PHYSICS:

1. A uniform elastic plank moves due to a constant force $F_0 = 84N$ distributed uniformly over the end face of the plank. The area of the end face is $10cm^2$ and young's modulus is $2.1 \times 10^{11} N/m^2$. Then the strain produced in the direction of the force is

1) 2×10^{-7} 2) 4×10^{-7}
3) 6×10^{-7} 4) 5×10^{-7}

2. An elastic rod of length l, Young's modulus Y and area of cross section A is rotating with angular velocity ω about its centre on a smooth surface. (m = mass of rod)

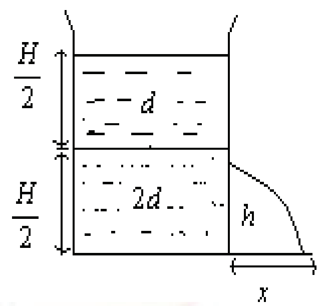
(1) The stress at a distance $\frac{l}{4}$ from the centre of rod is $\frac{3}{32}\frac{m\omega^2 l}{A}$

(2) The elongation in the rod is $\frac{m\omega^2 l^2}{6AY}$

(3) The elastic energy stored in the rod $\frac{m^2\omega^4 l^2}{288A^2Y}$

(4) The elastic energy stored in the rod $\frac{m^2\omega^4 l^2}{A^2Y}$.

3. A container of large uniform cross sectional area A resting on a horizontal surface, holds two immiscible, irrotational and incompressible liquids of densities d and 2d, each of height H/2 as shown. The lower density liquid is open to the atmosphere having pressure p_0



A tiny hole of area S(<<1) is punched on the vertical side of the container at a height $h\left(<\frac{H}{2}\right)$ Maximum horizontal distance x_m is

1) $\frac{H}{4}$ 2) 2H
3) $\frac{3H}{4}$ 4) $\frac{H}{2}$

4. A thin uniform metallic rod of length 0.5 m and radius 0.1 m rotates with an angular velocity 400 rad/sec in a horizontal plane about a vertical axis passing through one of its ends. The density of material of the rod is 10^4 kg/m^3 and the Young's modulus $y = 2\times10^{11} N/m^2$ The tension developed in the rod at a distance 0.25 m from the axis is

1) $8\pi\times10^6 N$ 2) $\frac{3}{2}\pi\times10^6 N$

3) $4\pi\times10^6 N$ 4) $2\pi\times10^6 N$

5. A uniform rope is rotated about an axis perpendicular to length and passing through one of its end. The ratio of stresses at end near the axis of rotation and middle point is (neglect gravity)

1) 2:1 2) 3:2

3) 4:3 4) 5:4

6. A cylindrical container of cross sectional area $100 cm^2$ is containing water upto a height of 2m. Now a cork ball of 5 kg is put into the container and it floats in equilibrium. If a tiny hole is made on vertical wall very close to base then the velocity of efflux will be (in m/s). ($g=10m/sec^2$)

1) $2\sqrt{10}$ 2) 5

3) $5\sqrt{2}$ 4) 10

7. A body is rotated in a circular path by means of a wire, which fails at angular velocity ω_0. If the wire is cut into two equal pieces and the same body is rotated by means of the two pieces together, then the failure takes place at angular velocity ω. The ratio $\frac{\omega}{\omega_0}$ is (neglect gravity)

1) 1 2) $\sqrt{2}$

3) 2 4) $2\sqrt{2}$

8. A uniform rope of mass m and length L is hanged freely from stationary ceiling. If the cross sectional area of rope is A and Young's modulus Y, then net elongation in the rope due to its own weight

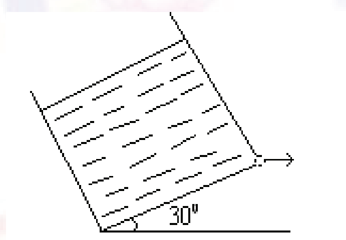
1) $\frac{mgL}{AY}$ 2) $\frac{mgL}{2AY}$

3) $\frac{mgL}{3AY}$ 4) $\frac{mgL}{4AY}$

9. The rubber cord catapult has cross sectional area $10^{-6}m^2$ and total un stretched length 0.1m. It is stretched to 0.12 m and then released to project a stone of mass $5\times10^{-3}kg$. If young's modulus of rubber is 0.5 Gpa, the velocity projection of the stone is

1) 0.5 m/s 2) 0.1 m/s
3) 2 m/s 4) 20 m/s

10. Liquid is filled in a vessel of square base (2m x 2m) up to a height of 2 m and the vessel is tilted from the horizontal at 30^0 as shown.



