Grade !0

Physics LO>9 Questions Bank

- Leader: Marven Waheed
- Co-Leader: Jomana Mohamed

1-Fundamental equation that relates pressure to fluid's speed, pressure and height is known as:

a) Speed equation.
b) Gravitational law.
c) Bernoulli's equation.
d) Equation of continuity.

2-A hydraulic press has a ram of 15 cm diameter and plunger of 1.5 cm. It is required to lift a weight of 1 ton. The weight required on plunger is equal to

(a) 10 kg

(b) 100 kg

(c) 1000 kg

(d) 1 kg

(e) 10,000 kg.

3-which one of the following is the characteristics of a fully developed laminar flow?

a) The pressure drop in the flow direction is zero.
b) The velocity profile changes uniformly in the flow direction.
c) The velocity profile doesn't change in the flow direction.
d) The velocity profile changes uniformly in opposite direction to the flow direction.

4- Water flow in a tube with rate of 250 kg/s. what will be the velocity of water comes out from the end of the tube that has diameter of 10cm? **Hint the mass flow rate= AVρ = 250."**

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5- water is streaming downward from a faucet opening with an area of 3×10^{-5} m^2. It leaves the faucet with speed of 5 m/s. the cross-sectional area of stream 0.5m below the faucet is:

a) 1.5×10^{-5}
b) 2×10^{-5}
c) 2.5×10^{-5}
d) 3×10^{-5}
e) 3.5×10^{-5}.

6- a longer tank filled with water has 2 holes in the bottom, one with twice the radius of other. In steady flow, the speed of water leaving larger hole……the speed of water leaving the smaller.

a) The same
b) Smaller than
c) Greater than
d) None of the above.

7- A constriction in a pipe reduces its diameter from 4.0 cm to 2.0 cm. Where the pipe is narrow the water speed is 8.0 m/s. Where it is wide the water speed is:

a) 2.0 m/s
b) 4.0 m/s
c) 8.0 m/s
d) 16 m/s

8- One piston in a hydraulic lift has an area that is twice the area of the other. When the pressure at the smaller piston is increased by Δp the pressure at the larger piston:

a) increases by $2\Delta p$
b) increases by $\Delta p/2$

c) increases by Δp
d) increases by 4Δp
e) does not change

9- The two arms of a U-tube are not identical, one having 2.5 times the diameter of the other. A cork in the narrow arm requires a force of 16 N to remove it. The tube is filled with water and the wide arm is fitted with a piston. The minimum force that must be applied to the piston to push the cork out is:

a) 8 N
b) 16 N
c) 32 N
d) 64 N
e) 100 N

10- Water pressurized to 3.5 x 105 Pa is flowing at 5.0 m/s in a horizontal pipe which contracts to 1/3 its former area. What are the pressure and velocity of the water after the contraction?

a) 2×10^5 Pa, 15 m/s
b) 3×10^5 Pa, 10 m/s
c) 3×10^5 Pa, 15 m/s
d) 4×10^5 Pa, 1.5 m/s

11- Raindrops are spherical because of

a) Viscosity
b) Air resistant
c) Surface tension force
d) Atmospheric pressure

12- The property by virtue of which liquid opposes relative motion between its different layers is called

a) Surface tension

b) Cohesion
c) Viscosity
d) Capillary

13- A liquid flow through a pipe with a diameter of 10cm at a velocity of 9cm/s. If the diameter of the pipe, then decreases to 6cm, what is the new velocity of the liquid?

a) 25cm/s
b) 18cm/s
c) 15cm/s
d) 21cm/s
e) 12cm/s

14- A channel of width 450mm branches into two sub-channels having width 300mm and 200mm as shown in the figure. If the volumetric flow rate (taking unit depth) of an incompressible flow through the main channel is 0.9m^3/s the velocity in the sub-channel of width 200mm is 3m/s, the velocity in the sub-channel of width 300mm is ?

Assume both intel and outlet to be the same elevation.

a) 2m/s
b) 5m/s
c) 1m/s
d) 1.5m/s

15- In laminar flow:

a) Experimentational is required for the simplest flow cases
b) Newtons low of viscosity applies
c) The fluid particles move in irregular and haphazard path
d) Viscosity is unimportant

16- In a turbulent flow in a pipe, the shear stress is

a) Maximum at the center and decrease linearly towards the wall
b) Maximum at the center and decrease logarithmically towards the wall
c) Maximum at the wall and decreases linearly to zero value at the center

d) Maximum midway between the center line and the wall
e) Maximum at the wall and decrease logarithmically to zero value at the center

17- A hydraulic lift has two pistons. If the area of piston B is greater than the area of piston A, find a relation in their masses.

a) Ma=Mb
b) Ma>Mb
c) Ma <Mb

18- How much work must be done to stop a 1200kg car moving at 99km/h in a strait path.?

a) 453750j
b) 59637j
c) 457531j
d) 543750j

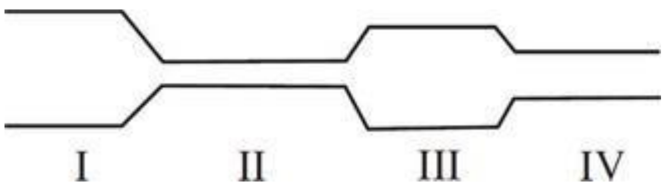
19- Bernoulli's theorem is applicable only for …………

a) Viscous liquid
b) Compressible liquid
c) Rational fluid
d) Non-compressible liquid

20- The pressure of water in pipe when water is not flowing is 3*10^5Pa and when the water flows the pressure falls to 205*10^5Pa. find the speed of water (in m/s)?

a) 5
b) 10
c) 20
d) 1

21-



A fluid flows through a pipe of changing cross sections as shown. In which section would the pressure of the fluid be greatest?

