Aga Khan University Examination Board

Notes from E-Marking Centre on SSC-I Physics Examination April/ May 2019

Introduction

This document has been produced for the teachers and candidates of Secondary School Certificate (SSC) Part I Physics. It contains comments on candidates' responses to the 2019 SSC Examination, indicating the quality of the responses and highlighting their relative strengths and weaknesses.

E-Marking Notes

This includes overall comments on candidates' performance on every question and *some* specific examples of candidates' responses which support the mentioned comments. Please note that the descriptive comments represent an overall perception of the better and weaker responses as gathered from the e-marking session. However, the candidates' responses shared in this document represent some specific example(s) of the mentioned comments.

Teachers and candidates should be aware that examiners may ask questions that address the Student Learning Outcomes (SLOs) in a manner that requires candidates to respond by integrating knowledge, understanding and application skills they have developed during the course of study. Candidates are advised to read and comprehend each question carefully before writing the response to fulfil the demand of the question.

Candidates need to be aware that the marks allocated to the questions are related to the answer space provided on the examination paper as a guide to the length of the required response. A longer response will not in itself lead to higher marks. Candidates need to be familiar with the command words in the SLOs which contain terms commonly used in examination questions. However, candidates should also be aware that not all questions will start with or contain one of the command words. Words such as 'how', 'why' or 'what' may also be used.

General Observations

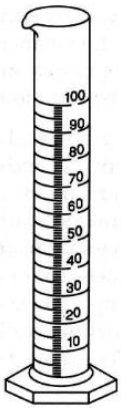
This year candidates performed well on questions related to measuring instruments, kinematics, gravitation, thermal expansion, word problems related to the uniformly accelerated motion. Whereas, low-scoring candidates struggled in questions based on equilibrium, pressure in liquids, transfer of heat, upthrust and major sources of energy.

Detailed Comments

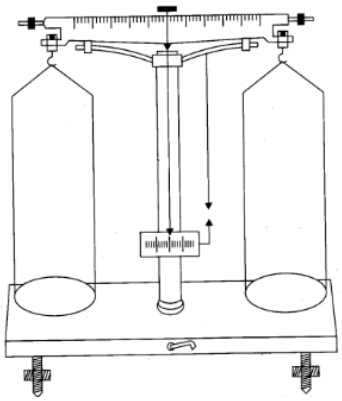
Constructed Response Questions (CRQs)

Question 1:

Write the name of the physical quantity which is measured by the given instruments.



(i)



(ii)

Better responses correctly wrote the name of the physical quantity which is measured by each of the given instruments i.e. volume and mass.

Example:

I volume

II Mass.

Weaker responses failed to write the correct names of the physical quantities. Such responses either mentioned the names of the measuring instruments i.e. measuring cylinder and physical balance or mentioned their functions. For example, some of the candidates wrote that measuring cylinder is used to measure the quantity of liquid and other fluids, whereas physical balance is used to find the weight of a solid.

Example:

I Measuring cylinder, measures liquid and small solids.

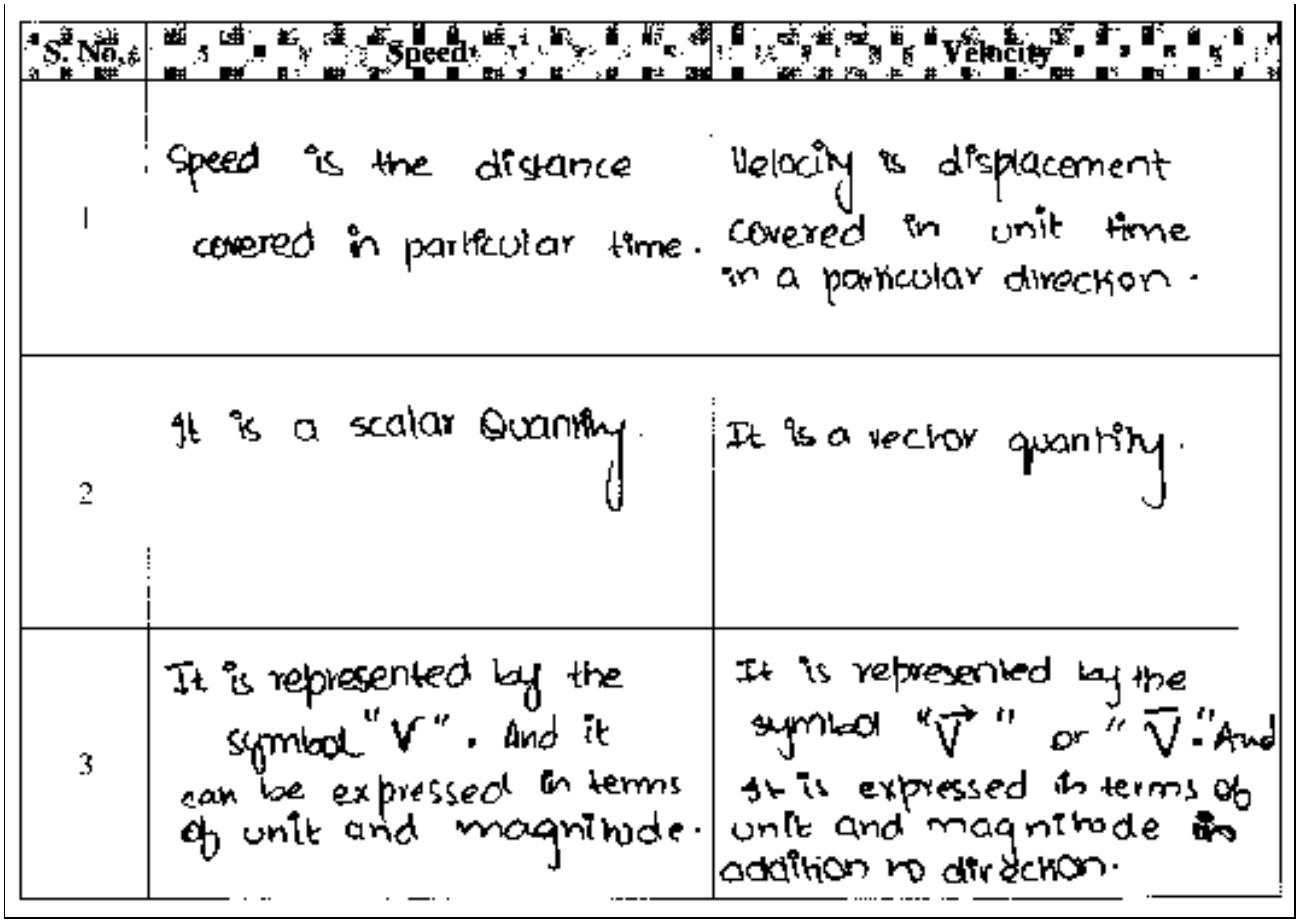
II Physical balance, measures the weight of the object.

Question 2:

Differentiate between speed and velocity in any THREE points.

Better responses were able to correctly differentiate between speed and velocity. High-scoring candidates differentiated in terms of direction, scalar and vector quantities, representation, magnitude, formulae and by the arithmetic and graphical representations.

Example:



S. No.	Speed	Velocity
1	Speed is the distance covered in particular time.	Velocity is displacement covered in unit time in a particular direction.
2	It is a scalar Quantity.	It is a vector quantity.
3	It is represented by the symbol "V". And it can be expressed in terms of unit and magnitude.	It is represented by the symbol "$\vec{V}$" or "$\bar{V}$". And it is expressed in terms of unit and magnitude in addition to direction.

Weaker responses revealed that candidates were unable to differentiate between speed and velocity in three points. Some of the low-scoring candidates only gave the correct formula of speed and velocity but were unable to write all three differences correctly.

Example:

S.No.	Speed	Velocity
1	The amount of distance covered in a given time is called speed.	Distance per unit time is called velocity.
2	It has only one formula to calculate.	~~It's SI unit is meter per second(m/s).~~ It has many formulas to calculate.
3	It is not used in formulas or equations.	It is used in formulas or equations.

Question 3:

What happens when a very heavy ball collides head on with a light stationary ball on a flat surface?

Describe your answer on the basis of law of conservation of momentum.

