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APPENDIX 1

PRE-TEST

1. Airport Y is located 600 km directly south of airport X. An aeroplane has to travel from X to Y while a wind blows at 40 km/h from the west. The aeroplane travels at an airspeed of 200 km/h.

   a. Draw a labeled vector diagram (not to scale) to show the direction in which the aeroplane should be pointed. Indicated the velocity of the plane relative to the ground by V_g. (6)
   b. Use the diagram in (a) to calculate the direction in which the plane should be pointed during the trip. (3)
   c. Calculate the time taken to reach Y. (6)

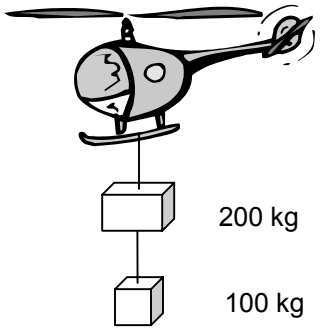
1. Lesego is an athlete running the 100 meter. He accelerates uniformly at 5 $m.s^{-2}$ for the first 10 meter. Then he runs at a constant velocity for the remainder of the race.
   a. Calculate the time he takes to run the first 10 m. (5)
   b. Calculate his speed at the end of the first 10 m. (5)
   c. Calculate his time for the 100 m. (5)

TOTAL 30

APPENDIX 2

FEBRUARY TEST

1. A helicopter accelerates vertically upwards at 2 $m.s^{-2}$. Two crates are hanging from the helicopter. Two different cables are used; one cable connects the crates while the other attaches the 200 kg crate to the helicopter as shown in the diagram.



a. Draw two labeled force diagrams, showing the forces acting on each crate. (5)
b. Write down the equation of motion for each crate and calculate tension in each cable. (7)
c. If the two crates were swopped such that the 100 kg is above the 200 kg, what would the tension be in
   (i) the upper cable and
   (ii) the lower cable? (2)

2. Thabang leans out of a window of a building and throws a ball vertically upwards . The ball reaches a maximum height of 45 m above the window. The window is 35 m above ground level.
a. Calculate the initial velocity of the ball. (5)
b. Calculate the time the ball takes to reach the ground. (6)
c. Calculate the velocity of the ball when it hits the ground. (5)

TOTAL 30

APPENDIX 3

MARCH TEST

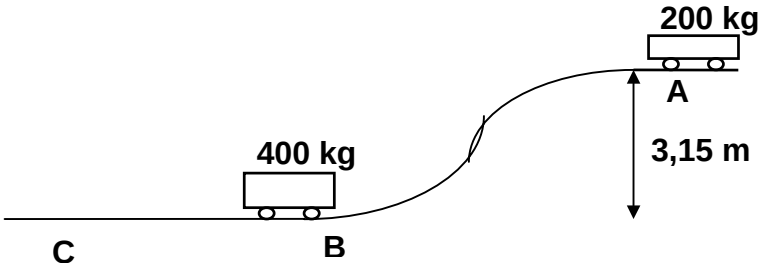
1 A lift with mass 2000 kg accelerates upwards through a height of 5 meter. The lift is driven by a motor supplying a constant vertical force of 30 000 N.

a Calculate the increase in the potential energy of the lift. (3)
b Calculate the work done by the motor. (3)
c Calculate the increase in the kinetic energy of the lift. (2)

2 A 60 g ball hits a wall with a horizontal velocity of 30 $m.s^{-1}$ South. The ball bounces back at 30 $m.s^{-1}$.

a. Calculate the force exerted by the wall on the ball if the impact lasts 0,01 seconds. (6)
b Is the momentum of the ball conserved during the collision? (1)

3 A car with mass 200 kg starts moving at 9 $m.s^{-1}$ at A shown in the diagram. It moves without friction to B and collides with a stationary 400 kg car when it reaches B. The cars move together after the collision.



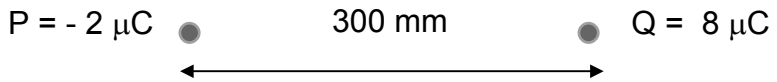
a Calculate the speed of the cars immediately after the collision. (9)
b The cars move together on a straight rough horizontal surface from B to C, coming to rest at C. Calculate the frictional force acting on the cars if the distance between C and B is 6 m. (6)

TOTAL 30

APPENDIX 4

MAY TEST

1 Two charged spheres are placed 300 mm apart as shown in the diagram.



a Calculate the electrostatic force between the two charges. (5)
b Calculate the electric field at the position of P. (5)

