GOVERNMENT OF SAMOA
MINISTRY OF EDUCATION, SPORTS AND CULTURE

STUDENT EDUCATION NUMBER									

Samoa Secondary Leaving Certificate

PHYSICS

2021

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 at the appropriate places in this booklet.
5. **All the formulas required are provided on page 31.**

STRANDS		Pages	Time (min)	Weighting
SECTION A	MULTIPLE CHOICE	2	20	16
STRAND 1	MEASUREMENTS	12	17	8
STRAND 2	WAVES	15	20	15
STRAND 3	MECHANICS	19	46	22
STRAND 4	ELECTROMAGNETISM	23	44	23
STRAND 5	NUCLEAR PHYSICS	28	16	8
STRAND 6	ELECTRICITY	29	17	8
TOTAL			**180**	**100**

Check that this booklet contains pages 2-32 in the correct order and that none of these pages are blank.

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

SECTION A: Multiple Choice (WEIGHTING 16)

For Questions 1 – 16, write the letter of your BEST answer in the box provided.

1. A physics student measured an electric current of 15μA in the electric circuit. Which of the following is the same as 15μA?

   A. 15×10^{-3} A
   B. 15×10^{6} A
   C. 0.015×10^{6}A
   D. 0.015×10^{-3} A

	SL 1

2. Select the one that is NOT a vector quantity.

   A. Velocity
   B. Force
   C. Work
   D. Weight

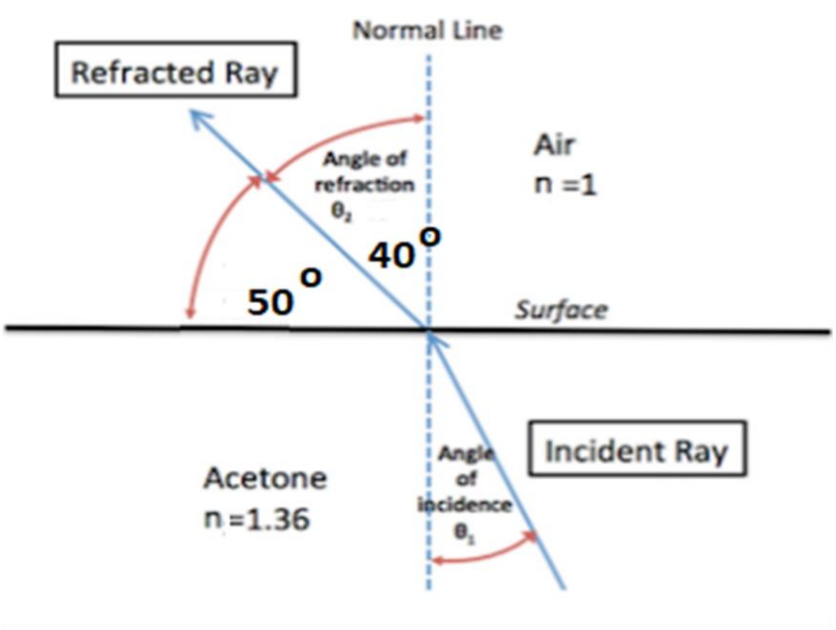
	SL 1

3. Which ONE of the following is NOT a property of an image formed by a convex mirror?

   A. The image is magnified.
   B. The image is virtual.
   C. The image is diminished.
   D. The image is upright.

	SL 1

4. A light ray travelling from acetone to air undergoes refraction. What is the value of the angle of incidence?



A. 28.2^{o}

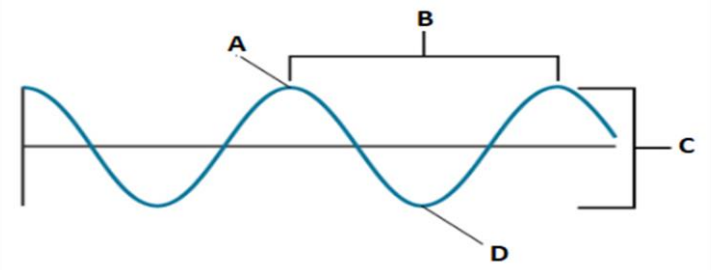
B. 34.3^{o}

C. 55.7^{o}

D. 40.0^{o}

	SL 1

5. Write the letter that <u>correctly</u> represents the wavelength in the diagram below.



A. A

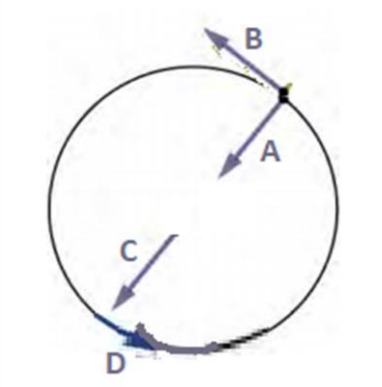
B. B

C. C

D. D

	SL 1

6. The diagram below shows an object moving at a uniform speed at the counter clockwise direction. Write the letter that represents the **velocity vector**.



A. A
B. B
C. C
D. D

	SL 1

7. A girl that is 1.5m tall throws a ball with an initial velocity of 5 m/s at an angle 30^{o} against a wall that is 4m away. What is the value of the vertical component of the initial velocity of the ball?

