World Bulletin of Social Sciences (WBSS)
Available Online at: https://www.scholarexpress.net
Vol. 9, April,2022
ISSN: 2749-361X

SOLUTION OF PROBLEMS OF HYDROSTATICS

Makhmudov Yusup Ganievich, Professor of Termez State University, Doctor of Pedagogical Sciences, Uzbekistan.
Imanov Bakhtiyor Berdievich, Associate Professor of the Pedagogical Institute of Termez State University, Candidate of Pedagogical Sciences, Uzbekistan.

Article history:

Received: 12th February 2022
Accepted: 12th March 2022
Published: 30th April 2022

Abstract:

This article provides examples of methods for solving problems in the field of hydrostatics in physics. With each problem-solving methodology, it has been shown that other problems can be solved. Before solving physical problems, opinions were expressed about the importance of analyzing drawings on the subject by logical reasoning.

Keywords: Temperature, Pressure, Volume, Surface, State, Mass, Atmospheric Pressure.

Task 1. When immersed in a fluid with a density of ρ_1, the body mass was P_1, and when immersed in a fluid with a density of ρ_2 equals to P_2. Determine the density ρ of the body.

Given: ρ_1 ; P_1 ; ρ_2; P_2
Need to find: ρ= ?

Solution: The weight of any body immersed in a liquid is equal to the volume of the liquid in this body, and the upward buoyancy force F_A acts on it.
For the first fluid:

$$P - F_A = P_1,$$

where *P* is the weight of the body in the air.

If written otherwise, it will be

$$V\rho g - V\rho_1 g = P_1, \quad Vg\,(\rho - \rho_1) = P_1 \qquad (1)$$

The same for the second fluid

$$P - F^1_A = P_2$$

or

$$V\rho g - V\rho_2 g = P_2, \qquad (2)$$

where V is the volume of the body,

$$Vg\,(\rho - \rho_2) = P_2.$$

Equating (1) and (2) one after the other, we get:

$$\frac{Vg\,(\rho-\rho_1)}{Vg\,(\rho-\rho_2)} = \frac{P_1}{P_2}, \quad \text{therefore} \quad P_2\,\rho - P_2\,\rho_1 = P_1\,\rho - P_1\,\rho_2,$$

or

$$\rho(P_2 - P_1) = P_2\,\rho_1 - P_1\,\rho_2, \quad \text{that's} \quad \rho = \frac{P_2\rho_1 - P_1\rho_2}{P_2 - P_1}$$

World Bulletin of Social Sciences (WBSS)
Available Online at: https://www.scholarexpress.net
Vol. 9, April,2022
ISSN: 2749-361X

Answer: $\rho = \dfrac{P_2\rho_1 - P_1\rho_2}{P_2 - P_1}$

Task 2. A body of mass *P* has a weight ρ_1 when immersed in a fluid of density P_1 and a weight P_2 in a fluid of unknown density. Determine the density ρ_1 of the unknown fluid.

Given:
P_1; P_2; ρ_1.

Need to find: ρ_2=?

Solution. The equilibrium condition for the body $P - F_A = P_1$, where F_A is the buoyancy force. This expression can be written as:

$$P - V_{P1g} = P_{1'}$$

In this case, the volume of the body V can be written for a second fluid of the same size:

$$P - V_{P2}\, g = P_2$$

Here

$$P - P_2 = V p_2 g \text{ ёки } \quad P2 = \frac{P - P_2}{Vg}.$$

From the first equation we find

$$P - P_1 = V\rho g; \quad V = \frac{P - P_1}{\rho 1 g}$$

We put the value of V into the expression of ρ_1:

$$P2 = \frac{(P - P2)\,p1g}{(P - P1)\,g} = \frac{(P - P2)\,\rho 1}{P - P1}.$$

$$\text{Answer}: \quad \rho_2 = \frac{(P - P2)\,\rho 1}{P - P1}.$$

Task 3. Water is poured into a cylindrical vessel with a cross-sectional surface S, in which a piece of ice with a lead cylinder floats. The volume of the piece of ice with a ball is equal to V and 1/20 of which protrudes from the water (Fig. 1). How does the water level *h* rise after ice melts?
The density of water is p_c =1г/cm^3, and that of ice is p_m = 0,9 г/cm^3, and that of lead is p_q =11,3 г/cm^3.

