Class 9 Important Questions
Floatation

VERY SHORT ANSWER QUESTIONS

Question 1. Define 'thrust'.
Answer: The total force exerted by a body perpendicular to the surface is known as thrust.

Question 2. What is the unit of thrust in SI ?
Answer: S.I. unit of thrust is newton (N).

Question 3. Define the term 'pressure'.
Answer: Pressure is defined as the force acting perpendicular on unit area of the surface.

Question 4. Name the SI unit of pressure.
Answer: S.I. unit of pressure is N/m^2 or pascal.

Question 5. State the relationship between thrust and pressure.
Thrust
Answer:

$$\text{Pressure} = \frac{\text{Thrust}}{\text{Area}}.$$

Question 6. Define 1 pascal.
Answer: 1 Pascal is defined as the pressure exerted by 1 N force acting perpendicular on the surface of 1 m^2 area.

Question 7. Define upthrust or buoyant force.
Answer: The upward force exerted by a liquid on a body which is immersed in the liquid is known as upthrust or buoyant force.

Question 8. State the factors on which upthrust or buoyant force depends.
Answer:

1. Size or volume of body immersed in a liquid,
2. Density of the liquid in which the body is immersed and
3. Acceleration due to gravity at the given place.

Question 9. When an object is immersed in a fluid, name the two forces acting on it.
Answer:

1. Weight of object in the vertically downward direction,
2. Upthrust or buoyant force in the vertically upward direction.

Question 10. Name the force experienced by an object in a fluid when immersed in it. What is its direction ?
Answer: Upthrust or Buoyant force. It acts on the object in upward direction.

Question 11. Why does a block of wood held under water rise to the surface when released ?

Answer: This is because the buoyant force or upthrust acting on the wooden block due to water is greater than the weight of the block.

Question 12. An object of weight 200 N is floating in a liquid. What is the magnitude of the buoyant force acting on it?
Answer: Magnitude of buoyant force = 200 N.

Question 13. Explain the factors which determine whether an object floats or sinks when placed on the surface of water.
Answer: Volume of the object and density of the water.

Question 14. Name the force acting on a body, when it is fully or partially immersed in a liquid.
Answer: Buoyant force.

Question 15. What will be the direction of buoyant force when suppose the weight of an object is acting from north to south in the fluid ?
Answer: From south to north as buoyant force acts opposite to the direction of the weight of the object.

Question 16. A body of weight 20 N floats half submerged in a liquid. What is the buoyant force on the body ?
Answer: 20 N

Based on Archimedes' Principle

Question 17. State Archimedes' principle.
Answer: When a body is immersed partially or completely in a fluid (liquid or gas), it experiences an upthrust or buoyant force which is equal to the weight of the fluid displaced by the body. The weight of the body decreases due to the buoyant force acting on the body, when immersed in a fluid. In other words, a body loses its weight, when immersed completely or partially in a fluid. The loss of weight of a body in a fluid is equal to the upthrust or buoyant force.
The upthrust or buoyant force = weight of fluid displaced by a body = weight of body in air – weight of body in fluid.

Question 18. Write the relationship between buoyant force acting on an object and weight of the liquid displaced by it.
Answer: Buoyant force = weight of liquid displaced by the object.

Question 19. State the physical expression relating weight of the body in the liquid, actual weight of the body in air and the weight of the liquid displaced by the body.
Answer: Weight of a body in a liquid = actual weight of the body – weight of the liquid displaced by the body.

Question 20. Give any two examples where Archimedes' principle is applied . **(Or)**
List two applications of Archimedes' principle.
Answer: Archimedes' principle is applied in designing

1. ships and submarines and
2. lactometer used for testing the purity of milk.

