MARKER CODE			

STUDENT EDUCATION NUMBER									

Sāmoa Secondary Leaving Certificate

PHYSICS

2015

QUESTION and ANSWER BOOKLET

Time allowed: 3 Hours and 10 Minutes

INSTRUCTIONS:

1. You have 10 minutes to read **before** you start writing.
2. Write your **Student Education Number (SEN)** in the space provided on the top right hand corner of this page.
3. Answer **ALL QUESTIONS**. Write your answers in the spaces provided in this booklet.
4. If you need more space for answers, ask the Supervisor for extra paper. Write your SEN on all extra sheets used and clearly number the questions. Attach the extra sheets at the appropriate places in this booklet.
5. **All the formulas required are provided in this Booklet on page 25**

STRANDS	Page Number	Time (minutes)	Weighting
STRAND 1: MEASUREMENTS	2	18	10
STRAND 2: WAVES	5	32	18
STRAND 3: MECHANICS	10	44	24
STRAND 4: ELECTROMAGNETISM	15	50	28
STRAND 5: NUCLEAR PHYSICS	21	18	10
STRAND 6: ELECTRICITY	23	18	10
TOTAL		**180**	**100**

Check that this booklet contains pages 2-26 in the correct order and that none of these pages is blank.

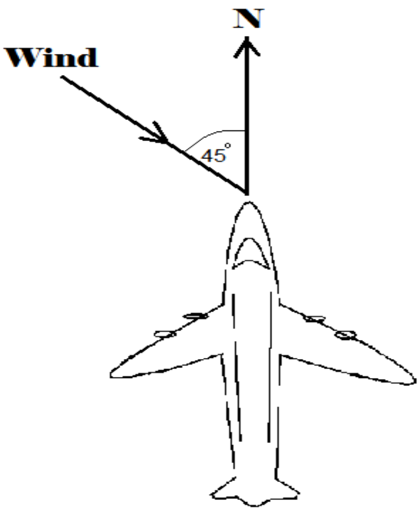
YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

STRAND 1: **MEASUREMENT** **WEIGHTING 10**

INSTRUCTION: Read the problem below to answer Number 1 – 5

PROBLEM:

A plane is flying due North at a velocity of 100km per hour. At the same time, there is a wind coming from the North – West direction with a velocity of 20km per hour affecting the plane's path.



1. Express 100km in scientific notation.

Skill Level 1	
1	
0	
NR	

2. Identify the appropriate SI unit for velocity.

Skill Level 1	
1	
0	
NR	

3 Add the two vectors together to get the resultant vector.

Skill Level 2	
2	
1	
0	
NR	

4 Distinguish between scalar and vector quantities.

Skill Level 3	
3	
2	
1	
0	
NR	

5 Explain why your answer in No.3 might not be true in real life situations

Skill Level 3	
3	
2	
1	
0	
NR	

STRAND 2: **WAVES** **WEIGHTING 18**

1. *When Sione visits the hospital to get a new pair of glasses, he finds out that lenses can be made from either plastic or glass.*

   Plastic has a refractive index of 1.60. Glass has a refractive index of 1.50.

   State the meaning of the term *“refractive index”.*

Skill Level1	
1	
0	
NR	

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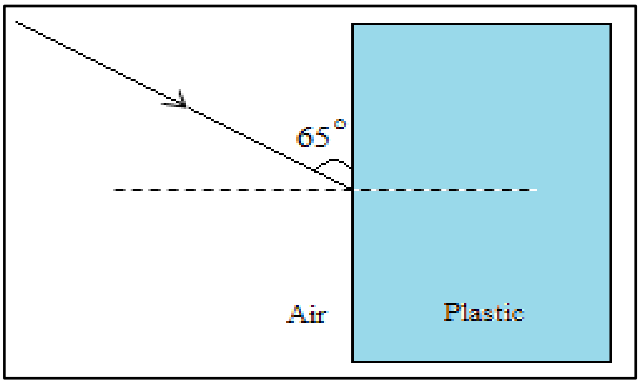
Use the diagram below to answer Number 2 – 4