2 Two large, oppositely charged parallel plates are placed 50 mm apart in vacuum. The electric field strength between the plates is 160 000 $V.m^{-1}$.

a Calculate the potential difference between the plates. (4)
b A proton is released from rest at the positve plate. Calculate the kinetic energy of the proton when it reaches the negative plate. (4)
c A positive ion is then released at the positive plate. It has the same charge but larger mass than the proton in (b). Is the kinetic energy of the ion larger, smaller or equal to that of the proton when it reaches the negative plate? Explain. (2)

3 While trying to do the Millikan experiment, a student observes a charged oil drop **accelerating** upwards at 1 $m.s^{-2}$ towards the negative plate. The mass of the oil drop is 4 x 10^{-6} kg, the potential difference between the plates is 6000 V and the plates are separated by 200 mm.

a Calculate the charge on the oil drop. (7)
b Does the acceleration of the oil drop increase, decrease or remain unchanged as the it moves closer to the top plate? Explain. (2)
c Peter calculated the charge on the oil drop and obtained an answer of 3,2 x 10^{-20} C. Why can you be sure that Peter's answer is wrong?(1)

TOTAL 30

APPENDIX 5:

JUNE EXAMINATION

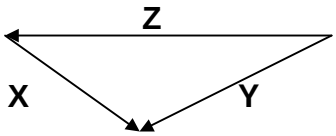
Physics Grade 12 Higher Grade

Time: 2 hours Total: 150

QUESTION 1

1.1 What is the relationship between the vectors **X, Y** and **Z** in the diagram?

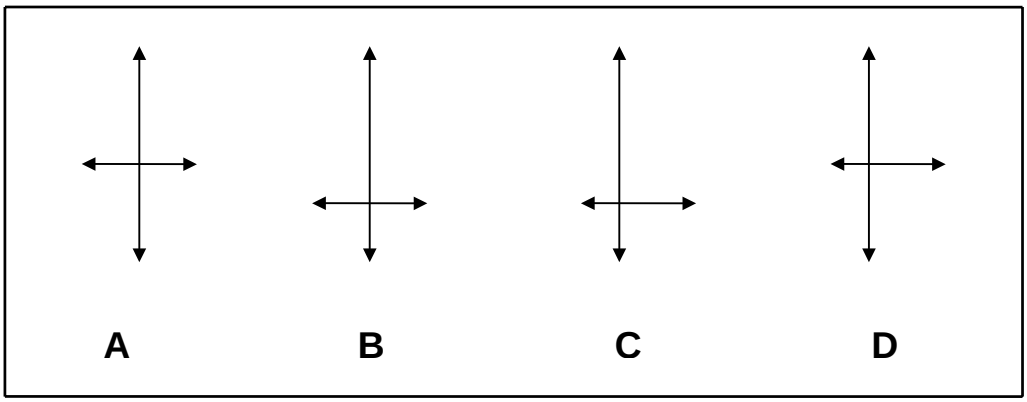
A **X + Y + Z = 0**
B **X = Y + Z**
C **Y = X + Z**
D **Z = X + Y**



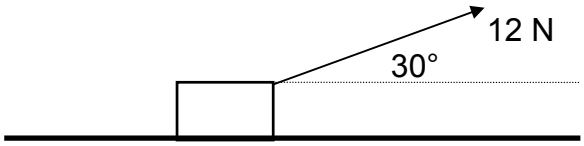
1.2 Ntabiseng throws a ball vertically upwards and catches it as it returns. At the turning point, the ball's acceleration:

A is zero
B changes direction;
C is 10 ms^{-2} downwards;
D is 10 ms^{-2} upwards.

1.3 A ship travels horizontally to the right at a constant velocity. Which diagram is the best representation of the forces acting on the ship?



1.4 James pulls a block at a constant velocity over a rough horizontal surface. He applies a 12 N force at an angle of 30° above the horizontal.



The frictional force is:

A	zero	B	12 N
C	6N	D	10,4 N

1.5 Thabang and Edwin investigate the relationship between mass and acceleration during a practical session. They measure the acceleration for different masses by stacking trolleys. They apply the same force in each case. The acceleration was 1,2 $m.s^{-2}$ for one trolley only. What is the acceleration for a stack of three trolleys?