A. $4 \times \cos 30^{o}$
B. $4 \times \sin 30^{o}$
C. $5 \times \cos 30^{o}$
D. $5 \times \sin 30^{o}$

	SL 1

8. Which of the following statements **BEST** describes the law of conservation of charge?

A. The electric charge can be positive or negative.
B. The electric charge is either created or destroyed.
C. The electric charge is neither created nor destroyed.
D. The electric charge is either visible or invisible.

	SL 1

9. During the movement of a current carrying conductor and a magnet, under which condition is the electric current <u>NOT induced</u>?

A. When the conductor moves perpendicular to the magnet.

B. When both are moving relative perpendicular to each other.

C. When the magnet moves perpendicular to the conductor.

D. When both are moving relative parallel to each other.

	SL 1

10. What is the **BEST** reason for having the commutator in the simple DC motor?

A. It completes the circuit.

B. It reserves the current in the armature.

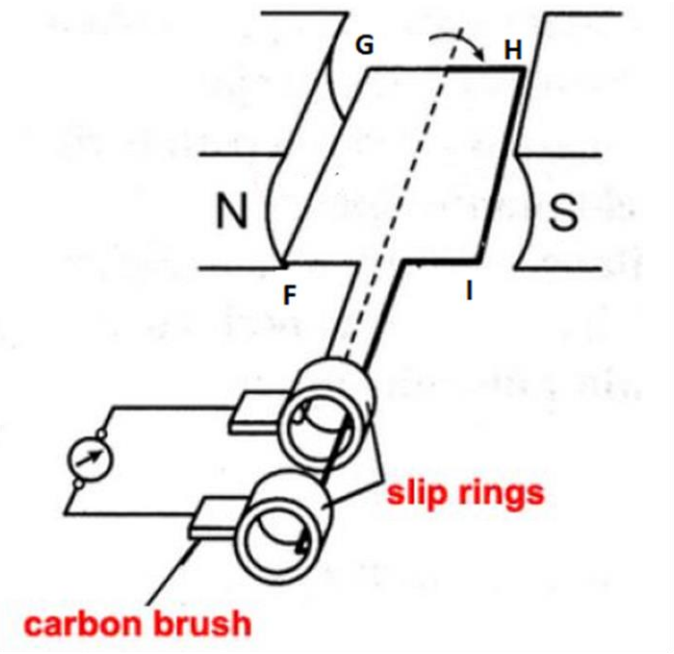
C. It provides lubrication.

D. It reduces electric sparks.

	SL 1

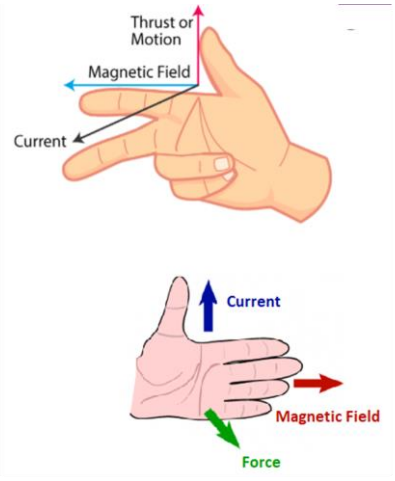
Use the following diagram to answer Question 11.

Given below is a simple AC generator. In order to find the direction of induced current in the armature, the Fleming's Hand Rule (or Slap/Palm Rule) is applied.

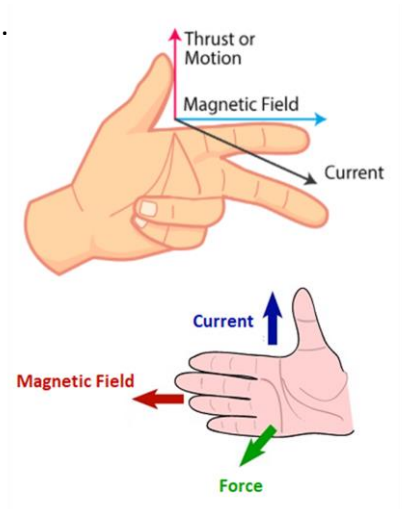


11. Which of the following shows the correct hand to use (left or right) and the correct representation (current, magnetic field, and force) of the fingers?

A.



B.



	SL 1

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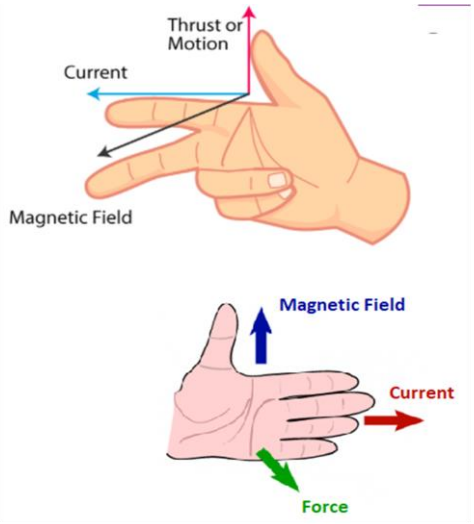