A ray of light enters the plastic lens as shown



2. Find the size of the angle of incidence.

Skill Level1	
1	
0	
NR	

3. Find the size of the angle of reflection.

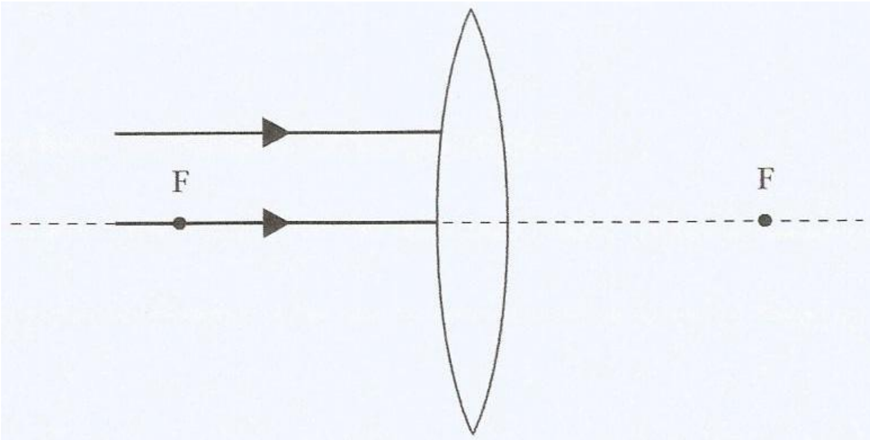
Skill Level1	
1	
0	
NR	

4. Calculate the size of the critical angle at the plastic/air boundary, and indicate what this angle means.

Skill Level 4	
4	
3	
2	
1	
0	
NR	

Use the diagram below to answer Number 5 – 8

The lenses in Sione's glasses are convex. Two parallel rays are shone into a convex lens as shown in the diagram below.



5. Complete the paths of the rays to show how they continue through the plastic and into the air. (Show refraction at both boundaries).

Skill Level 2	
2	
1	
0	
NR	

6. Define *refraction of light*.

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Skill Level1	
1	
0	
NR	

7. Name ONE property of a convex lens.

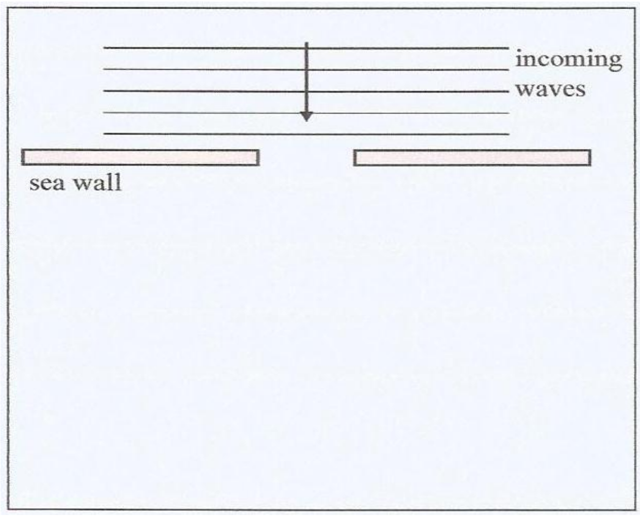
Skill Level1	
1	
0	
NR	

8. *A second lens has identical shape, but is made from glass with refractive index of 1.50.*
Describe how the focal length of the two lenses compare.

Skill Level 2	
2	
1	
0	
NR	

Use the diagram below to answer Number 9 – 11

The diagram shows a sea wall that has a gap to allow boats to pass through. Pepe watches the waves as they come through the gap. She notices that the behaviour of the waves depends on their wavelength.



9. Is the wavelength longer, shorter or the same size as the gap in the sea wall?

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Skill Level1	
1	
0	
NR	

10. In the above diagram, draw the wave pattern that Pepe would observe after the waves pass through the gap.

Skill Level 3	
3	
2	
1	
0	
NR	

11. State the name of the phenomenon demonstrated in number 9 and 10 above.

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Skill Level1	
1	
0	
NR	

STRAND 3: MECHANICS WEIGHTING 24

An aircraft is flying at a height of 600 m above the ground.

1. State TWO reasons why the aircraft flying is **not** an example of a projectile motion.

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Skill Level 2	
2	
1	
0	
NR	

2. *While the aircraft is flying horizontally at a speed of 35 ms^{-1}, a packet is dropped from it.*
What type of motion will the packet experience?

Skill Level 1	
1	
0	
NR	

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3. Calculate the speed of the packet when it reaches the ground and draw a vector diagram.