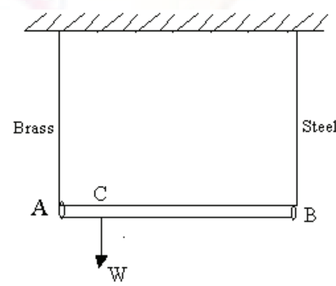
Find the velocity of efflux if liquid does not spills out?

1) 3.2 m/s 2) 4.96 m/s
3) 8.6 m/s 4) 2.68 m/s

11. The length of a metal wire is l_1 when the tension in it is T_1 & l_2 when the tension is T_2. The natural length of the wire is

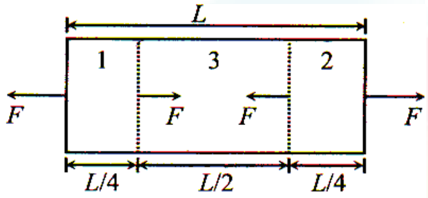
1) $\frac{l_1T_2-l_2T_1}{T_2-T_1}$ 2) $\frac{l_1T_2-l_2T_1}{T_1+T_2}$
3) $\frac{l_1T_2-l_2T_1}{T_1-T_2}$ 4) $\frac{l_1T_1-l_2T_2}{T_1+T_2}$

12. A 2m long light metal rod AB is suspended from the ceiling horizontally by means of two vertical wires of equal length tied to its ends. One wire is of brass and has cross section of $0.2\times10^{-4}m^2$ and the other is of steel with $0.1\times10^{-4}m^2$ cross section. In order to have equal stress in the two wires, a weight is hang from the rod. The position of the weight along the rod from end A should be.



1) 66.6 cm 2) 133 cm
3) 44.4 cm 4) 155.6 cm

13. External forces acting on a rod of length L, cross - sectional area A and Young's modulus Y are as shown in the figure. Choose the correct alternative.



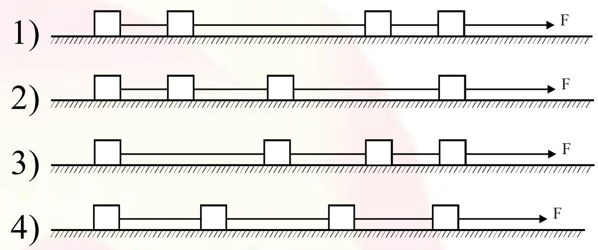
(1) there will be no change in length of rod.

(2) the net change in length of rod is $\frac{2FL}{AY}$

(3) the net change in length of rod is $\frac{FL}{2AY}$

(4) the net change in length of rod is $\frac{FL}{AY}$

14. Each of the pictures shows four objects tied together with rubber bands being pulled to the right across a horizontal frictionless surface by a horizontal force F. All the objects have the same mass; all the rubber bands obey Hooke's law, have the same equilibrium length, and the same force constant. Which of these pictures drawn most correctly depicts the steady state of configuration?

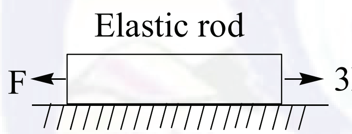


15. A uniform metal wire of mass M, cross sectional radius r and Young's modulus Y is in the form of a ring of radius R and it is rotated about a vertical axis through its center at an angular speed of ω. The change in radius (ΔR) of the ring due to rotation would be ?

1) $\frac{M\omega^2R^2}{\pi^2r^2Y}$ 2) $\frac{M\omega^2R^2}{2\pi^2r^2Y}$

3) $\frac{M\omega^2r^2}{\pi^2r^2Y}$ 4) $\frac{M\omega^2r^2}{2\pi^2r^2Y}$

16. A uniform elastic rod of cross section are A, natural length L and Youngs modulus Y is placed on a smooth horizontal surface. Now two horizontal forces (of magnitude F and 3F) directed along the length of rod and in opposite direction act at two of its ends as shown. After the rod has acquired steady state, the extension of the rod will be



