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Profile of Students' Misconceptions on Substance Pressure Using a Three-tier Diagnostic Test

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ABSTRACT

Research aims to find out misconceptions experienced by students on the subject matter of substance pressure. This type of research is quantitative descriptive research using a survey method. The instrumental test used was a three-tier diagnostic test to determine the under-examined misconceptions. The research sample consisted of 43 junior high school students who had previously received substance-pressure learning materials in class. The data were analyzed by categorizing them into understanding the concept, needing more knowledge, errors, and misconception. The results of the study were as follows: (1) 9% of the students understood the concept, 51% of the students had a misconception, 34% of the students were lack of knowledge, and 6% of the students had some errors (2) misconceptions with the highest percentage were in the sub-concept of pressure gases with an average percentage of 70%, then the pressure of liquids (capillarity and osmosis in plant stems) was 52%, the pressure of solids was 51%.

INTRODUCTION

Students learn the concept of knowledge about a phenomenon around them through the formal education system or informally. Before students take part in learning at school, their minds have embedded various concepts about natural phenomena related to learning science. Students have an initial idea before students do learning at school. The initial images possessed by students can be obtained from interactions with the surrounding environment (Prodjosantoso & Hertina, 2019; Soeharto & Csapo, 2022). The initial concept possessed by students can be called preconception. Preconception can also be interpreted as students' initial concept about a phenomenon or object (Laksana, 2016; Mufidah & Budiarto, 2018). According to Rukmana (2017), preconceptions can arise due to students' limited thinking power and information. Students' preconceptions are only sometimes by the actual concept. The preconception of students is very important because it is one of the causes of misconceptions. The discrepancy between preconceptions and actual concepts can lead to misconceptions in students.

A misconception is a way of processing information in the student's brain. When students get new information/knowledge, the information is indirectly passed on to long-term memory. In long-term memory, there is a process of searching for new information and connecting it with already-owned information. Searching for information in long-term memory may not be as desired because some information may be forgotten while searching for that information. Recalling information in long-term memory serves to discover students' concepts (Palisoa et al., 2021). This can lead to misconceptions if the knowledge/information differs from the knowledge the experts have agreed upon. Misconceptions, according to (Kiray & Simsek, 2015; Saputra et al.,

2018; Soeharto & Csapo, 2021), are conceptions that students own, but these conceptions are not appropriate/unacceptable by experts in their fields. Misconceptions can be interpreted as the inability to accurately relate their initial concept to the next (Malikha & Amir, 2018). So misconceptions can lead to conceptual errors in the material to be studied.

Every student must have their misconceptions (Steegen et al., 2018). Misconceptions can hinder students' thinking from developing ideas in the ongoing learning process and further learning. Misconceptions tend to be resistant even though formal learning has been carried out (Malikha & Amir, 2018; Laliyo, 2019). So that students who experience misconceptions will assume that the concepts they have are correct (Putro et al., 2019). Cognitive conflict is needed to change misconceptions in students because it can form new conceptions that follow facts or theories and reduce misconceptions in students (Nadelson et al., 2018).

Misconceptions can occur due to many factors. Factors that can cause misconceptions include teachers who cannot understand concepts during the delivery of material in class, inappropriate descriptions in textbooks, cultural contexts, everyday language, and learning methods that are not delivered correctly (Munawaroh & Falahi, 2016; Setiawan et al., 2017). In addition, the misconceptions experienced by students can be obtained from experiences gained in everyday life (Wibowo et al., 2017). The misconceptions brought by students can lead to a chain of misconceptions (Gurbuz, 2016; Steegen et al., 2018). Therefore, if the misconceptions that occur in students are not detected early, it will affect learning at the next level. Therefore, at school, the teacher plays an essential role in knowing the misconceptions experienced by students so that they can be dealt with immediately.