Skill Level 3	
3	
2	
1	
0	
NR	

Calculation:

Vector diagram:

4. Calculate how much time it takes the parcel to hit the ground.

Skill Level 2	
2	
1	
0	
NR	

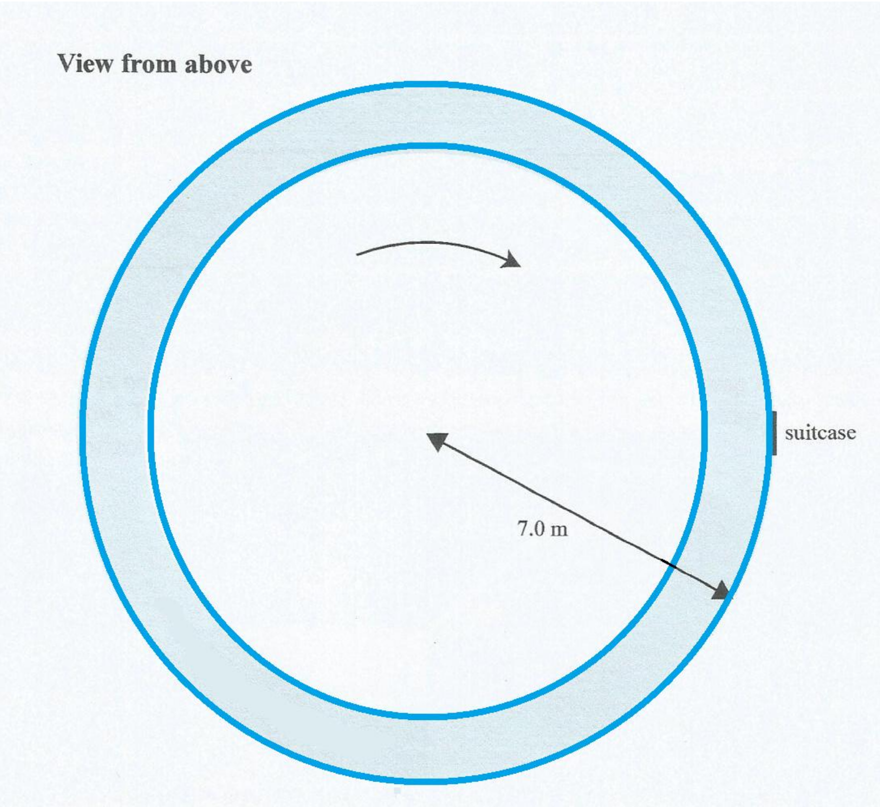
5. State the value of the acceleration due to gravity which affects the motion of the packet

Skill Level1	
1	
0	
NR	

6. Sketch the path of the packet if your eyes are level with the aircraft and looking from the side.

Skill Level1	
1	
0	
NR	

7. *The baggage at the airport is delivered on a horizontal circular conveyor belt that is moving at constant speed. The radius of the circular belt is 7.0 m.*
Draw an arrow in the diagram to show the direction of the velocity of the suitcase.



Skill Level1	
1	
0	
NR	

8. Calculate the time it takes for the belt to complete ONE rotation if the unbalanced force on the suitcase is 5.5 N.

Skill Level 4	
4	
3	
2	
1	
0	
NR	

10. According to Newton's law of motion, it is the unbalanced force that produces the

Skill Level1	
1	
0	
NR	

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11. State the formula for calculating centripetal force.

Skill Level1	
1	
0	
NR	

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12. Give ONE application of circular motion.

Skill Level1	
1	
0	
NR	

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13. Convert 20^0 Celsius to Kelvin.