Question 21. State the principle on which working of hydrometer is based.
Answer: Archimedes' principle:
A Greek scientist Archimedes conducted many experiments and concluded that when a body or an object is immersed partially or completely in a liquid or a gas (i.e., fluid), it experiences an upthrust or buoyant force. The upthrust or buoyant force is equal to the weight of the fluid displaced by the body. As a result of the buoyant force acting on an object, the weight of the object decreases, when immersed in a fluid. The finding of Archimedes is known as Archimedes' principle.
Archimedes' principle is used to design :

1. the ships and submarines
2. the hydrometers to find the densities of liquids
3. the lactometers to test the purity of milk.

Question 22. Define density. Give SI unit of density.
Answer: Density of an object is defined as mass per unit volume of the object. That is, density = mass/volume .
S.I. unit of density is kg/m^3 (kg m^{-3}).

Question 23. Define relative density of a substance.
Answer: It is defined as the ratio of the density of the substance to the density of water.

Question 24. If the relative density of a substance is less than 1, will it float or sink in water ? Support your answer.
(Density of water = 1000 kg/m^3). (CBSE 2011)
Answer:

$$\text{Relative density of substance} = \frac{\text{Density of substance}}{\text{Density of water}}$$

As relative density of substance is less than 1, so density of substance is less than the density of water. Hence, the substance will float in water.

Question 25. Relative density of aluminium is 2.7. Explain this statement.
Answer:
Aluminium is 2.7 times heavier than the equal volume of water.

Question 26. The density of a solid is 7.9 g cm^{-3} in air. What is the density of the solid in SI unit (kg m^{-3}) ?
Answer:
Density = 7.9 g cm^{-3} = 7.9 x 1000 kg m^{-3} = 7.9 x 10^3 kg m^{-3}.

Question 27. Relative density of gold is 19.3. The density of water is 1000 kg/m^3. What is the density of gold in SI units ?
Answer: Density of gold = Relative density of gold x density of water = 19.3 x 1000 kg/m^3 = 19300 kg/m^3

SHORT ANSWER QUESTIONS

Question 1. Differentiate between thrust and pressure. State the unit in which they are measured.
Answer: Thrust: The total force exerted by a body perpendicular to the surface is known as thrust.
Pressure: Pressure is defined as the force acting perpendicular on unit area of the surface.
S.I. unit of thrust is newton (N).
S.I. unit of pressure is N/m^2 or pascal.

Question 2. The wheels of an army tank rest on a steel belt. Give reason. **(Or)**
Why an army tank weighing more than a thousand tonne rests upon a continuous chain.
Answer:
Pressure exerted by army tank on the ground is given

$$P = \frac{\text{weight of tank}}{\text{area of the steel belt}}.$$

Since area of steel belt is more than the area of the wheels of the tank, so tank exerts less force on the ground. Hence, the ground under the tank does not sink under the weight of the tank.

Question 3. Why are railway tracks laid on large sized concrete sleepers ? Explain.
Answer : The weight or thrust of the train is spread over large area of sleepers. Therefore, the pressure acting on the ground under the sleepers is reduced. This prevents the sinking of the ground under the weight of the train.

Question 4. Why do buildings have wide foundations ?
Answer: So that the weight of the buiding is spread over a large area and hence less pressure is exerted on the ground. Hence, the building is prevanted to sink under its weight.

Question 5. Which will exert more pressure, 100 kg mass on 10 m^3 or 50 kg mass on 4 m^2 ? Give reason.
Answer:

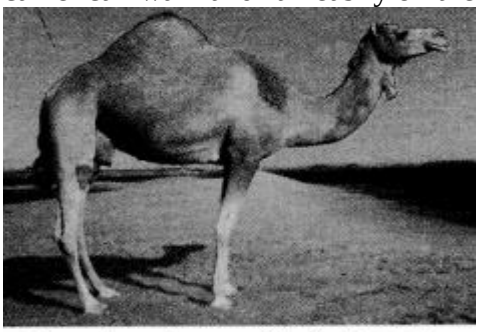
$$\text{Pressure exerted by 100 kg, } P_1 = \frac{\text{Forece}}{\text{Area}} = \frac{mg}{A} = \frac{100 \times 10}{10} = 100 \text{ Pa}$$

$$\text{Pressure exerted by 50 kg, } P_2 = \frac{mg}{A} = \frac{50 \times 10}{4} = 12{\cdot}5 \text{ Pa}$$

Thus, $P_1 > P_2$.

