

NCERT SOLUTIONS

CLASS IX SCIENCE

CHAPTER 10- GRAVITATION

Question 1:

Why is it very difficult to hold a school bag with a long string and thin strap?

Answer:

The force exerted by a thin and strong string is equally spread on a very less area and hence the force applied due to the bag is more. The pressure is inversely proportional to its area. So the pressure exerted on the body by thin straps of the school bag will be more and hence will be more painful to carry the bag. If the area of the given bag is reduced, pressure of the bag increases.

Question 2:

What is meant by buoyancy?

Answer:

When a body is submerged in a fluid, the fluid exerts an upward force on the submerged body. This upward force is exactly similar to the weight of the fluid replaced by the submerged body and this is called the buoyancy. Simply put, it is called as the force exerted by the fluid when an object is submerged in it.

Question 3:

Why does an object float or sink when placed on the surface of the water?

Answer:

This is because of the density of the object placed on the water surface as the water decides the capacity of floating or submerging of the object in water. The density of water is equal to 1 gm/cm^3 .

1. If the density of an object is lower than the density of water, then the object will float.
2. If the density of an object is greater than the density of water then the object will sink.

Question 4:

You find your mass to be 52 kg on a weighing machine. Do you truly believe that your mass is 52 kg?

Answer:

The weight machine actually measures the weight of the body that acts on the weighing machine courtesy of the acceleration due to gravity. Hence, the reading of 52 kg given by a weight machine is actually the force exerted by your body on the machine. Your mass may be close or equal to 52 kg as we consider earth's gravity as the standard.

Question 5:

You have a bag of wool and a steel bar, each indicating a mass of 200 kg when measured on a weight machine. In reality, one is heavier than the other. Can you say which one is heavier and why?

Answer:

Density is equal to the ratio of mass and volume. The volume of cotton is more and since density is inversely proportional to the volume of mass, the steel bar is heavier than that of wool.

Question 6:

Mention the direction in which the buoyant force acts on a submerged body.

Answer:

The buoyant force acts in a vertically upward direction which is opposite to the direction in which force from the object acts.

Question 7:

Why does a block of wood immersed in a fluid, come up to the surface?

Answer:

The density of the block of wood is lesser than that of water. Thus the buoyant force from water is greater than that of the force exerted by the wood block. Thus, the block of wood comes back to the surface after immersing it.

Question 8:

The volume of 60 g of a substance is 10 cm^3 . If the density of water is 1 g/cm^3 , find out whether the substance will float or sink.

Answer:

Mass=60 g, Volume = 10 cm^3

Density= Mass /Volume = $60/10\text{cm}^3$

$\therefore$ Density = 6 g/cm^3

The density of water is 1 g/cm^3 . As the density of the given substance is more than the density of the water, the substance will get submerged in water.

Question 9:

The volume of a 200 g sealed packet is 150 cm^3 . Will the packet float or sink in water if the density of water is 1 kg/cm^3 ? What will be the mass of the water displaced by this packet?

Answer:

Mass of the packet =200 g

Volume of the packet = 150 cm^3

Density of the packet =?

Density =Mass/volume

= $200\text{g}/150 \text{ cm}^3 =1.33 \text{ g/cm}^3$,

The packet will sink in water, as the density of packet is greater than the density of water.

Mass of the water= (packet Volume= 150 cm^3) * (Density of water = 1 g/cm^3).

Mass of the water that has been displaced by the body=150g.

More Questions Solved

(i)Multiple Choice Questions

(ii)Fill the correct option:

1. *The device that is used to measure the purity of milk is _____*

(1) Hydrometer (2) lactometer (3) hygrometer (4) maltometer

2. *A block of wood floats while a hammer sinks in the water. This is due to _____*

(1) density of wood is more than hammer

(2) density of hammer is more than wood.

(3) Density of wood is less than the density of water.

(4) Density of iron is lesser than that of the density of water.