There are various ways to discover the misconceptions that occur in students, one of which is using a three-tier diagnostic test instrument. Three-tier diagnostic tests can be used to find out the misconceptions that occur in students (Nurrohmah et al., 2018; Liampa et al., 2019; Soeharto et al., 2019). The three-tier diagnostic test consists of three levels, the first level is multiple choice, the second level is the reason for the answers given at the first level, and the third level is the level of confidence in the selected answers (Zulfadli & Munawwarah, 2016). The confidence level for the third level on the three-tier diagnostic test uses CRI (Certainty of Response Index) with a scale of 0-5 (Prastiwi et al., 2017).

In learning science, students can experience misconceptions. Learning complex science concepts will lead to misconceptions (Gurel et al., 2015). The misconceptions that occur in science concepts tend to be resistant to students' thinking (Soeharto & Csapo, 2022). One of the science materials that often occurs misconceptions is the concept of substance pressure. In the matter of pressure, the material discusses the pressure of solids, the pressure of liquids, and the pressure of gases. In substance pressure, students experience misconceptions due to a lack of understanding of the correct concept.

A three-tier diagnostic test can identify misconceptions experienced by students. Research that has been done previously by (Gurel et al., 2015; Rukmana, 2017) showed that a three-tier diagnostic test could identify misconceptions experienced by students in materials related to pressure. The research will be carried out using a three-tier diagnostic test and will be used on substance pressure material. The substance pressure material that will be identified does not only cover the scope of physics or biology but

includes both relevant to the pressure material that students usually encounter in everyday life.

In some cases, students can explain the material pressure of substances but cannot mention the application of the concept of pressure itself (Yudhittiara et al., 2017; Idayanti et al., 2019). Students can be found when working on questions; when the questions are changed more, they can only do it if they know/memorize the formula, not the concept. So this research aims to determine the misconceptions experienced by students about the material pressure of substances.

RESEARCH METHOD

General Background

This type of research is quantitative descriptive research. This research describes the misconceptions experienced by students about the material pressure of substances. The method used in this research is a survey method. The research data used the results of a three-tier diagnostic test to find out students' misconceptions.

Participants

The population of this research is all 9th-grade students who have received substance-pressure material. The research subjects consisted of 43 students from grades 9C and 9D who had received material on substance pressure at 3rd state-JHS Kamal for the academic year 2022/2023.

Instrument and Procedures

The instrument used in this research is a three-tier diagnostic test comprising 15 questions on the material pressure of substances, including the sub-concepts of solid, liquid, and gas. The steps in this research can be seen in Figure 1.

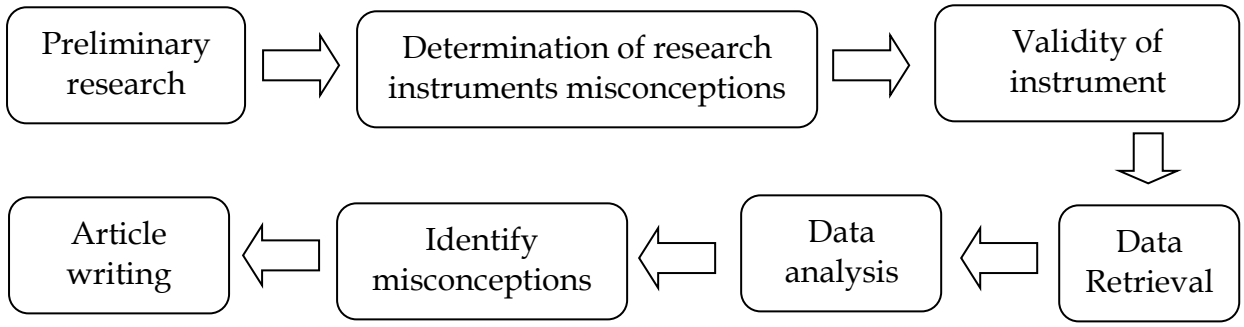

Figure 1. Research method.

