STUDENT EDUCATION NUMBER									

GOVERNMENT OF SAMOA
MINISTRY OF EDUCATION, SPORTS AND CULTURE

Samoa Secondary Leaving Certificate

PHYSICS

2017

QUESTION and ANSWER BOOKLET

Time allowed: 3 Hours & 10 minutes

INSTRUCTIONS

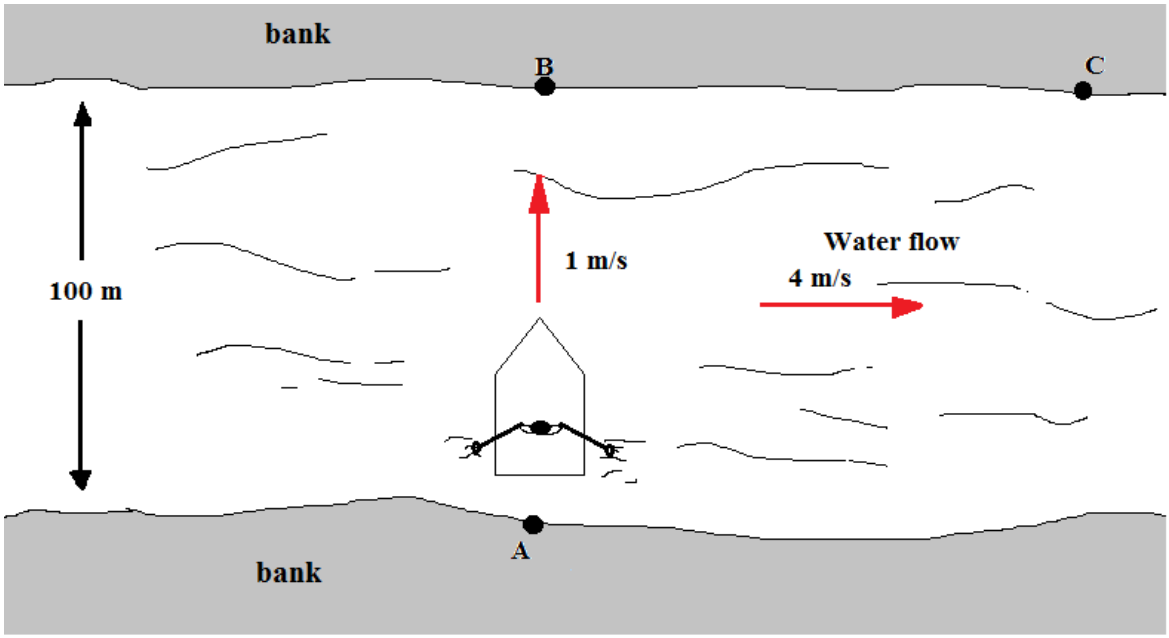
1. You have 10 minutes to read **before** you start the exam.
2. Write your **Student Education Number (SEN)** in the space provided on the top left hand corner of this page.
3. **Answer ALL QUESTIONS.** Write your answers in the spaces provided in this booklet.
4. If you need more space, ask the Supervisor 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.

   NOTE: All required formulas are provided on the last page.

Check that this booklet contains pages 2-21 in the correct order and that none of these pages are blank.

HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION

James rows a boat across a river at a velocity of 1 m/s from point **A** and he reaches point **C**. The river is flowing downstream at a rate of 4 m/s and the average distance between the river banks is 100 m.



1. (a) Calculate the distance between point **B** and **C**.

SL 3

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(b) In the space given below use a vector diagram to determine the resultant displacement of the boat. (Use the scale of 1cm = 40m)

SL 2

(c) The boat reaches point **C**. Explain how James would row his boat in order to reach point **B**.

SL 3

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(d) How long would it take James to cross the river from point **A** to point **C**?

SL 1

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(e) Determine the relative velocity of the boat with respect to the river bank.