A	3,6 $m.s^{-2}$	B	0,6 $m.s^{-2}$
C	0,4 $m.s^{-2}$	D	0,33 $m.s^{-2}$

1.6 An object with mass m hangs at rest from a string. The string exerts a force T on the object. Which statement is correct?

i $F_{resultant} = mg$
ii $T = mg$
iii $F_{resultant} = 0$
iv $T = ma$

A	ii and iii	B	i and iv
C	only i	D	only iii

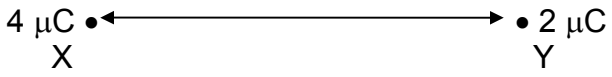
1.7 A satelite orbits the earth at a height 2 times the radius of the earth. What is the weight of a 90 N instrument in the satellite?

A	45 N	B	30 N
C	22,5 N	D	10 N

1.8 A stone with mass m falls from a cliff and hits a pool of mud with a speed v. It sinks to a depth d into the mud before coming to rest . How much work does the stone do on the mud?

A	½ mv^2	B	mgd
C	½ mv^2 + mgd	D	½ mv^2 - mgd

1.9 The electrostatic force on the 2 μC charge at Y in the diagram below is 10 N.

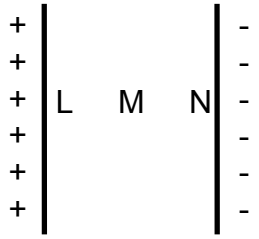


What is the electrostatic force on the charge at X?

A 10 N to the right
B 10 N to the left
C 5 N to the right
D 5 N to the left

1.10 A negatively charged particle is placed between two oppositely charged parallel plates shown in the diagram. At which position will it experience the largest force?

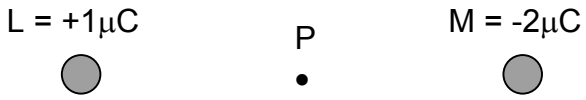
A at L
B at M
C at N
D the force is the same at L, M and N



1.11 A student calculates charges on oil drops in a Millikan experiment and obtains the answers A to D below. In which one of the calculations did he make a mistake?

A $3{,}2 \times 10^{-19}$ C
B $4{,}8 \times 10^{-18}$ C
C $-6{,}4 \times 10^{-19}$ C
D $1{,}6 \times 10^{-20}$ C

1.12 P is a point halfway between charges L and M as shown in the diagram. The electric field strength of charge L has a magnitude E at point P.



What is the resultant field strength at P?

A E, to the right
B E, to the left
C 3 E, to the left
D 3 E, to the right

[12 x 4 = 48]

QUESTION 2

2.1 A minibus travels at a constant speed of 32 $m.s^{-1}$ on a straight road. The driver sees a stationary truck 130 m down the road. The reaction time of the driver is 0,2 s. The driver then applies the brakes, decreasing his speed uniformly at 4 $m.s^{-2}$
Does the minibus come to rest before reaching the truck? Do a suitable calculation to support your answer. (10)

2.2 A helicopter pilot leans out of the helicopter door while ascending (going up) vertically at an unknown constant speed. At a height of 7 m above the ground, he accidentally drops his pipe. The pipe starts from rest relative to the helicopter and reaches the ground within 1,4 seconds. Ignore friction and calculate:

a the speed of the helicopter; (5)

b the maximum height the pipe reach above the ground. (6)

c Draw displacement-time and a velocity-time graphs for the motion of the pipe. Numerical values are **not required** on the graphs (4)

[25]

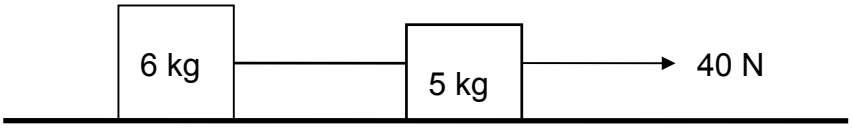
QUESTION 3

3.1 A 80 kg lady stands on a bathroom scale in a lift.

a Determine the reading on the scale when the lift accelerates downward at 1 $m.s^{-2}$ (6)

b Give the value of the resultant force on the lady. (2)

8 Two blocks with masses 6 kg and 5 kg are connected by a light string and pulled over a rough surface by a 40 N force applied to the 6 kg block. The frictional forces are 4 N on the 6 kg block and 3 N on the 5 kg block.



a. Write down the equation of motion for each block. (6)

b Use the equations in (a) to calculate the acceleration of the blocks and the tension in the string. (4)

