GOVERNMENT OF SAMOA

STUDENT EDUCATION NUMBER									

Samoa Secondary Leaving Certificate

PHYSICS

2023

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 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 paper to write your answers, ask the supervisor. Write your SEN on all extra sheets used and clearly number the questions. Attach the extra sheets to the appropriate places in this booklet.
5. **All the formulas required are provided on page 24.**

STRANDS		Pages	Time (min)	Weighting
STRAND 1	MEASUREMENTS	2 – 3	17	10
STRAND 2	WAVES	4 – 7	20	18
STRAND 3	MECHANICS	8 – 12	46	23
STRAND 4	ELECTROMAGNETISM	13 – 18	44	29
STRAND 5	NUCLEAR PHYSICS	19 – 20	16	10
STRAND 6	ELECTRICITY	21 – 23	17	10
TOTAL			**180**	**100**

Check that this booklet contains pages 2 - 25 in the correct order and that none of these pages are blank.

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

STRAND 1 **MEASUREMENTS** **WEIGHTING 10**

1. Express 131.045 N in the scientific notation.

SL 1

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2. A student's final calculation came up to 23.4001 mm. Write 23.4001 mm to four (4) significant figures.

SL 1

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3. Newton (N) is the SI unit of force. Express the unit of Newton (N) in terms of the basic unit of time (s), mass (kg) and length (m).

SL 2

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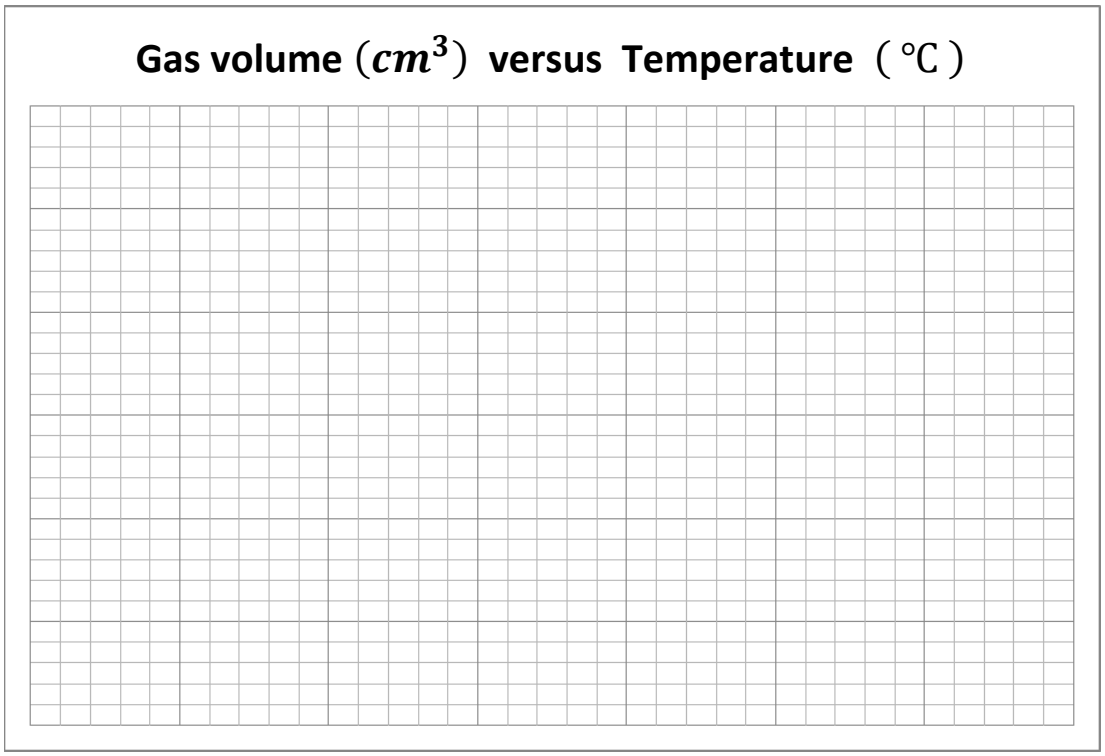
4. Ruta, who is a physics student, carried out an experiment to find how the volume of a certain gas in a storage bag changes over different temperatures. The values that she got are given in the table below:

SL 3

Temperature (^oC)	Volume (cm^3)
0	400
20	600
30	700
60	1000

Plot the values obtained by Ruta on the grid provided and draw the best fit line.