This research is included in the prelim research. The initial stage is to make a three-tier diagnostic test instrument on substance stress material to find out the misconceptions experienced by students. Two validators then validated the diagnostic test instrument. The validation results stated that the test instrument was classified as valid with a percentage of 93.18% and reliable with a reliability value of 0.98. After validation and the instrument were declared valid, the next stage was data collection at 3rd state-JHS Kamal. The data were analyzed using the test instrument category to determine the percentage of misconceptions students experienced about substance pressure.

Data Analysis

The data obtained from the three-tier diagnostic test results were then analyzed using the combined three-tier diagnostic test category from Zulfadli & Munawwarah (2016), which included understanding concepts, not understanding concepts, errors, and misconceptions. The combination of three-tier diagnostic test categories can be seen in Table 1.

Table 1. Combination of three-tier diagnostic test answers.

Category	Answer Type		
	Answer	**Reason**	**CRI**
Understand the concept	Correct	Correct	CRI > 2,5
Lack of knowledge	Correct	Correct	CRI ≤ 2,5
	Correct	False	CRI ≤ 2,5
	False	Correct	CRI ≤ 2,5
	False	False	CRI ≤ 2,5
Error	False	Correct	CRI > 2,5
Misconception	Correct	False	CRI > 2,5
	False	False	CRI > 2,5

(Zulfadli & Munawwarah, 2016)

The next step is to calculate the percentage of each student understanding the concept, not understanding the concept, error, and misconception using the formula:

$$P = \frac{F}{N} \; x \; 100\%$$

Description:
P = the information you are looking for
F = frequency of student response
N = number of students

RESULTS AND DISCUSSION

The results of data analysis regarding misconceptions using a three-tier diagnostic test on the substance pressure material can be seen in Figure 2.

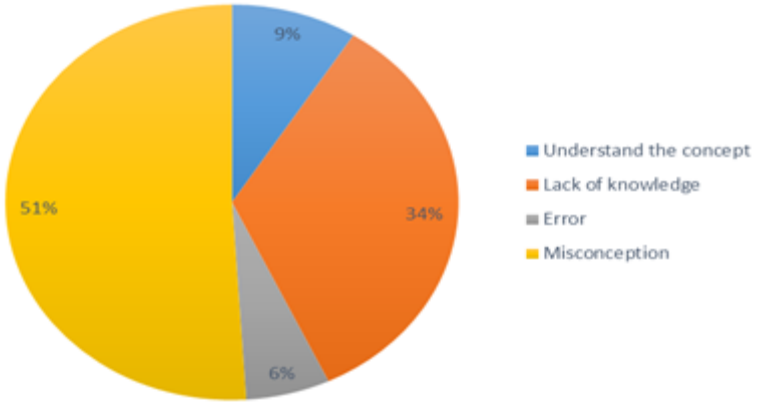

Figure 2. Results of three-tier diagnostic test analysis.

Figure 2 shows that of the 43 respondents, students experienced misconceptions about substance pressure 51%, students understood the concept 9%, students

experienced not knowing the concept 34%, and students experienced errors 6%. This shows that the misconceptions that occur in material pressure matter still tend to be high. Even though students have received substance-pressure material before at school, students still need clarification. Misconceptions can happen to anyone without exception, starting from a person, student, teacher, or even at the professor level (Suprapto, 2020). Following previous research, it was stated that students' misconceptions about substance pressure tend to be high and resistant (Mustikasari et al., 2017; Idayanti et al., 2019; Putri et al., 2021).

In the matter of pressure, several sub-concepts are discussed, namely the pressure of solids, the pressure of liquids (Archimedes' law, hydrostatic pressure, Pascal's law, capillarity, and osmosis in plants), and gas pressure. Table 2 shows the percentage of students' misconceptions about each sub-concept of the substance pressure material.

Table 2. Students' misconceptions about the material pressure of substances.