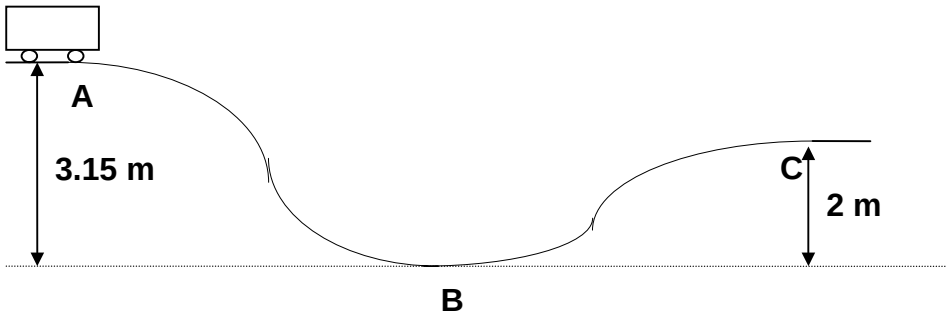
[18]

QUESTION 4

4.1 During a game of marbles, a 4 gram marble moves at 3 $m.s^{-1}$ North and collides with an 8 gram marble moving at 1 $m.s^{-1}$ South. The 4 g marble moves at 1 $m.s^{-1}$ South after the collision.

a Calculate the velocity of the 8 gram marble after the collision. (6)
b Calculate the average force on the 4 g marble during the collision if the marbles are in contact for 0,01seconds. (6)
c What is the force on the 8 g marble during the collision? (2)

4.2 A car with mass 200 kg starts at A and rolls down a track as shown in the diagram. It reaches B with a speed of 12 $m.s^{-1}$.



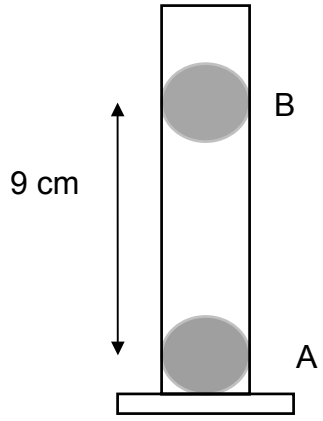
a Calculate the speed with which the car has started at A. Assume there is **no friction** between A and B. (5)
b The track between B and C is **rough**. The car does work of 2 300 J against friction while moving from B to C. Calculate the speed of the car when it reaches C. (5)
[24]

QUESTION 5

5.1 Two parallel metal plates are separated by 3 cm. The electric field strength between the plates is 90 000 V/m. A particle with a charge of 2 μC is released from rest at the positive plate.

a Calculate the potential difference between the two plates. (4)
b Calculate the kinetic energy of the charge when it reaches the negative plate. (4)
c How does the potential energy of the particle change while it moves to the negative plate? (2)

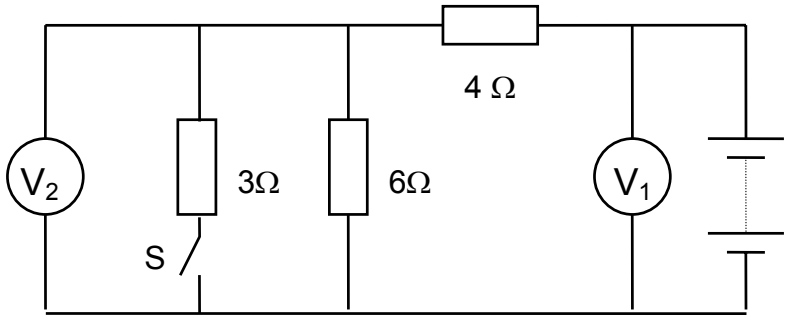
5.2 A charged polystyrene ball A lies at the bottom of a glass cylinder. An identically charged polystyrene ball B is dropped into the cylinder. B is repelled by A and comes to rest above A such that the distance between the centers of the balls is 9 cm. The mass of each ball is 10 g. Calculate the charge on each ball. (7)



[17]

QUESTION 6

The EMF of the battery in the diagram below is 14 volt. When the switch S is closed, the reading on voltmeter V_1 is 12 volt. Calculate the following when the switch is closed:



a the current in the 4 Ω resistor; (6)
b the reading on voltmeter V_2;. (3)
c the current in the 3 Ω resistor; (3)
d the internal resistance of the battery. (3)
e How would the following change if the switch S were opened? (3)
i) the total resistance;
ii) the current in the battery;
iii) the reading on the voltmeter V_1. [18]

TOTAL 150

APPENDIX 6

TREATMENT GROUP'S QUESTIONNAIRE

1. Do you believe that your own problem solving skills have improved by using the strategy?

A Yes B No C I'm not sure

Comment:……

2. Do you think that you will keep using the strategy if your teacher says you need not use it?

A Yes B No C Only for difficult problems

Comment:……

3. How often did you use the strategy when doing homework?

A I seldom used the strategy.
B I used it for most of my homework problems.
C I only used it for difficult homework problems.
D I don't do homework.