3. *The relative density of gold is 20.8 and the density of a fluid is 103 kg/m^2 . The density of silver is _____*

(1) $1.8 \times 10^4 \text{ N/m}^3$ (2) $10.8 \times 13 \text{ N/m}^3$ (3) $1.8 \times 10^4 \text{ kg/m}^3$ (4) $10.8 \times 10^4 \text{ kg/m}^3$

4. *Buoyant force applied by different fluids on a given body is _____*

(1) Same (2) different (3) zero (4) negligible

5. *Fluid A is denser than fluid B. A body of wood is dipped in both the fluids. The buoyant force experienced by the body in*

(1) Liquid A is more (2) liquid B is more (3) liquid A is less (4) none of the above

Answer: 1. 2, 2. 3, 3. 2, 4. 2, 5. 3

Very Short Answer Type Questions

Question 1:

What is the S.I. unit of thrust?

Answer:

Newton

Question 2:

What is the S.I unit of pressure?

Answer:

The S.I. unit of pressure is Pascal.

Question 3:

Define thrust.

Answer:

The net force applied by a body in a specified direction is called thrust.

Question 4:

Define pressure.

Answer:

The force exerted per unit area is called pressure.

Question 5:

Why is it easier to swim in sea water than in river water?

Answer:

The density of sea water is high due to dissolved salts in it as compared to the density of river water. Hence the buoyant force applied on the swimmer by the sea water is high which helps in floating and makes swimming simpler.

Question 6:

Why does a lorry or a bike have much wider tires?

Answer:

The pressure exerted by it can be scattered to more area which helps in avoiding friction, wear and tear of tires.

Question 7:

State why are knives sharp.

Answer:

To increase the given pressure, area is reduced, as pressure is inversely proportional to its area. Thus, pressure or force applied on a body comparatively increases.

Question 8:

Why do you think the wall of a reservoir dam is thicker at the bottom?

Answer:

The pressure of water in dams at the bottom is large. To withstand this pressure, dams have wider, thicker walls.

Question 9:

Why do nails have pointed tips?

Answer: The force when acting on a smaller area, exerts more pressure. Therefore, the nails have pointed sharp tips.

Question 10:

Why do we feel light while swimming?

Answer:

It is due to the buoyant force that is acting upwards on the swimmer's body and thus making the swimmer feel light while swimming.

Question 11:

Define density and write its unit.

Answer:

The density of a given substance is defined as mass per unit volume. Its unit is given as kg/m^3 .

Question 12:

Define relative density.

Answer: The relative density is defined as the ratio of the density of the substance to the density of water.

Short Answer Type Questions

Question 1:

A ship made of iron does not sink but an iron nail sinks in water, why?

Answer: The iron nail sinks because of its high density and less buoyant force acting on it due to lesser surface area. Whereas the surface area of a ship is greater and thus experiences a higher buoyant force. Due to this fact, a ship floats but an iron nail sinks.

Question 2:

Camels can walk comfortably on desert sand but we are not able to walk easily on desert sand. Why do you think so?

Answer:

The surface area of a camel's feet is broad and larger. Thus, the pressure exerted is low. However, when we walk, our legs sink because the pressure exerted by our body is not equally distributed but is directional towards the legs.

Question 3:

Define lactometer and hydrometer.

Answer: To find the purity of milk, a lactometer is used. To find the density of liquid, a hydrometer is used.

Question 4:

The relative density of Ag is 10.8. What does this mean?

Answer:

It means that the relative density of the Ag is 10.8 times more than that of water.

Question 5:

The relative density of gold is 18.3. The density of water is 10^3 kg/m^3 . What is the density of gold in its S.I units?

Answer:

The relative density of gold is 18.3

Relative density of gold = Density of gold / Density of water.

That is, Density of gold = Relative density of gold $\times$ Density of water.

= $18.3 \times 10^3 \text{ kg/m}^3 = 18300 \text{ kg/m}^3$.

Question 6:

What is Archimedes' principle?

Answer: When a body is immersed fully or partially in a fluid, it experiences an upward force that is equal to the weight of the fluid displaced by it. It is used in designing of ships, boats and submarines.

Question 7:

Two wood pieces of same size and mass are dipped in two beakers containing water and oil. One wood floats on water, but the other one sinks in oil. Why?