5. Referring to Question 4, determine the equation of the best fit line.

(Hint: y =mx+ c)

SL 3

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6. Name **ONE** property of a convex mirror.

SL 1

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7. Define refraction of light.

SL 1

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8. The frequency produced by a dipper in a ripple tank for wave generation is set to two waves for every second. Define frequency of a wave and calculate the frequency of the waves being generated in the ripple tank.

SL 2

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9. Describe what the dual nature of light means.

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SL 2

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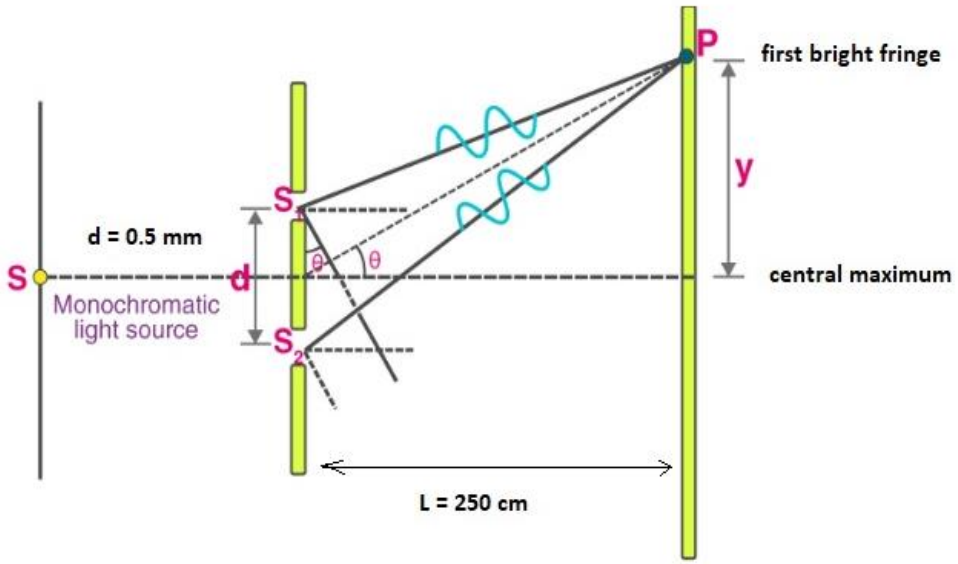
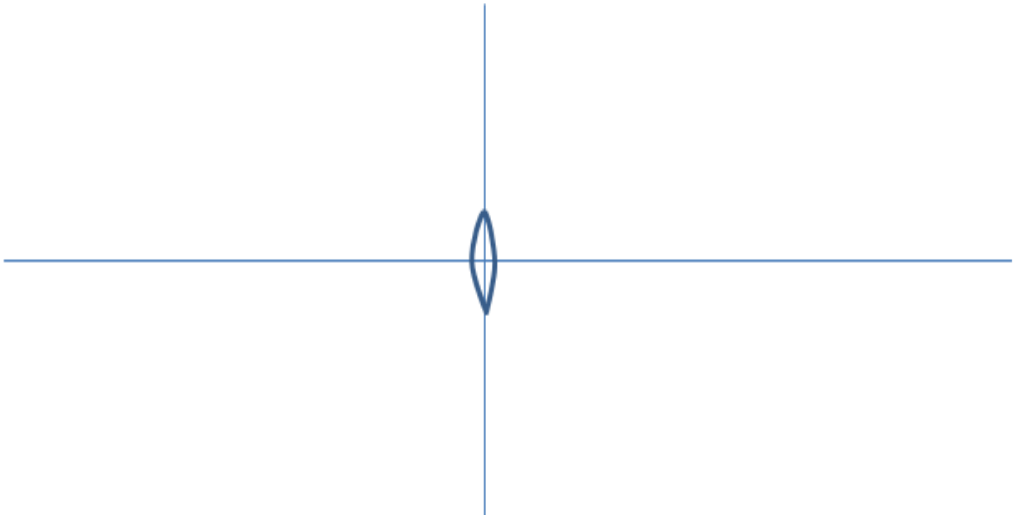
10. In a Young's double slit experiment, slits are separated by 0.5 mm, and the screen in placed 250 cm away. A beam of light consisting of wavelength of 550 mm is used. Calculate the distance, y, between the first bright fringe and the central maximum. (Hint: $\tan\theta \approx \sin\theta$)