A. Section I

B. Section II

C. Section III`

D. Section IV

22- A fluid of density ρ flows through a horizontal pipe with negligible viscosity. The flow is streamlined with constant flow rate. The diameter of the pipe at Point 1 **is d and the flow speed is V. If the diameter of the pipe at Point 2 is d/3, then the pressure at Point 2 is**

A. less than the pressure at Point 1 by 4 ρv^2
B. less than the pressure at Point 1 by 40 ρv^2
C. more than the pressure at Point 1 by 4 ρv^2
D. more than the pressure at Point 1 by 40 ρv^2

23. An ideal fluid flows through a pipe with radius Q and flow speed V. If the pipe splits up into three separate paths, each with radius (Q/2), what is the flow speed through each of the paths?

A. 1/3 V
B. 2/3 V
C. 4/3 V
D. 4V

24. A liquid flows at a constant flow rate through a pipe with circular cross-sections of varying diameters. At one point in the pipe, the diameter is 2 cm, and the flow speed is 18 m/s. What is the flow speed at another point in this pipe, where the diameter is 3 cm?

A. 4 m/s

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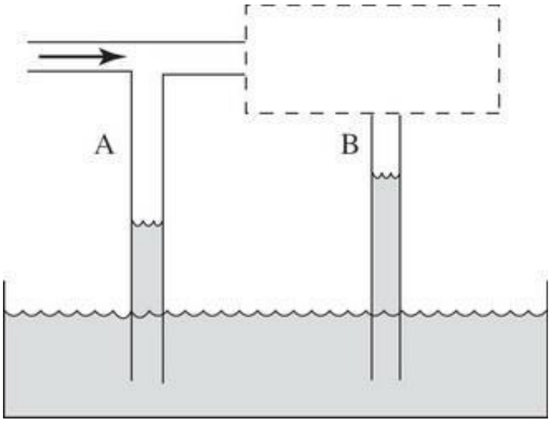
B. 6 m/s

C. 8 m/s

D. 12 m/s

25-.



A tube with two T branches that have an open end is inserted in a liquid. However, the section of the tube above section B is hidden from view. The hidden section may be wider or narrower. Air is blown through the tube and the water levels rise as shown. You can say

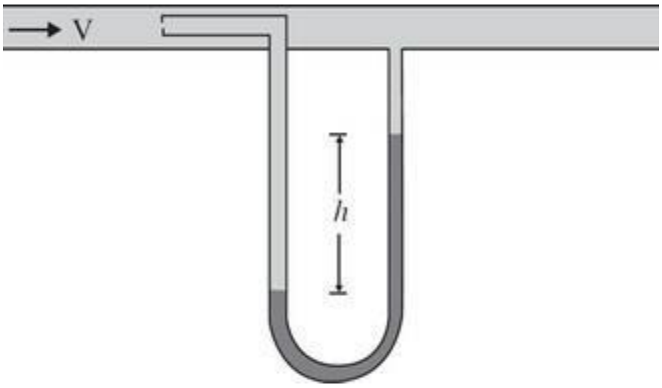
A. the picture as drawn below is impossible—A and B must be at equal heights

B. the tube is narrower, and the air speed is greater above section B

C. the tube is narrower, and the air speed is less above section B

D. the tube is wider, and the air speed is greater above section B

26.



The instrument in an aircraft to measure airspeed is known as the pitot tube, shown in the figure above. The opening facing the incoming air (with the small aperture) is the part meant to capture the air at rest. The opening perpendicular to the flow of air

(with the large aperture) is meant to capture air at speed. If h = 1 m and the fluid within the manometer is water, what is the airspeed? Take the density of air to be r_{air} = 1.2 kg/m^3.

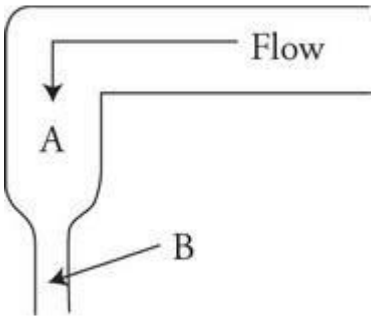
A. 27 m/s

B. 68 m/s

C. 95 m/s

D. 128 m/s

27.



Bubbles in a carbonated liquid drink dispenser flow through a tube as shown in the figure. Which of the following correctly describes the behavior of the bubbles as they move from point A to point B? The vertical distance between points A and B is small.

A. The bubbles increase in speed and expand in size.

B. The bubbles increase in speed and decrease in size.

C. The bubbles decrease in speed and expand in size.

D. The bubbles decrease in speed and decrease in size.

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28. A dentist's chair makes use of Pascal's principle to move patients up and down. Together, the chair and a patient exert a downward force of 2269 N. The chair is attached to a large piston with an area of 1221 cm2 • To move the chair, a pump applies force to a small piston with an area of 88.12 cm2 • What force must be exerted on the small piston to lift the chair?

29. An engineering student wants to build her own hydraulic pump to lift an 1815 N crate. The pump will have two pistons connected via a fluid chamber. The student calculates that she will be able to exert 442 N of force on the small piston, which will have an area of 50.2 cm2 • What area must the large piston be to exert the desired force?

30. The motor on a construction grade hydraulic shovel exerts 3.11 x 10 7 Pa of pressure on a fluid tank. The: fluid tank is connected to a piston that bas an area of 153 cm2 • How much force does the piston exert?

31- An ideal fluid flows through a pipe made of two sections with diameters of 1.0 and 3.0 inches, respectively. The speed of the fluid flow through the 3.0-inch section will be what factor times that through the 1.0-inch section?

a.6.0

b.9.0

c.1/3

d.1/9

32- The flow rate of a liquid through a 2.0-cm-radius pipe is 0.008 0 m3/s. The average fluid speed in the pipe is:

a.0.64 m/s.

b.2.0 m/s.

c.0.040 m/s.

d.6.4 m/s.

33- What happens to the speed of blood in an artery when plaque starts to build up on the artery's sides?