Sub-Concept	Understand the concept	Lack of knowledge	Misconception	Error
Solid pressure	4%	38%	51%	7%
Gaseous pressure	9%	19%	70%	2%
Hydrostatic pressure	22%	30%	43%	5%
Archimedes law	10%	41%	42%	7%
Capillarity and osmosis	2%	44%	52%	2%
Pascal law	12%	36%	40%	12%

Table 2 shows that the highest percentage of misconceptions is the concept of gas pressure, with a percentage of 71%. This is in line with previous research by Idayanti et al. (2019) that the sub-concept of gas pressure has the highest misconceptions compared to the misconceptions in the sub-concept of liquid pressure and solid pressure. In gaseous pressure, the average student experiences misconceptions because they need to understand the differences in air pressure in various surrounding conditions, both air pressure during the breathing process and air pressure in certain areas. Some questions discuss the pressure difference when drinking using a straw under gaseous pressure. The average student thinks that when we drink using a straw, this is a symptom of capillarity. The reason reinforces that the students chose: the air pressure inside the mouth to be greater than the outside air pressure so that water could be pulled up. The correct concept is that air pressure always flows from places with high air pressure to places with low air pressure (Giancoli, 2014). When you enlarge the oral cavity, the pressure inside the oral cavity becomes smaller than the surrounding air pressure. Higher outside air pressure causes water to be pushed in through the gap of the straw into the oral cavity, which has lower pressure.

In addition to gas pressure, students need more clarification about liquid pressure, namely the capillarity of plant stems by 52%. On average, students think that rising water in the stems of water-loving plants is an osmosis event. The reason reinforces this that the students chose, namely that there is a compressive force that causes water to be lifted towards the stem. Mustikasari et al. (2017) state that students experience misconceptions about the explanation of capillarity in plant stems. The correct concept is that plants can absorb water due to the stem capillary process, namely that there is the suction power of the leaves along the xylem and phloem vessels, as well as the attractive force of water molecules along the xylem vessels (Campbell, 2010). In solids, pressure students experience a misconception of 51%. Students need clarification about

the relationship between surface area and pressure. The average student assumes that all blocks with different surface areas and given the same force will get the same pressure. The reason reinforces this that the students chose: the cross-sectional area does not affect the pressure. The correct concept is that the surface area of an object is inversely proportional to pressure. The smaller the surface area of an object, the smaller the pressure generated, and vice versa if the smaller the surface area of an object, the greater the pressure generated (Serway & Jewett, 2009).

Misconceptions experienced by students in hydrostatic pressure material were 43%. Students need clarification about the relationship between liquid depth and the resulting hydrostatic pressure. On average, students think fish on the water's surface has the most significant hydrostatic pressure. Reason reinforces this the students chose: the closer to the surface of the liquid, the greater the hydrostatic pressure of an object. Research conducted by Handayani et al. (2017) states that students experience a misconception about hydrostatic pressure; objects on a liquid's surface have the most significant hydrostatic pressure. The correct concept is that hydrostatic pressure is affected by the object's depth from the liquid's surface; the greater the depth value of an object in the liquid, the greater the resulting hydrostatic pressure (Giancoli, 2014). At the same time, the misconceptions experienced by students in Archimedes' law material were 42%. Students need clarification about the buoyant force that works on Archimedes' principle. The average student thinks that when the block is put into the water, it becomes lighter because the mass of the block disappears. Is reinforced by the reasons the students chose, namely the buoyant force that causes the block's mass to disappear. This is in line with Handayani et al.'s research (2019) which states that students experience misconceptions about Archimedes' principle, that is, the mass of an object will disappear when it is in a liquid. The correct concept is that the weight of an object when it is in a liquid will decrease because a buoyant force pushes it up (Giancoli, 2014).