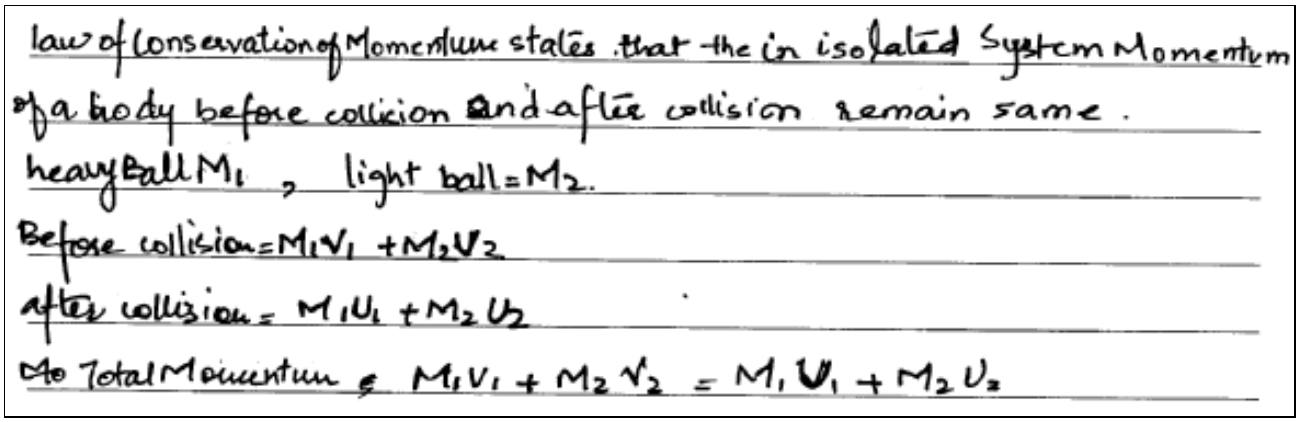
Better responses correctly described that when a very heavy ball collides head on with a light stationary ball on a flat surface, the velocity of the heavy ball remains unchanged and the lighter ball will move in the same forward direction with nearly twice the velocity of the heavy ball. Few candidates also described the idea about momentum before and after collision of the balls.

Example:

When a very heavy ball collides with a light stationary ball it transfers its momentum to the light ball, hence the total momentum before and after collision remains constant of an isolated system. When heavy ball collides with light ball it gives it's velocity to the light ball but the total momentum remains conserved because no net force can enter into isolated system.

Weaker responses misunderstood the demand of the question and stated the definition of law conservation of momentum. Some of the low-scoring candidates also tried to verify the law of conservation of momentum by showing mathematical steps.

Example:


law of conservation of Momentum states that the in isolated System Momentum of a body before collision and after collision remain same.
heavy Ball M_1, light ball $= M_2$.
Before collision $= M_1V_1 + M_2V_2$
after collision $= M_1U_1 + M_2U_2$
So Total Momentum $= M_1V_1 + M_2V_2 = M_1U_1 + M_2U_2$

Question 4:

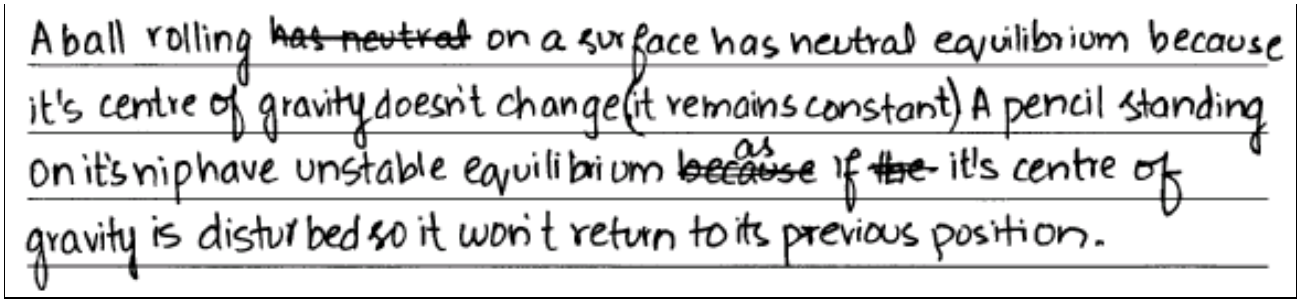
There are three states of equilibrium.

Write any ONE example of any two states of equilibrium from daily life. For each example, mention clearly which state of equilibrium is involved.

Better responses correctly wrote two states of equilibrium from daily life with one example of each. The candidates also clearly mentioned the state of equilibrium in relation to written examples. Such responses included the following states of equilibrium and their examples.

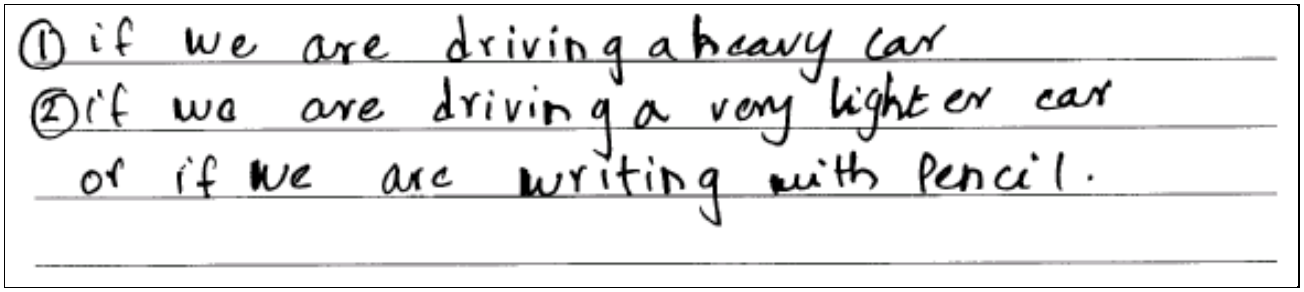
Stable Equilibrium : A chair at rest
Unstable Equilibrium : A stick on the tip of a finger
Neutral Equilibrium : A ball rolled on the floor

Example:


A ball rolling ~~has neutral~~ on a surface has neutral equilibrium because it's centre of gravity doesn't change (it remains constant) A pencil standing on it's nip have unstable equilibrium ~~because~~ as if ~~the~~ it's centre of gravity is disturbed so it won't return to its previous position.

Weaker responses wrote irrelevant terms such as heavy and light cars move in the uniform speed, pencils are in rest position. Candidates mixed up different concepts of forces. Responses from the low-scoring candidates showed lack of conceptual understanding of the centre of gravity and stability of different objects.

Example:



Question 5:

Consider the mass of the Earth and the Moon are 5.98×10^{24} kg and 7.35×10^{22} kg respectively.

The distance between the Earth and the Moon is 3.84×10^{5} km.

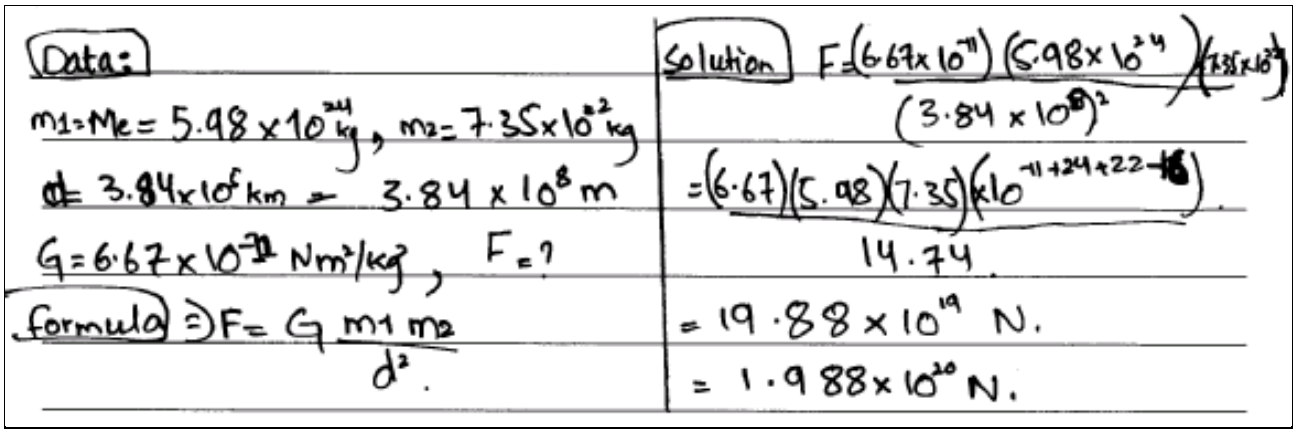
The value of gravitational constant is 6.67×10^{-11} Nm^2/kg^2.

Calculate the gravitational force exerted by the Earth on the Moon.

Better responses correctly calculated the gravitational force exerted by the Earth on the Moon by converting different systems of units.

High-scoring candidates wrote the correct formula of gravitational force, $F = G\frac{m_1 m_2}{r^2}$ followed by substitution of the correct values in the formula $F = (6.67\times10^{-11})\frac{(5.98\times10^{24})(7.35\times10^{22})}{(3.84\times10^{8})^2}$ and finally, they calculated the correct value of gravitational force $F = 1.99\times10^{20}\,N$.

Example:



Weaker responses failed to calculate the gravitational force exerted by the Earth on the Moon. Low-scoring candidates wrote the formula of the radius and diameter of the orbits of the Earth and substituted the values of gravitational constant (G), mass of the Earth (Me), radius of the Earth (R) and height from the surface of the Earth (h).