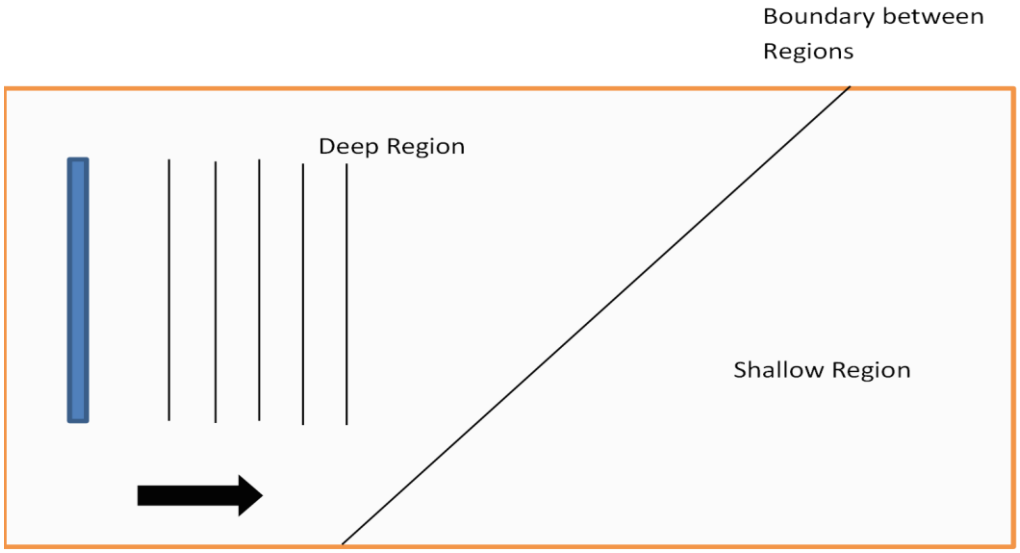
SL 3

11. An object is placed 50 cm from the biconvex lens, which has a focal length of 20 cm. Use the axis given below to draw a ray diagram to determine the location of the image, the nature of the image, and the magnification of the image. (Hint: Use the scale factor 10:1). Give all the important details.



SL 4

12. Draw and describe how the straight waves propagated to the right in the ripple tank behave when it reaches the boundary of a shallow region.



SL 4

13. Referring to the diagram in Question 12, some waves are partially reflected at the boundary and 'out of phase'. Define the term 'out of phase' in relation to waves.

SL 1

14. What does the slope of a velocity-time graph represent?

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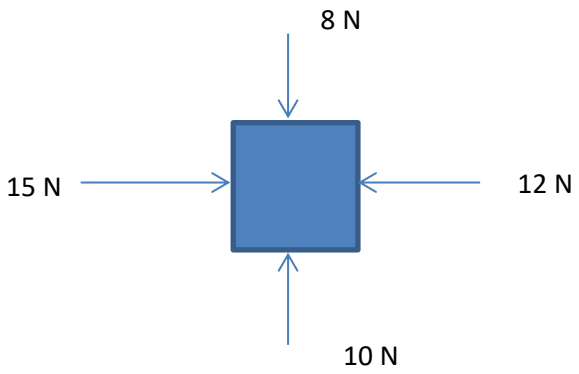
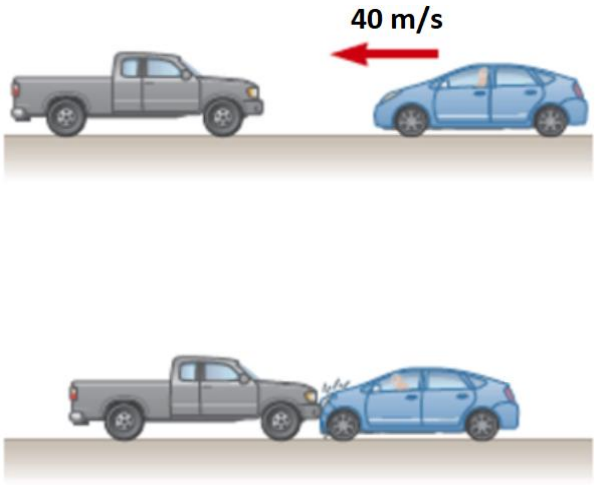
SL 1

15. Four horizontal forces of different sizes are acting on the box at four directions as given in the diagram below. Calculate the final resultant force.