34- An ideal fluid, of density 0.85 · 103 kg/m3, flows at 0.25 kg/s through a pipe of radius 0.010 m. What is the fluid speed?

a.0.85 m/s

b.1.3 m/s

c.3.0 m/s

d.0.94 m/s

35- Water (density = 1 · 103 kg/m3) flows at 15 m/s through a pipe with radius 0.040 **m. The pipe goes up to the second floor of the building, 3.0 m higher, and the pressure remains unchanged. What is the speed of the water flow in the pipe on the second floor?**

a.13 m/s

b.14 m/s

c.15 m/s

d.16 m/s

36- Think of Bernoulli's equation as it pertains to an ideal fluid flowing through a horizontal pipe. Imagine that you take measurements along the pipe in the direction of fluid flow. What happens to the sum of the pressure and energy per unit volume?

a. It increases as the pipe diameter increases.

b. It decreases as the pipe diameter increases.

c. It remains constant as the pipe diameter increases.

d. No choices above are valid.

37- A 15 000-N car on a hydraulic lift rest on a cylinder with a piston of radius 0.20 **m. If a connecting cylinder with a piston of 0.040-m radius is driven by compressed air, what force must be applied to this smaller piston in order to lift the car?**

a.600 N

b.1 500 N

c.3 000 N

d. 15 000 N

38- if the radius of the output piston is doubled the output force increase by factor

a. 2
b. 4
c. ½
d. ¼

39- A hydraulic lift has pistons with diameters 8.00 cm and 36.0 cm, respectively. If a force of 825 N is exerted at the input piston, what maximum mass can be lifted by the output piston?

a. 3.4 ×10^3 g
b. 25.0 × 10^2 kg
c. 1.7 × 10^3 kg
d. 1.1 × 10^4 kg

40- A unit for viscosity, the centipoise, is equal to which of the following?

a.10-3 N s/m^2

b.10-2 N s/m^2

c.10-1 N s/m^2

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d.102 N s/m^2

41- A pipe carrying water has a radius of 1.0 cm. If the flow velocity is 9.0 cm/s, which of the following characterizes the flow? Take the viscosity of water to be 1.0 · 10-3 N s/m.

a. streamlined

b. unstable

c. turbulent

d. stagnant

43- If p is a pressure and ρ is a density, then p/ρ has units of:

A. m^2

B. m^2/s^2

C. N/m^2

D. kg/m^2

E. m^3/kg

44- The equation of continuity for fluid flow can be derived from the conservation of:

A. energy

B. mass

C. angular momentum

D. volume

E. pressure

45- Bernoulli’s equation can be derived from the conservation of:

A. energy

B. mass

C. angular momentum

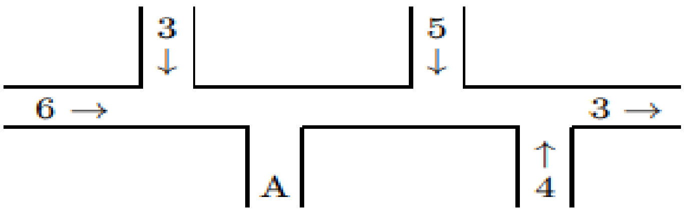
D. volume

E. pressure

46- The diagram shows a pipe of uniform cross section in which water is flowing. **The directions**

of flow and the volume flow rates (in cm^3/s) are shown for various portions of the pipe. The

direction of flow and the volume flow rate in the portion marked A are:



A. ↓ and 3 cm^3/s

B. ↑ and 7 cm^3/s

C. ↓ and 9 cm^3/s

D. ↑ and 11 cm^3/s

E. ↓ and 18 cm^3/s

47- A lawn sprinkler is made of a 1.0-cm diameter garden hose with one end closed and 25 holes,

each with a diameter of 0.050 cm, cut near the closed end. If water flows at 2.0 m/s in the hose,

the speed of the water leaving a hole is:

A. 2.0 m/s

B. 32 m/s

C. 40 m/s

D. 600 m/s

E. 800 m/s

48- Water (density = 1.0 × 10^2 kg/m3^) flows through a horizontal tapered pipe. At the wide end its speed is 4.0 m/s. The difference in pressure between the two ends is **4.5×10^3 Pa. The speed**

of the water at the narrow end is:

A. 2.6 m/s

B. 3.4 m/s

C. 4.0 m/s

D. 4.5 m/s

E. 5.0 m/s

49- A non-viscous incompressible liquid is flowing through a horizontal pipe of constant cross

section. Bernoulli's equation and the equation of continuity predict that the drop in pressure

along the pipe:

A. is zero

B. depends on the length of the pipe

C. depends on the fluid velocity

D. depends on the cross-sectional area of the pipe

E. depends on the height of the pipe

50- Consider a pipe containing a fluid, with the pipe being horizontal. To apply Bernoulli's equation

to this situation:

A. set v equal to zero

B. set g equal to zero

C. set h equal to zero

D. set v and h both equal to zero

E. cannot be done; Bernoulli's equation applies only to fluids in motion

51- A large water tank, open at the top, has a small hole in the bottom. When the water level is 70 cm above the bottom of the tank, the speed of the water leaving the hole:

A. is 2.5 m/s

B. is 3.7 m/s

C. is 4.4 m/s

D. cannot be calculated unless the area of the hole is given

E. cannot be calculated unless the areas of the hole and tank are given

52- A non-viscous incompressible fluid is pumped steadily up a vertical pipe with uniform cross

section. The difference in pressure between points at the top and bottom:

A. is the same as it would be if the fluid were motionless

B. is greater at higher flow rates than at lower flow rates

C. is less at higher flow rates than at lower flow rates

D. does not depend on the density of the fluid

E. is zero

53- Which has the greatest effect on the flow of fluid through a narrow pipe? That is, if you made a 10% change in each of the quantities below, which would cause the greatest change in the flow rate?