1) $\frac{2F}{YA}L$ 2) $\frac{4F}{YA}L$ 3) $\frac{F}{YA}L$ 4) $\frac{3F}{2YA}L$

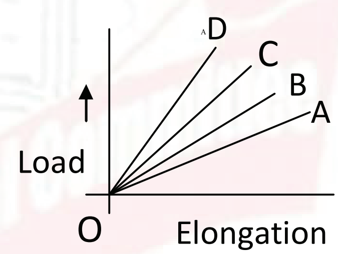
17. A composite wire (uniform cross section of $5.5\times10^{-5}m^2$) is made of a steel wire of length 1.5 m and a copper wire of length 2.0 m. The extension produced in this composite wire, when it is loaded with a mass of 200 kg is $\left(Y_{Steel}=2\times10^{11}N/m^2,\right.$ $\left.Y_{Copper}=1\times10^{11}N/m^2, g=10m/s^2\right)$ (Weight of the composite wire is negligible)

1) 0.5 mm 2) 1mm
3) 2 mm 4) 4 mm

18. The work done in stretching a wire by 0.1 mm is 4 J. The work done in stretching another wire of same material, but with double the radius and half the length by 0.1mm is

1) 16 J 2) 32 J 3) 64 J 4) None

19. The load versus elongation graphs for four wires A, B, C and D of the same material of same length are shown in the figure. The thickest wire is represented by the line:



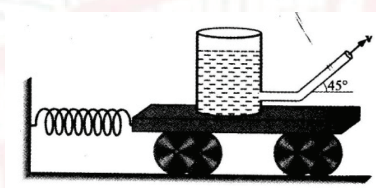
1) OD 2) OC
3) OB 4) OA

20. A uniform plank is resting over a smooth horizontal floor and is pulled by applying force at its one end. Which of the following statement is correct?
1) Stress developed in plank material is maximum at the end at which force is applied and decreases linearly to zero at the other end
2) A uniform tensile stress developed in the plank material
3) Since the plank is pulled at one end only therefore it states to accelerate along the direction of the force. Hence, no stress is developed in the plank material.
4) none of the above

21. Water is filled in a uniform container of area of cross section A. A hole of cross section area a (<< 1) is made in the container at a height of 20 m above the base. Water streams out and hits a small block placed at some distance from container. With what speed (in ms^{-1}) the block should be moved such that water streams always hits the block.
(Given $\frac{a}{A}=\frac{1}{20}$). (Take g = 10 ms^{-2})
1) 4 2) 6 3) 5 4) 1

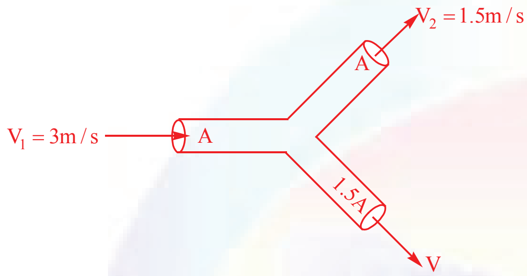
22. In a test experiment on a model aeroplane in a wind tunnel, the flow speeds on the upper and lower surfaces of the wing are 70m/s and 63m/s respectively. What is the lift on the wing if its area is $2.5m^2$?
Density of air = $1.3kg/m^3$
1) $1.51\times10^3 N$ 2) $3.26\times10^3 N$
3) $5.68\times10^3 N$ 4) $9\times10^3 N$

23. A tank and a through are placed on a trolley as shown. Water issues from the tank through at 5cm diameter nozzle at 5m/s and strikes the through which turns it by 45^0. Determine the compression of the spring of stiffness2000N/m



1) 2m 2) 0.0173m
3) 4m 4) 1.73m

24. An incompressible liquid flows through a horizontal tube in the following fig. Then the velocity v of fluid is



1) 3.0m/s 2) 1.5m/s
3) 1.0m/s 4) 2.25m/s

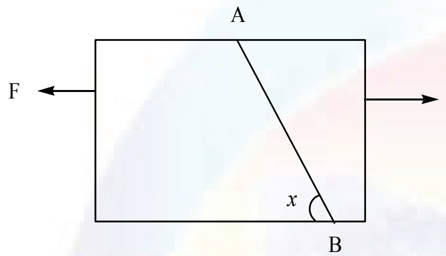
25. There is a small hole near the bottom of an open tank filled with water. The speed of water ejected depends on
1) area of the hole
2) density of liquid
3) height of liquid from hole
4) area of the vessel

26. A large tank filled with water to a height 'h' is to be emptied through a small hole at the bottom. The ratio of time taken for the level of water fall from h to h/2 and h/2 to zero is
1) $\sqrt{2}$ 2) $\frac{1}{\sqrt{2}}$ 3) $\sqrt{2}-1$ 4) $\frac{1}{\sqrt{2}-1}$