SL 1

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STRAND 2: **WAVES** **Weighting 18**

Define the following terms:

2. (a) *Real image.*

SL 1

(b) *Dual nature of light.*

SL 1

(c) *Refractive Index.*

SL 1

(d) *Frequency of wave.*

SL 1

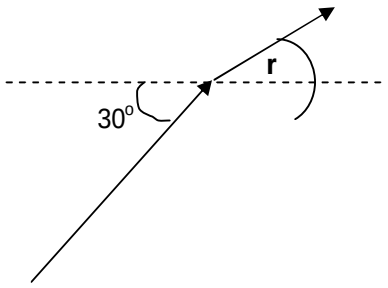
(e) *Diffraction of wave.*

SL 1

(f) Discuss the weaknesses of the *corpuscular light model*.

SL 4

(g) The diagram given below shows a ray of light incident on the face of a cube made of glass of refractive index 1.50.



Calculate the angle **r**.

SL 1

(h) Two converging lenses, A and B, which have the same physical appearances and constructional dimensions, were used in an experiment. However, the lenses are made up of different materials. Lens A has an index of refraction of 1.53 while lens B is 1.32.

Describe the differences in focal lengths of the lenses.

SL 2

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(i) Describe the production of shadows in terms of rectilinear propagation.

SL 2

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(j) Compare and contrast the properties of concave and convex mirrors.

SL 3

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(k) Name ONE property of a convex mirror.

SL 1

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3. (a) Calculate the final temperature of the mixture, if a piece of copper of 0.1 kg at 100ºC was placed in a polystyrene cup of water. The initial temperature of the water in the cup is 10ºC and its mass is 0.3 kg. Assume that there is no exchange of heat between the cup and environment, the specific heat capacity of water is 4200 J/kgºC, the specific heat capacity of copper is 400 J/kgºC.

SL 4

(b) Convert 10ºC to Kelvin temperature.

SL 1

(c) Define specific heat capacity.

(d) Determine the amount of heat energy required to raise the mixture in 3(a), copper and water, by 20ºC.

SL 4

(e) The mixture was placed in the fridge and allowed to freeze. Describe the heat required to change the water to ice.

SL 2

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(f) The fridge needs to do electrical work of 1.7 mega joules in order to freeze the mixture. Calculate the fridge rated power if it takes an hour to freeze the mixture.

SL 2

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(g) State the formula for calculating work done.

SL 1

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(h) If the compressor in the fridge does electrical work and possesses kinetic energy, state the SI unit for kinetic energy.

SL 1

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(i) Inside the compressor of the fridge is a piston that pumps refrigerant around the refrigeration system through copper tubes. The piston moves at a distance of 0.10 m for each cycle. If the compressor operates at 10 cycles per second and runs for one hour with a total work of 1.7 mega joules, calculate the average force produced by the piston for each cycle.

SL 4

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(j) The piston exerts pressure on the refrigerant in every cycle in the refrigeration system. Define the *SI unit of pressure*.

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SL 1

(k) When the compressor pump operates, the piston moves and has a momentum. Define *momentum of the piston*.

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SL 1

(l) State Newton's second law of motion.

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SL 1

(m) Define *acceleration*.

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SL 1

(n) Several assumptions are made when solving kinematic problems under free fall motion.
State ONE assumption.

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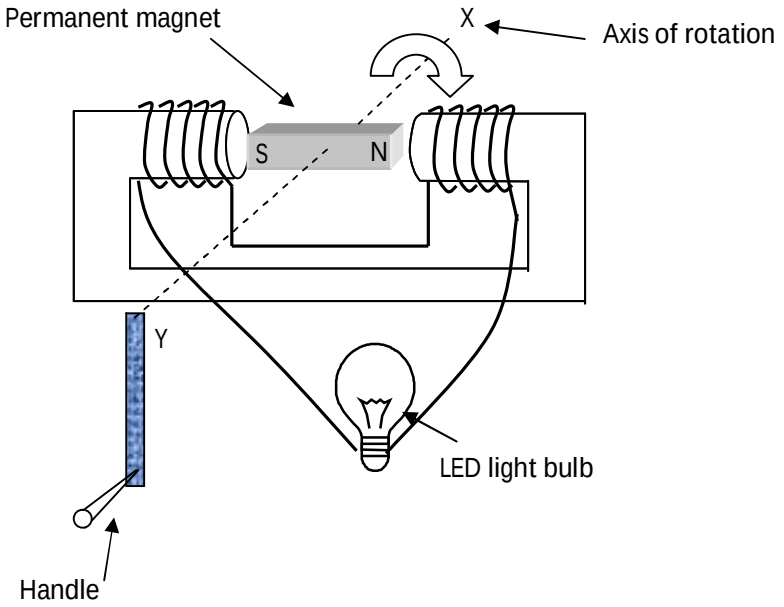
SL 1