Example:

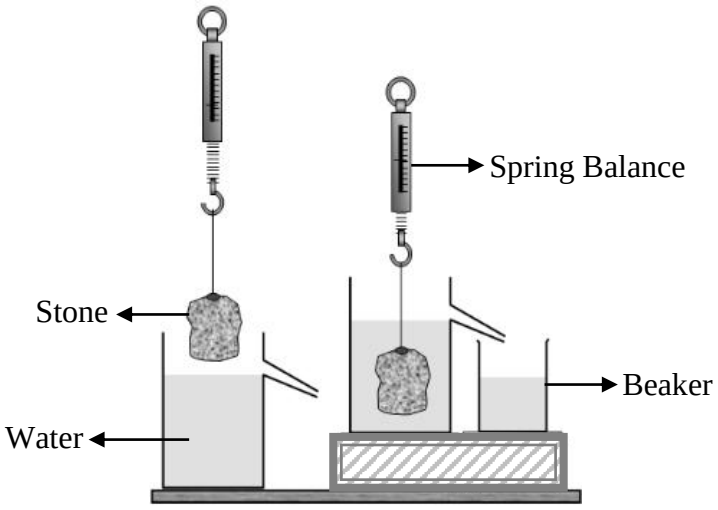
$$F_g = G\frac{M_e m}{(R+h)^2}$$

$$F_g = 6.67\times10^{-11}\cdot\frac{5.98\times10^{24}\cdot7.35\times10^{22}}{(6.4\times10^{6}+3.84\times10^{8})^2}$$

$$F_g = 6.77\times10^{23}\ N$$

Question 6:

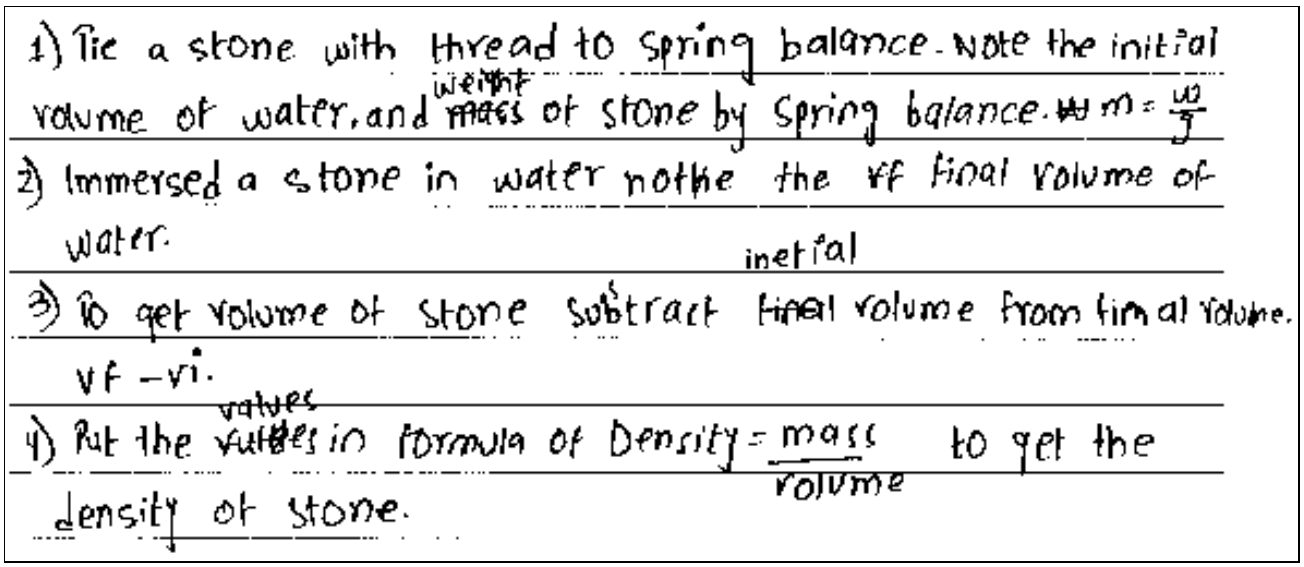
What are the FOUR necessary steps to find the density of a stone with the help of the given apparatus?



Better responses correctly wrote all four necessary steps to find the density of a stone with the help of the shown apparatus. High-scoring candidates wrote their answers point by point as follows:

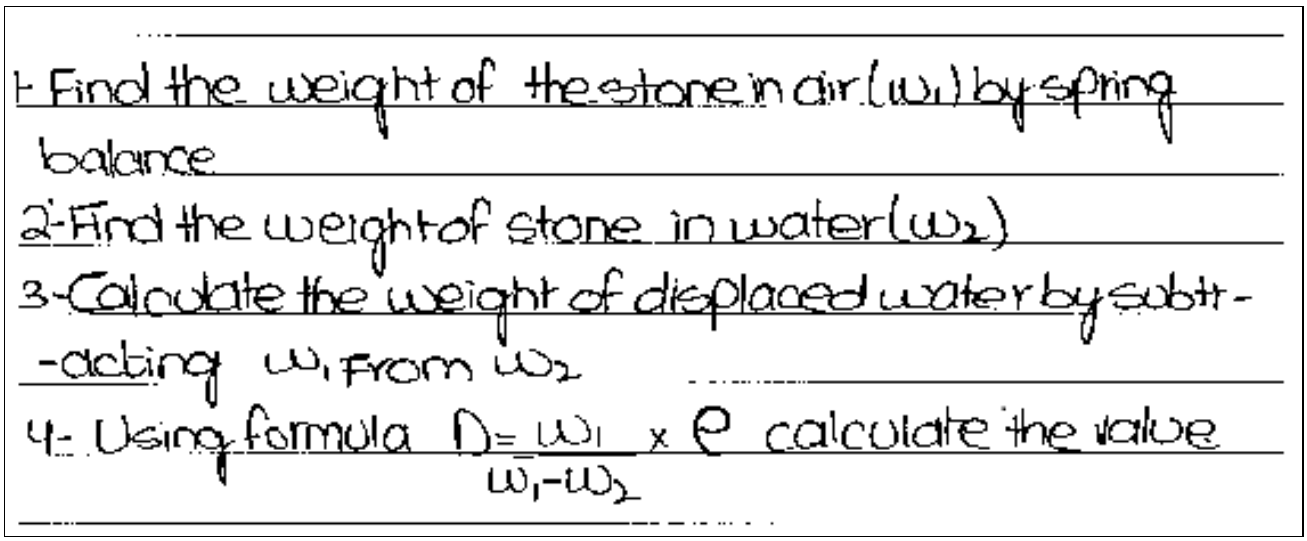
1. First, find the weight of the stone by hanging it to the spring balance without water.
2. Hang the stone into the beaker filled with water. The displaced water will be collected with the help of a nozzle in another beaker and its volume is measured.
3. Convert the weight into mass of the stone by using formula, W = mg.
4. Divide the mass of the stone by volume and find the density using the formula Density = Mass/Volume.

Example:


1) Tie a stone with thread to spring balance. Note the initial volume of water, and weight mass of stone by spring balance. ~~W~~ $m = \frac{w}{g}$
2) Immersed a stone in water nothe the vf final volume of water.
3) To get volume of stone subtract final volume from inetfial volume. vf − vi.
4) Put the values in formula of Density = $\frac{mass}{volume}$ to get the density of stone.

Weaker responses mentioned the concept of weight and discussed Archimedes' principle which was not the demand of the question. Many candidates wrote about the formula for finding out the density of an object. Few candidates wrote the description of every labelled thing/ item shown in the given diagram.

Example:


1- Find the weight of the stone in air (w_1) by spring balance
2- Find the weight of stone in water (w_2)
3- Calculate the weight of displaced water by subtr- -acting w_1 From w_2
4- Using formula $D = \frac{w_1}{w_1 - w_2} \times e$ calculate the value

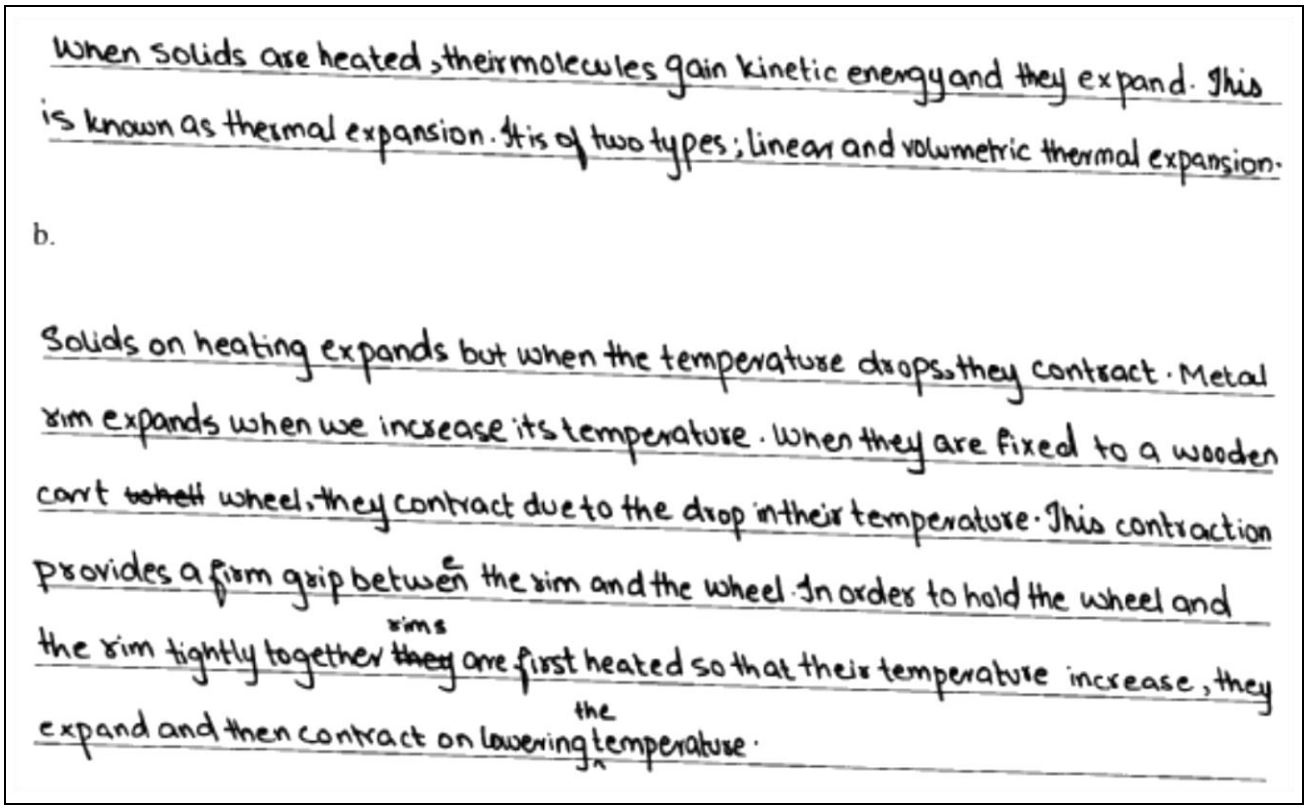
Question 7:

a. Define thermal expansion of solids.

b. The temperature of a metal rim is increased before fixing it to a wooden cart wheel.
Give a scientific reason to support this statement.

Better responses correctly defined thermal expansion of solids in part (a) by writing that 'it is the expansion of solids (OR) an increase in size (volume of a body) with the rise of temperature (thermal energy) on heating.'
In part (b), high-scoring candidates correctly provided a scientific reason that the temperature of a metal rim is increased before fixing it to a wooden cart wheel because 'metals expand with the rise in temperature and contract on cooling. Some of the candidates wrote that the metallic rim used is slightly smaller in diameter than the wheels and on increasing temperature the rim expands, so it can easily lie on the wheels.

Example:

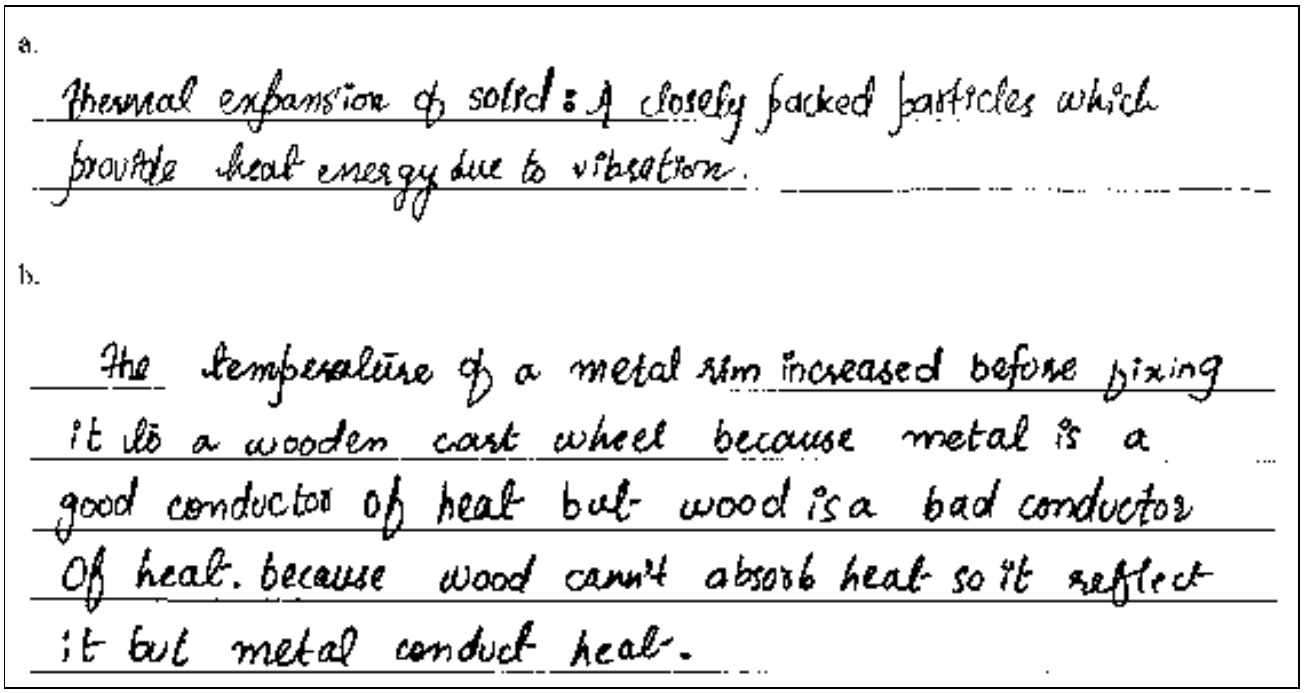

When solids are heated, their molecules gain kinetic energy and they expand. This is known as thermal expansion. It is of two types; linear and volumetric thermal expansion.

b.

Solids on heating expands but when the temperature drops, they contract. Metal rim expands when we increase its temperature. When they are fixed to a wooden cart ~~wheel~~ wheel, they contract due to the drop in their temperature. This contraction provides a firm grip between the rim and the wheel. In order to hold the wheel and the rim tightly together ~~they~~ rims are first heated so that their temperature increase, they expand and then contract on lowering the temperature.

Weaker responses exhibited that candidates were unable to define thermal expansion of solids and also failed to provide a scientific reason for the given situation. Few of the low-scoring candidates only wrote the correct definition but wrongly gave the scientific reason and wrote the concept of good and bad conductors of heat.

Example:


a.

Thermal expansion of solid: A closely packed particles which provide heat energy due to vibration.

b.

The temperature of a metal rim increased before fixing it to a wooden cart wheel because metal is a good conductor of heat but wood is a bad conductor of heat. because wood can't absorb heat so it reflect it but metal conduct heat.

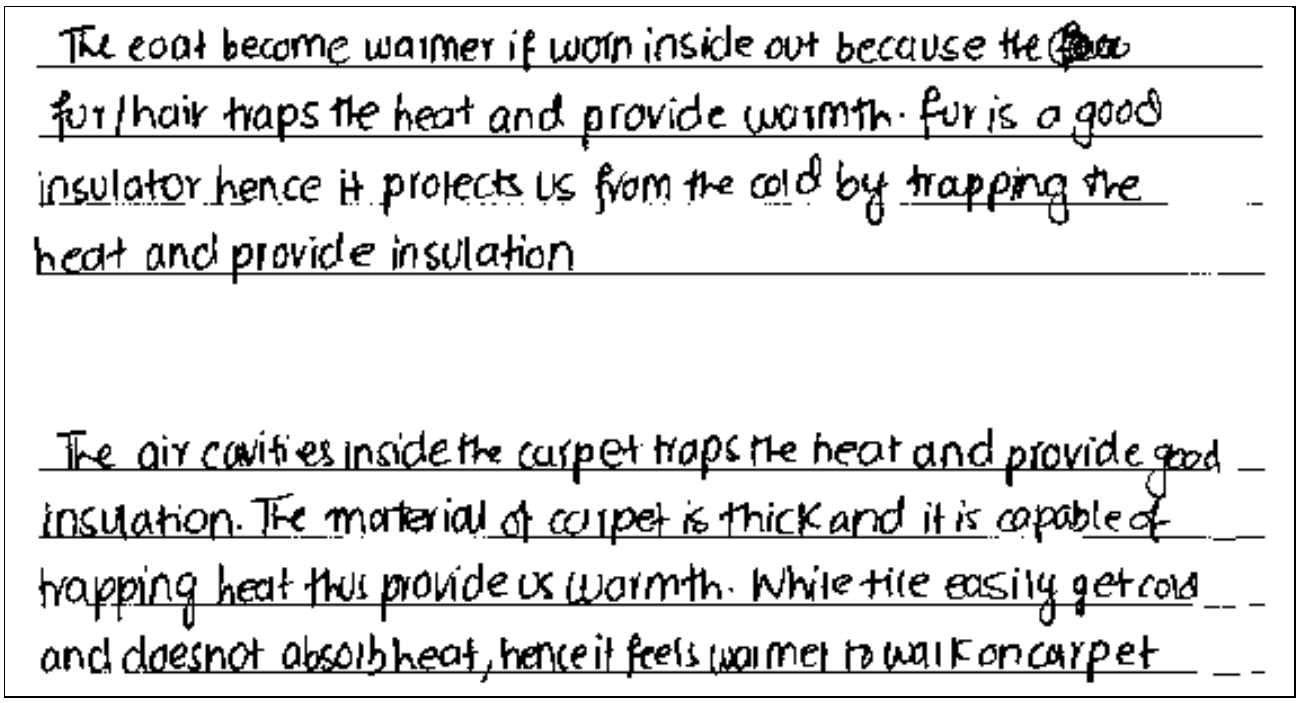
Question 8:

a. An animal fur coat is made in such a way that the inner surface is animal's skin and the outer surface is fur/ hair.
Why is this coat warmer if it is worn inside out (i.e. the inner surface becomes the outer)?

b. Walking barefoot on a carpet feels warmer than walking on tiles. Give a scientific reason to support this statement.