27. A slightly conical wire of length l and radii r_1 *and* r_2 is stretched by two forces applied parallel to length in opposite directions and normal to end faces. If y denotes the young's modulus then the elongation in the wire is
1) $\frac{Fl}{2\pi r_1 r_2 y}$ 2) $\frac{Fl}{\pi r_1 r_2 y}$
3) $\frac{2Fl}{\pi r_1 r_2 y}$ 4) $\frac{Fl}{4\pi r_1 r_2 y}$

28. A mass m kg is whirled in a vertical plane by tying it at the end of a flexible wire of length l and area of cross section A. When the mass is at its lowest position where its velocity $v=\sqrt{5gl}$ the strain produced in the wire is (young's modulus of the wire is y)
1) $\frac{Ay}{6mg}$ 2) $\frac{6mg}{Ay}$
3) $\frac{5mg}{Ay}$ 4) $\frac{Ay}{5mg}$

29. Two equal and opposite forces each F act on a rod of uniform cross-sectional area A, as shown. The shearing stress on the section AB will be



1) $\frac{F\sin x\cos x}{A}$ 2) $\frac{F\sin x}{A}$

3) $\frac{F\cos x}{A}$ 4) $\frac{F\sin^2 x}{A}$

30. A wire of length 1m and radius 1mm is subjected to a load. The extension is x. The wire is melted and then drawn into a wire of square cross-section of side 2mm. What is its extension under the same load?

1) $\frac{\pi^2 x}{16}$ 2) πx^2 3) $\frac{\pi^2 x}{3}$ 4) $\frac{\pi}{x}$

CHEMISTRY:

31. What is the EMF of the galvanic cell (K_{sp} of AgCl $=1.0\times10^{-10}$, $E^0_{Ag^+/Ag}=+0.80v$)

$Ag, AgCl_{(s)} | KCl_{(aq)}(1M) || AgNO_{3(aq)}(1M) | Ag$

1) zero 2) -0.592 V

3) 1.391 V 4) 0.592 V

32. Given

$E^0_{Fe^{3+}/Fe}=-0.036V$, $E^0_{Fe^{2+}/Fe}=-0.439V$. The value of standard electrode potential for the change, $Fe^{3+}_{(aq)}+e^- \rightarrow Fe^{2+}_{(aq)}$ will be

1) – 0.072 V 2) 0.385 V

3) 0.770 V 4) – 0.270 V

33. Consider the standard potentials of the following cells.

$(i)\ Mg^{2+}+2e^- \rightarrow Mg \quad E^0=-2.37V$

$(ii)\ Zn^{2+}+2e^- \rightarrow Zn \quad E^0=-0.76V$

$(iii)\ Ni^{2+}+2e^- \rightarrow Ni \quad E^0=-0.25V$

$(iv)\ Fe^{3+}+3e^- \rightarrow Fe \quad E^0=-0.04V$

Which is the strongest reducing agent

1) Mg^{2+} 2) Mg

3) Fe^{3+} 4) Fe

Sri Chaitanya IIT Academy., India.

A.P, TELANGANA, KARNATAKA, TAMILNADU, MAHARASHTRA, DELHI, RANCHI

A right Choice for the Real Aspirant

ICON CENTRAL OFFICE, MADHAPUR - HYD

Sec: Jr.Super60 | Date: 24-09-16

Time: 07:30AM to10:30AM | WTM-21 | Max. Marks: 360

KEY SHEET

PHYSICS:

1	1	**2**	1	**3**	3	**4**	4	**5**	3	**6**	1
7	3	**8**	2	**9**	3	**10**	2	**11**	1	**12**	1
13	3	**14**	2	**15**	2	**16**	1	**17**	2	**18**	2
19	1	**20**	1	**21**	4	**22**	1	**23**	2	**24**	3
25	3	**26**	3	**27**	2	**28**	2	**29**	1	**30**	1

CHEMISTRY:

31	4	**32**	3	**33**	2	**34**	1	**35**	1	**36**	1
37	1	**38**	1	**39**	2	**40**	4	**41**	3	**42**	3
43	1	**44**	1	**45**	4	**46**	3	**47**	1	**48**	2
49	1	**50**	4	**51**	3	**52**	1	**53**	4	**54**	2
55	4	**56**	2	**57**	2	**58**	4	**59**	2	**60**	1

MATHEMATICS:

61	3	**62**	3	**63**	2	**64**	1	**65**	4	**66**	3
67	2	**68**	1	**69**	1	**70**	1	**71**	2	**72**	4
73	1	**74**	4	**75**	2	**76**	2	**77**	2	**78**	2
79	2	**80**	3	**81**	2	**82**	2	**83**	1	**84**	1
85	3	**86**	1	**87**	3	**88**	2	**89**	2	**90**	4

SOLUTIONS

PHYSICS:

1. $\frac{\Delta l}{l}=\frac{F_o}{2AY}$.