Toma made a simple homemade generator from a piece of permanent magnet and two coils of wire wound on a piece of iron facing opposite each other. The coils are connected in series while the other two ends are connected to a small LED light bulb. The permanent magnet is connected to a handle which allows it to rotate clockwise through the axis of rotation X-Y.



4. (a) State ONE condition that is necessary to generate voltage to light up the LED bulb.

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SL 1

(b) Define *electromagnetic induction*.

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SL 1

(c) If a straight wire conductor is moved through a magnetic field, state the angle between the direction of the moving wire conductor and the field, in order to produce a maximum induced voltage.

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SL 1

(d) Explain the effect of the induced current generated in the coils if:

(i) the magnet is rotated anticlockwise;
(ii) the speed of rotation is increased;
(iii) if a stronger permanent magnet is used;
(iv) if the number of turns in the coil is increased.

SL 4

(i)_____

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(ii)_____

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(iii)_____

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(iv)_____

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(e) Indicate on the diagram the direction of the induced current if the permanent magnet is rotated clockwise.

SL 1

(f) A permanent magnet has a magnetic field strength of 0.04 tesla, and the speed at which it is moving near the coil is 2m/s. The total effective length of the coil to produce maximum voltage is 5m. Calculate the maximum voltage induced in the coil.

SL 3

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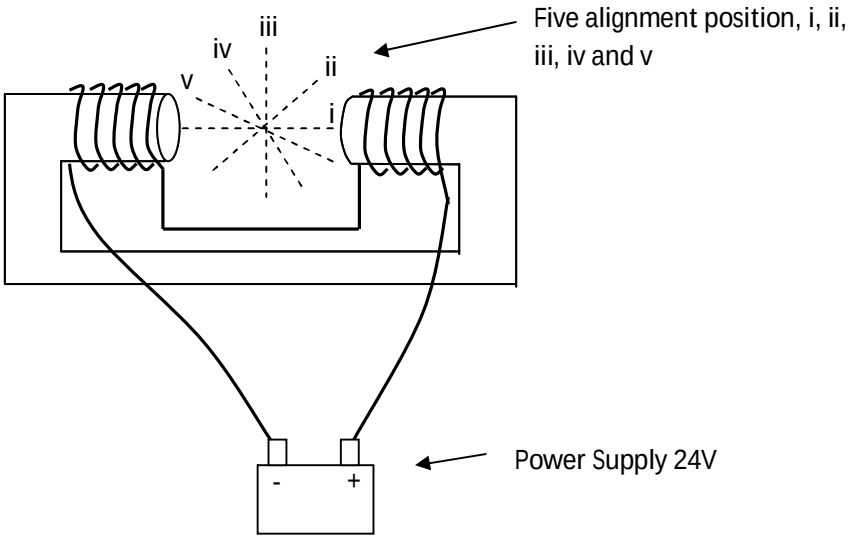
Toma replaced the LED light bulb with a DC power supply of 24 volts. He found out that the permanent magnet would rotate and stop at a certain alignment position.



(g) On the diagram, circle the alignment position, (i), (ii), (iii), (iv), (v) at which the magnet stopped rotating.

SL 1

(h) Describe the principle of the electric motor.