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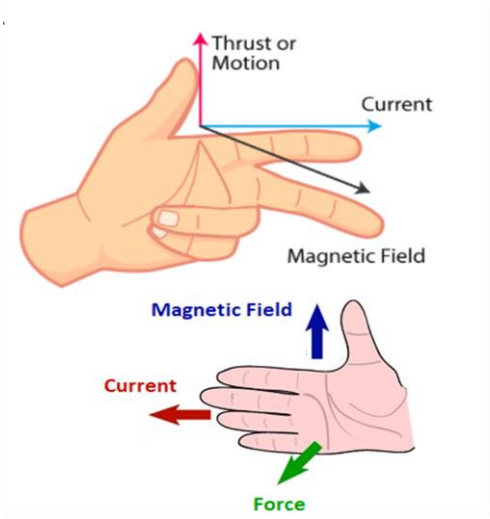
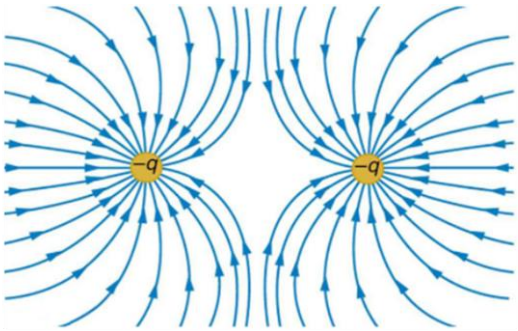
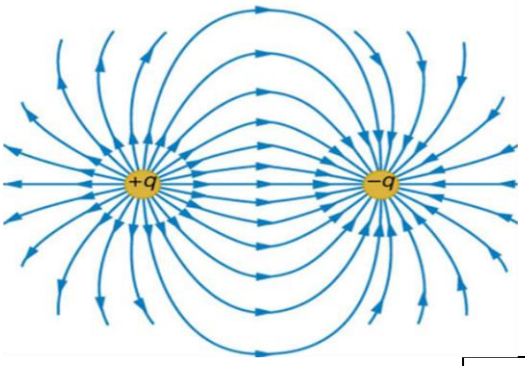


12. Choose the <u>incorrect</u> electric field line patterns from two electric charges.

A.

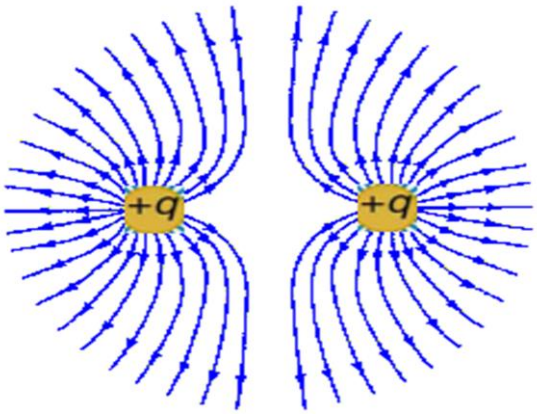


B.

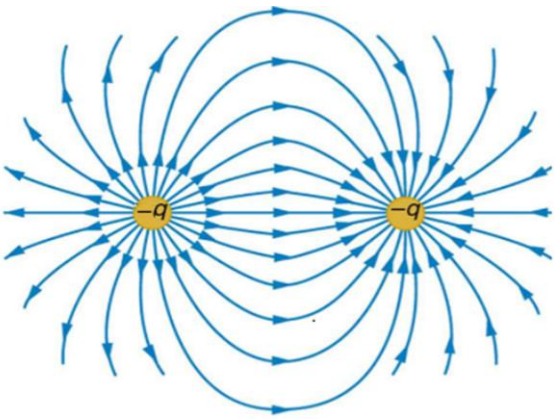


SL 1

C.



D.



13. What is a photon?

A. It is a light particle.

B. It is an electron particle.

C. It is a proton particle.

D. It is a neutron particle.

	SL 1

14. The correct definition of an isotope are forms of the same element that have the same number of:

A. protons but different number of neutrons.

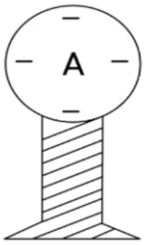
B. neutrons and with same number of electrons.

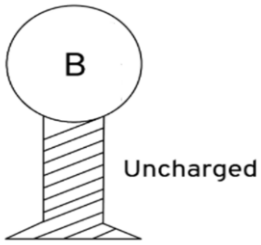
C. electrons but different number of neutrons.

D. neutrons but different number of electrons.

	SL 1

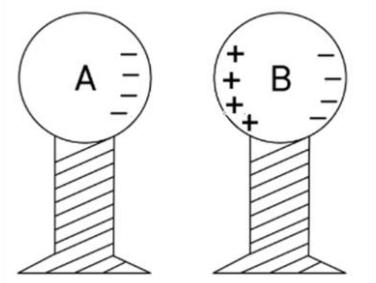
15. A neutral sphere B, was brought near the negative charged sphere A. Which of the following is the correct distribution of charges on sphere B?



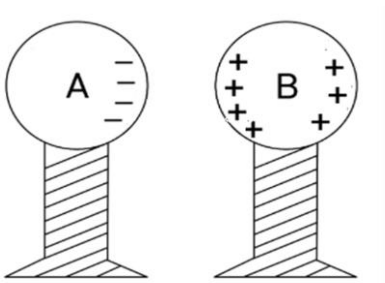


	SL 1

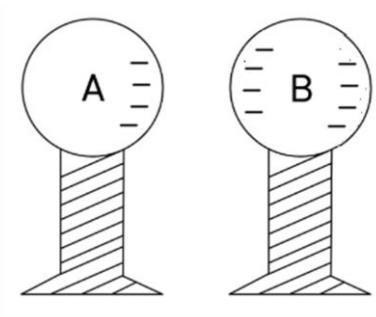
A.