Skill Level1	
1	
0	
NR	

14. Define the term *specific heat capacity*.

Skill Level1	
1	
0	
NR	

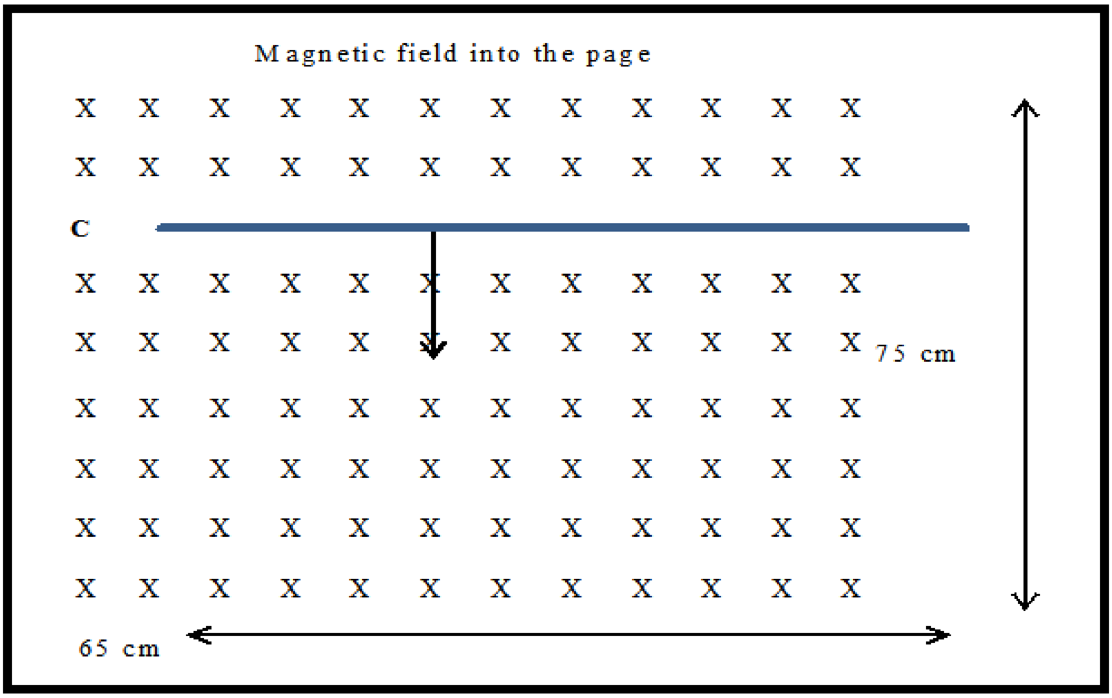
15. *A 15 gram sample of a metal at 27.0°C is placed in a Styrofoam cup containing 50.0 grams of water at 85.0°C. The water cools down and the metal warms up until thermal equilibrium is achieved at 83.0°C.*
Assuming all the heat lost by the water is gained by the metal and that the cup is perfectly insulated, determine the specific heat capacity of the metal. The specific heat capacity of water is 4.18 J/g/°C.

Skill Level 4	
4	
3	
2	
1	
0	
NR	

STRAND 4: **ELECTROMAGNETISM** **WEIGHTING 28**

Use the diagram below to answer Number 1 – 4

The conducting wire **C** is moved in a magnetic field as shown in the diagram below.



Strength of magnetic field = 0.80 T
Speed with which the wire is moved = 12 ms^{-1}
Charge on electron = 1.6×10^{-19} C

1. What is the angle between the magnetic field and the direction of the conducting wire?

Skill Level1	
1	
0	
NR	

2. Draw on the diagram the direction of the magnetic force experienced by the electrons in the wire.

Skill Level1	
1	
0	
NR	

3. Explain in detail what happens to the electrons in the wire as the wire is moved in the magnetic field.

Skill Level 3	
3	
2	
1	
0	
NR	

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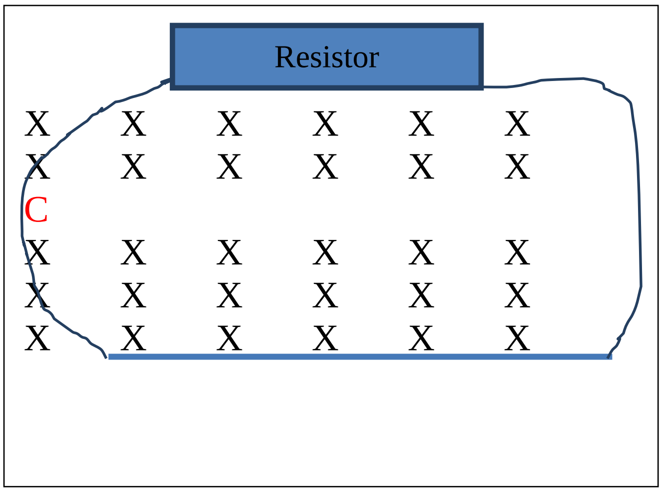
4. Calculate the size of the induced voltage across the wire.

Skill Level 3	
3	
2	
1	
0	
NR	

Use the diagram below to answer Number 5 – 7

The wire is now connected to a resistor to make a complete circuit as shown in the diagram below. The resistance of the resistor and the wire is = 4.5Ω.