Comment:……

4. When did your teacher use the strategy in the classroom?

A He/she only used it when showing us how the strategy works.
B He/ she seldom used it.
C He/she often used it.
D He/she only used it for difficult problems.

Comment:……

5. What is your opinion on the "structured problem solving strategy"?

A It is a waste of time.
B Sometimes it helps.
C It helps me find the right formula and solve the problem.
D it helps me understand and solve the problem.

Comment:……

APPENDIX 7

VIDEO GROUP'S QUESTIONNAIRE

1. Some students did not use the strategy when answering test and exam question. What do you think is the reason?

2. Do you think the strategy was helpful, even if students did not write all the steps in exams?

3. You used to solve Physics problems in your own way before you learnt the strategy. Which step(s) of the strategy were not part of your own approach? Explain.

4. Do you think that students who learnt the strategy have an advantage over students who did not learn the strategy? Explain.

5. Did the strategy change your way of thinking and doing when you solve problems? Explain.

6. Did the strategy in any way improve your understanding of Physics?

7. How often did you use the strategy when doing homework / classwork?

8. How often did your teacher use the strategy when doing problems on the blackboard?

9. What does your teacher normally say/do before writing the appropriate formula on the blackboard?

APPENDIX 8

TEACHERS' QUESTIONNAIRE

1. Did your grade 12 students participate in any science project **other** than the project on "Structured Problem Solving" during the year 2001? Please give details.

---

2. You attended a few workshops on the " Structured Problem Solving Strategy" . Did you attend any **other** teacher workshops or in-service training courses during the year 2001? Please give details.

---

3. Few students wrote down the 7 steps of the "Structured Problem Solving Strategy" when answering test and examination questions. Does this mean that the strategy **does not work**? Please give your opinion.

---

4. You used to solve problems in your own way before learning the "Structured Problem Solving Strategy". Some aspects of the strategy may be similar to your own approach. Which aspects of the strategy **differ** from your own approach?

---

5. Do you think that your future teaching methods will reflect some aspects of the "Structured Problem Solving Strategy"? Please state those aspects that you **intend to apply in future.**

---

6. Do you think that teaching the strategy to your learners improved your **own** ability to solve physics problems? Please discuss.

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7. Do you think that teaching the strategy to your learners made you a more effective teacher in Chemistry? Please discuss.

---

8. Do you think that using the strategy **changed** your students' ways of thinking about physics? Please discuss.

---

9. Do you think that using the strategy changed your students' ways of thinking about **chemistry**? Please discuss.

---

10. Do you think that students who learnt the "Structured Problem Solving Strategy" have an advantage over students who did not learn it?

---

11. What **recommendations** would you make to improve the "Structured Problem Solving Strategy"?

---

12. If there are any other thoughts that you would like to share, please use the space below.

---

13. Please indicate to which extent you agree with the statements below. Indicate each choice by ticking the appropriate number on a 5-point scale.
1=strongly disagree
2=disagree
3=unsure
4=agree
5=strongly agree

"Structured Problem Solving" improved my students':