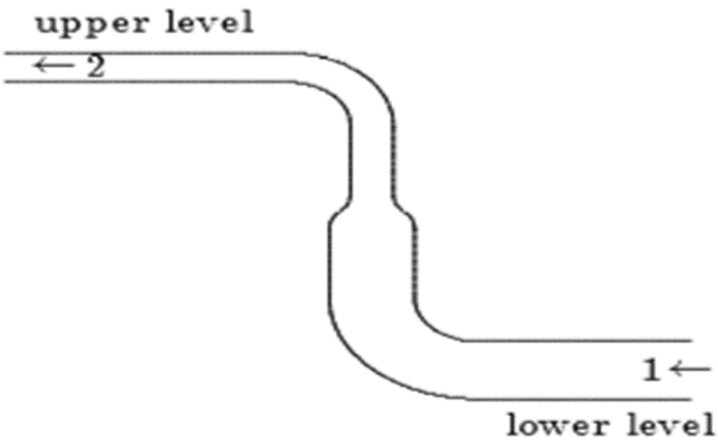
A) the fluid viscosity.
B) the pressure difference.
C) the length of the pipe.
D) the radius of the pipe.

54- Pascal's Law is also known as

a-fluid-pressure transmission law

b-principle of transmission of fluid pressure c-principle of transmission of fluid-pressure d-principle of transmission

55- Water is pumped through the hose shown below, from a lower level to an upper level. Compared to the water at point 1, the water at point 2:



A. has greater speed and greater pressure

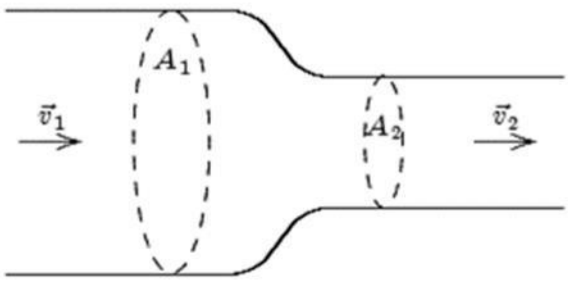
B. has greater speed and less pressure

C. has less speed and less pressure

D. has less speed and greater pressure

E. has greater speed and the same pressure

56- An incompressible liquid flows along the pipe as shown. The ratio of the speeds v2/v1 is:



A. A_1/A_2

B. A_2/A_1

C. $\sqrt{A_1/A_2}$

D. $\sqrt{A_2/A_1}$

E. V_1/V_2

57- A large water tank, open at the top, has a small hole in the bottom. When the water level is 30m above the bottom of the tank, the speed of the water leaking from the hole:

A. is 2.5m/s

B. is 24m/s

C. is 44m/s

D. cannot be calculated unless the area of the hole is given

E. cannot be calculated unless the areas of the hole and tank are given

58- A pipe with a diameter of 4 centimeters is attached to a garden hose with a nozzle. If the velocity of flow in the pipe is 2m/s, what is the velocity of the flow at the nozzle when it is adjusted to have a diameter of 8 millimeters?

a- 16.6m/s

b- 50m/s

c- 25m/s

d- 20ms

59- The small piston of a hydraulic lift has an area of 0.20 m, A car weighing 1.20 ***10^ 4N sits on a rack mounted on the large piston. The large piston has an area of 0.90 m2. How large a force must be applied to the small piston to support the car. a-3.6 *10^3**

b-2.7*10^3 c-

2.4*10^3 d-

1.7*10^3

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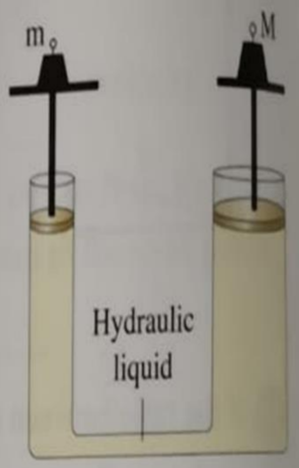
15 The cross-sectional area of the small piston of a hydraulic press is (a) and carries a mass (m) while the cross-sectional area of its big piston is (10 a) and carries a mass (M). When the two pistons are in equilibrium and by ignoring their masses, then ....



a) M = m
b) M = 10 m
c) M = 100 m
d) M = 0.1 m

61- A fluid is drawn up through a tube as shown below. The atmospheric pressure is the same at both ends. Use Bernoulli's equation to determine the speed of fluid flow out of the tank. If the height difference from the top of the tank to the bottom of the siphon is 1.0 m, then the speed of outflow is:

a.1.1 m/s

b.2.2 m/s

c.4.4 m/s

d.8.8 m/s

62- The flow rate of blood through the average human aorta, of radius 1.0 cm, is about 90 cm3/s. What is the speed of the blood flow through the aorta?

a.14 cm/s

b.32 cm/s

c.37 cm/s

d.29 cm/s

1- Ans:C

because its equation is:

$$p_1 + \frac{1}{2}\rho v^2 + \rho g y_1 = p_2 + \frac{1}{2}\rho v^2 + \rho g y_2.$$

2- Ans: (a),

$$\frac{F_1}{A_1} = \frac{F_2}{A_2}$$

$\frac{1000\times10}{(\frac{15}{100}\div2)^2} = \frac{F_2}{(\frac{1.5}{100}\div2)^2}$ **, Then F_2 = 100N, then its weight = 100÷10 = 10 kg.**

3- Ans: (c)

4-

$V=\frac{M}{\rho A} = \frac{250}{1000\times(\frac{0.1}{2})^2\times\pi}$ **= 31.8 m/s.**

5- Ans:C

$$A_1V_1 = A_2V_2$$

$$\mathbf{5 \times 3 \times 10^{-5} = A_2V_2}$$

$$\mathbf{A_2V_2 = 1.5 \times 10^{-4}}\text{………. }\mathbf{(1)}$$

$$\therefore P_1 + \rho g h_1 + \frac{1}{2}\rho V^2{}_1 = P_2 + \rho g h_2 + \frac{1}{2}\rho V^2{}_2$$

$$\#pressure\ is\ constant$$

$$V^2{}_2 = 2g(h_1 - h_2) + V^2{}_1$$

$$\mathbf{2 \times 10(0.5) + 5^2{}_1}$$

$$\mathbf{= 35}$$

$$\therefore V_2 = \sqrt{35}$$

$\therefore V_2$ **= 5.9...(back to (1))**

$$\therefore A_2 = 2.5 \times 10^{-5} m/s$$

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6- Ans: (a)