Better responses correctly analysed and explained the scientific reasons in both parts. In part (a), candidates mentioned that an animal fur coat is made in such a way because the fur traps air which is a good insulator/ poor conductor. If the fur coat is worn from the inside out, the air/ heat acts as an insulator, then it will keep the body heat intact.
In part (b), high-scoring candidates gave the reason that walking barefoot on a carpet feels warmer than walking on tiles because the carpet traps air which is a good insulator and prevents body heat from being lost through our barefoot. Some of the candidates wrote that tiles are good conductor and take heat from our body when we are barefoot and carpet's rough surface absorbs most of the body's heat.

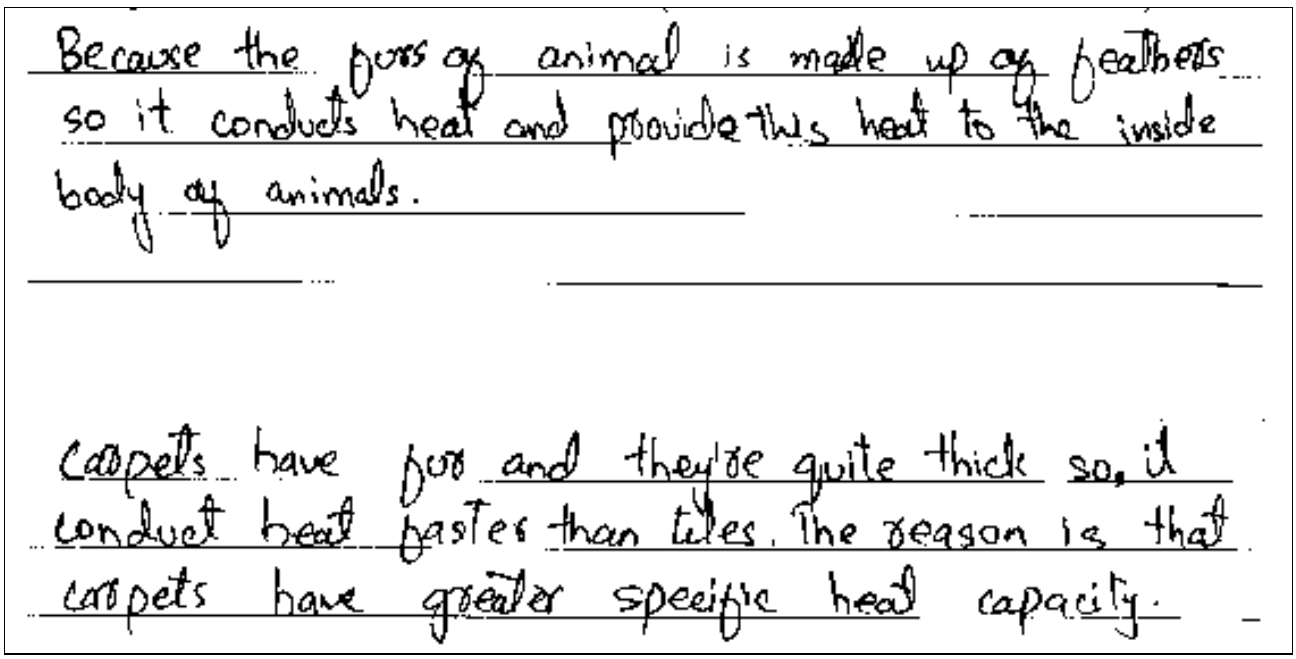
Example:


The coat become warmer if worn inside out because the fur/hair traps the heat and provide warmth. fur is a good insulator hence it protects us from the cold by trapping the heat and provide insulation

The air cavities inside the carpet traps the heat and provide good insulation. The material of carpet is thick and it is capable of trapping heat thus provide us warmth. While tile easily get cold and doesnot absorb heat, hence it feels warmer to walk on carpet

Weaker responses were unable to explain the concept and got confused between absorbers and reflectors of heat. Some of the candidates provided the reason of smooth and rough surface or the process of heat transfer which was not required in the question.

Example:


Because the furs of animal is made up of feathers so it conducts heat and provide this heat to the inside body of animals.

Carpets have fur and they're quite thick so, it conduct heat faster than tiles. The reason is that carpets have greater specific heat capacity.

Extended Response Questions (ERQs)

These questions offered a choice between part **a** and **b**.

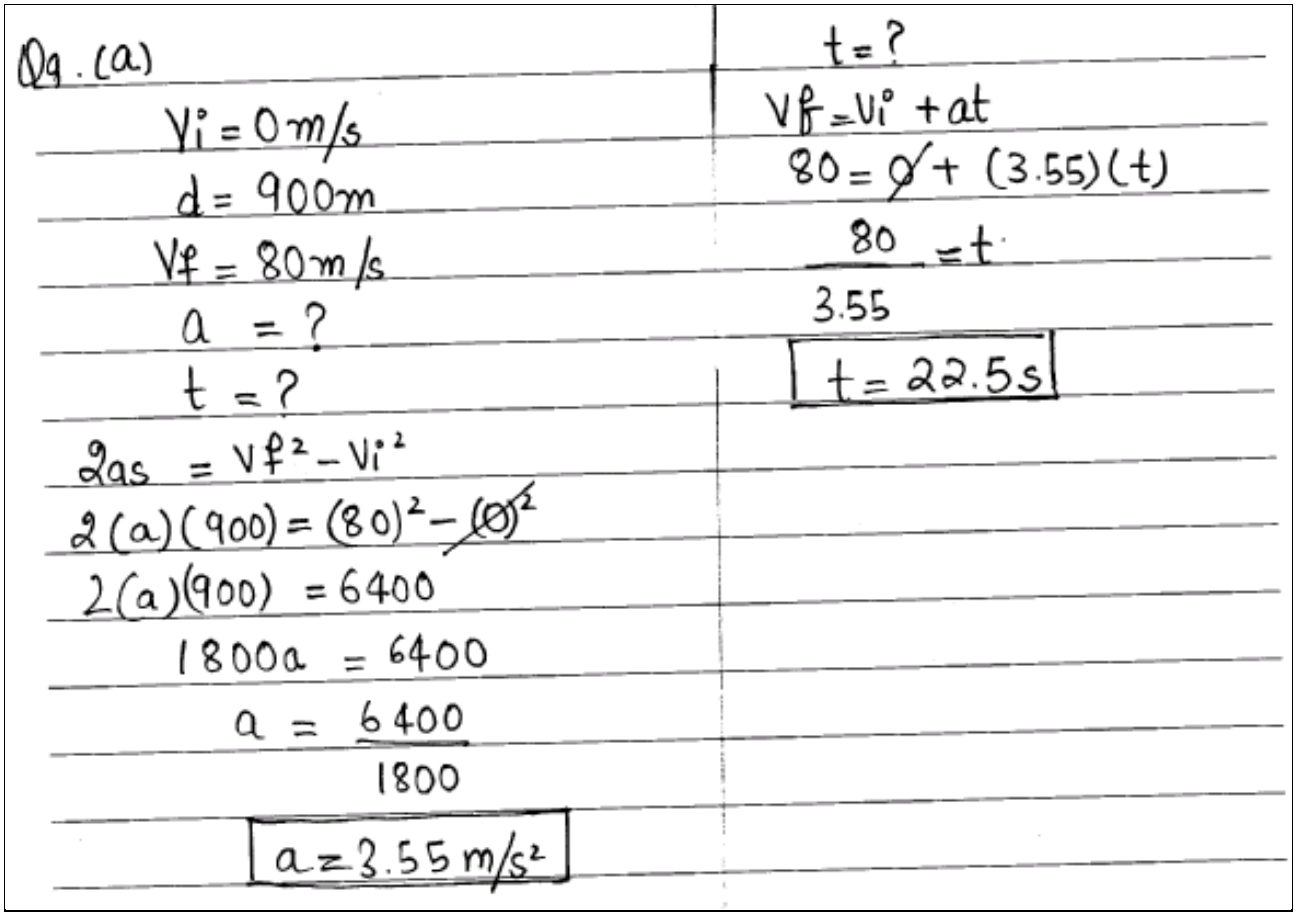
Majority of the candidates attempted question **9a** and they scored well in this part.

Question 9a:

A sports car starts from rest. It covers a distance of 900 m to attain a speed of 80 m/s. Determine the acceleration of the car and the time required to reach this speed.