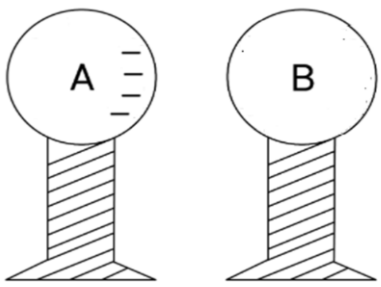
B.



C.



D.



16. The direction of the conventional current is best defined as the direction of which type of particle?

A. Protons.

B. Positive electric charges.

C. Electrons.

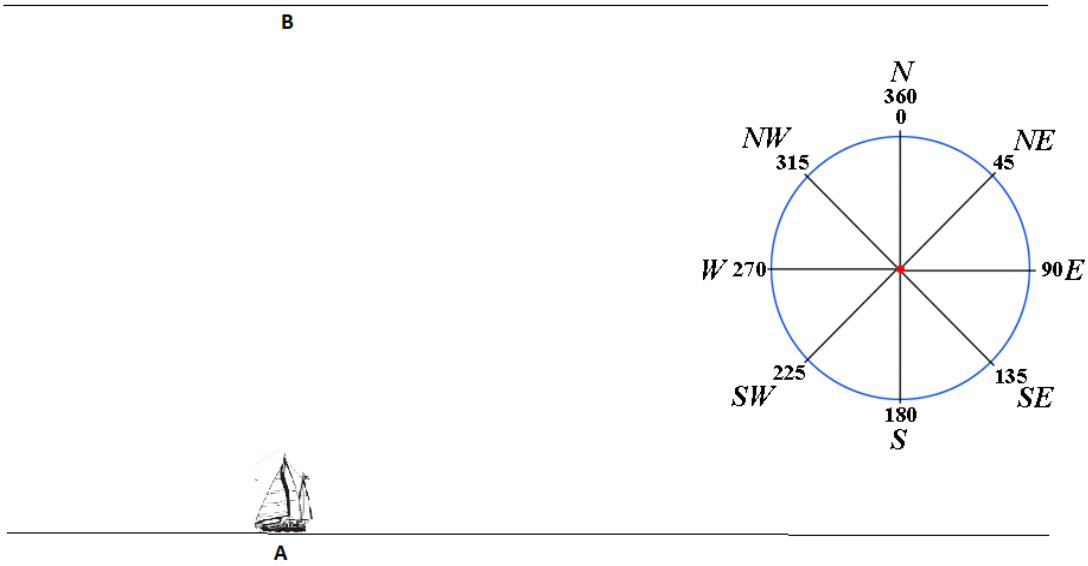
D. Negative electric charges.

SL 1

SECTION B: Extended Responses (Weighting 84)

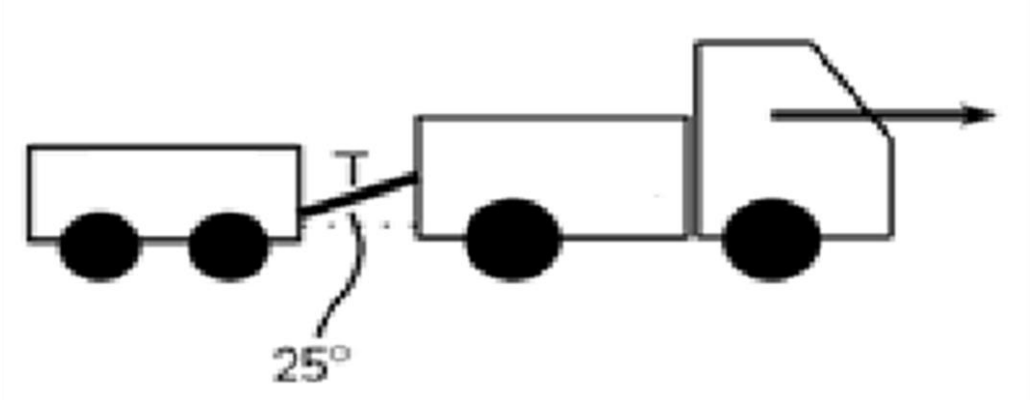
STRAND 1:	MEASUREMENTS	WEIGHTING 8

17. A ship sets sail from A to B. The ship's velocity relative to the ocean is 10.0m/s. The local ocean current is 1.50m/s in the direction of 45^{o} (or north east). Use the scale of 1m/s = 1cm and draw a vector diagram to represent the two velocity vectors.



SL 2

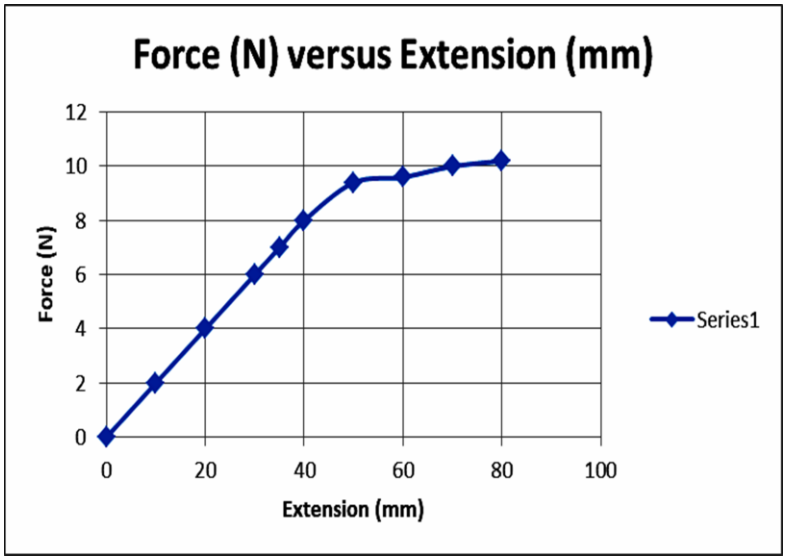
18. A truck is pulling a trailer with a tension force of 5000N, at an angle of 25^{o} above the horizontal. Calculate the horizontal and the vertical components of the tension force.