2. Tension in the rod at a point $\frac{l}{4}$ from the centre $T=\int_{l/4}^{l/2}\frac{m}{l}x\omega^2 dx=\frac{3}{32}m\omega^2 l$

Elongation in the rod $\Delta l=\frac{m\omega^2}{2AlY}\int_{-l/2}^{l/2}\left(x^2-\frac{l^2}{4}\right)dx=\frac{m\omega^2 l^2}{12AY}$

3. Horizontal distance $x=v\sqrt{\frac{2h}{g}}=\sqrt{\left(\frac{3H-4h}{2}\right)g.\frac{2h}{g}}$

$x^2=3hH-4h^2$

$2x\frac{dx}{dh}=6H-16h,\ for\ x\,to\,be\ \max.\frac{dx}{dh}=0$

$\therefore h=\frac{3H}{8}$

$x_m=\sqrt{3hH-4h^2}\,,h=\frac{3H}{8}$

$\sqrt{3\times\frac{3H}{8}\times H-4\times\frac{9H^2}{64}}$

$\sqrt{\frac{18H^2-9H^2}{16}}=\frac{3H}{4}$

4. $dT=dmr\omega^2=(\rho A\,dr)r\,\omega^2$

$T=\int\rho A\,\omega^2 rdr=\frac{1}{2}\rho A\omega^2\left(L^2-r^2\right)$

5. $\sigma=\frac{T}{A}=\frac{m\omega^2}{2LA}\left(L^2-x^2\right)\Rightarrow\frac{\sigma_1}{\sigma_2}=\frac{\frac{mw^2}{2LA}\left(L^2-0^2\right)}{\frac{mw^2}{2LA}\left(L^2-\frac{L^2}{4}\right)}=\frac{4}{3}$

6. $P_0+\frac{mg}{A}+\rho gh=P_0+\frac{1}{2}\rho v^2$

7. $T=M\omega_0^2 L$

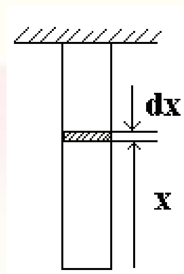
$T^{'}=M\omega_0^2\frac{L}{2}$

$$\sigma = \frac{T}{A} = \frac{T'}{2A}$$

$$\frac{2\omega_0^2}{\omega^2} = \frac{T}{T'} = \frac{1}{2}$$

$$\frac{\omega_0}{\omega} = \sqrt{\frac{1}{4}} = \frac{1}{2}$$

8.



$$T(x) = \frac{mgx}{L}$$

Elongation in element

$$= \frac{T\,dx}{YA} = \frac{1}{YA}\frac{mg}{L}x\,dx$$

$\therefore$ Net elongation

$$= \frac{mgL}{2YA}$$

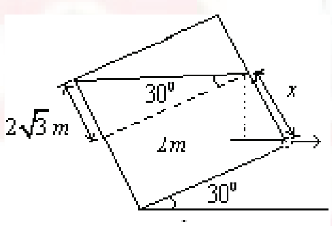
9. Elastic Potential energy = Kinetic energy of the stone

$$\Rightarrow \frac{1}{2} \times 0.5 \times 10^9 \times \left(\frac{2}{100}\right)^2 \times 0.1 \times 10^{-6} = \frac{1}{2} \times \frac{5}{100} \times v^2$$

$$\Rightarrow v = 2m/s$$

Correct option (d)

10.