Answer: The wood floats on water because the density of wood is lower than the density of water, and the other wood sinks in the oil because the density of wood is more than the oil.

Question 8:

What are liquids? Why is Archimedes' principle applicable only for liquids? Give the applications of Archimedes' principle.

Answer:

Liquids are the substances which can flow. Archimedes' principle is based on the upward force exerted by fluids on any object immersed in a fluid. Hence, it is applicable only for fluids. Applications of Archimedes' principle:

1. It is used to design ships and submarines.
2. To determine the purity of milk using lactometers which are designed based on the principle of Archimedes' principle
3. To make hydrometers which are used to determine the density of liquids.

Long Answer Type Questions

1. With the help of an activity, prove that the force acting on a lower area exerts a larger pressure.

Answer:

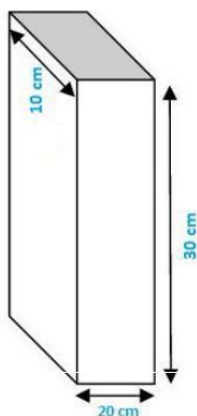
Consider a block of wood kept on a tabletop. The mass of the wooden block is 5 kg. Its dimensions are 30 cm x 20 cm x 10 cm.

Now we have to find the pressure applied by the wooden block on the tabletop by keeping it vertically and horizontally.

The mass of the wooden block = 5 kg

Weight of the wooden block applies a thrust on the tabletop

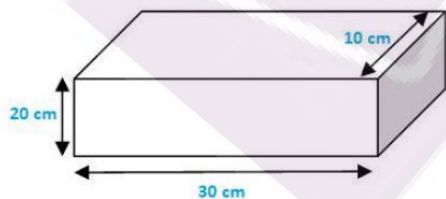
$$\text{Thrust} = F = mg = 5 \text{ kg} \times 9.8 \text{ m/s}^2 = 49 \text{ N}$$



(Case a)—When the wooden box is kept vertically with sides 20 cm x 10 cm,

$$\text{Area of a side} = \text{length} \times \text{breadth} = 20 \text{ cm} \times 10 \text{ cm} = 200 \text{ cm}^2 = 0.02 \text{ m}^2$$

$$\text{Pressure} = \text{Thrust} / \text{Area} = 49 \text{ N} / 0.02 \text{ m}^2 = 2450 \text{ N/m}^2$$



(case b)—When the block is kept horizontally with side 30 cm x 20 cm,

$$\text{Area} = \text{length} \times \text{breadth} = 30 \text{ cm} \times 20 \text{ cm} = 600 \text{ cm}^2 = 0.06 \text{ m}^2$$

$$\text{Pressure} = \text{Thrust} / \text{area} = 49 \text{ N} / 0.06 \text{ m}^2 = 816.7 \text{ N/m}^2.$$

Activity — Based Questions

Question 1.

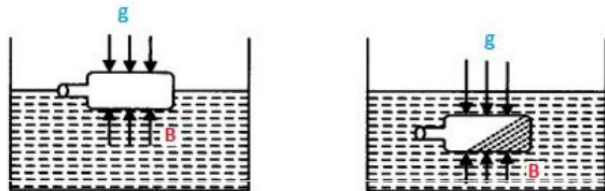
Take a plastic bottle. With an airtight stopper, close the mouth of the bottle. Put the bottle in a bucket filled with water. You can see that the bottle floats. If you apply a

downward pressure by pushing the bottle into the water, you will feel an upward force from under the water. Try to give a total pressure by an even deeper push. You will find it hard to push deeper. This clearly says that the water gives a force on the bottle in the upward direction. The upward force given by the water increases as the bottle is pushed deeper inside till it is completely submerged. Now, release the bottle. It floats back to the surface of the water.

Does any gravitational force act on this? If so, why doesn't the bottle stay submerged in water after it is released? How can you submerge the bottle in water?