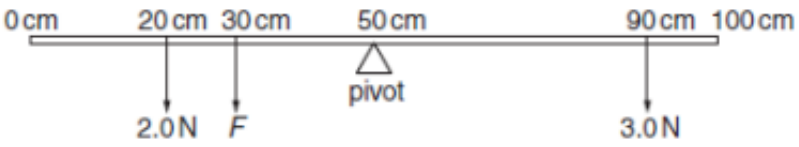
SL 2

16. A car of mass 1000 kg was travelling at 40 m/s collides head-on with a pickup truck of mass 5000 kg which was at rest. If the two vehicles stuck together after the collision, calculate their final velocity.



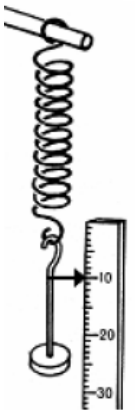
SL 2

17. A light metre rule is pivoted at its centre. Three load forces of 2 N, F and 3 N, are acting at their respective positions of 20 cm, 30 cm and 90 cm. Calculate the **<u>total clockwise moment</u>** about the pivot.



SL 2

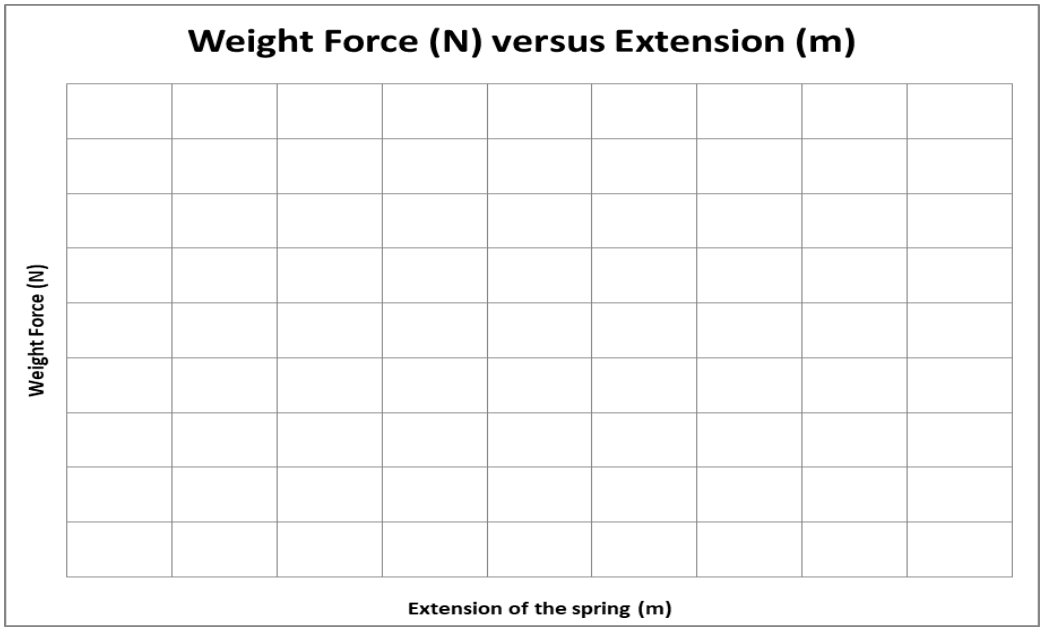
18. A physics student wants to verify Hooke's Law by setting up a mass-spring system as shown below. The result of the experiment is given in the table below, where the extension length is the length of the spring at different masses.



Trial	Mass (grams)	Weight Force in (Newton)	Extension length of the spring in (mm)	Extension length of the spring in (m)
1	0	0	0	0
2	10	0.1	10	0.01
3	20	0.2	20	0.02
4	30	0.3	30	0.03
5	40	0.4	40	0.04