Question 6. Explain, why a truck or a motor bus has much wider tyres ?
Answer: The weight of truck or motor bus spreads over large area on the surface of road or ground and hence less pressure is exerted by truck or a motor bus on the road. Therefore, the ground under them does not sink.

Question 7. Account for the statement : "camel walks easily on sand but it is difficult for a man to walk on sand though a camel is much heavier than a man".
Answer: A camel walks easily on the sandy surface than a man inspite of the fact that a camel is much heavier than a man.
This is because the area of camel's feet is large as compared to the area of man's feet. So the pressure exerted by camel on the sandy surface is very small as compared to the pressure exerted by man. Due to large pressure, sand under the feet of a man yields (i.e., sink) and hence he cannot walk easily on the sandy surface. On the other hand, sand under the feet of camel does not sink much due to small pressure. Hence camel can walk and run easily on the sandy surface.



Camel walks easily in desert

Question 8. A Sharp knife is more effective than a blunt knife. Why ? (**Or)**
Cutting and piercing tools are made sharp. Give reason.
Answer: Pressure (P = F/A) exerted by sharp knife on an object is more than the pressure exerted by a blunt knife. Therefore, sharp knife is more effective in cutting the object than a blunt knife.

Question 9. Why does an iron nail sinks in water but a wooden cork floats on water ?
Answer: The weight of iron is greater than the upthrust of water on the iron nail, so iron nail sinks in water. On the other hand, the upthrust on cork is more than the weight of the cork. Hence wooden cork floats on water.

Question 10. A balloon filled with hydrogen gas floats in air. Explain why ?
Answer: The upthrust or buoyant force acting on hydrogen balloon is greater than the weight of the hydrogen balloon. So it floats in air.

Question 11. An object of volume V is immersed in a liquid of density p. Calculate the magnitude of buoyant force acting on the object due to liquid.
Answer: Magnitude of buoyant force acting on the object due to liquid = weight of liquid displaced
= mass of liquid displaced x g ($\therefore$ W = mg)
= Volume of body x density of liquid x g = $V\rho g$
Thus, buoyant force depends upon

1. the volume of the immersed portion of the object and
2. density of the liquid.

Question 12. An object is immersed in different liquids. Is same buoyant force acts on the object due to all liquids ?
Answer: We know, buoyant force acting on an object due to a liquid is directly proportional to the density of the liquid. Since different liquids have different densities, so different buoyant forces act on the object due to different liquids. An iron sphere is suspended with an iron string.

Question 13. The length of the string increases (i.e. string is stretched). Now the iron sphere is completely immersed in water and the increase in length of the string decreases. Explain why?
Answer: The length of the string increases due to the weight of the suspended iron sphere. When the sphere is immersed in water, buoyant force due to water acts on the sphere in the upward direction.
Now, the net force (or weight) acting on the string = actual weight of the sphere – buoyant force acting on it. Since the net force acting on the string decreases and hence the extension of the string also decreases.

Question 14. Two blocks, one of iron and other of wood are immersed in water at the same depth. Will both come upward ? Why ?
Answer: Wooden block will come upward. This is because upthrust of water on the wooden block is greater than its weight. In other words, density of wood is less than the density of water and density of iron is greater than the density of water.

Question 15. Lead has greater density than iron and both are denser than water. Is the buoyant force on a lead object greater than or lesser than or equal to the buoyant force on an iron object of the same volume ? Explain your answer giving reason.
Answer: Buoyant force on an object depends upon

1. the volume of the object and
2. density of the liquid in which the object is immersed.

Since volume of both objects is same and both are immersed in water, therefore, buoyant force on lead object is equal to the buoyant force on iron object.