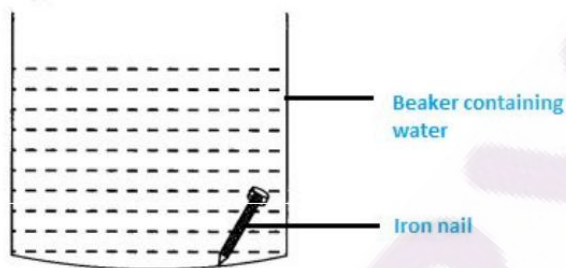
Answer:

Yes, the bottle is attracted downwards by the earth's gravitational force. On pushing the bottle with force in the water, it does not remain there but comes up because of the upward force exerted by water on the bottle. This upward force is called the up thrust or buoyant force. When the upward force or buoyant force is greater than the downward force 'g', the bottle will float. But if the downward force is greater than upward force, the bottle will sink. The upward force (buoyant force) acting on the bottle can be reduced by increasing the force on the bottle or by filling the bottle with sand, water etc.



Question 2:

Take a beaker filled with water. Take an iron nail and place it on the surface of the water. Observe what happens.

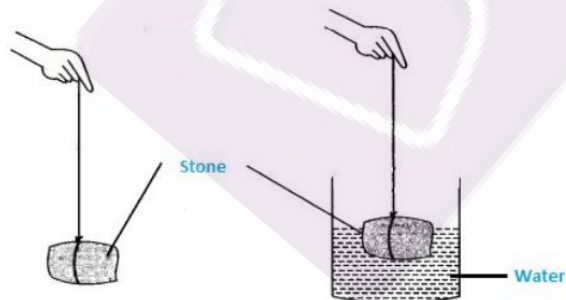


Answer:

The iron nail sinks as the density of the nail is more and the downward force exerted on nail is more than the buoyant force.

Question 3:

Take a piece of stone and tie it to one end of a rubber string or a spring balance. Suspend the stone by holding the balance or the string as shown in the figure.



Note the elongation of the string or the reading on the spring balance due to the weight of the stone.

Now, slowly dip the stone in the water in a container as shown in Fig. (b).

Observe what happens to the elongation of the string or the reading on the balance.

Observations:

- In Fig. (a) the elongation of the string is 6 cm.
- In Fig. (b) when the stone is dipped in water, the length of the string reduced to 5 cm.
- The length of the string in case (b) decreases due to the upward force exerted by water on the stone called as buoyant force.

Value — Based Questions

Question 1:

A milkman sold his milk in the city and always carried lactometer with him. The customers trusted him and his business flourished.

- (a) What is lactometer?
- (b) What is the principle of working of a lactometer?
- (c) What value of milkman is seen in this case?

Answer:

- (a) Lactometer is a device that measures the purity of milk.
- (b) The principle of lactometer is 'Archimedes' principle. It states that when a body is immersed fully or partially in a fluid, it experiences an upward force that is equal to the weight of the fluid displaced by it.
- (c) The milkman is very honest and trustworthy.

Question 2:

Reeta was wearing a high heel shoe for a beach party. Her friend told her to wear flat shoes as she will be tired soon with high heels and will not feel comfortable,

- (a) Why would one feel tired with high heel shoes on beach?
- (b) Give the unit of pressure.
- (c) What value of Reeta's friend is seen in the above act?

Answer:

- (a) The high heel shoes would exert a lot of pressure on the loose sand of beach and will sink more in the soil as compared to flat shoes. Hence a large amount of force will be required to walk with heels.
- (b) Unit of pressure is Pascal.
- (c) Reeta's friend showed the value of being helpful, concerned and intelligent.

Question 3:

In a school fair, there was a game in which one needs to find the heaviest ball without holding them in hand. Three balls were given and a few disposable glasses were kept. Tarun saw his friend struggling to win the game as he was unable to find the heaviest ball. Tarun helped him by dipping the three balls one by one in the glasses full of water up to the brim and finally they won the game.

- (a) Why did Tarun tell his friend to dip the balls one by one in completely filled glasses of water?
- (b) Name the principle used here.
- (c) What value of Tarun is reflected in this case?