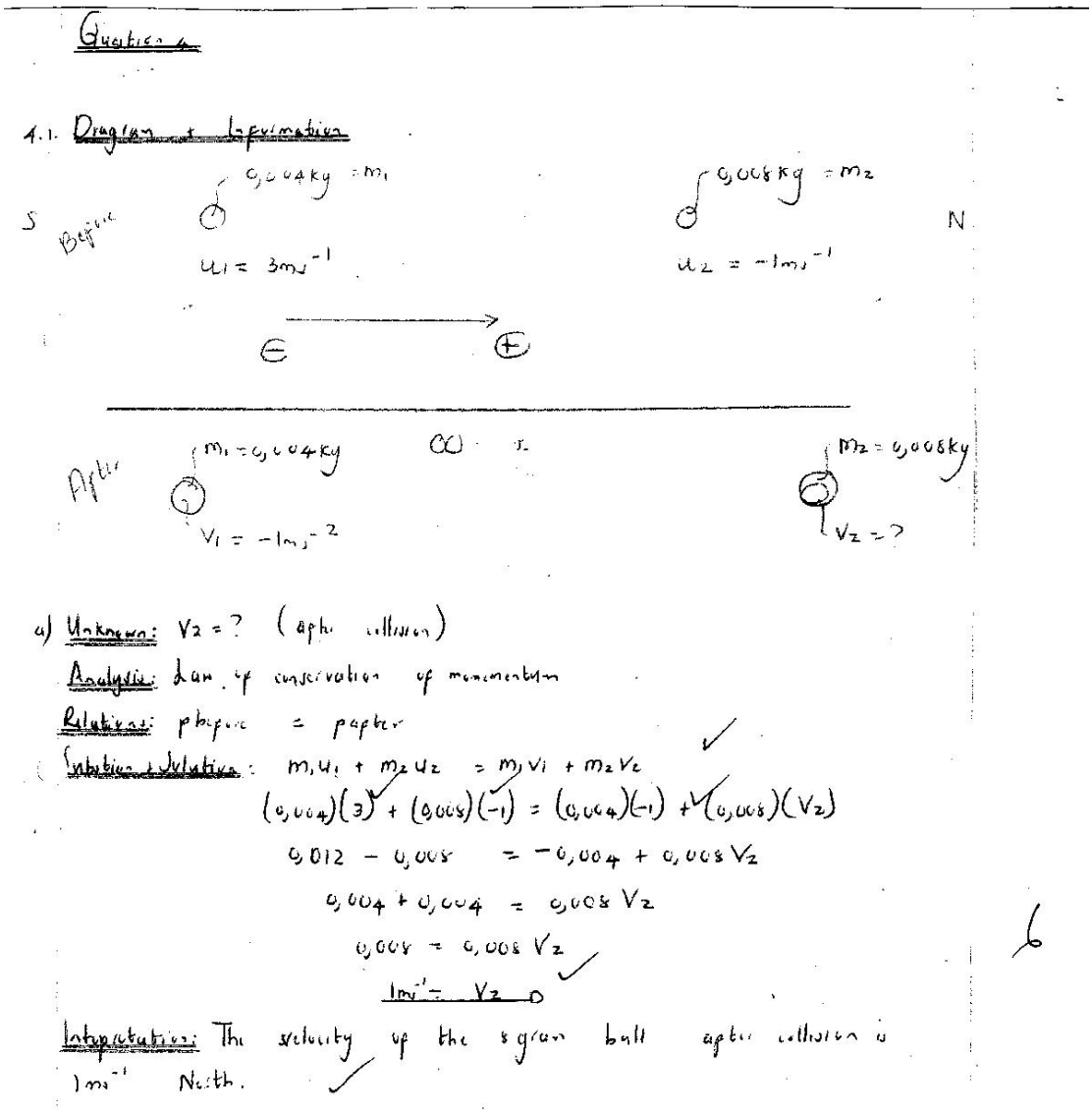
marks	1	2	3	4	5
self-confidence	1	2	3	4	5
understanding of physics concepts	1	2	3	4	5
problem solving skills	1	2	3	4	5
enjoyment of physics	1	2	3	4	5
ability to formulate thoughts mathematically	1	2	3	4	5
ability to formulate thoughts in words	1	2	3	4	5