Velocity of water surface, v_1=0 From
Bernoulli equation P+2ρV^2+ρgh=constant

$P_{atm}+2\rho V^2_1+\rho g h_1=P_{atm}+2\rho V^2_2+\rho g h_2$

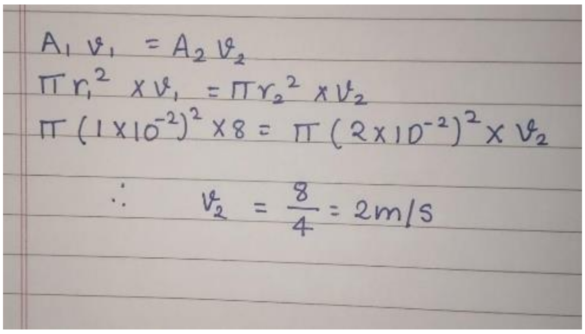
$2\rho V^2_2+=\rho g(h1-h2)$

$V^2=2g(h_1-h_2)$ Velocity of
water is $2g(h_1-h_2)$

Speed of water from hole is independent on area.

Hence, in steady flow the speed of water leaving the larger hole is the same as the speed of the water leaving the smaller.

7- Ans: (a)



$A_1 v_1 = A_2 v_2$

$\pi r_1^2 \times v_1 = \pi r_2^2 \times v_2$

$\pi(1\times10^{-2})^2 \times 8 = \pi(2\times10^{-2})^2 \times v_2$

$\therefore \quad v_2 = \frac{8}{4} = 2 m/s$

8- Ans: C

according to pascal's law: the pressure is constant.

9- ANS: E

$P_1 = P_2$

$F_1/A_1 = F_2/A_2$

$F_1/F_2 = A_1/A_2$

where,

$F_1/16\ N = (\pi d_1^2/4)/(\pi d_2^2/4)$ $F_1 =$
$(16\ N)(d_1^2/d_2^2)$

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but, it is given that the diameter of wider arm is 2.5 times the diameter of the narrow arm.

$d_1 = 2.5\ d_2$

Therefore,

$F_1 = (16\ N)[(2.5\ d_2)^2/d_2^2]$

$F_1 = (16\ N)(6.25)$

$\underline{F_1 = 100\ N}$

10- Ans: (a)

$$A_1 V_1 = A_2 V_2$$

$$V_2 = \frac{A_1 V_1}{A_2}$$

$$V_2 = \frac{A_1 \times 5}{\frac{1}{3} A_1}$$

$$V_2 = 15\ m/s$$

$$P_1 + \frac{1}{2}\rho V_1^2 = P_2 + \frac{1}{2}\rho V_2^2$$

$$P_2 = \frac{1}{2}\rho(V_1^2 - V_2^2) + P_1$$

$$P_2 = \frac{1}{2} \times 1000(5^2 - 15^2) + 3.5 \times 10^5$$

$$P_2 = 2.5 \times 10^5\ Pa$$

11- Ans: C

12- Ans: C

13- Ans: a

Rate of flow, A * v, must remain constant. Use the continuity equation, A1v1=A2v2.

Solving the initial cross-sectional area yields: A1=πr2=25πcm2. The initial radius is 5cm.

Then find the final area of the pipe: A2=πr2=9πcm2. The final radius is 3cm.

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Using these values in the continuity equation allows us to solve the final velocity.

(25πcm2)(9cm/s)=(9πcm2)v2 v2=25cm/s

14- Ans: C

Calculation:

$Q_1 = Q_2 + Q_3$

$A_1V_1 = A_2V_2 + A_3V_3$

$\Rightarrow 0.9 = 300 \times 10^{-3} \times V_2 + 200 \times 10^{-3} \times 3$

$\Rightarrow 0.9 = 0.3\,V_2 + 0.6$

$\Rightarrow$ **$V_2 = 1$ m/s**

15- Ans: b

16- Ans: d

17- Ans: C

From **Pascal's Law,** the pressure inside the liquid will be equal at every place. So the pressure at A and B will be equal.

$P_A = P_B$

$Pressure = \frac{Force}{Area}$

$\frac{F_A}{A_A} = \frac{F_B}{A_B}$

$\frac{m_A g}{A_A} = \frac{m_B g}{A_B}$

$\frac{m_A g}{A_A} = \frac{m_B g}{A_B}$

$\frac{m_A}{m_B} = \frac{A_A}{A_B}$

if $A_A < A_B$

then $m_A < m_B$

18- Ans: a

Solution: The work-kinetic energy theorem states that the net work done on an object is equal to the change in the object's kinetic energy.

$$W_{net} = K_2 - K_1$$

where $K = \frac{1}{2}mv^2$ is the kinetic energy of an object.

In this case, the initial and final velocities of the car are given, so $v_i = 99\,\mathrm{km/h}$ and $v_f = 0$. The wanted quantity is the net work done on the car $W_{net} = ?$. Applying the work-kinetic energy theorem formula, we have

$$W_{net} = \frac{1}{2}m(v_2^2 - v_1^2)$$

$$= \frac{1}{2}(1200)(0 - (27.5)^2)$$

$$= 453750 \quad \mathrm{J}$$

19- Ans: b

20- Ans: b

Initial velocity (v_1) = 0 m/s, Initial pressure (P_1) = 3×10^5 Pa, and Final pressure (P_2) = 2.5×10^5 Pa

- According to **Bernoulli's principle**

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

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

Above equation can be written as

$$\Rightarrow v_2^2 = \frac{2(P_1 - P_2)}{\rho}$$

$$\Rightarrow v_2^2 = \frac{2(3\times10^5 - 2.5\times10^5)}{10^3} = 10^2 m^2/s^2$$

$\Rightarrow v_2 = 10$ m/s

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21- ANS: A

According to the Bernoulli effect, the flow speed will be lowest, and thus the pressure will be greatest, in the section of the pipe with the greatest diameter

22- ANS: B

Speed becomes greater when the cross-sectional Area becomes smaller, so pressure is lower. Eliminate (C) and (D). Since the diameter has decreased by 3, the cross-sectional area decreases by a factor of 9. This means the flow speed must increase by a factor of 9.