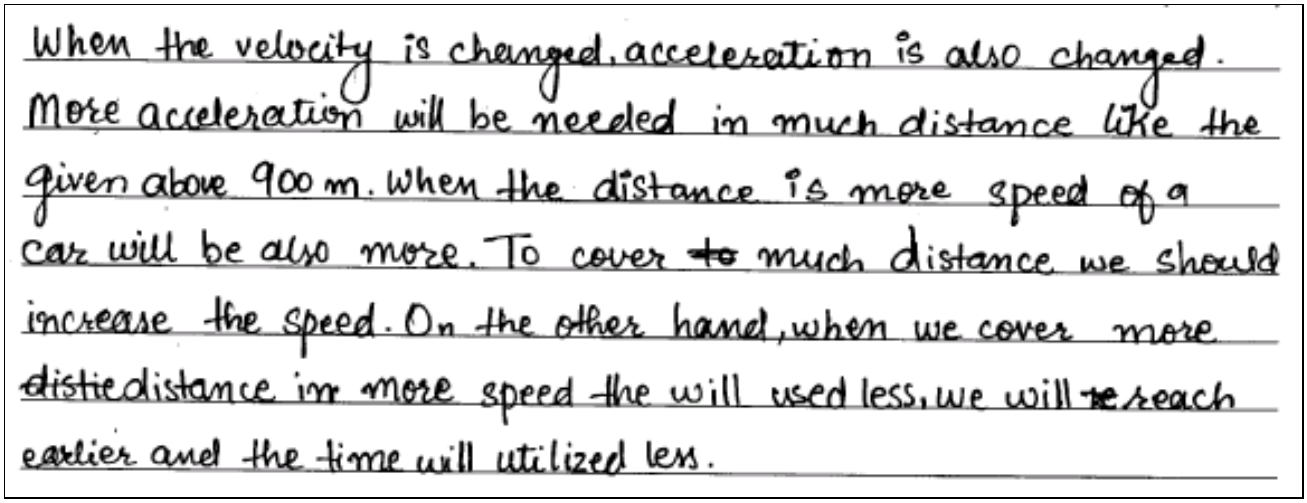
Better responses correctly determined the acceleration of the car and the time required by writing the correct data, equations of motion ($v_f = v_i + at$, $v_f^2 = v_i^2 + 2aS$ (OR) $2aS = v_f^2 - v_i^2$) and values of acceleration, $a = 3.56\ m/s^2$ and time $t = 22.47$ s.

Example:



Weaker responses neither wrote the correct data nor equations of motion. They mixed up more than two or three equations of motion in their answers. Few of the low-scoring candidates were unable to solve the numerical (word problem) and wrote their answer in descriptive form which was not the demand of the question.

Example:


When the velocity is changed, acceleration is also changed. More acceleration will be needed in much distance like the given above 900 m. When the distance is more speed of a car will be also more. To cover ~~to~~ much distance we should increase the speed. On the other hand, when we cover more ~~distie~~distance in more speed the will used less, we will ~~be~~ reach earlier and the time will utilized less.

Question 9b:

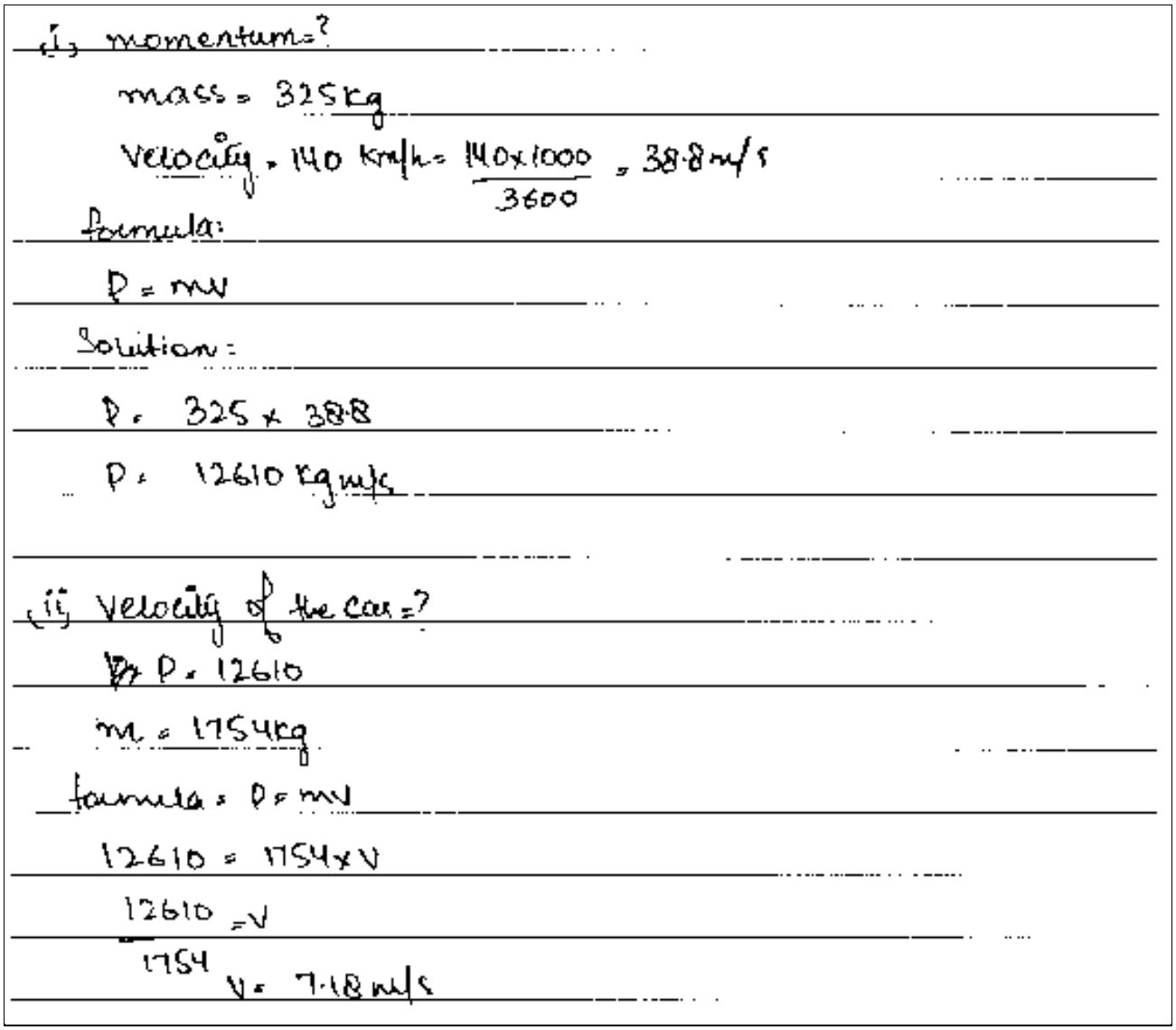
Two vehicles, a sports bike and a car of masses 325 kg and 1754 kg respectively, are moving with different velocities.

a. Find the momentum of the sports bike at the speed of 140 km/h.

b. Hence, find the velocity of the car if momentum of both the vehicles is same.

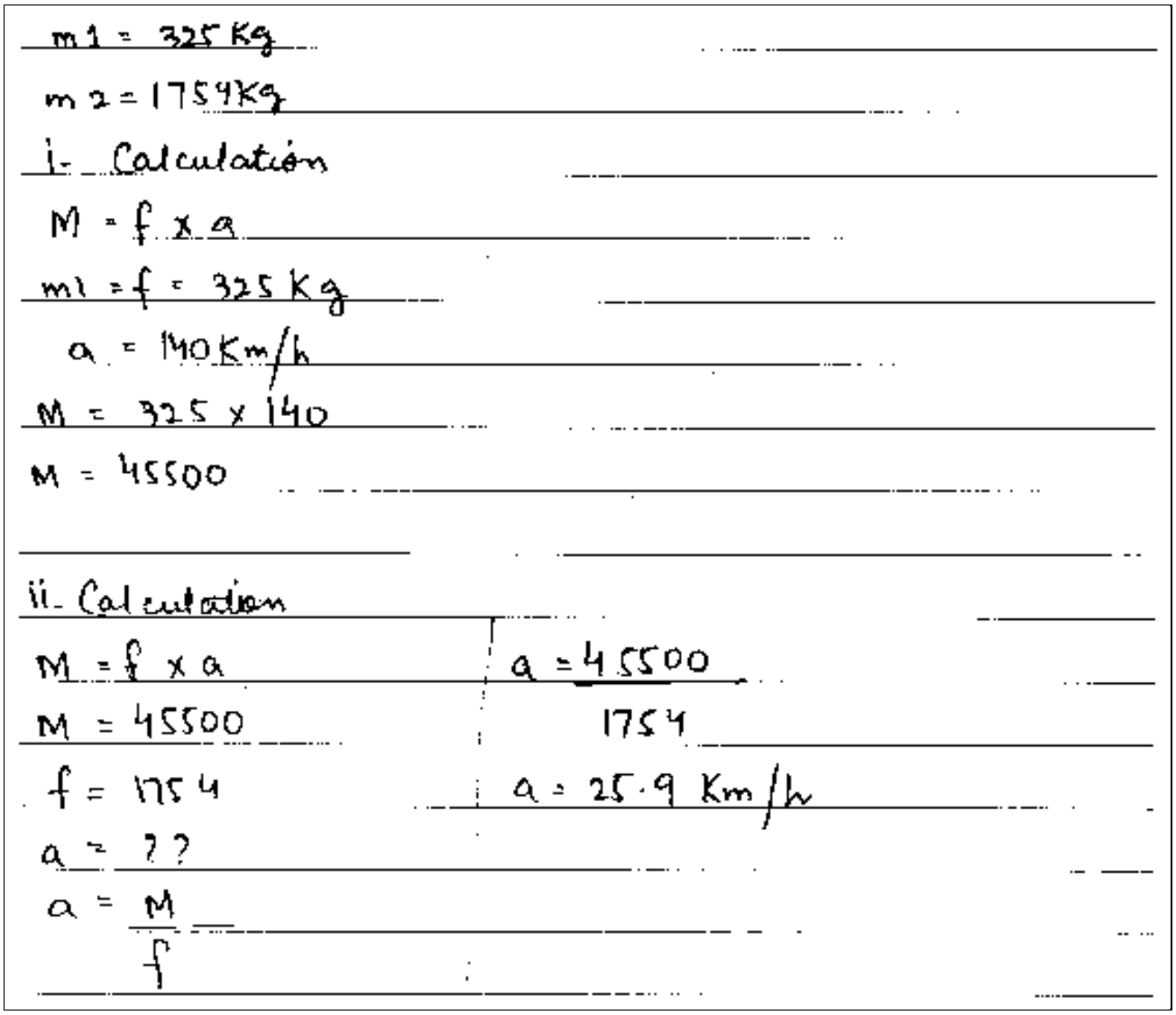
Better responses correctly found the momentum of the sports bike and the velocity of the car by extracting the correct data from the question, converting units in different systems and by using the correct formula of momentum, P = m.v found the correct value of momentum, P = 12639.25 kg.m/s. In part (b), candidates used the same formula of momentum and found the correct value of velocity v = 7.205 m/s.