Volume of the liquid is constant

$$\Rightarrow 2 \times 2 \times 2 = 2 \times \frac{1}{2}\left[x \times x + \frac{2}{\sqrt{3}}\right] \times 2 \quad \therefore x = 1.42m$$

h = x $\sin 60^0 = 1.2m \;\; \therefore v = \sqrt{2gh} = 4.96\, m/s$

Correct option (b)

11. $l_1 = L + \Delta l_1$ & $l_2 = L + \Delta l_2$

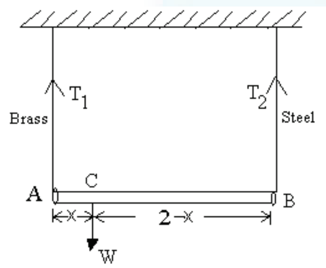
$l_1 - L = \Delta l_1$

$l_1 - L = \dfrac{T_1 L}{ys}$

$l_2 - L = \dfrac{T_2 L}{ys}$

$\dfrac{l_1 - L}{l_2 - L} = \dfrac{T_1}{T_2}$

12.



Let T_1 and T_2 be the tensions in brass and steel wire respectively. Let weight 'w' be hanged from a point which is at a distance x from A.

Then $T_1 x = T_2(2-x) \quad -(1)$

$T_1 + T_2 = w \quad -(2)$

As stresses in the wires are same

$\dfrac{T_1}{T_2} = \dfrac{A_1}{A_2} = \dfrac{0.2\times10^{-4}}{0.1\times10^{-4}} = 2 \Rightarrow T_1 = 2T_2 \quad -(3)$

From (2) and (3)

$T_1 = \dfrac{2w}{3}\, and\, T_2 = \dfrac{w}{3}$

From (1) $\therefore \dfrac{2w}{3}x = \dfrac{w}{3}(2-x) \Rightarrow 3x = 2 \Rightarrow x = 0.666m = 66.6cm$

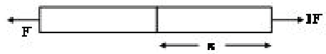
13. Only part '1' and '2' will elongated. There will be no deformation in part '3'. net change in length of ROD is $=\left(\dfrac{F}{AY}\dfrac{L}{4}\right)2 \;= \dfrac{FL}{2AY}$

14. Conceptual

15. Conceptual

16. Tension in rod at a distance x from right edge is

$$T = F\left(3 - 2\frac{x}{L}\right)$$



$\therefore$ net extension in rod $= \int_0^L \frac{T}{4A}dx = \frac{2F}{YA}L$

17. Stress S is same for both wires, so

$$\Delta l = \Delta l_{steel} + \Delta l_{copper} = s\left(\frac{l_s}{Y_s} + \frac{l_c}{Y_c}\right)$$

$$\text{or } \Delta l = \frac{mg}{A}\left(\frac{l_s}{Y_s} + \frac{l_c}{Y_c}\right)$$

$$= \frac{200\times10}{5.5\times10^{-5}}\left(\frac{1.5}{2\times10^{11}} + \frac{2}{1\times10^{11}}\right)$$

$$= \frac{2\times10^9}{55\times10^{11}}$$

$$= \frac{2}{55}\times10^{-2}$$

$$= 10^{-3}\text{m} = 1\text{mm}$$

18. $w = \frac{1}{2}Fx$ where x ix elongation $= \frac{Fl}{Ay}$

Given x and y are constant

$$\therefore \frac{w_1}{w_2} = \frac{F_1}{F_2} = \frac{A_1}{A_1}\cdot\frac{l_2}{l_1} = \frac{r_1^2}{r_2^2}\cdot\frac{l_2}{l_1}$$

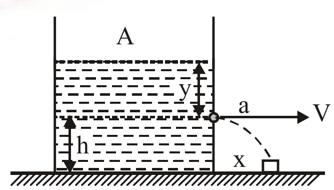
$$\therefore w_2 = 8\times4 = 32J$$

19. $y = \frac{FL}{A\Delta L} = \tan\theta = \frac{F}{l} = \frac{yA}{l} \Rightarrow \tan\theta\,\alpha\,A$

Since Y, F and L are same for all wire

20. Conceptual Question

21. Velocity of efflux $v = \sqrt{2gy}$



Range $x = \sqrt{2gy}\times\sqrt{\frac{2h}{g}}$

The velocity of the block must be $\left(\frac{dx}{dt}\right)$.

$$\therefore \quad V_b = \frac{dx}{dt} = \sqrt{\frac{2h}{g}} \times \sqrt{2g} \times \frac{1}{2\sqrt{y}}\frac{dy}{dt}$$

$$V_b = \frac{\sqrt{h}}{\sqrt{y}}.\frac{dy}{dt} \qquad \ldots(i)$$

Using equation of continuity

$$\frac{Ady}{dt} = a\sqrt{2gy} \qquad \ldots(ii)$$

equation (i) and (ii)

$$V_b = \sqrt{\frac{h}{y}} \times \frac{a}{A}\sqrt{2gy}$$

$$V_b = \sqrt{2gh} \times \frac{a}{A} \;\; = 20 \times \frac{1}{20} = 1\ \text{ms}^{-1}.$$