SL 2

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(i) To form a motor, Toma wanted to obtain a continuous rotation of the permanent magnet.
Suggest a modification that he can do to keep the magnet rotating in one direction.

SL 3

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(j) Express 24 volts to micro volts.

SL 1

(k) State what 24 volts meant in terms of energy and charge.

SL 1

(l) Determine the work done by his motor if it was used to raise a mass of 200g through a height of 150cm.

SL 4

(m) If it took 45 seconds to raise the mass of 200g through a height of 200cm, calculate the power output of the motor.

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SL 2

(n) Toma's motor has a lot of losses when it is in operation but some quantities in the electric circuit of the motor are conserved.

Name **ONE** quantity that is conserved.

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SL 1

(o) If Toma's motor operates for 30s with an input current of 1 ampere, calculate the total number of charges flow from the battery.

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SL 2

5. (a) Explain the causes of <u>deflection of alpha particles</u> in Rutherford's experiment.

SL 3

(b) State ONE similarity between Thompson's and Rutherford's model of the atom.

SL 1

(c) Define the term *photon*.

SL 1

(d) Describe the photoelectric effect that occurs on the surface of a metal or a semiconductor material.

SL 2

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(e) Blue light has a frequency of 7.7×10^{14} Hz, while red light has a frequency of 4.3×10^{14} Hz.
Calculate the energy carried by each light.

Blue light

SL 3

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Red light

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6. Sione received a box as a birthday present from a friend in New Zealand. In the box are several electrical components and an instruction sheet.

Given below is the list of parts found in the box.

Items	Description
P	6 dry batteries of 1.5volts
Q	Light bulb at 20Ω
R	Light bulb at 30 Ω
X	Resistor at 30 Ω
Y	Resistor at 30 Ω
Several pieces of wire for electrical connection.	
2 bulb holders	
Battery holder	

"Instruction:
Step 1: Connect items P, X and Q in series.
Step 2: Connect items Y and R in series
Step 3: Connect the two ends of Y and R series circuit from Step 2, across X and Q to form a parallel combination."

(a) Use the information in the instruction sheet to draw Sione's electric circuit diagram.

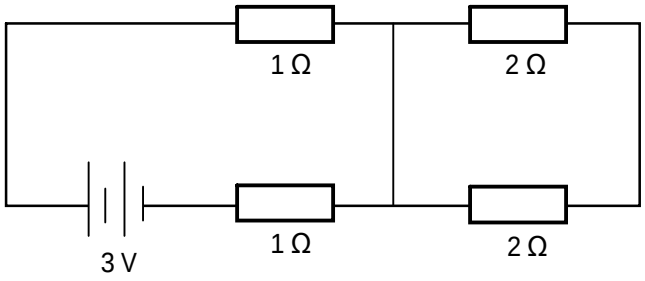
SL 1

SL 3

(b) On the diagram, indicate the direction of the flow of conventional current through all components in the circuit.

SL 1

(c) Calculate the effective (total) resistance of the circuit given below.



SL 3

(d) Calculate the total current flowing through the circuit, using the total resistance calculated in (c).

SL 2

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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

$p = mv$

$\Delta p = p_f - p_i$

$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$

$\tau = BANI \cos\theta$

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

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

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

$V = \Delta E/q$

$V = IR$

$P = VI$

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

$F = Bqv$

$P = \Delta E/t$

$V = Bvl$

Energy and Mechanics

$W = Fd$

$E = mgh$

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

$F = kx$

$E_p = \frac{1}{2}kx^2$

List of constants

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

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

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

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

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

h = 6.6 x 10^{-34} Js

$E = hf$

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PHYSICS

2017

(For Scorers only)

CURRICULUM STRANDS	Weighting	Scores	Chief Scorer
STRAND 1: MEASURMENT	10		
STRAND 2: WAVES	18		
STRAND 3: MECHANICS	24		
STRAND 4: ELECTROMAGNETISM	28		
STRAND 5: NUCLEAR PHYSICS	10		
STRAND 6: ELECTRICITY	10		
TOTAL	**100**		