SL 3

19. The graph given below represents data from an experiment on Hooke's Law. Spring force versus the extension of the spring. Calculate the slope of the graph, for extension 0 to 40 mm.

SL 3



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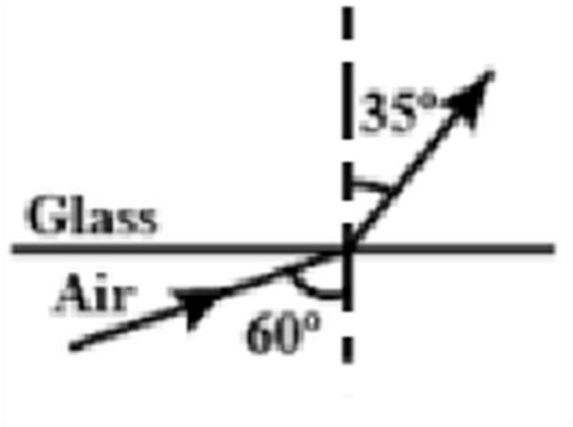
20. A beam of light travels from air to glass. Use the diagram to describe the relationship. Also, relate each term given in the diagram to the formulae $n_1 \sin\Theta_1 = n_2 \sin\Theta_2$.



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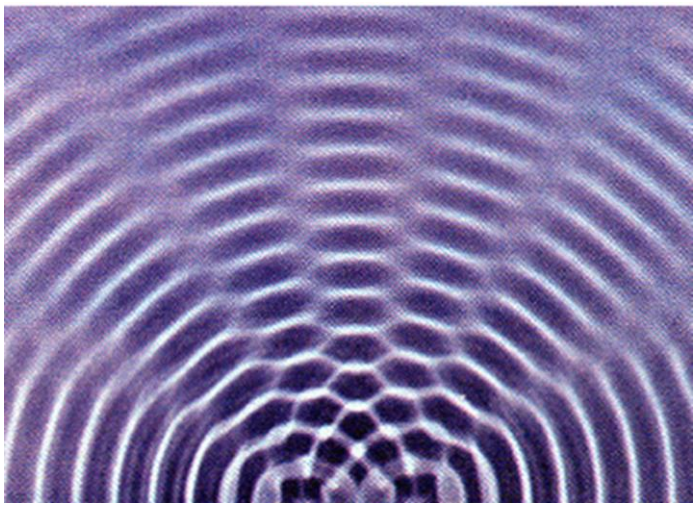
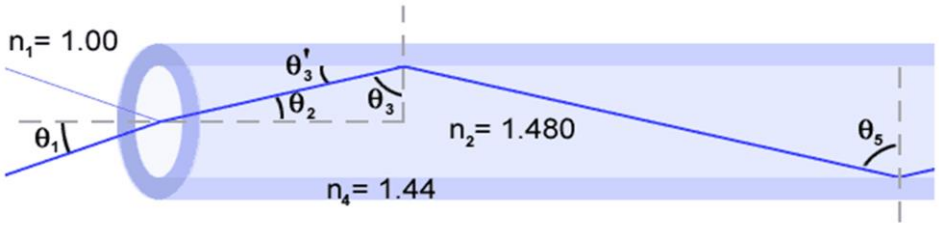
SL 2

21. Draw and label a nodal line and an anti-nodal line in the interference pattern of water waves given below.



SL 2

22. The inner core of the fibre optic cable has a refractive index of 1.480, and the outer cladding has an index of refraction of 1.44. Calculate the critical angle for the inner core-to-outer cladding interface and describe the total internal reflection of light in the fibre optic.



Calculation for the critical angle.

SL 3

Describe the total internal reflection:

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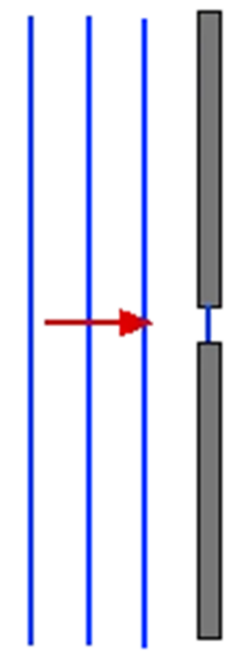
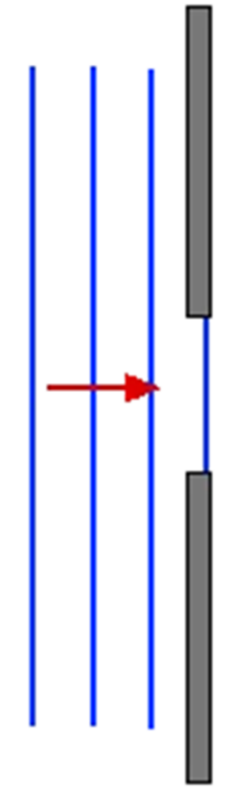
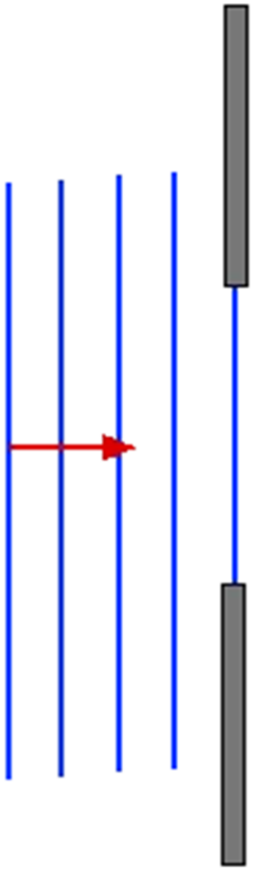
23. In the diagram below there are three different setups of different aperture sizes. Draw how the waves would diffract and discuss how the size of the aperture relative to the wavelength, affects the wave diffraction pattern.







Discussion:

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SL 4

24. In a physics experiment, a converging mirror (concave mirror) was used to study the nature of the image when the object was placed at two different locations.

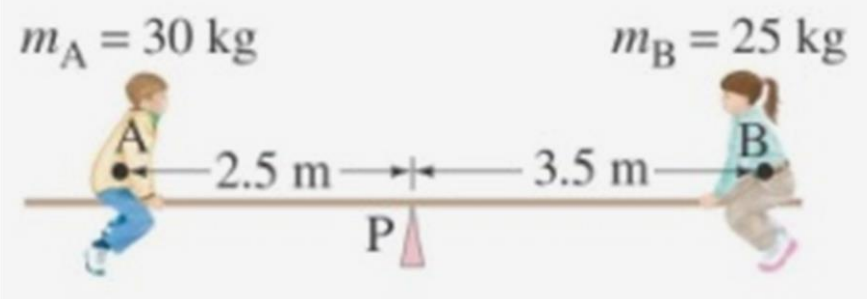
- The first position was when the object was placed between the focal point and the mirror.
- The second position was when the object was placed between the focal point and the centre of curvature.
- Explain the nature of the images in these two positions. *(You may use a diagram/diagrams to illustrate your answers).*

SL 4

25. A man of 1.8 metre height shot a gun horizontally. Calculate the horizontal distance travelled by the bullet if its initial velocity is 540 m/s and the time for the bullet to drop to the ground is 0.6 seconds.

SL 2

26. A light board serves as a seesaw for two children. Child A has a mass of 30 kg and sits 2.5 m from the pivot point, P. Calculate the net torque on the seesaw.



SL 2

27. A car of mass 3000 kg which was initially at rest, accelerated at a rate of 2m/s^2 for 10 seconds. Calculate the final momentum of the car at 10 seconds.

SL 2

28. An object is thrown at an angle above the horizontal undergoes projectile motion. Describe how each of the velocity components of the initial velocity changes, as the object is in flight.

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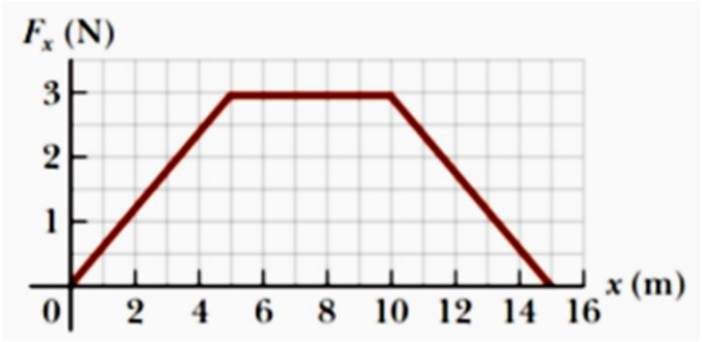
SL 2

29. A varying pulling force is exerted on an object when pulling along the horizontal positive direction. Explain how the work done is calculated from the force-displacement graph and calculate the total work done.



SL 3

Explanation:

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Calculation:

30. How many moles of gas are contained in 22.41 litres at 99.85 kPa and 0^{o} C.

SL 3

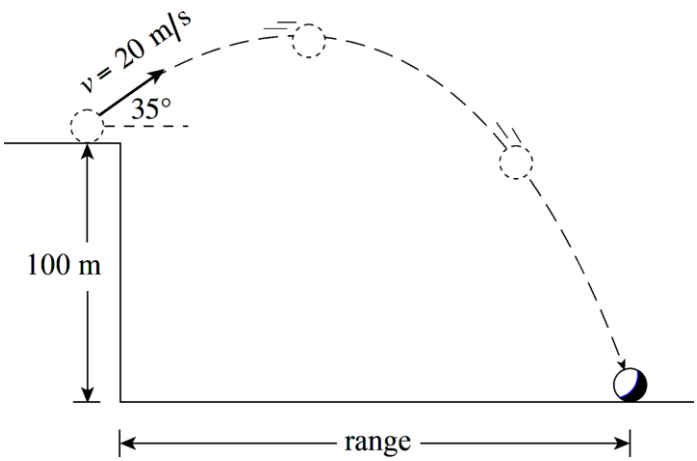
31. In an experiment to measure the specific heat capacity of an unknown piece of metal nugget, the piece of metal nugget of mass 0.02 kg, was taken from the freezer, which was set at -10 ^{o}C. The metal was placed inside the copper calorimeter which contains water. Assume that there is no heat lost to the environment. Use the data given below to calculate the specific heat capacity of the piece of metal nugget.
(Hint: Heat gained by the nugget = Heat loss by the water)

