satellite is in stable orbit, the centripetal force is provided by the gravitational force. That is $\frac{m v_0^2}{r} = \frac{G M m}{r^2}$ or $v_0 = \sqrt{\frac{G M}{r}}$ -------- (1) If h is the height of the satellite above earth, r = R + h $v_0 = \sqrt{\frac{G M}{R+h}}$ -------- (2) But $g = \frac{G M}{R^2}$ or $G M = g R^2$ -------- (3). Substituting eq(3) in eq(2) we get $v_0 = \sqrt{\frac{g R^2}{R+h}}$ -------- (4) According to the above equation the orbital velocity of a satellite is independent of mass of the satellite but depends on the mass of the planet. c) If gases molecules were present in moon, the rms velocity of the gas molecules would be greater than escape velocity on the surface of moon and hence all gases molecules were escaped out.	**1** **2** **1**
19	a)Hooke's law states that within the elastic limit stress is directly proportional to strain. Stress α Strain Stress = K x Strain Where K is known as modulus of elasticity. If a material obey Hooke's law, the graph connecting stress and strain will be a straight line.  	**1**

b)

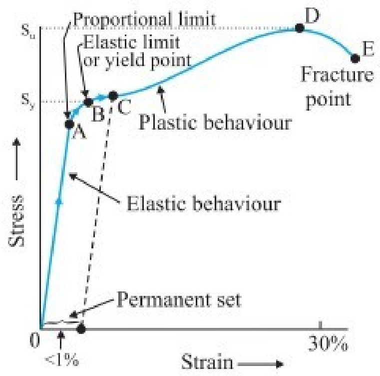


Fig. 2

2

c) If the points D and E are very close to each other the material is brittle and if they are far apart, the material is ductile.

1

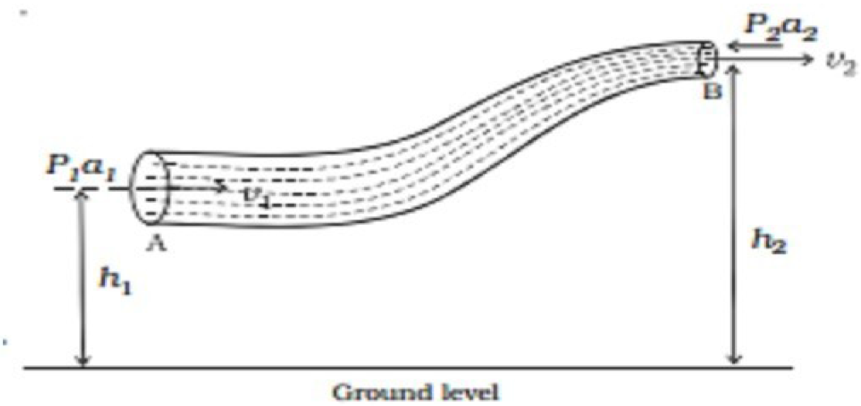
20 **Bernoulli's theorem:**

It states that "for the stream line flow of an ideal liquid, the total energy (sum of pressure energy, potential energy, and kinetic energy) per unit mass remains constant at every cross section through out the flow"

$$\frac{P}{\rho}+\frac{V^2}{2}+gh \quad \text{or} \quad P+\frac{\rho v^2}{2}+\rho gh$$

This is the conservation law of energy for a flowing liquid.

Proof:



Let

P 1 --> pressure applied at A,

P 2 --> pressure at B,

a 1 --> area of cross section at A,

a 2 --> area of cross section at B,

h 1 --> mean height of section A

h 2 --> mean height of section B,

v 1 --> normal velocity of liquid at A

v 2 --> normal velocity of liquid at B.

ρ--> density of liquid.

Net work done per second on the liquid by the pressure energy in moving the liquid from section A to B = $P_1 V - P_2 V$

4

[By equation of continuity volume of liquid ‘V’ flowing per second remains constant]
The increase in potential energy /second of the liquid = $mgh_2 - mgh_1$
The increase in kinetic energy /second of the liquid = $\frac{1}{2} mv_2^2 - \frac{1}{2} mv_1^2$
According to work energy principle,
work done/second by the pressure energy= increase in PE/second + increase in KE/second.

$$P_1 V - P_2 V = mgh_2 - mgh_1 + \frac{1}{2} mv_2^2 - \frac{1}{2} mv_1^2$$

$$P_1 V + mgh_1 + \frac{1}{2} mv_1^2 = P_2 V + mgh_2 + \frac{1}{2} mv_2^2$$

Dividing by 'm',

$$\frac{P_1 V}{m} + gh_1 + \frac{1}{2} v_1^2 = \frac{P_2 V}{m} + gh_2 + \frac{1}{2} v_2^2$$

$$\frac{P_1}{\rho} + gh_1 + \frac{1}{2} v_1^2 = \frac{P_2}{\rho} + gh_2 + \frac{1}{2} v_2^2$$

ie., $$\frac{P}{\rho} + gh + \frac{1}{2} v^2 = constant.$$

OR $$P + \rho gh + \frac{\rho v^2}{2} = constant$$

Thus, Pressure energy per unit mass+ PE per unit mass + KE per unit mass = a constant.
This proves Bernoulli’s theorem