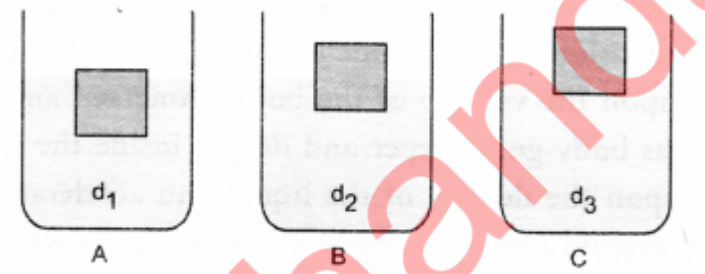
Question 16. Explain, why a truck or a motor bus has much wider tyres ? (CBSE 2011, 2015, 2016)
Answer: Discussed ABOVE

Question 17. A ship is loaded in sea water to maximum capacity. What will happen if this ship is moved to river water ? Why?
Answer: When ship is moved to river water from sea water, then upthrust acting on the ship decreases because density of river water is less than the density of sea water. Hence, the net weight of the ship will be more in river water than in sea water. Hence, more portion of the ship will be inside the river water.

Question 18. Why do we feel lighter when we swim ? **(Or)**
When we jump into a swimming pool, we feel lighter. Why ?
Answer: When we swim in water, two forces acts on our body. One is the gravitational force equal to our weight in the downward direction and the other is the up thrust or buoyant force in the upward direction. Hence, the net downward force or the apparent weight of our body is less than our actual weight. Therefore, we feel lighter, when we swim.

Question 19. An egg sinks in fresh water but floats in highly salty water. Give reason. (CBSE 2012)
Answer: Upthrust acting on egg in fresh water is less than the weight of egg. Therefore, it sinks in fresh water. However, the density of salty water is much greater than the density of fresh water, so upthrust acting on egg in salty water is greater than the weight of egg. Therefore, it floats in salty water.

Question 20. The following figure shows three identical blocks of wood floating in three different liquids A, B and C of densities d_1, d_2 and d_3 respectively. Which of these has the highest density. Give reason to justify your answer.



Answer:
In case of liquid C, upthrust is maximum. Since upthrust depends on the density of liquid, therefore, density of liquid C (i.e., is the highest.

Question 21. When an object is immersed into the fluid, two forces act on the object in the vertically opposite directions. Name them and also write the factors on which the magnitude of these forces depends on.
Answer:

1. Weight of object = mg. It depends on the mass (or volume and density of object) and acceleration due to gravity.
2. Upthrust of fluid on the body = $V\rho g$.
   It depends on the volume (V) of immersed portion of object, density (ρ) of fluid and acceleration due to gravity.

Question 22. The density of turpentine at 293 K is given as 870 kg m^{-3} Identify and write the names of substances that sink in turpentine at the same temperature.

S.No.	Substances	Density (kg)
1	Wood	690
2	Ice	920
3	Rubber	970
4	Paraffin wax	900
5	Cork	240
6	Bone	1850

Answer:
A substance sink in a liquid, if density of substance is greater than the density of liquid. Therefore, ice, rubber, paraffin wax and bone will sink in turpentine.

Question 23. When a metallic block is immersed below the surface of a liquid, state and define the upward force acting on it.
Answer: It is a buoyant force. The upward force exerted by a liquid is known as buoyant force. Buoyant force = $V\rho g$, where V on the metallic block immersed in the liquid is the volume of metallic block immersed in the liquid and ρ is the density of the liquid.

Question 24. State the condition under which an object floats on the surface of a liquid. What is the volume of the liquid displaced by the object ? (CBSE 2014, 2015)
Answer: An object floats on the surface of a liquid if upthrust on the body is greater than the weight of the object. Volume of the liquid displaced is equal to the volume of the body.