Given:
S; V;
$k = \frac{1}{20}$;
p_c =1г/cm^3;
p_m=0,9 г/cm^3; p_q = 11,3 г/cm^3;

Need to find: h =?

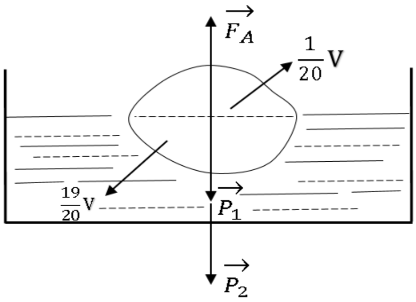


Figure 1

World Bulletin of Social Sciences (WBSS)
Available Online at: https://www.scholarexpress.net
Vol. 9, April,2022
ISSN: 2749-361X

Solution. Three forces on a piece of ice, i.e. buoyancy force $F_A = \frac{19}{20}V'\rho g$; weight of the lead ball $P_1 = V'\rho_{\text{к}} g$, where V' - is the volume of lead; ice weight is $P = (V - V') = \rho_{\text{м}} g$.

The condition for the balance of these forces:

$$\frac{19}{20}V\rho_{\text{c}} g = V'\rho_{\text{к}} g + V\rho_{\text{м}} g - V'\rho_{\text{м}} g,$$

$$\frac{19}{20}V\rho_{\text{c}} - V\rho_{\text{м}} = V'(\rho_{\text{к}} - \rho_{\text{м}}),$$

From this $V' = \frac{(\frac{19}{20}\rho_{\text{c}} - \rho_{\text{м}})}{\rho_{\text{к}} - \rho_{\text{м}}}$ - the size of the lead ball.

The total weight of the items inside the container does not change, so the pressure force acting on the bottom of the container does not change even after the ice has melted. After the ice melts, the compressive strength is equal to the sum of the compressive forces of the water in the vessel and the lead bottle. This means that the water pressure is lower than before, so the water level should decrease. Reduced water pressure must be filled with a lead cylinder. The pressure of the ball on the bottom of the vessel is equal to the force of two forces: the gravity of the lead ball and the Archimedean force acting on the ball after the ice melts. This equal force is equal to the force of gravity of the water in the vessel, as it were "reduced". Comparing these forces, it is possible to determine h when the water level drops.

$P = V\rho_{\text{к}} g$ — weight of lead cylinder in air, or

$P = \frac{V\rho_{\text{к}}(\frac{19}{20}\rho_{\text{c}} - \rho_{\text{м}})g}{\rho_{\text{к}} - \rho_{\text{м}}}$; $P'_A = \frac{V\rho_{\text{к}}(\frac{19}{20}\rho_{\text{c}} - \rho_{\text{м}})g}{\rho_{\text{к}} - \rho_{\text{м}}}$ – buoyancy force acting on the balloon.

$R = hS\rho_{\text{c}} g$ – is the weight of "reduced" water in the tank. In this case

$$\frac{V\rho_{\text{к}}(\frac{19}{20}\rho_{\text{c}} - \rho_{\text{м}})g}{\rho_{\text{к}} - \rho_{\text{м}}} - \frac{V\rho_{\text{к}}(\frac{19}{20}\rho_{\text{c}} - \rho_{\text{м}})g}{\rho_{\text{к}} - \rho_{\text{м}}} = hS\rho_{\text{c}} g$$

or

$$\frac{V\left(\frac{19}{20}\rho_{\text{c}} - \rho_{\text{м}}\right)(\rho_{\text{к}} - \rho_{\text{c}})}{\rho_{\text{к}} - \rho_{\text{м}}} = hS\rho_{\text{c}},$$