Data:

Initial temperature of the piece of nugget = -10^{o}C.
Initial temperature of the calorimeter and water = 10^{o}C.
The final temperature of the mixture (water, copper and the piece of nugget) = 8.6^{o}C
Specific heat capacity of water = 4,200 J/kg ^{o}C
Specific heat capacity of copper = 400 J/kg ^{o}C.
Mass of water = 0.01kg
Mass of the copper calorimeter = 0.05 kg
Mass of the piece of nugget = 0.02 kg

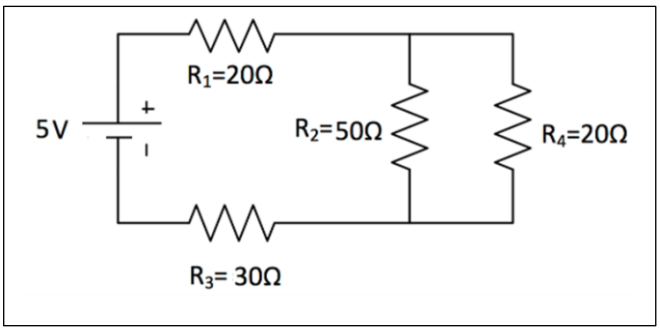
SL 4

32. A projectile is launched from a cliff 100 metres above level ground with a launch velocity of 20 metres per second and the launch angle of 35° above the horizontal. Determine the landing range of the object.



SL 4

33. Determine the total resistance of the circuit.



SL 2

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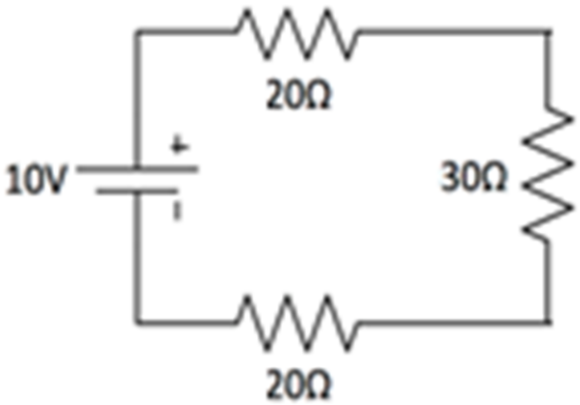
34. Calculate the voltage across the resistor 30 ohms.



SL 2

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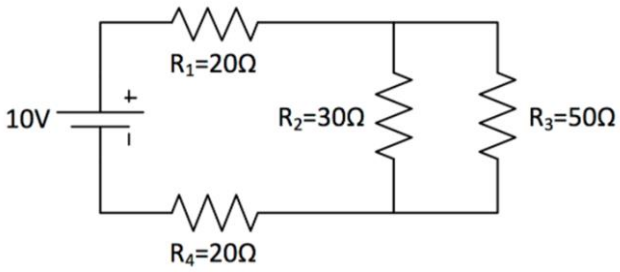
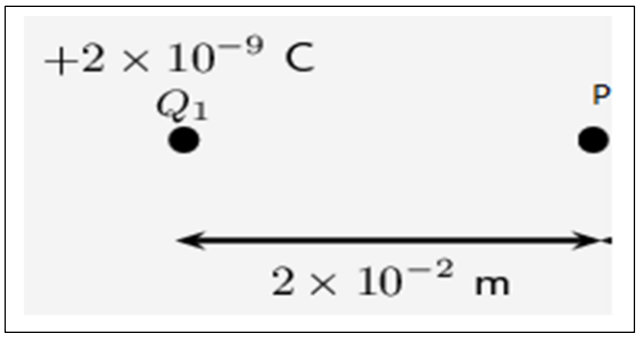
35. Determine the current supply by the battery.



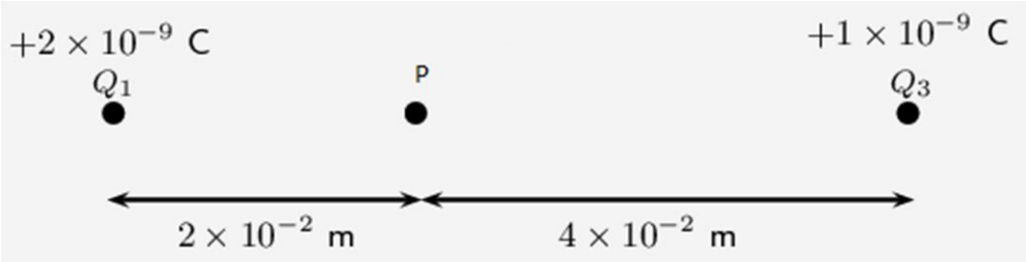
SL 2

36. Calculate the electric force exerted by the charge Q_1 on P, and indicate the direction of the force at P. (Point P has a charge of 1 C).