The misconceptions experienced by students on the concept of Pascal's law are 40%. Students need clarification about the application of Pascal's principle. The average student assumes that the required entry force is greater than the resulting exit force. This is reinforced by the reason the students chose that if the exit cross-sectional area is larger, the resulting exit force will be smaller. Wartono et al. (2016) stated that students experienced a misconception. Namely, students thought that the entry force was inversely proportional to the cross-sectional area of the inlet press on the piston. The correct concept is that the inlet cross-sectional area is smaller than the exit area, so the required entry force is smaller and produces a large exit force (Giancoli, 2014). So the compressive force is directly proportional to the compressive cross-sectional area, and the outgoing force is directly proportional to the exit cross-sectional area. Students experience misconceptions because they have the wrong preconceptions about substance pressure, so students tend to choose the wrong answers and reasons. Some students choose the answer correctly, but the reasons are incorrect, causing misconceptions. Misconceptions will undoubtedly hinder the process of accepting new concepts in students (Mulyastuti et al., 2016). Therefore, student involvement in the learning process is deemed necessary because it will positively impact the achievement of the concepts being taught (Widodo et al., 2018).

Students experience misconceptions because students need to be corrected in answering questions and giving reasons for the answers given, but their level of confidence is high. In addition, some students need clarification because the answers

given are correct, but the reasons given are wrong, with a high level of confidence. This proves that the three-tier diagnostic test can easily find out the misconceptions experienced by students. Another cause of students needing clarification is that the information provided by the teacher is inappropriate and cannot be accepted optimally by students. This happened because in the misconception analysis carried out, the condition of the students had received substance-pressure material from the teacher. Prayitno & Hidayati's research (2022) states that the information given by the teacher needs to be received better by students. In addition, students' misconceptions about substance stress material can occur because the use of learning models, methods, and learning media used by teachers during learning also have an effect. The lack of self-confidence and students' inability to explain the concepts being studied will affect the misconceptions experienced by students (Setiawan et al., 2017). Therefore the role of the teacher becomes essential during learning at school to discover and even overcome misconceptions experienced by students (Shofiyah, 2017).

Misconceptions experienced by students regarding the subject matter of substance pressure still need to be lowered. Such as research previously conducted by Ardiansyah (2019), which stated that the misconceptions experienced by students regarding material pressure were relatively high. Because of the high number of misconceptions experienced by students, it is necessary to reduce misconceptions to overcome misconceptions so that a chain of misconceptions does not occur in the future.

CONCLUSION

Based on the findings, analysis, and discussion, students' misconceptions about the substance pressure material using the three-tier diagnostic test tend to be high. This can be seen from the results of the three-level diagnostic test analysis on the substance stress material produced: students who understand the concept by 9%, lack of knowledge by 34%, wrong concept by 51%, and error by 6%. The highest misconceptions are found in the sub-concept of gas pressure at 70%, then the sub-concept of solid pressure at 51%, and the sub-concept of liquid pressure (osmosis and capillarity in plant stems) at 52%. Because of the high level of misconceptions in students, it is necessary to reduce misconceptions to overcome student misconceptions so that a chain of misconceptions does not occur at the next level.

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Appendix

Three Tier Diagnostic Test Questions

1. There are two blocks, namely beam 1 and beam 2. Block 1 has a cross-sectional area 2 times the cross-sectional area of beam 2. If a force of the same magnitude is applied to beam 1 and beam 2, then... .
   A. the pressure in block 1 is twice that of block 2
   B. the pressure of block 1 is four times less than that of block 2
   C. the pressure in block 2 is twice that of block 1
   D. the pressure in block 2 is four times less than in block 1
   Reason
   A. the smaller the cross-sectional area that is owned, the greater the pressure generated
   B. the smaller the cross-sectional area it has, the smaller the pressure generated
   C. the greater the cross-sectional area that is owned, the greater the pressure generated
   D. cross-sectional area and force do not affect the pressure that will be generated
   Certain of Response Index
   0 1 2 3 4 5