Answer:

- (d) Tarun wanted to measure the amount of water displaced by each ball when dipped in water.
- (b) The principle used is 'Archimedes' principle.
- (c) Tarun showed the value of being helpful, kind and intelligent.

Buoyancy

Question 1:

Define Pressure.

Answer:

Pressure can be defined as the force acting per unit area of the object.

The SI unit of Pressure is N/m^2 or Pascal (Pa).

Question 2:

Define density/mass density.

Answer:

Density or Mass density can be defined as the ratio of mass per unit volume.

The SI unit of density is kg/m^3 . The object will float or sink in a liquid completely depending on the density of the object.

Question 3:

The weight of a man is 690N having $5.3 \times 10^{-3} \text{ m}^3$ of blood. Find

a) Weight of blood. (Density of blood is 1060 kg/m^3)

b) Express it as a percentage of body weight.

Answer:

a)

$$\therefore m = \rho.V \quad \& \quad W = m.g$$

$$\therefore W = (\rho V)g = 1060 * 5.3 * 10^{-3} * 9.8$$

$$\Rightarrow W = 54N$$

b) Percentage (%) of blood weight w.r.t. body's weight = $(54N/690N)*100 = 78\%$

Question 4:

A glass is filled with water (density = 1000 kg/m^3) and the pressure exerted at the bottom is P. Take another glass and fill it with kerosene (density = 817.5 kg/m^3). Pressure exerted in the second glass will be

a) smaller than P.

b) same as P.

c) larger than P.

d) cannot be determined.

Answer:

Correct answer is (b) as the pressure at any point is equal to $h\rho g$. H and g are fixed. So the fluid with lesser density will apply lesser pressure.

Question 5:

Define thrust or buoyant force.

Answer:

Thrust or buoyant force can be defined as the upward force exerted by a liquid when a body is immersed in the liquid.

Question 6:

Mention the factors on which the buoyant force depends on.

Answer:

The factors on which buoyant force depends on are as follows:

a) Volume of the object, which is immersed inside the liquid.

b) Density of the liquid.

Question 7:

When we place objects on the surface of water, some float and some sink. Explain why.

Answer:

The density of an object is either higher than the density of the liquid or lesser than the density of the liquid. If the density of an object is higher, then it sinks in the liquid. If the density of an object is lesser, then it floats in the liquid. When it sinks, the buoyant force acting on the object is lesser than the force of gravity and when it floats, the buoyant force acting on the object is greater than the force of gravity.

Question 8:

Consider the following figure which shows four containers having a liquid at the same height. Which of the following will be the correct ascending order of the pressure exerted on the bottom of the container due to the liquid?





- a) 2,4,3,1.
 b) 1,2,3,4.
 c) 4,3,1,2.
 d) Same pressure in each case.

Answer:

- d) Same pressure in each case.

Question 9:

Define one Pascal.

Answer:

The pressure experienced by the surface is said to be one Pascal when a force of one newton acts normally on an area of cross-section 1 m^2 .

Question 10:

State Archimedes' Principle. Based on the principle, write its applications.

Answer:

Archimedes' Principle states that when a body is partially or wholly immersed in a fluid, it experiences an upthrust and apparently loses its weight which is equal to the weight of the fluid displaced by the immersed part of the body.

Its applications are as follows:

- 1) Designing of ships and submarines.
- 2) Lactometers, device used to determine the purity of a sample of milk.
- 3) Hydrometers, device used for determining the density of liquids.

Questions 11:

The mass of a rectangular bar of an iron piece is 0.320 Kg and its dimensions are $2 \times 2 \times 10 \text{ cm}^3$. Calculate its specific gravity. Will the bar float or sink in water?

Answer:

Specific gravity, also known as relative density, can be defined as the ratio of the density of a substance to the density of water (i.e. 1 g/cm^3).

Therefore, Specific Gravity of iron = Density of Iron/Density of Water

Density of Iron = Mass/Volume

$$= 320\text{g} / (2 \times 2 \times 10 \text{ cm}^3)$$

$$= 8 \text{ g/cm}^3$$

$$\text{Density of Water} = 1 \text{ g/cm}^3$$

$$\text{Therefore, Specific Gravity of Iron} = 8/1 = 8$$

Since, the density of the bar is more than the density of water, the bar will sink.