$v_2 = 9v$

Using Bernoulli's Equation

$$P_1 + \frac{1}{2}\rho v_1^2 + \rho g y_1 = P_2 + \frac{1}{2}\rho v_2^2 + \rho g y_2$$

Because there is no change in height, we can eliminate it from both sides of the equation

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

$$P_1 - P_2 = \frac{1}{2}\rho (v_2^2 - v_1^2) = \frac{1}{2}\rho ((9v)^2 - v^2) = 40\rho v^2$$

23- ANS: C

If flow rate is constant for ideal fluids, then it becomes an inverse relationship between *v*, flow speed, and *A*, the cross-section area of the pipe

$A_1v_1 = A_2v_2 \longrightarrow \pi R^2 v_f = \pi (R/2)^2 v \longrightarrow v_f = 4v$

but there are 3 pipes, so 4/3 v.

24- ANS: C

The Continuity Equation, *Av* = constant, tells us that *v*, the flow speed, is inversely proportional to *A*, the cross-sectional area of the pipe. Since *A* is proportional to d^2, where *d* is the diameter of the pipe, we can say that *v* is inversely proportional to d^2. Now, if *d* increases by a factor of 3/2 (from 2 cm to 3 cm), then *v* decreases by a factor of $(3/2)^2 = 9/4$. Thus, the flow speed at the point

25- ANS: B

Because the fluid is higher in section B, the air speed must be greater above section B. This must be due to a narrower tube.

26- ANS: D

First, we will use Bernoulli's Equation to find the difference in pressure between the end of the tube capturing air at rest and the end capturing the air at speed. Let's call these ends A and B. Bernoulli's Equation tells us

$$P_A + \frac{1}{2}\rho_{air}v_A^2 + \rho_{air}gy_A = P_B + \frac{1}{2}\rho_{air}v_B^2 + \rho_{air}gy_B$$

Since end B is the end that captures the air at rest, $v_B = 0$. Looking at the figure, the heights of the two ends are basically the same, or $y_A \approx y_B$. So, we get

$$P_A - P_B = \frac{1}{2}\rho_{air}v_B^2$$

Now, in the manometer, we know that the pressure on the fluid near end A is just P_A, and the pressure on the fluid near end B is just P_B, so the difference in the two pressures must equal the weight of the fluid of height h, or

$$P_A - P_B = \rho_f gh$$

Putting these two things together, we get

$$\rho_f gh = \frac{1}{2}\rho_{air}v_B^2$$

$$\rightarrow v_B^2 = 2\frac{\rho_f}{\rho_{air}}gh$$

$$\rightarrow v_B = \sqrt{2\frac{\rho_f}{\rho_{air}}gh} = \sqrt{2\frac{1{,}000\ kg/m^3}{1.2\ kg/m^3}(9.8\ \text{m/s}^2)(1\ \text{m})} = 128\ \text{m/s}$$

So, the airspeed is 128 m/s.

27- ANS: A

Due to conservation of mass (continuity), the fluid must increase in velocity when the cross-sectional area decreases. Due to conservation of energy (Bernoulli), as the velocity of the fluid increases, the static pressure in the fluid

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decreases. This means the pressure on the bubbles will decrease, allowing them to expand in size

28-

Solution

Step 1: List the given and unknown values.

Given: $F_2 = 2269$ N
$A_1 = 88.12$ cm^2
$A_2 = 1221$ cm^2

Unknown: F_1

Step 2: Write the equations for Pascal's principle and pressure, force, and area.

$$p_1 = p_2$$
$$pressure = \frac{force}{area}$$

Step 3: Substitute force and area into the first equation, and rearrange for the desired value.

$$p_1 = p_2$$
$$\frac{F_1}{A_1} = \frac{F_2}{A_2}$$
$$F_1 = \frac{(F_2)(A_1)}{A_2}$$

Step 4: Insert the known values into the equation, and solve.

$$F_1 = \frac{(2269 \text{ N})(88.12 \text{ cm}^2)}{1221 \text{ cm}^2}$$
$$F_1 = 163.8 \text{ N}$$

29-

Solution

Step 1: List the given and unknown values.

Given: $F_1 = 442$ N
$A_1 = 50.2$ cm^2
$F_2 = 1815$ N

Unknown: A_2

Step 2: Write the equations for Pascal's principle and pressure, force, and area.

$$p_1 = p_2$$
$$pressure = \frac{force}{area}$$

Step 3: Substitute force and area into the first equation, and rearrange for the desired value.

$$p_1 = p_2$$
$$\frac{F_1}{A_1} = \frac{F_2}{A_2}$$
$$A_2 = \frac{F_2(A_1)}{F_1}$$

Step 4: Insert the known values into the equation, and solve.

$$A_2 = \frac{(1815\ \text{N})(50.2\ \text{cm}^2)}{442\ \text{N}}$$
$$A_2 = 206\ \text{cm}^2$$

30-

Solution

Step 1: List the given and unknown values.