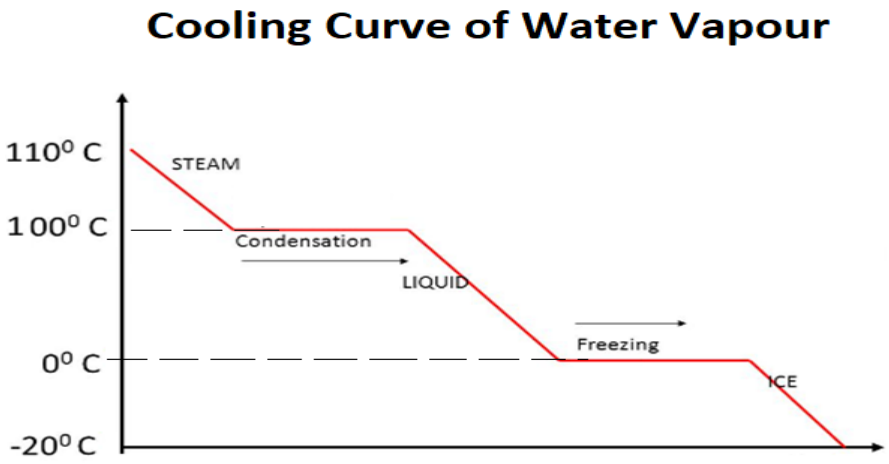
SL 3

Use the table above to sketch the graph of weight force (N) versus the extension of the spring (m).



Use the graph (page 10) to determine the spring constant of the spring.

19. The diagram shows the cooling of water vapour from 110°C to -20°C ice. During the cooling, latent heat is given off at two stages. Describe one of the two stages of water cooling.



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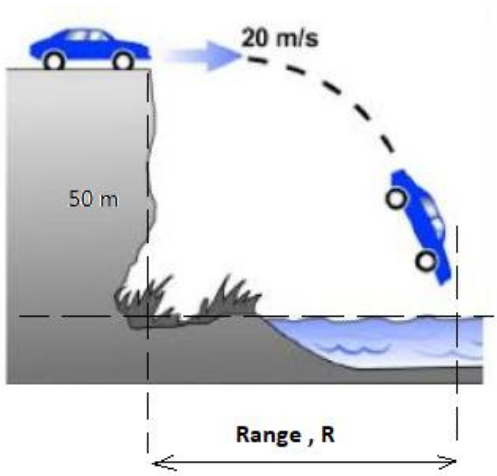
SL 2

20. Calculate the number of joules of energy released when 2.55 grams of water vapour at 110°C freezes into ice at -20°C.

SL 3

21. A stunt driver for a movie set drove the car off the cliff, which is 50 m high at a velocity of 20 m/s. Calculate the range, R, travelled by the car.



SL 4

22. A drone flies in a circle of radius of 50*m*, taking a time of 40*s* to complete one revolution. Calculate the magnitude of the acceleration of the drone towards the centre of its circular path.

SL 4

23. State the unit of an electric charge.

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SL 1

24. Define electric current in a circuit.

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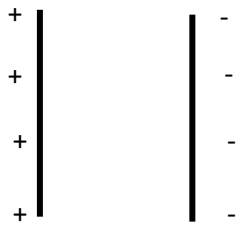
SL 1

25. Draw the electric, field lines between two plates that are oppositely charged.

SL 1



26. Define the role of friction in charging a plastic ruler when rubbing with hair.

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SL 1

For Question 27, choose and write the LETTER of the correct answer in the box provided.

27. Which of the following equations is useful in finding the strength of the electric field?

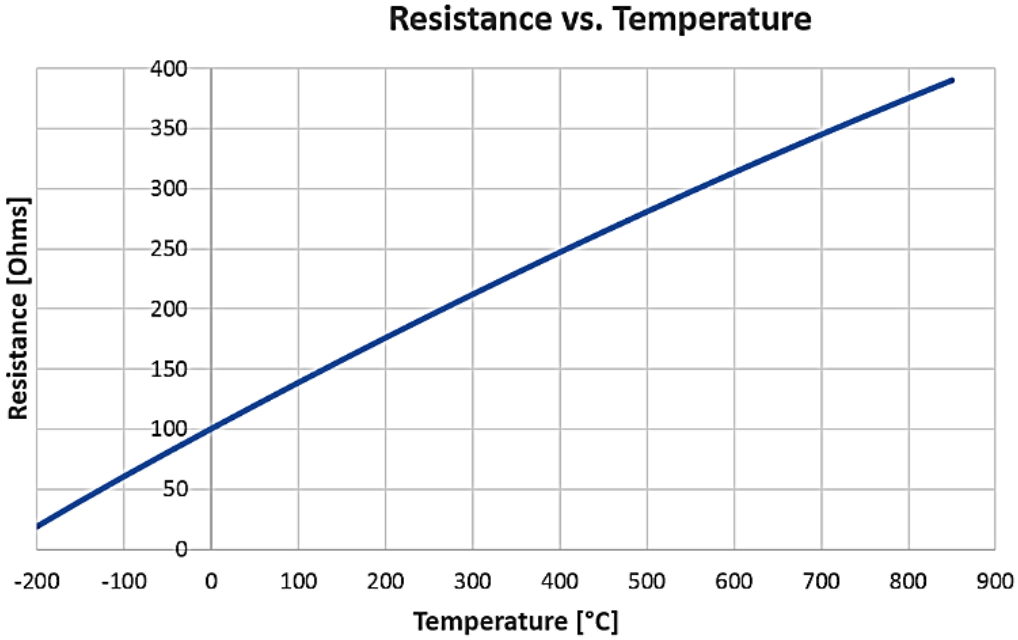
A. $F = kQ1Q2/r^2$
B. $F = Bqv$
C. $F = BIL$
D. $F = mg$