Question 12:

A sheet of paper falls slower than the one that is crumpled into a ball. Why?

Answer:

The paper in sheet form has a larger surface area than that of a crumpled paper ball. As the air offers resistance to falling objects, the sheet experiences much more pressure (air resistance) than the crumpled ball and falls slower.

Question 13:

In which direction does buoyant force on an object immersed in a liquid act?

Answer:

It acts vertically upwards.

Question 14:

When a block of plastic is released underwater, it comes up back to the surface of the water. Why?

Answer:

When a block of plastic is released underwater it comes up back to the surface of the water because the upward buoyant force acting on the block is greater than the downward gravitational force due to its weight.

Question 15:

The mass and the volume of a substance are 50 g and 20 cm^3 respectively. Will the substance float or sink in the water?

Answer:

Given, mass of the substance (m) = 50 g

Volume of the substance (v) = 20 cm^3

Therefore, Density of the substance = $m/v = 50/20 = 2.5 \text{ g/cm}^3$

Since the density of a substance is more than the density of water, the substance will sink.

Question 16:

It is difficult to hold a school bag having a thin strap and a strong string. Why?

Answer:

We know that, Pressure = Force/Area, which implies that pressure is inversely proportional to the surface area on which the force acts. The contact area of a thin string, strap is very small and therefore it exerts larger pressure on the shoulder.

Question 17:

When you find your mass on a weighing machine, is it the actual mass?

Answer:

When we weigh our mass in a weighing machine we experience an upward thrust (buoyant force) due to air. Actually, the weighing machine shows our apparent weight.

Apparent weight = True weight – buoyant force

Question 18:

While climbing up a mountain, our ears 'pop' because of the change in atmospheric pressure. In which direction does our eardrum move when we climb up?

Answer:

Our eardrum moves outward as the internal pressure of the body is higher than the atmospheric pressure.

Question 19:

Is the Archimedes' principle applicable to gases?

Answer:

Yes. The Archimedes' principle is applicable to fluids (both liquids and gases).

Question 20:

The weight of an empty glass is 1 N. The glass is completely filled with water and then the glass weighs 4 N. Now we throw away the water and fill it partly with sand, it weighs 4 N. Now we fill the rest of the glass with water, the weight becomes 6 N. Calculate the relative density of sand.

Answer:

Given, weight of empty glass = 1 N

Weight of glass filled with water = 4 N

Therefore, weight of water filled in the glass = $4 - 1 = 3 \text{ N}$

Since, Weight = mg (let $g = 10 \text{ m/s}^2$)

Therefore, mass of water filled in the glass = $3/10 = 0.3 \text{ Kg}$

Density of water = 1000 Kg/m^3

Since, Density = mass/volume

Therefore, volume of water 3 N or empty glass = mass/density

$= 0.3/1000 = 3.0 \times 10^{-4} \text{ m}^3$ (i)

Weight of glass + partly filled sand = 4 N

Weight of glass + partly filled sand = 4 N

Therefore, Weight of partly filled sand = 4 - 1 = 3 N

Mass of sand in the glass = 3/10 = 0.3 Kg

Weight of glass + sand + water = 6 N

Therefore, weight of water in glass = 6 - 4 = 2 N

From (i), volume of water occupied by 2 N water in glass = $2.0 \times 10^{-4} \text{ m}^3$ (ii)

Therefore, volume occupied by sand = (i) - (ii) = $1.0 \times 10^{-4} \text{ m}^3$

& density of sand = mass/volume = $0.3 \text{ Kg} / 1.0 \times 10^{-4} = 3000 \text{ Kg m}^{-3}$

Relative density of sand = density of sand/density of water

= $3000/1000 = 3$

Solved Numericals

Question 1:

Find out what will be the pressure exerted by the block of cube having a mass of 1kg whose sides are of 1cm each. The cube is lying on the table. Take $g = 10 \text{ m/s}^2$