from this

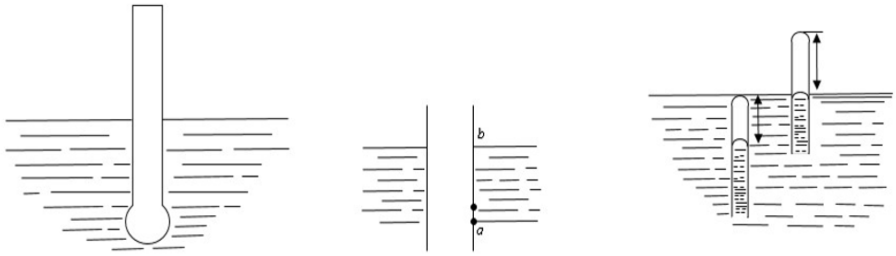
$$h = \frac{V}{S}\,\frac{V\rho_{\text{к}}\left(\frac{19}{20}\rho_{\text{c}} - \rho_{\text{м}}\right)(\rho_{\text{к}} - \rho_{\text{c}})}{\rho_{\text{c}}(\rho_{\text{к}} - \rho_{\text{м}})} = 0{,}048\frac{V}{S}.$$

Answer: $h = 0{,}048\frac{V}{S}$.

Task 4. Hydrometer consisting of a cylindrical tube with a cross section of S with grit, floats in a fluid of

World Bulletin of Social Sciences (WBSS)
Available Online at: https://www.scholarexpress.net
Vol. 9, April,2022
ISSN: 2749-361X

density ρ. The hydrometer is slightly immersed in the fluid and then released. Determine the period of these oscillations. The mass of the hydrometer is *M.*



Given: S; ρ; *M.*

Need to find: T = ?

Solution. We will use the formula (72) on page 79 of the book "Questions and Problems in Physics" (second revised edition, "Higher School", M., 1975) by Tarasov L.V., Tarasova A.N.

$$T = 2\pi\sqrt{\frac{m}{k}}$$

It says that "the period of oscillation depends on the properties of the oscillatory system and does not depend on the method of excitation of oscillations." Thus, we can find *k* for our case and answer the question of the problem. The role of the repulsive force is played by the buoyancy force. Suppose that the hydrometer is immersed from "*a*" to "*b*" and released (Fig. 75). In this case, the shift is equal to "*ab*". The value of the repulsive force is calculated from $F = kx$, where

Figure 2

$F = (ab)S\rho g$ $\quad$ $x = ab$, therefore $(ab)S\rho g = k(ab)$. From this $k = S\rho g$. Then

$$T = 2\pi\sqrt{\frac{m}{k}} = 2\pi\sqrt{\frac{M}{S\rho g}}$$

So, $\quad T = 2\pi\sqrt{\frac{M}{S\rho g}}$

Answer: $T = 2\pi\sqrt{\frac{M}{S\rho g}}$

World Bulletin of Social Sciences (WBSS)
Available Online at: https://www.scholarexpress.net
Vol. 9, April,2022
ISSN: 2749-361X

LITERATURE

1. Makhmudov Yu.G. Collection of tasks and questions in physics. Tutorial. - Tashkent: Teacher, 1994. -22444 p.
2. Makhmudov Yu.G. A set of observational problems and questions from physics. Tutorial. - Tashkent: Factorprint, 2022. - 400 p.
3. Makhmudov Yu.G., Imanov B.B., Raimov G.F. A set of tasks and questions in physics. Tutorial. - Tashkent: Factor-press, 2021. - 544 p.
4. Imanov B.B. Competences The Quality Of Education And Their Organization. Asian Journal of Multidimensional Research (AJMR) Vol 10, Issue 5, May 2021.
5. Imanov B.B. The Lesson as a factor for improving the quality of education. SCIENCE AND WORLD International scientific journal. No. 7 (83), 2020.