Example:



Weaker responses were unable to apply the correct concepts and formula of momentum. Low-scoring candidates failed to connect the two parts of the question and used formula F = ma for finding momentum and velocity of the sports bike and the car respectively. Some of the candidates were confused in understanding the demand of the question and used formula for the law of conversation of momentum. Few candidates deviated from the requirement of the numerical and calculated the acceleration of sports bike and the car.

Example:


m1 = 325 Kg
m2 = 1754Kg
i- Calculation
M = f x a
m1 = f = 325 Kg
a = 140 Km/h
M = 325 x 140
M = 45500
ii- Calculation
M = f x a
M = 45500
f = 1754
a = ??
a = M / f
a = 45500 / 1754
a = 25.9 Km/h

Majority of the candidates attempted question **10a** and they scored well in this part.

Question 10a:

Explain renewable and non-renewable sources of energy and give any THREE examples of each source.

Better responses correctly explained renewable and non-renewable sources of energy with the correct examples of each. High-scoring candidates mentioned the important points in their answers. For example, renewable energy provides necessary support to get rid of our over-dependence on oil, while it strengthens our economy and defence capability of our country. They wrote the following examples in their explanation.

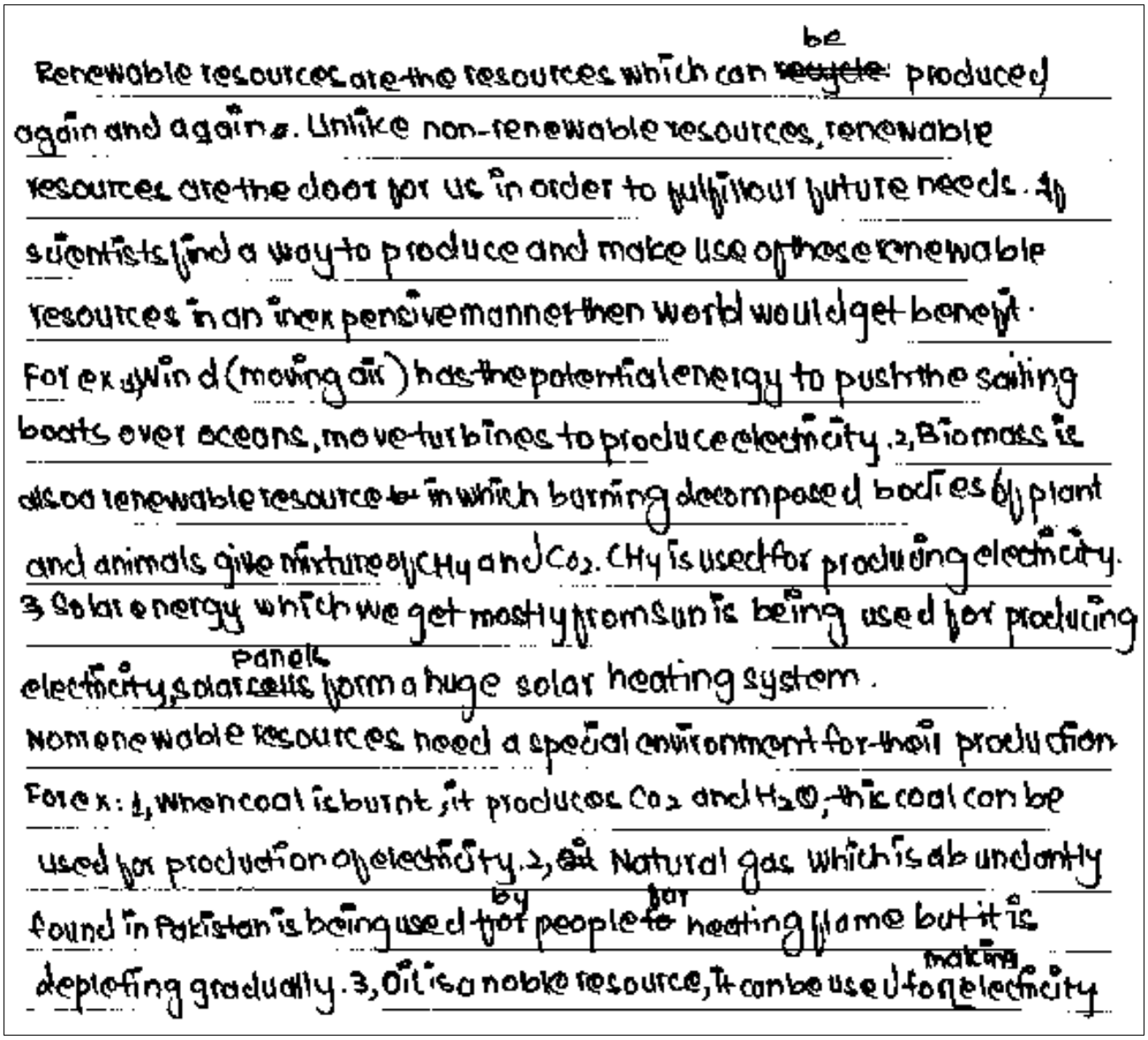
Example of renewable sources of energy:

i. Energy from water (hydral)
ii. Energy from the sun
iii. Wind energy
iv. Geothermal energy
v. Energy from biomass

Example of non-renewable sources of energy:

i. Energy from coal
ii. Energy from petrol
iii. Energy from natural gas
iv. Nuclear energy

Example:


Renewable resources are the resources which can ~~recycle~~ be produced again and again. Unlike non-renewable resources, renewable resources are the door for us in order to fulfill our future needs. If scientists find a way to produce and make use of these renewable resources in an inexpensive manner then world would get benefit. For ex: Wind (moving air) has the potential energy to push the sailing boats over oceans, move turbines to produce electricity. 2, Biomass is also a renewable resource in which burning decomposed bodies of plant and animals give mixture of CH_4 and CO_2. CH_4 is used for producing electricity. 3, Solar energy which we get mostly from sun is being used for producing electricity, solar panels form a huge solar heating system.
Non renewable resources need a special environment for their production For ex: 1, When coal is burnt, it produces CO_2 and H_2O, this coal can be used for production of electricity. 2, ~~Oil~~ Natural gas which is abundantly found in Pakistan is being used by people for heating flame but it is depleting gradually. 3, Oil is a noble resource, it can be used for making electricity

Weaker responses showed that candidates were unable to provide the correct explanation. Candidates were confused between different energy sources and mixed up the examples of renewable and non-renewable energy sources. Low-scoring candidates wrote the names of renewable energy sources like air and water. They mentioned irrelevant terms in their answers like oxygen gas, petrol, and diesel etc.

Example:

(a). Renewable energy sources are those energy sources which can be finished after their use or are in small quantity.

For example :- Coal, fossil fule and water.

These energies are in small quantity and can be finished.

- Non - Renewable sources are those which can be used agin and agin. and are in large amount.

For example :- light energy, Sunlight, wind energy.

These sources can be used agin and agin.