Answer:

Pressure = Force (F) / area (A)

Force, $F = mg = 1000 \times 9.81 \text{ gm m/s}^2$

Area, $A = 1 \times 1 \text{ cm}^2 = 1 \text{ cm}^2$

Thus, the pressure that would be exerted on the table is $P = (9.81 \times 1000) / 1$

Or $P = 9.81 \times 10^5 \text{ pa}$

Question 2 :

A spring balance is used to determine the mass of a solid iron cube whose side is 3cm. Supposing the iron has a density of approx 8.5 g/cm^3 , then the solid weight would be best determined by using the spring balance of range:

A: 0-250gwt; LC 1gwt

B: 0-250gwt; LC 5gwt

C: 0-1000gwt; LC 5gwt

D: 0-1000gwt; LC 10gwt

(LC – least count)

Answer:

Edge = 3cm

Density = 8.5 g/cm^3

Mass = Volume x Density = $(3 \times 3 \times 3) \times 8.5 = 229.5 \text{ gwt}$

Hence the second spring balance having range from 0-250 with LC 5gwt would be suitable.

Question 3:

If the water density is between 1 g/cm^3 - 3 g/cm^3 , will a solid body of mass having 150g and its volume 250 cm^3 float or sink when put in water?

Answer:

If the density of water is lesser than that of the substance then the substance will float in water.

And if the density of water is greater than that of the substance then the substance will sink in water.

Density of a solid body, $D = \text{Mass} / \text{volume}$

$D = 150/250 = 0.6 \text{ gm/cm}^3$ which is lesser than the density of water ($1 \text{ gm/cm}^3 - 3 \text{ gm/cm}^3$)

Hence the body is said to float on water.

Question 4:

What is the relative density of a body when its weight is 50 N in air and only 40 N when immersed in water?

Answer:

Relative density is the ratio of density of the body in air to the density of the body in water

$$X_1 = 50 \text{ N}$$

$$X_2 = 40 \text{ N}$$

Therefore, $X_1 / X_2 = 50 / 40$ or the relative masses $m_1 / m_2 = 5 / 4$

Density = mass / volume and since volume remains constant,

The relative density = $D_1 / D_2 = 5 / 4$

Question 5 :

From a height of 2m, a ball having relative density of 0.8 falls into water. Find the depth in which the ball sinks.

Answer:

Velocity of the ball:

$$V = \sqrt{2gh} = \sqrt{2 \times 10 \times 2} = 6.32 \text{ m/s}$$

Buoyant force of water will try to stop the ball.

Buoyant force = weight of displaced water = dVg

Where d = density of water V = volume of the ball, $g = 10 \text{ m/s}^2$

Deceleration of the body by buoyancy force, $a = (dVg) / m$

Where $m = d'V$ d' = density of the block

$$a = dVg / (d'V) = dg / d' = (d/d') * g = g / (0.8) = 10 / 0.8 \text{ (Given, } d'/d = 0.8) = 12.5 \text{ m/s}^2$$

Net deceleration of the ball, $a' = a - g = 2.5 \text{ m/s}^2$

Final speed of the ball $v' = 0$

$$\text{Use } v'^2 = v^2 + 2a's = \text{depth of the ball in water} \Rightarrow 0 = 6.32^2 + 2 \times 2.5 \times s \Rightarrow s = 8 \text{ m}$$

Question 6 :

A mixture is obtained when 2 equal masses of water and relative density of a liquid are mixed. What will be the relative density of the mixture? (in g/cm^3)

a: 2/3

b: 4/3

c: 3/2

d: 3

Answer:

Since the masses are equal, let it be m .

Relative density,

Of water = p_1

Of Liquid = p_2

Of the mixture = p

Volume of water: V_1

Volume of liquid: V_2

The volume of the mixture is, $V = V_1 + V_2$ (1)

Also, $V = \text{mass} / \text{density}$

$$\text{Thus, } 2m/p = m/p_1 (V_1) + m/p_2 (V_2)$$

Here $p_1 = 1$, $p_2 = 2$

Now,

$$2/p = 1/p_1 + 1/p_2$$

By substituting the values, we

$$p/2 = 2/3$$

or the relative density of the combined liquid will be, $p=4/3$

Short Answers

Q1. Why is it hard to carry a backpack with strong but thin straps?