5. Draw an arrow on the diagram above to show the direction of the current through the resistor.

Skill Level1	
1	
0	
NR	

6. Calculate the size of the current through the resistor as the wire is being moved in the magnetic field.

Skill Level 2	
2	
1	
0	
NR	

7. Name the type of connection between the resistor and the conducting wire C.

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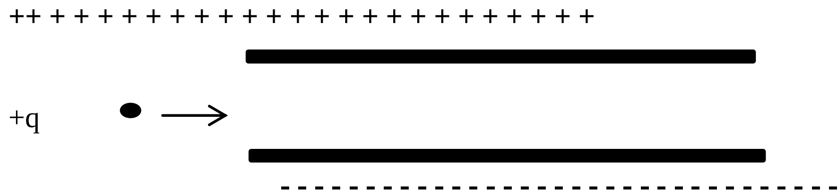
Skill Level1	
1	
0	
NR	

Use the diagram below to answer Number 8 – 15

A velocity sorter is an apparatus that can be used to obtain a stream of charged particles, all travelling with the same velocity. The diagram below shows a simplified velocity sorter. A stream of protons is made to pass between two parallel charged plates.

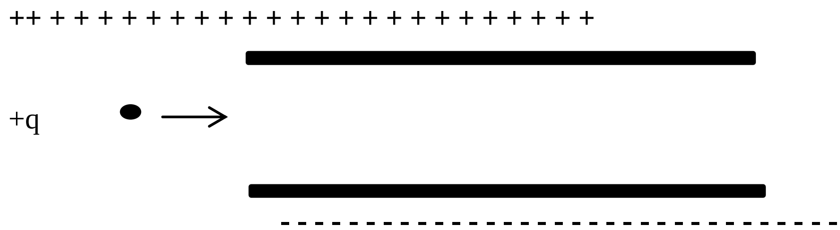


8. On the diagram above, use arrows to draw the electric field between the plates.

Skill Level1	
1	
0	
NR	

9. On the diagram below, draw the path of the proton in the field.

Skill Level1	
1	
0	
NR	



10. State TWO reasons why the proton follows this path.

Skill Level 2	
2	
1	
0	
NR	

11. The proton is travelling through a magnetic field and electric field. State the direction of the magnetic field that would allow the protons to go in a straight line. Choose your answer from:

- *towards the top of the page*
- *toward the bottom of the page*
- *left*
- *right*
- *into the page*
- *out of the page*

Skill Level1	
1	
0	
NR	

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12. Discuss the effects of the speed of the proton on the size of the electric force and on the size of the magnetic force acting on the proton.

(i) Effect of speed of proton on electric force.

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Skill Level 4	
4	
3	
2	
1	
0	
NR	

(ii) Effect of speed of proton on magnetic force.

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13. The voltage between the plates is 220 V. The plates are 5.0 cm apart.
Calculate the size of the **electric force** on the proton.
Charge on the proton = 1.60×10^{-19} C.

Skill Level 4	
4	
3	
2	
1	
0	
NR	

14. 3.5×10^{15} protons enter the field in 10 seconds. Calculate the size of the current flow.

Skill Level 2	
2	
1	
0	
NR	

15. Define *current* with respect to your answer in Number 14

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Skill Level1	
1	
0	
NR	

STRAND 5: NUCLEAR PHYSICS WEIGHTING 10

For thousands of years, atoms were thought to be tiny solid spheres. Following his discovery of the electron in 1897, JJ Thompson proposed a new model of the atom. A few years later, as a result of his "alpha particle scattering" experiment, Rutherford proposed an improved model.

1. State ONE way in which Thompson's and Rutherford's models of the atom were similar.

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Skill Level1	
1	
0	
NR	

2. Identify the key difference between Thompson's and Rutherford's models of the atom**.**

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Skill Level1	
1	
0	
NR	

3. *Uranium 238 decays to thorium (Th) by emitting an alpha particle.*
Complete the equation for this reaction using appropriate symbols and numbers.

Skill Level 2	
2	
1	
0	
NR	

$^{238}_{92}U \rightarrow$ ____________________ + ______________________

4. As part of an experiment, Rutherford placed an alpha particle emitter into a jar. When the jar was later tested it contained the gas helium that was not previously present.

Explain how the helium was formed.

Skill Level 3	
3	
2	
1	
0	
NR	

5. The isotope radon 222 ($^{222}_{86}\mathrm{Rn}$) undergoes two consecutive radioactive decays and turns into the isotope polonium 218 ($^{218}_{84}\mathrm{Po}$).