Question 10b:

I. Which types of forces act on a body in a fluid, if it is

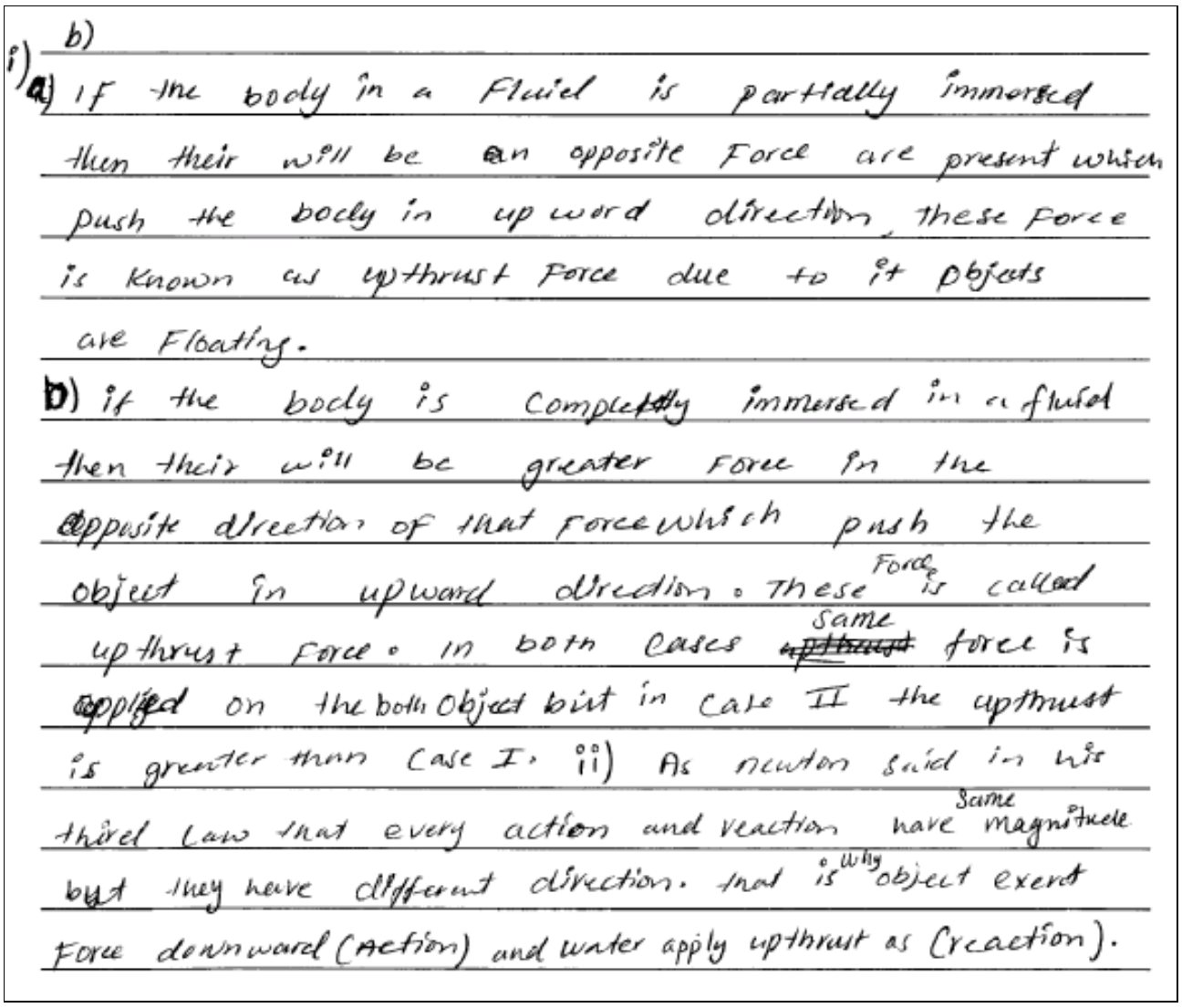
   i. partially immersed.
   ii. completely immersed.

II. Why this upthrust acts in the upward direction?

Better responses correctly named the types of forces that act on a body in a fluid, if it is partially and completely immersed. They wrote in their answer the concept of upthrust and buoyancy as when a body is partially immersed, only its lower surface experiences an upward pressure of the liquid and when an object is completely immersed, its lower surface will experience an upward pressure of the fluid and its upper surface will also experience a pressure in the downward direction.

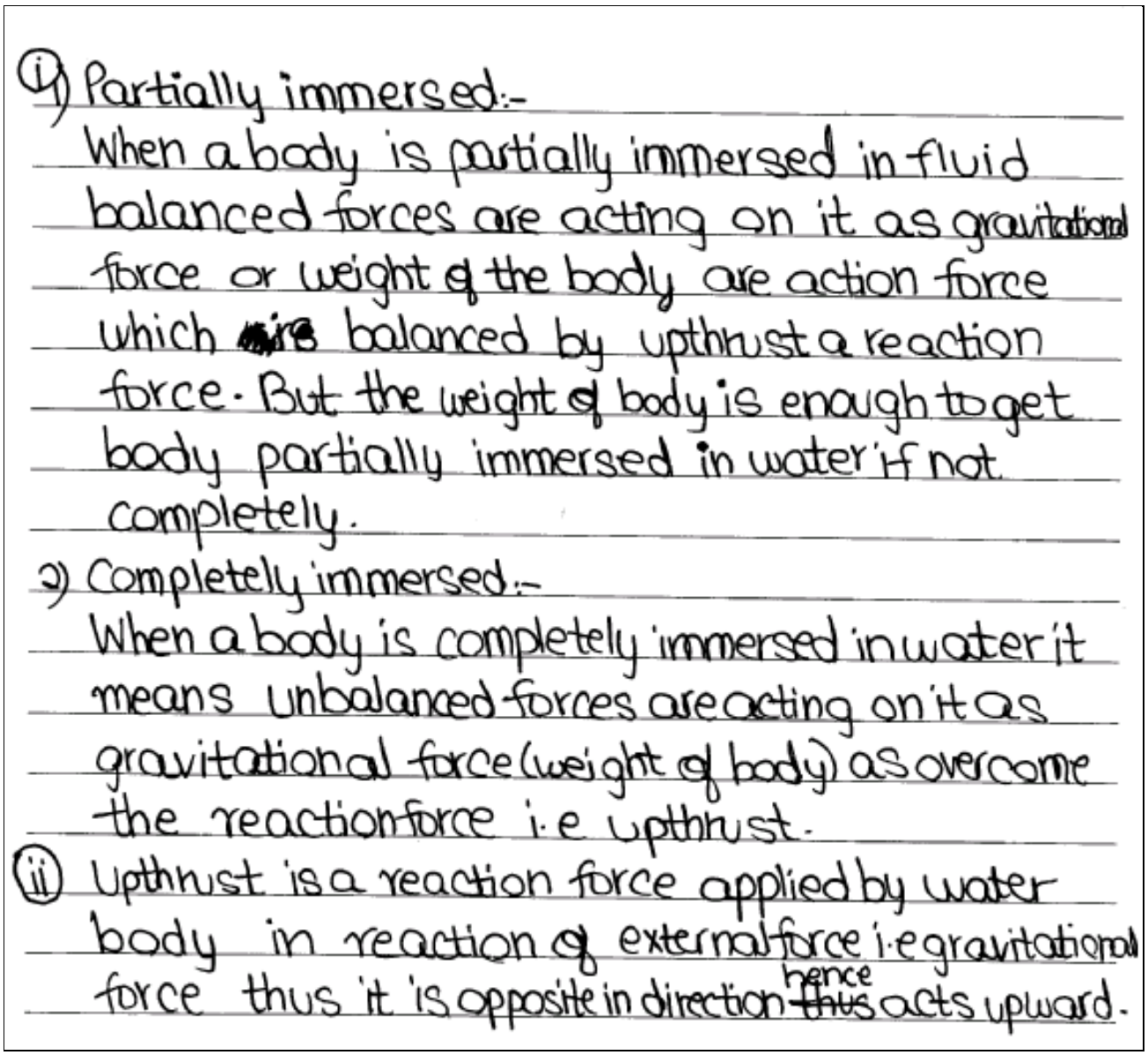
In the second part of the question, the candidates wrote that in case of partial or total submersion, the pressure of liquid on the lower surface is always greater and in upward direction which is termed as upthrust.

Example:



Weaker responses displayed that candidates were unable to name the types of the forces that act on a body in a fluid. Some of the low-scoring candidates wrote irrelevant terminologies like gravitational force, weight of a body and direction of motion of the object in fluid. They were also unable to state the reason behind the acting of upthrust in the upward direction.

Example:


(i) Partially immersed:-
When a body is partially immersed in fluid balanced forces are acting on it as gravitational force or weight of the body are action force which are balanced by upthrust a reaction force. But the weight of body is enough to get body partially immersed in water if not completely.
2) Completely immersed:-
When a body is completely immersed in water it means unbalanced forces are acting on it as gravitational force (weight of body) as overcome the reaction force i.e upthrust.
(ii) Upthrust is a reaction force applied by water body in reaction of external force i.e gravitational force thus it is opposite in direction hence ~~thus~~ acts upward.