	SL 1

28. Draw the electric field lines between two positive charges.

SL 1

29.

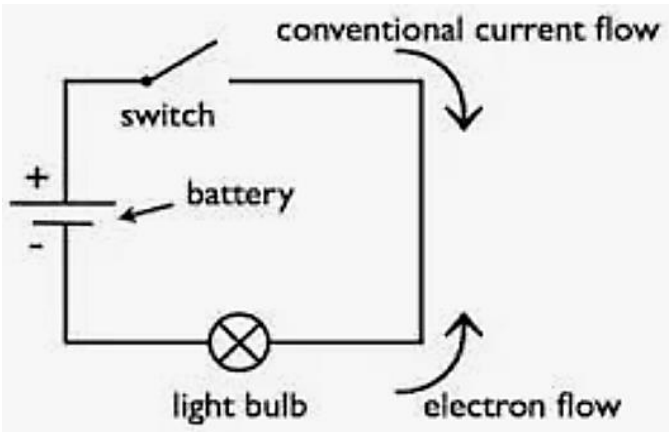


The graph of resistance versus temperature of a certain wire conductor is given above.

Explain how the resistance of the wire conductor varies over the temperatures, from -200°C to 850°C.

SL 3

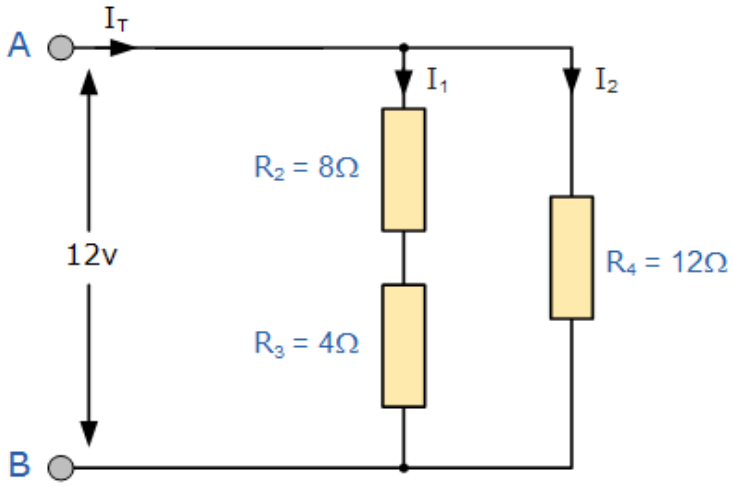
30.



The conventional current is the flow of positive charges from the positive terminal to the negative terminal of a battery. However, the real flow of electricity in a circuit is done by the flow of "free electrons". Explain why the real flow of electricity is determined by the flow of free electrons.

SL 3

Use the following circuit to answer Questions 31 to 34.



31. Calculate the total resistance of the circuit.

32. If 12 V is supplied to the circuit, what is the total current that travels through the circuit?

SL 2

33. Calculate the potential difference across the three resistors, R_2, R_3 and R_4.

SL 2

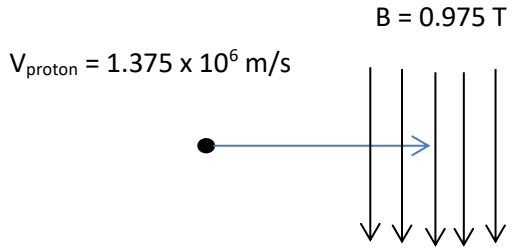
34. Determine the total power consumed by the resistors.