2. Look at the picture below!

   If wooden blocks 1, 2, and 3 are pressed against the muddy ground with the same force. The thing that will happen to muddy ground is... .
   A. wood 1 makes deeper marks than Wood 2 on muddy soils
   B. wood 2 produces deeper marks than Wood 1 on muddy soils
   C. wood 3 produces deeper marks than wood 2 on muddy soils
   D. wood 1, wood 2, wood and 3 make the same marks on muddy soil
   Reason
   A. the cross-sectional area of wood 1 is smaller than the cross-sectional area of wood 3
   B. the cross-sectional area of wood 2 is smaller than the cross-sectional area of wood 1
   C. the cross-sectional area of wood 3 is smaller than the cross-sectional area of wood 2
   D. the cross-sectional area of wood 1, wood 2, and wood 3 does not affect
   Certain of Response Index
   0 1 2 3 4 5

3. If there are 2 nails (nail 1 and nail 2), where nail 2 is hit with a hammer with a force 2 times the force exerted on nail 1. What can happen is ... .
   A. the 1st nail will go deeper than the 2nd nail into the wooden board
   B. nail 2 will go deeper than nail 1 in the wood board
   C. nails 1 and 2 stuck to the same depth in the wooden board
   D. nails 1 and 2 will not stick into a wooden board
   Reason
   A. the applied force does not affect the pressure
   B. the applied force affects the pressure
   C. the force exerted is directly proportional to the pressure
   D. the force exerted is inversely proportional to the pressure
   Certain of Response Index
   0 1 2 3 4 5

4. When Andi drinks using a straw, water can enter Andi's mouth through the straw. This can happen because...
   A. the presence of symptoms of diffusion
   B. the presence of symptoms of osmosis
   C. there is a difference in pressure
   D. there is a difference in volume

Reason

A. the air pressure inside the mouth is greater than the air pressure outside, so water can rise from the glass to the mouth through a straw
B. the air pressure in the mouth is less than the air pressure outside, so that water can rise from the glass to the mouth through a straw
C. the air pressure in the mouth is equal to the air pressure outside, so that water can rise from the glass to the mouth through a straw
D. the air pressure in the mouth is almost the same as the outside air pressure, so that water can rise from inside the glass to the mouth through a straw

Certain of Response Index

0 1 2 3 4 5

5. Balloons filled with gas that is lighter than air will be able to fly. However, if the balloon reaches a certain height, what can happen is...

A. the balloon will burst
B. the balloon is getting bigger
C. the balloon will shrink
D. the balloon will disappear

Reason

A. the balloon is made of very thin material, when traveling long distances the balloon rubs against the air so that the balloon becomes thinner and eventually breaks
B. the higher the balloon, the hotter the balloon becomes because it is close to the sun, the high heat causes the balloon to melt and the balloon will burst
C. the air in the balloon will expand after traveling very far, and the elasticity of the balloon is unable to withstand the expansion of the air inside the balloon, so the balloon will break
D. the higher the place, the lower the air pressure, at a certain height the air pressure in the balloon becomes greater than the air pressure outside the balloon, so the balloon bursts

Certain of Response Index

0 1 2 3 4 5

6. When Indah climbed a high mountain, Indah found it difficult to breathe and Indah was advised to bring a spare oxygen cylinder in anticipation of an emergency. This can happen because... .

A. the air pressure is getting higher
B. the air pressure is getting lower
C. the air pressure does not change
D. unstable air pressure

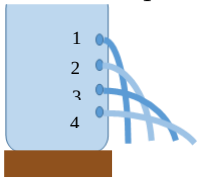
Reason

A. the higher the place, the lower the air pressure, making it difficult to breathe
B. the higher the place, the higher the air pressure, making it difficult to breathe
C. the higher the place, the air pressure will remain/constant, making it difficult to breathe
D. the higher the place, the air pressure will continue to fluctuate, making it difficult for Indah to breathe

Certain of Response Index

0 1 2 3 4 5

7. Look at the picture below!



The shower of water that comes out of the faucet produces a different shower distance. In your opinion, the heaviest shower of water is at ... .