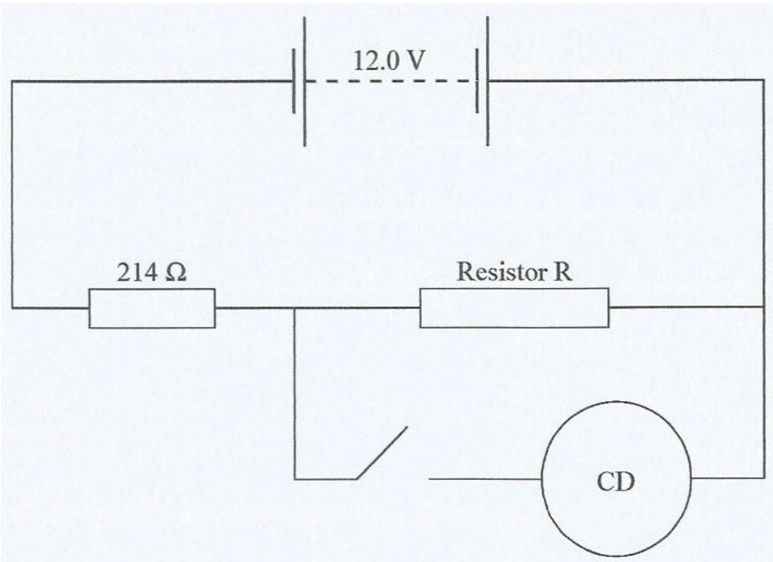
Carry out calculations to determine the TWO separate emissions. Name the emissions.

Skill Level 3	
3	
2	
1	
0	
NR	

STRAND 6: ELECTRICITY WEIGHTING 10

Use the diagram below to answer Number 1 – 5

Mele has a battery-operated CD player that she wants to connect to her car battery. The voltage of her car battery is 12.0 V and her CD player is marked “4.5 V, 25 mA”. She knows she cannot connect it directly to the car battery, so she decides to connect it in a circuit as shown below. The switch is initially closed.



1. Define the term *voltage.*

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Skill Level1	
1	
0	
NR	

2. Identify the electrical symbol for the volt meter.

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Skill Level1	
1	
0	
NR	

3. Calculate the resistance of the CD player.

Skill Level 2	
2	
1	
0	
NR	

4. Calculate the **voltage** across the 214 Ω resistor if the CD player has the correct voltage across it when the **switch** is **closed**.

Skill Level 3	
3	
2	
1	
0	
NR	

5. Show that the appropriate value of resistor R is 450 Ω.

Skill Level 3	
3	
2	
1	
0	
NR	

PHYSICS EQUATIONS SHEET

Kinematics

v = u + at

$d = ut + \frac{1}{2}at^2$

$v^2 = u^2 + 2ad$

$v = \frac{\Delta d}{\Delta t}$

$a = \frac{\Delta v}{\Delta t}$

Momentum

$p = mv$

$\Delta p = p_f - p_i$

$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$

Light and Waves

$\frac{1}{f} = \frac{1}{d_i} + \frac{1}{d_o}$

$m = \frac{H_i}{H_o} = \frac{d_i}{d_o}$

$n_1 \sin\theta_1 = n_2 \sin\theta_2$

$T = \frac{1}{f}$

$v = f\lambda$

Circular Motion

$a = \frac{v^2}{r}$

$F = \frac{mv^2}{r}$

$v = \frac{2\pi r}{T}$

Electricity and Magnetism

P = $\frac{W}{t}$

I = $\frac{Q}{t}$

V = IR

P = VI

B = $\frac{kI}{d}$

F = Bqv

$\tau = BANI \cos\theta$

V = Bvl

Energy and Mechanics

W = Fd

E = mgh

$E_k = \frac{1}{2}mv^2$

F = k x

$E_p = \frac{1}{2}k x^2$

List of constants

$e = 1.6 \times 10^{-19} C$

$k = 2 \times 10^{-7} NA^{-2}$

$m_e = 9 \times 10^{-31} kg$

$G = 6.67 \times 10^{-11} Nm^2 / kg^2$

$k = 9.0 \times 10^9 Nm^2C^{-2}$

Student Education Number									

PHYSICS

2015

(For Markers only)

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STRAND 1: MEASUREMENTS	10			
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TOTAL	**100**			