SL 2

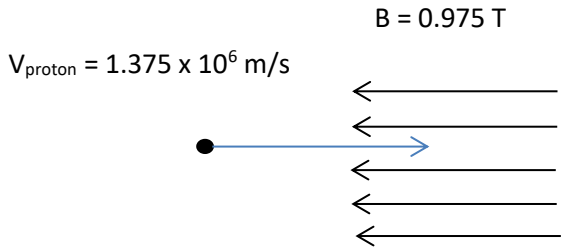
35. A proton with a charge of 1.602×10^{-19} C is moving at a velocity of 1.375×10^{6} m/s through a 0.975 T magnetic field. Calculate the force experienced by the proton if the angle between the proton's velocity and the magnetic field is (i) 90^{o} and (ii) when it is 0^{o}.

SL 4

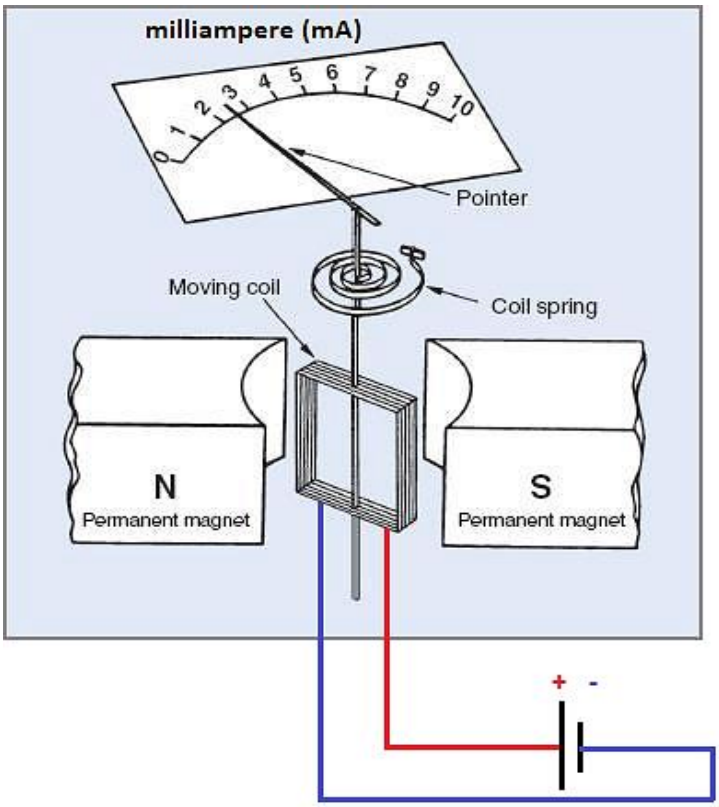
$\theta = 90^{o}$



$\theta = 0^{o}$



36. The diagram given below shows the internal moving parts of a moving coil milli ammeter. A battery of 1.5 V is connected to the metre. Study the diagram and answer the questions that follow.



SL 4

(i) What is the reading registered by the pointer?

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(ii) What is the purpose of the coil spring?

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(iii) Explain in details what would happen to the pointer reading if another battery is connected in series to make it 3V?

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37. State ONE feature of Thompson's model of the atom.

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SL 1

38. Give ONE feature of Rutherford's model of the atom.

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SL 1

39. Describe the photoelectric effect.

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SL 2

40. (a) A photon of light has a frequency (f) of 2.68 x 10^6 Hz. Calculate its energy.

SL 3

(b) A blue light has a wavelength of 450 nm. Calculate the frequency and the energy of the blue light.

41. The half-life of Zinc-71 is 2.4 minutes. If one had 100 grams at the beginning, how many grams would be left after 7.2 minutes has elapsed?