Given:	$p_1 = 3.11 \times 10^7$ Pa
	$A_2 = 153\ \text{cm}^2$
Unknown:	F_2

Step 2: Write the equations for Pascal's principle and pressure, force, and area.

$$p_1 = p_2$$
$$pressure = \frac{force}{area}$$

Step 3: Substitute force and area into the first equation, and rearrange for the desired value.

$$p_1 = p_2$$
$$p_1 = \frac{F_2}{A_2}$$
$$F_2 = (p_1)(A_2)$$

Step 4: Insert the known values into the equation, and solve.

$$F_2 = (3.11 \times 10^7\ \text{Pa})(153\ \text{cm}^2)$$
$$F_2 = \left(\frac{3.11 \times 10^7\ \text{N}}{\text{m}^2}\right)(1.53 \times 10^{-2}\ \text{m}^2)$$
$$F_2 = 4.76 \times 10^5\ \text{N}$$

31- ANS: d

$d_1 = 1 \qquad d_2 = 3$

$A_1 V_1 = A_2 V_2$

$A_1 = \left(\frac{1}{2}\right)^2 \pi \quad , \quad A_2 = \left(\frac{3}{2}\right)^2 \pi$

$\left(\frac{1}{2}\right)^2 \pi V_1 = \left(\frac{3}{2}\right)^2 \pi V_2 \qquad \frac{1}{4} \cancel{\pi} V_1 = \frac{9}{4} \cancel{\pi} V_2$

$\frac{1}{4} V_1 = \frac{9}{4} V_2 \qquad \frac{V_2}{V_1} = \frac{1/4}{9/4} = \frac{1}{9}$

$\frac{V_2}{V_1} = \frac{1}{9}$ "D". ∴ the speed of the fluid flow through the 3 inch section will be $\frac{1}{9}$ times that through the 1 inch section.

32- ANS: d

* $r = 2\,cm$ the flow rate $= 0.0080\ m^3/s$

$r = 0.02\ m$ $AV =$ the flow rate of the fluid.

$(0.02)^2 \pi V = 0.0080$

$\frac{11}{8750} V = 0.0080$ $V = 0.0080 \times \frac{8750}{11} = 6.36\ m/s$

$\simeq 6.4\ m/s$ "D"

33- Ans: The cross-section area will decrease so the speed of blood increase

34- ANS: d

$Q_m = 0.25$ $\rho = 0.85 \times 10^3$ $r = 0.01\,m$

$V = ?$

$Q_m = \rho A V$ $\therefore V = \frac{Q_m}{\rho A} =$

$= \frac{0.25}{0.85 \times 10^3 \times \pi \times (0.010)^2} = 0.935\ m/s$

$\simeq 0.94\ m/s$ "D".

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35- ANS: a

55) $\rho = 1.10^3\ kg/m^3$ $v = 15\ m/s$

$r = 0.040$ $y = 3\ m$

Bernoulli equation:- $P_1 + \frac{1}{2}\rho v_1^2 + \rho g y_1 = P_2 + \frac{1}{2}\rho v_2^2 + \rho g y_2$

$\because$ the pressure remains unchanged $\therefore P_1 = P_2$

$$\therefore \frac{1}{2}\rho v_1^2 + \rho g y_1 = \frac{1}{2}\rho v_2^2 + \rho g y_2$$

hight $(y)_1 = 0$ $\therefore \frac{1}{2}\cancel{\rho} v_1^2 = \frac{1}{2}\cancel{\rho} v_2^2 + \cancel{\rho} g y_2$

$$\frac{1}{2} v_1^2 = \frac{1}{2} V_2^2 + g y_2$$

$$\frac{1}{2}(15)^2 = \frac{1}{2} V_2^2 + 10 \times 3$$

$$V_2 = \sqrt{\left(\frac{1}{2}(15)^2 - 30\right) \times 2} = 12.8 \simeq 13\ m/s$$

36- Ans: C

It remains constant as the pipe diameter increases.

37- ANS: a

26) $\because P_1 = P_2$ $\frac{F_1}{A_1} = \frac{F_2}{A_2}$

$F_2 = 15000\ N$

$A_1 = \pi \times (0.04)^2 = 5.028 \times 10^{-3}\ m^2$

$A_2 = \pi \times (0.2)^2 = 0.1257\ m^2$

$$F_1 = \frac{A_1 F_2}{A_2} = \frac{15000 \times 5.028 \times 10^{-3}}{0.1257} = 600\ N \quad (\text{"A"})$$

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38- Ans: B

the output force increases by factor 4

39- Ans: C

$$\frac{F_1}{A_1} = \frac{F_2}{A_2}$$

$d_1 = 8\,cm = r = 4\,cm = 0.04\,m$

$d_2 = 36\,cm = r = 18\,cm = 0.18\,m$

$A_1 = \pi (0.04)^2 = 5.028 \times 10^{-3}\,m^2$

$A_2 = \pi (0.18)^2 = 0.1018\,m^2$

$F_1 = 825\,N$

$$F_2 = \frac{A_2 \times f_1}{A_1} = \frac{825 \times 0.1018}{5.028 \times 10^{-3}} = 16706.25\,N$$

the maximum mass can be lifted by the output piston

$$= \frac{16706.25}{9.8} = 1704.7 = 1.7 \times 10^3\,kg$$

40- ANS: a

41- ANS: a

43- ANS: B

$\because P = \rho g h$

$\therefore P/\rho = gh \quad , \quad g \rightarrow m/s^2 \quad , \quad h \rightarrow m$

$\therefore gh = m^2/s^2 \quad , \quad P/\rho = m^2/s^2$

44- ANS: B

$\because m_1 = m_2$ at Δt

$\therefore \rho V_1 = \rho V_2$ at Δt , $V = A \Delta x$

$\therefore \rho A_1 \Delta x_1 = \rho A_2 \Delta x_2$, $x = vt$

$\therefore A_1 v_1 \Delta t = A_2 v_2 \Delta t$

$\therefore A_1 v_1 = A_2 v_2$

, $\therefore$ Continuity is derived from Conservation of mass

45: ANS: A

$\because$ Bernoulli $\rightarrow P_1 + \frac{1}{2}\rho v_1^2 + \rho g h_1 = P_2 + \frac{1}{2}\rho v_2^2 + \rho g h_2$

$\therefore P + \frac{1}{2}\rho v^2 + \rho g h$ is constant.

Where P is pressure , $\frac{1}{2}\rho v^2$ is the fluids kinetic energy , $\rho g h$ is the fluids potential energy.