Question 25. A cube of side 3 cm is immersed in water and then in saturated salt solution. In which case will it experience a greater buoyant force. If each side of the cube is reduced to 2 cm and then immersed in water, what will be the effect on the buoyant force experienced by the cube as compared to the first case for water. Give reason for each case.
Answer:
Initial volume of cube, $V_i = (3\ cm)^3 = 27\ cm^3$
Final volume of cube, $V_f = (2\ cm)^2 = 8\ cm^3$

1. Buoyant force = Vρg, where p is the density of liquid. Since density of saturated salt solution is greater than the density of water, therefore, the cube will experience a greater buoyant force in saturated salt solution than in water.
2. Since the volume of the cube decreases, so the cube will experience a less buoyant force in water as compared to the first case.

Question 26. While drawing water from a well, a bucket of water appears to be heavier as it comes out of the water. Explain giving reasons. **(Or)**
Why is a bucket of water lighter when in water than when it is taken out of water ?
Answer:
When the bucket is inside water, its weight is less than its weight in air due to the upthrust of water.

Question 27. A student took solid bodies of different shapes, sizes and materials and noted down the apparent loss in weight on partially or fully immersing the bodies in different liquids. Based on the observations, he wrote the following conclusions. Which conclusion is incorrect and why ?
(a) Upthrust depends upon the volume of the body immersed and density of liquid.
(b) Upthrust increases as body goes deeper and deeper inside the liquid.
(c) Upthrust depends upon the density of the liquid and acceleration due to gravity.
(d) Upthrust does not depend upon the shape of the vessel in which liquid is filled. (CBSE 2014)
Answer:
Upthrust = Vρg, where V = volume of body immersed in liquid, ρ = density of liquid, g = acceleration due to gravity.
Therefore, conclusion **(b)** is incorrect as upthrust does not depend on the depth of the body inside the liquid.

Question 28. If two equal weights of unequal volumes are balanced in air, what wil} happen when these are completely dipped in water ?
Answer: When two weights of unequal volumes are dipped in water, buoyant force acting on the weight of larger volume is more than that on the weight of smaller volume. Hence, weight of smaller volume in water is more than the weight of larger volume. Therefore, these weights are not balanced in water.

Question 29. An object of mass 500 gm is immersed into a measuring jar containing water. The initial level of water in the measuring jar is 50 cc. Due to the immersion of the object, the water level in the measuring jar reaches to 100 cc. Calculate the mass of the water displaced due to the immersion of the object.
Answer: Mass of water displaced = Volume of immersed portion of object x density of water
= (100 – 50) cm^3 x 1 g cm^{-3} = 50 g.

Question 30. If a body is compressed to half its previous volume, what will be the effect on its density and why ?
Answer:

$$\text{Density} = \frac{\text{mass}}{\text{volume}}.$$

If volume of body becomes half its previous volume, then its density becomes double i.e., two times its previous value.

LONG ANSWER QUESTIONS

Question 2. Archimedes Principle has wide application in making ships and submarines. Explain.
Answer:
Floatation of Ships: Iron needle is solid and compact. The density of iron is greater than the density of the water. The weight of the needle is greater than the weight of water displaced by the needle. So iron needle sinks in water. On the other hand, iron ship is not solid. It is hollow and filled with air. So, the average

density of the ship as a whole is less than the density of the water. Therefore, the immersed portion of the ship displaces water equal to its weight. Hence the ship floats on the surface of water.

Floatation of Submarines: Submarines are just like ships. The difference between them is that submarines are provided with ballast tank [i.e., hot air tank in the form of a balloon to make it heavier). When ballast tank is empty, submarine acts as a ship. Under this condition, the submarine displaces more weight of sea water than its own weight. Hence, it floats in the sea water.

When the submarine is to dive in water, the doors of the ballast tank are opened. The water enters into the ballast tank and increases the weight of the submarine. When the weight of the submarine becomes more than the weight of the water displaced by it ; it sinks in water.

To take the submarine again on the surface of water, the compressed air is allowed to enter the ballast tank As a result of this, the water from the ballast tank is forced out. Therefore, the ballast tank is emptied. Again the submarine behaves as a ship and begins to float on the surface of the sea water.