A. point 1
B. point 2
C. point 3
D. point 4

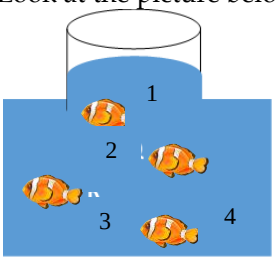
Reason

A. hydrostatic pressure does not affect
B. the resulting hydrostatic pressure is the same
C. has the lowest hydrostatic pressure
D. has the greatest hydrostatic pressure

Certain of Response Index

0 1 2 3 4 5

8. Look at the picture below!



Fish swimming in the aquarium looks like in the picture. So what can happen to fish is...

A. the fish at point 1 has the greatest hydrostatic pressure
B. the fish at point 2 has the greatest hydrostatic pressure
C. the fish at point 3 has the greatest hydrostatic pressure
D. the fish at point 4 has the greatest hydrostatic pressure

Reason

A. fish 1 is close to the surface, so the hydrostatic pressure is greatest
B. fish 2 is close to the surface, so the hydrostatic pressure is the lowest
C. fish 3 is in the middle, so the hydrostatic pressure is the lowest
D. fish 4 is at the bottom, so the hydrostatic pressure is the greatest

Certain of Response Index

0 1 2 3 4 5

9. There are two objects, namely objects 1 and 2 which have the same characteristics. If the two objects are put into the water, they will both float in the same position. Which of the following statements is true regarding the buoyant force that occurs on objects 1 and 2, namely ....

A. the buoyant force on object 1 and object 2 is different
B. the buoyant force on object 1 and object 2 is the same
C. buoyancy 1 is less than buoyancy 2
D. buoyancy 2 is less than buoyancy 1

Reason

A. the volumes of objects 1 and 2 that are immersed in water are the same
B. the volumes of objects 1 and 2 that are immersed in water are different
C. the volume of object 1 is greater than 2 which is immersed in water
D. the volume of object 1 is smaller than 2 which is immersed in water

Certain of Response Index

0 1 2 3 4 5

10. If there are ball 1 and ball 2 which are put into the water, but ball 1 is submerged ¾ part and ball 2 is submerged ½ part. Then the buoyant force that occurs on the two balls is ....

A. the buoyancy force of ball 1 is less than the buoyancy of ball 2
B. the buoyancy force of ball 1 is greater than the buoyancy of ball 2
C. the buoyancy force of ball 2 is the same as the buoyancy of ball 1
D. the buoyancy force of ball 2 is greater than the buoyancy of ball 1

Reason

A. the greater the volume of the submerged ball, the smaller the buoyant force
B. the smaller the volume of the submerged ball, the greater the buoyant force
C. the smaller the volume of the submerged ball, the more it loses its buoyant force
D. the greater the volume of the submerged ball, the greater the buoyant force

Certain of Response Index

0 1 2 3 4 5

11. When the henna plant stems are soaked in water that has been dyed for about one hour, the water that has been dyed can seep into the henna plant stems. Events that occur in the absorption of water on the stems of water-loving plants are influenced by adhesion and cohesion forces due to the process of ... .
    A. osmosis
    B. filtering
    C. capillarity
    D. substance pressure

    Reason

    A. the ability of the stem xylem to raise the water level higher than that outside the vessels because the adhesion force on water and minerals is greater than the cohesion force
    B. the ability of the stem xylem to raise the water level higher than that outside the vessels because the adhesion force on water and minerals is smaller than the cohesion force
    C. the ability of the stem phloem to raise the water level higher than that outside the vessel because the adhesion force on water and minerals is greater than the cohesion force
    D. the ability of the stem phloem to raise the water level higher than that outside the vessel because the adhesion force on water and minerals is smaller than the cohesive force

    Certain of Response Index

    0 1 2 3 4 5

12. Plants need water to survive. Water in plants can be absorbed through the roots. Plant roots absorb water by...
    A. capillarity
    B. osmosis
    C. permeable
    D. is semipermeable