SL 3

42. An electrical circuit use a voltage of 3V to power a load. What does voltage mean?

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SL 1

43. Define the term electrical resistance in an electrical circuit.

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SL 1

44. Describe the process of electrolysis.

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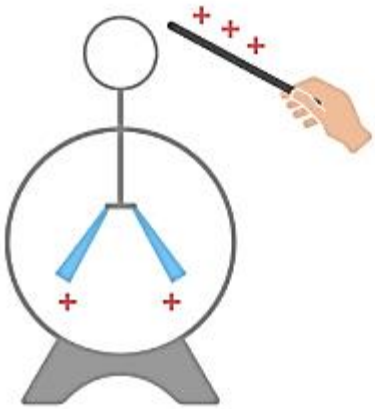
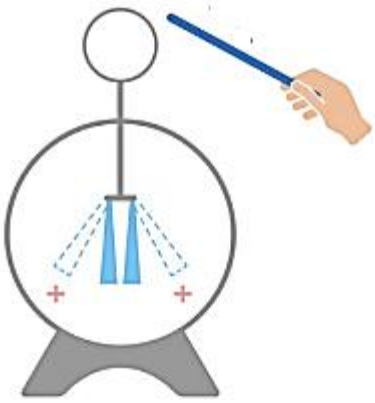
SL 2

Positive Electroscope



Unknown Charged Rod



45. An electroscope was positively charged with a positive charged rod. However, when an unknown charged rod was brought near the positive electroscope, the leaves of the electroscope collapsed. Explain why the leaves of the electroscope collapse when the unknown charged rod was brought near it.

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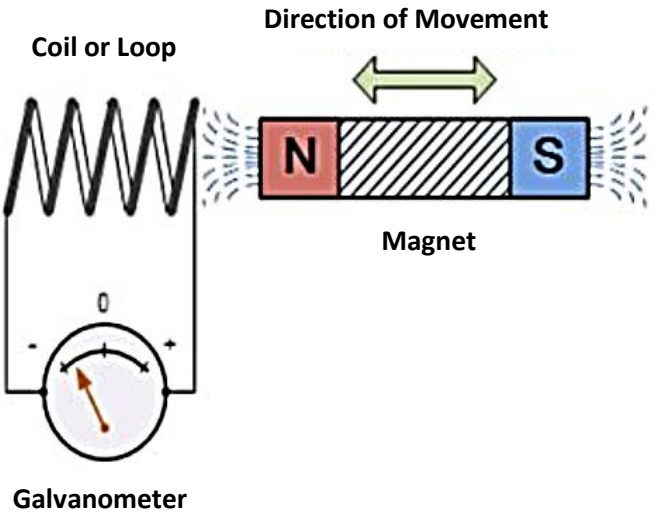
SL 3

46. Explain the factors that would increase the electrical current that formed by electromagnetic induction.



SL 3

PHYSICS FORMULA SHEET

Kinematics

$v = u + at$

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

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

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

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

$p = mv$

$\Delta p = p_f - p_i$

$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$

$\tau = BANI \cos\theta$

Electricity and Magnetism

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

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

$V = \frac{\Delta E}{q}$

$V = IR$

$P = VI$

$PV = nRT$

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

$F = Bqv$

$F = IBL$

$P = \frac{\Delta E}{t}$

$V = Bvl$

List of constants

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

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

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

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

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

$1\ atm = 101.3\ kPa$

$R = 0.08205\ L\ atm\ /\ mol\ K$

$mass\ of\ proton = 1.67 \times 10^{-27} kg$

Circular Motion

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

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

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

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

$F = kx$

Energy and Mechanics

W = Fd

E = mgh

E = hf

Light and Waves

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

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

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

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

$v = f\lambda$

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

$p.d = d\sin\theta = n\lambda \quad (n = 0,1,2, \ldots.)$

$p.d = d\sin\theta = \left(n - \frac{1}{2}\right)\lambda \quad (n = 0,1,2, \ldots.)$

Heat

Q = mCΔT

$H = mL$

$h = 6.6 \times 10^{-34}$ Js

$C_{water} = 4{,}200$ J/kgK

Specific heat capacity of vapour: $C_{vapour} = 2{,}000$ J/kgK

Specific heat capacity of ice: $C_{ice} = 2{,}110$ J/kgK

Latent heat water of vapourization =2,260,000 J/kg

Latent heat of fusion of ice = 33,600 J/kg

STUDENT EDUCATION NUMBER									

SSLC PHYSICS

2023

(For Scorers only)

STRANDS		Weighting	Scores	Check Scorer	AED check
STRAND 1	MEASUREMENTS	10			
STRAND 2	WAVES	18			
STRAND 3	MECHANICS	23			
STRAND 4	ELECTROMAGNETISM	29			
STRAND 5	NUCLEAR PHYSICS	10			
STRAND 6	ELECTRICITY	10			
	TOTAL	**100**			