$\therefore$ Bernoulli's law can be derived from the Conservation of energy.

46: ANS: E

$\because$ Continuity $\rightarrow A_1 V_1 = A_2 V_2$,

$\because$ The pipe has uniform shape.

$\therefore A_1 = A_2$ and $V_1 = V_2$

So, R_v (input) $= 6 + 3 + 5 + 4 = 18\ m^3/s$

$\therefore R_v$ (output) $= 3 + 15 = 18\ m^3/s$

47: *ANS: B*

$\because A_1 V_1 = A_2 V_2$

$A_1 = \pi (\tfrac{1}{2} \times 10^{-2})^2 = 7.85 \times 10^{-5}\ m^2$

$V_1 = 2\ m/s$, $A_1 V_1 = (7.85 \times 10^{-5}) \times 2$

$= 1.57 \times 10^{-4}\ m^3/s$

Then, $A_2 V_2 = 1.57 \times 10^{-4}\ m^3/s$

$\because A_2 = \pi (\frac{0.05}{2} \times 10^{-2})^2 = 1.96 \times 10^{-7}\ m^2$

$\therefore V_2 = 1.57 \times 10^{-4} / 1.96 \times 10^{-7} \simeq 800\ m/s$

Since there 25 holes,

V of fluid leaving a hole $= 800/25 = 32\ m/s$

48: ANS: E

$\because (P_1 - P_2) = \tfrac{1}{2} \rho (V_2^2 - V_1^2) + \rho g (h_2 - h_1)$.

$\because$ The pipe is horizontal

$\therefore h_2 - h_1 = 0$ (no change in height)

$\therefore 4.5 \times 10^3 = \tfrac{1}{2} (1 \times 10^3)(V_2^2 - 4^2)$

$\therefore V_2 = 5\ m/s$

49- ANS: A

$\because$ The pipe is horizontal

$\therefore h_2 - h_1 = 0 \rightarrow$ Potential energy $= 0$ (1)

, $\because$ Cross section is constant

$\therefore A_1 = A_2$, $\therefore V_1 = V_2 \Rightarrow$ kinetic energy $= 0$ (2)

From (1) & (2);

$P_1 - P_2 = 0$

50- ANS: C

$\because$ The pipe is horizontal
$\therefore h_2 - h_1 = 0$ (no change in height)

51- ANS: B

$\because$ The tank is open from the top & the bottom
$\therefore$ P at top = P at bottom = 1 atm
$\therefore P_1 - P_2 = 0$
$, \therefore 0 = \frac{1}{2}\rho(V_2^2 - V_1^2) + \rho g(h_2 - h_1)$
$\Rightarrow \frac{1}{2}\rho(V_2^2 - V_1^2) = -\rho g(h_2 - h_1)$
, $\because$ The hole is at bottom
$\therefore h_2 = 0 , V_1 = 0$ (1)
, $\because$ the velocity at the top of the tank $= 0$ (2)
From (1) & (2) :
$\therefore g h_1 = \frac{1}{2} V_2^2 = (9.8)(70 \times 10^{-2}) = \frac{1}{2} V_2^2$
$\therefore V_2 = 3.7$ m/s

52- ANS: A

$\because$ The fluid is pumped steadily
$\therefore V_2 = V_1 , (V_2^2 - V_1^2) = 0$
$\therefore P_1 - P_2 = \rho g(h_2 - h_1)$
$\Rightarrow$ if the fluid is motionless :
$P = \underline{\rho g h}$

53- ANS: D

54- ANS: B

55- ANS: B

56- ANS: A

(Because area has an inverse proportion with velocity.)

57- ANS: B

(The difference in pressure =0, because the tank is opened and exposed to the atmospheric pressure.)

58- ANS: b

Flow rate in a pipe must be constant in order to create linear flow. This flow rate is given by the product of the cross-sectional area and the velocity of the fluid.

$$A_1V_1=A_2V_2$$

The cross-sectional areas of the pipe and nozzle can be found using their radii. Note that you were given dimensions in terms of diameter, so be sure to divide by 2 to get the radius.

$A=\pi r^2$

$A_1= \pi\ (0.02m^2) =0.0004\pi\ m^2$

$A_2= \pi\ (0.004m^2)= 0.000016\pi\ m^2$

Use these areas and the initial velocity to calculate the final velocity in the nozzle.

$(0.0004\ \pi m^2)\ (2\ m/s) = (0.000016\ \pi\ m^2)\ V_2$

$V_2=(0.0004\pi\ m^2)\ (2m/s)/0.000016\pi\ m^2$

v2=50m/s

59- ANS: B

Use the equation for pressure and apply Pascal's principle.

$$\frac{F_1}{A_1}=\frac{F_2}{A_2}$$

$$F_1=\left(\frac{A_1}{A_2}\right)F_2=\left(\frac{0.20\ m^2}{0.90\ m^2}\right)(1.20\times10^4\ N)$$

$$\boxed{F_1=2.7\times10^3\ N}$$

60-B

$$\frac{F_1}{a_1}=\frac{F_2}{a_2}$$

$$\frac{m}{a}=\frac{M}{10a}$$

$$\frac{m\times10\cancel{a}}{\cancel{a}}=M \qquad M=10\,m$$

61- ANS:C

$\Delta P=0$ $\qquad V_1 =$ Zero

$(h_2-h_1) = 1$

$$0=\rho g(1)+\frac{1}{2}\rho(v_2-0)^2$$

$$\rho g=-\frac{1}{2}\cancel{\rho}v_2^2 \qquad \times 2$$

$$2g=-V^2$$ no velocity in (-)

$$\sqrt{2\times9.8}=V$$

$$V=4.4\ m/s$$

62- ANS: D

$A\times V$ = flow rate

$$(1)^2\times\frac{22}{7}\times V=90$$

$$V=90\div\frac{22}{7}$$

$$=28.6\simeq29\ cm/s$$

Good job