Answer:

It is hard to carry a backpack with thin straps because a thin strap has very small contact area and so it exerts a lot of pressure on our shoulders.

Q2. Explain upthrust.

Answer:

The upward force exerted by a fluid on a body is called upthrust. When a body is fully or partially submerged in a fluid (liquid or gas), the fluid exerts an upward force on the body. This upward force is called buoyancy or upthrust.

Q3. Why does a ball float when placed on the surface of water?

Answer:

A ball floats when placed on the surface of water because of the buoyant forces that the water is exerting on the ball.

Q4. Why is the cutting edge of a knife as sharp as possible?

Answer:

The cutting edge of a knife is as sharp as possible to create as much pressure as possible even with a small force.

Q5. If your weight is 39kg, is your mass also 39kg?

Answer:

Our body weight is the product of mass and gravitational force. So, our body mass will not be 39kg.

Q6. What is the direction of buoyant forces acting on an object immersed in water?

Answer:

The immersed object experiences buoyant forces vertically upwards from the center of gravity of the displaced liquid.

Q7. Explain why a block of plastic rises up to the water surface even when we release it underwater.

Answer:

The plastic block experiences an upthrust force from the water larger than the gravitational force. This is why the plastic rises to the surface.

Q8. A substance has a mass of 60gm and a volume of 30cm³. the density of water is 1g/cm³. Can this substance float on water?

Answer:

Given, mass = 60gm

Volume = 32cm³

Therefore, Density = $60/30 = 2\text{g/cm}^3$

Since density of this substance is more than the density of water (1 gm/cm³), it will not be able to float.

Q9. Will a 600g bottle with a volume of 480cm³ float in water (density of water = 1g/cm³)? What mass of water will be displaced by the bottle?

Answer:

Given,

Mass of bottle = 600g

Volume of bottle = 480 cm³

Thus, density of bottle = $600/480$

$= 1.25\text{cm}^3$

Since $1.25 > 1$, the bottle won't float.

Volume of water displaced = 480cm³

Therefore, weight of water displaced = volume x density = 480g.

Q10. State the Archimedes' Principle. Write two applications it has.

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Answer:

Archimedes' Principle states that any object partially or fully submerged in a fluid at rest experiences an upthrust force equal to the weight of the fluid displaced by the body.

Application of the principle:

- (a) Floating of large ships and U-boats.
- (b) Flying hot air balloons.

Q11. Explain how submarines sink and float in water.

Answer:

Submarines have a huge ballast tank which they use to float or sink. If they need to go underwater they fill up the tank with water, this makes the U-boat heavy and allows it to sink. If the submarines need to rise to the surface they release the water from the tank, this makes them lighter and thus they rise up.

MCQs:

Q1. Unit of pressure is :

- (a)N/m (b)kg/m (c)N/m² (d)Nm

Ans. (d)

Q2. Pressure inside a liquid is:

- (a)same in all direction (b)maximum near the bottom (c)greater near the walls (d)none of these.

Ans. (a)

Q3. Unit of Relative Density is:

- (a)g/m³ (b)no unit (c)pascal (d)depends upon the substance.

Ans. (b)

Q4. If the area of an object is less, then the pressure acting on it will be

- (a)less (b)remains the same (c)more (d) can't be determined.

Ans. (c)

Q5. Mass per unit volume of a substance is its

- (a)density (b)specific gravity (c)relative density (d)weight

Ans. (a)

Q6. If a cube of ice floating on the water surface melts, will the water level

- (a)rise? (b)remain same? (c)dip? (d)none of these

Ans. (b)

Q7. A cruise ship is carrying 100 people, and the amount of water it is displacing is 1000 m³. If all of them eat half a kg of food during dinner, the water displaced by the ship will be

- (a)more (b)less (c)same (d)none of these.

Ans. (c)

VSAQ

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