APPENDIX 9

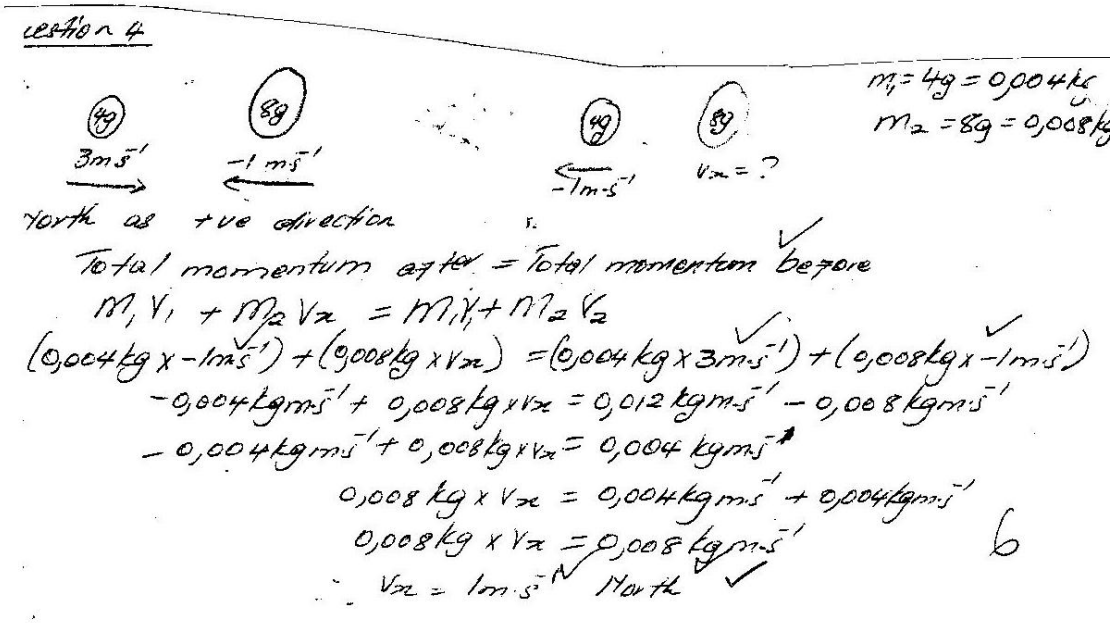
EXAMPLES OF CONCEPTUAL AND ALGEBRAIC SOLUTIONS PRESENTED IN THE JUNE EXAM

Question 4.1 (a)
During a game of marbles, a 4 gram marble moves at 3 $m.s^{-1}$ North and collides with an 8 gram marble moving at 1 $m.s^{-1}$ South. The 4 g marble moves at 1 $m.s^{-1}$ South after the collision.
Calculate the velocity of the 8 gram marble after the collision. (6)

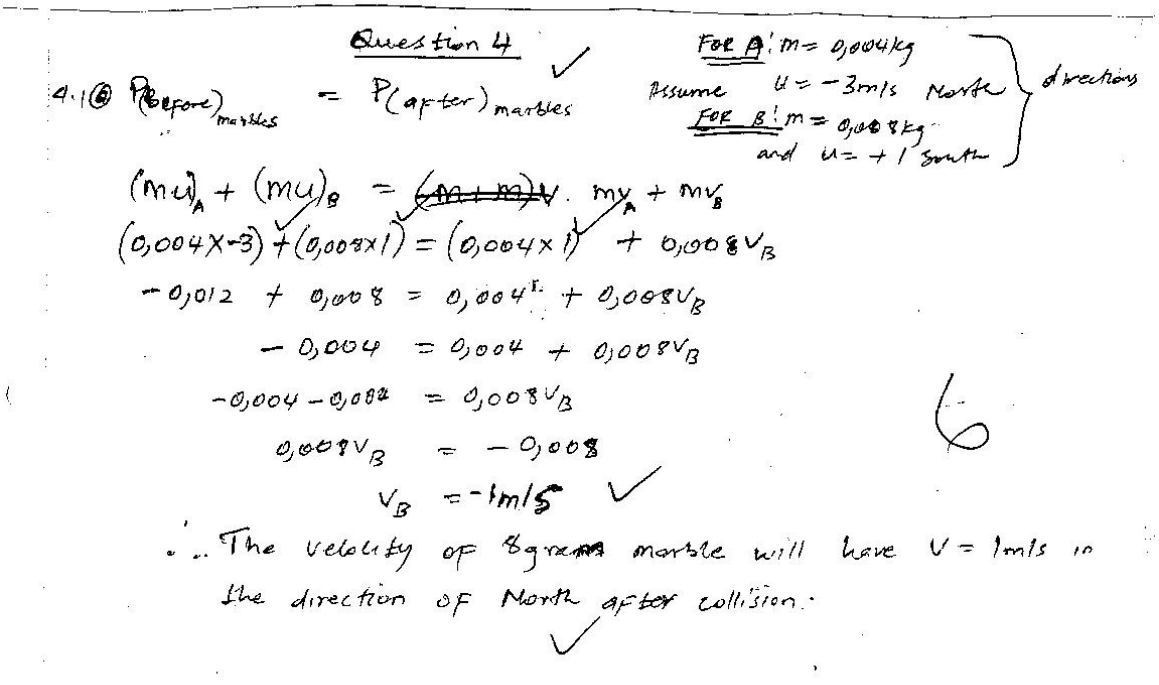
1. Conceptual approach by a treatment group student using the strategy.