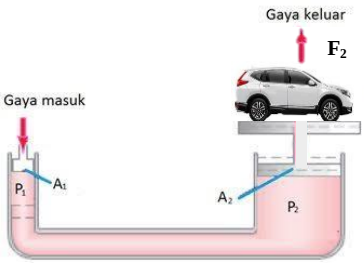
    Reason

    A. the concentration of liquid in the root tissue is more dilute (hypotonic) than the mineral solution in the soil which causes water (solvent) to move from the soil to the root tissue
    B. the concentration of liquid in the root tissue is more concentrated (hypotonic) than the mineral solution in the soil which causes water (solvent) to move from the soil to the root tissue
    C. the concentration of liquid in the root tissue is more concentrated (hypertonic) than the mineral solution in the soil which causes water (solvent) to move from the soil to the root tissue
    D. the concentration of liquid in the root tissue is the same as the mineral solution in the soil which causes water (solvent) to move freely from the soil to the root tissue

    Certain of Response Index

    0 1 2 3 4 5

13. Look at the picture below!



    At the car wash, there is a device called a hydraulic car lift machine. This tool serves to lift the car so that the bottom of the car can be reached. Which of the following statements is true regarding the working principle of a hydraulic car lifter is … .
    A. the cross-sectional area of A_1 is made smaller than the cross-sectional area of A_2
    B. the cross-sectional area of A_1 is made larger than the cross-sectional area of A_2
    C. the cross-sectional area of A_1 and A_2 is made of the same size
    D. cross-sectional area is made sober because it will not affect

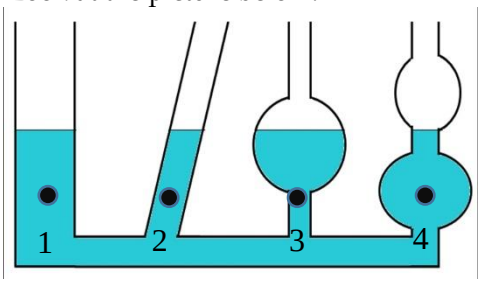
Reason

A. so that the resulting exit force (F_2) is smaller so that the car can be lifted
B. so that the resulting exit force (F_2) is the same as the applied entry force
C. so that the resulting exit force (F_2) is greater so that the car can be lifted
D. so that the resulting exit force (F_2) is proportional to the incoming force (F_1)

Certain of Response Index

0 1 2 3 4 5

14. Look at the picture below!



If the vessels are connected as in the picture above filled with water until they reach the same height, then the liquid pressure experienced by points 1, 2, 3, and 4 is ....

A. the pressure at points 1 and 4 is greater than the pressure at points 2 and 3
B. the pressure at points 1, 2, and 4 is less than the pressure at point 3
C. the pressure at 3 and 2 is the same as the pressure at 4 and different from 1
D. the pressure at point 1, point 2, point 3, and point 4 has the same magnitude

Reason

A. sustain more water at the top
B. the cross-sectional area of the vessel downwards is getting smaller
C. at all points has the same depth
D. several points are under pressure from the side

Certain of Response Index

0 1 2 3 4 5

15. Blood pressure in the human circulatory system has a working principle like Pascal's principle, this is because ... .

A. human blood pressure is the pressure in a closed room
B. human blood pressure is the pressure in an open space
C. human blood pressure is the pressure in a semi-enclosed space
D. human blood pressure is the pressure in a semi-open space

Reason

A. when the heart pumps blood, the blood will be under pressure so that its flow does not pass through the blood vessels
B. when the heart pumps blood, the blood will be under pressure that flows out of the blood vessels
C. when the heart pumps blood, the blood is not under pressure so that its flow flows in the blood vessels
D. when the heart pumps blood, the blood will be under pressure which makes it flow through the blood vessels

Certain of Response Index

0 1 2 3 4 5