22. Let $P_1\, and\, P_2$ be the presences on upper and lower surfaces of the wing. Using Bernoulli's equation

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

Neglecting gravitation head between lower and upper surfaces

$$P_1 - P_2 = \frac{\rho}{2}\left(v_2^2 - v_2^2\right) = \frac{1.3}{2}\left(70^2 - 63^2\right) = 605.105 N/m^2$$

Lift force on the wing $=(P_2 - P_1) \times projected\ area\ of\ wing$

$= 605.15 \times 2.5 = 1.51 \times 10^3 N$

23. The rate of flow through the nozzle $Q = Av = \frac{\pi}{4}(0.05)^2 \times 5 = 9.81 \times 10^{-3} kg/m^3$

The reaction force at the mouth of the nozzle $F = \rho v Q = 1000 \times 5 \times 9.81 \times 10^{-3} = 49.05N$

The direction of F is along the direction of nozzle.

The horizontal component of this force $F_x = F\cos 45^0 = \frac{49.05}{\sqrt{2}} N$

If x is the compression of the spring, then $F_x = kx$

$$x = F_x / k = 0.0173m$$

24. $A_1v_1 = A_2v_2 + A_3v_3 \Rightarrow 3 \times A = A \times 1.5 + 1.5 \times A \Rightarrow v = 1m/\sec$

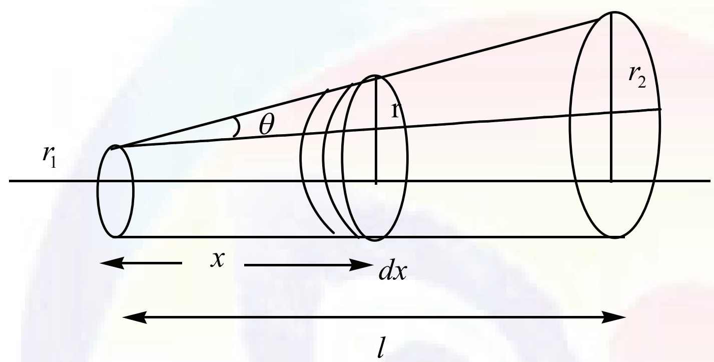
25. Conceptual

26. $t = k\left(\sqrt{h_1} - \sqrt{h_2}\right)$

$t_1 = k\left(\sqrt{h} - \sqrt{\frac{h}{2}}\right)\ t_2 = k\left(\sqrt{\frac{h}{2}} - 0\right)$

$\frac{t_1}{t_2} = \sqrt{2} - 1$

27.



$\tan\theta = \frac{r_2 - r_1}{l} = \frac{r - r_1}{x}$

$r = r_1 + \left(\frac{r_2 - r_1}{l}\right)x$

$dl = \frac{Fdx}{\pi r^2 y} \Rightarrow \int dl = \int_0^l \frac{Fdx}{\pi y\left(r_1 + \left(\frac{r_1 - r_2}{l}\right)x\right)^2}$

28. $y = \frac{Fl}{Ae}, \frac{e}{l} = \frac{F}{Ay} = \frac{6mg}{Ay}$

29. $stress = \frac{F\tan x}{A} = \frac{F\cos x}{A} = \frac{F\sin x\cos x}{A}$

30. Volume=constant, $\pi r^2 l = a^2 l^1, e = \frac{Fl}{YV}$

$Y = \frac{Fl}{\Delta e}$, $e\alpha \frac{l}{A}\alpha \frac{1}{A^2}$, $\frac{e_1}{e_2} = \frac{A_2^2}{A_1^2}, \frac{x}{e_2} = \frac{\left[\left(2\times10^{-3}\right)^2\right]^2}{\left(\pi\times10^{-6}\right)^2}$, $e_2 = \frac{\pi^2 x}{16}$

_Final Key

S.NO	SUB	Q.NO	GIVEN KEY	FINALIZED KEY	EXPLANATION
1	PHY	4	4	2	Key Change
2	PHY	6	1	3	Key Change
3	PHY	9	3	4	Key Change