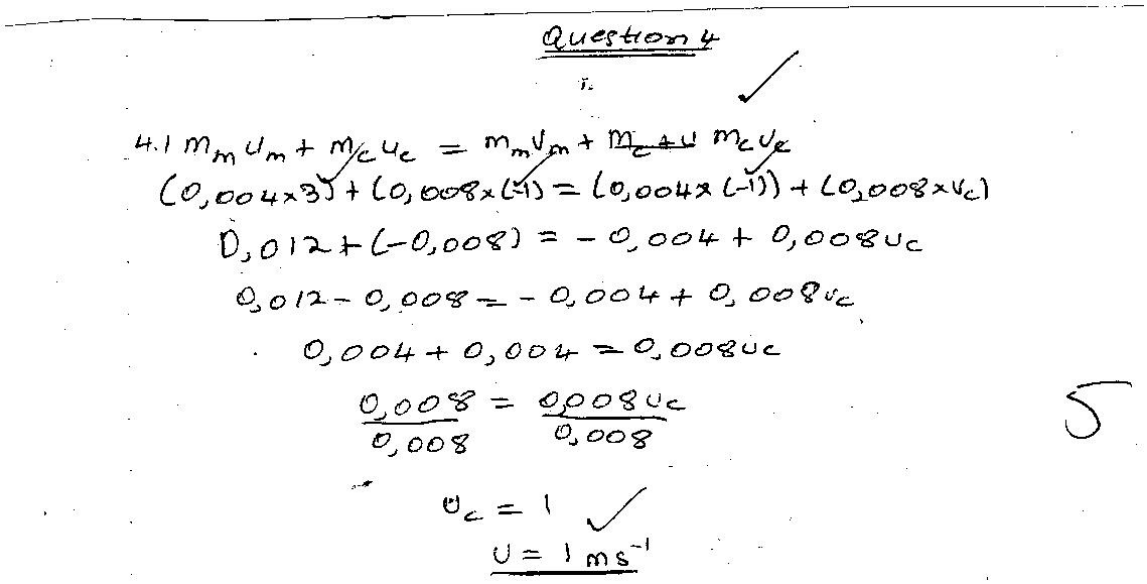
2. Conceptual approach by a treatment group student who did not show steps of the problem solving strategy.



3. Conceptual approach by a control group student.



4. Algebraic approach by a control group student.



Question 4

4.1 $m_m u_m + m_c u_c = m_m v_m + m_c v_c$

$(0,004 \times 3) + (0,008 \times (-1)) = (0,004 \times (-1)) + (0,008 \times v_c)$

$0,012 + (-0,008) = -0,004 + 0,008 v_c$

$0,012 - 0,008 = -0,004 + 0,008 v_c$

$0,004 + 0,004 = 0,008 v_c$

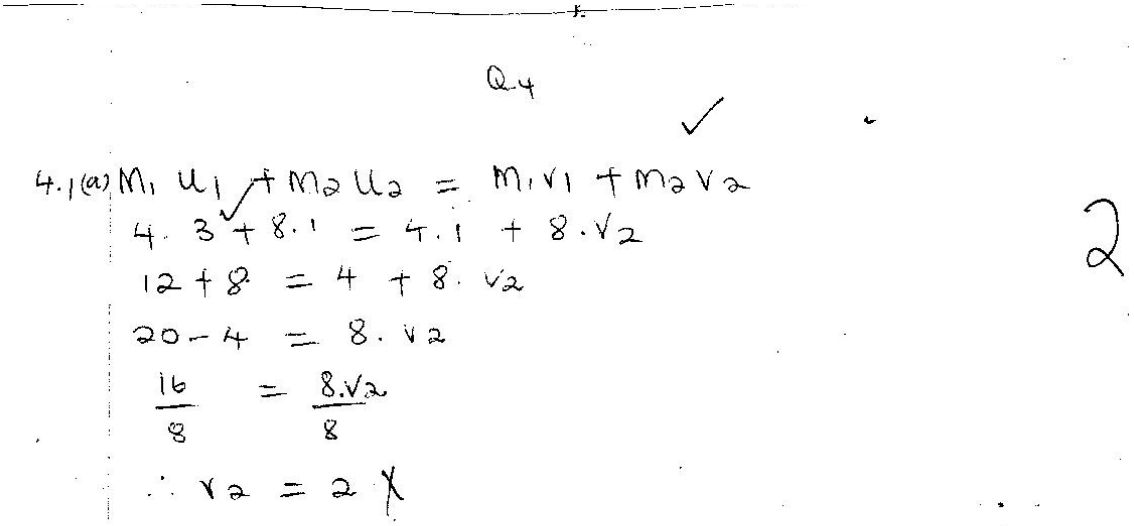
$\frac{0,008}{0,008} = \frac{0,008 v_c}{0,008}$

$v_c = 1$

$v = 1 \text{ ms}^{-1}$

5

5. Algebraic approach with incorrect substitution by a control group student.



Q4

4.1(a) $M_1 u_1 + M_2 u_2 = M_1 v_1 + M_2 v_2$

$4 \cdot 3 + 8 \cdot 1 = 4 \cdot 1 + 8 \cdot v_2$

$12 + 8 = 4 + 8 \cdot v_2$

$20 - 4 = 8 \cdot v_2$

$\frac{16}{8} = \frac{8 \cdot v_2}{8}$

$\therefore v_2 = 2$

2