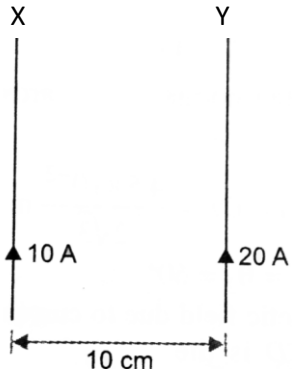
SL 3

37. Calculate the net force exerted by Q_1 and Q_3 at point P. (Point P has a charge of 1 C).



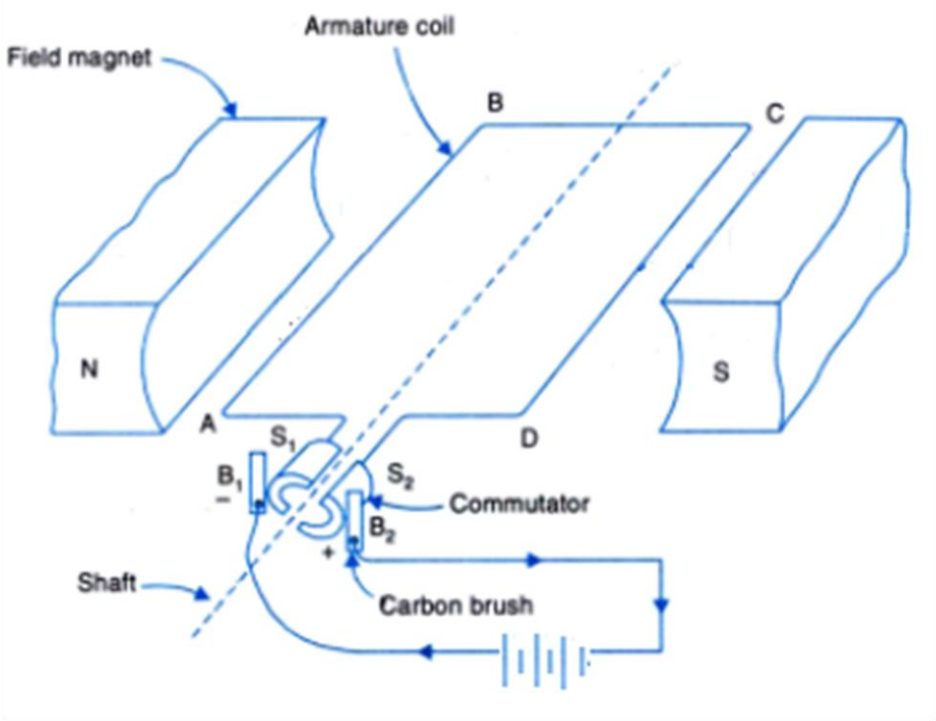
SL 3

38. Two electrical wires, X and Y, of 1 metre in length, are placed parallel to each other. They carry electrical current of 10A and 20A. The two wires are 10cm apart. Calculate the force experienced by the wire X, due to the interaction with the magnetic field generated from wire Y.



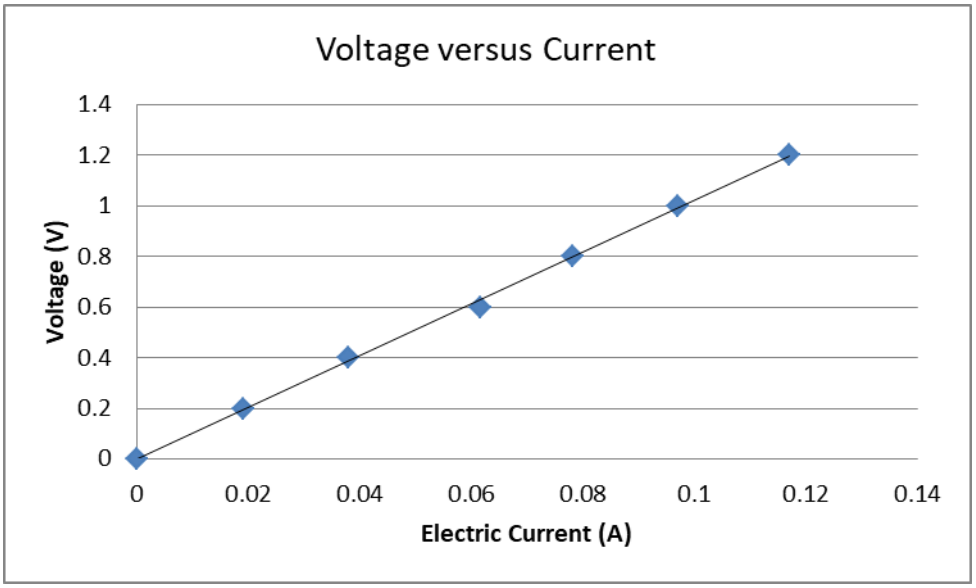
SL 4

39. A structure of a simple DC motor is given below. The electric current flows through the armature ABCD will produce a force. In each section (AB, BC, CD, and DA) of the rectangular armature, explain how the force is produced in these sections (AB, BC, CD and DA) and causes the motor to rotate.



SL 4

40. The graph given below shows the relationship between the voltage and the electric current through a resistor from a physics experiment. Use the graph to determine the resistance value of the resistor.



SL 3

41. Describe the characteristics of gamma rays.

SL 2

42. Explain the link between alpha particles and the helium nucleus.

SL 3

43. Explain why different metals require different light energy to remove the electrons from a metal surface.

SL 3

44. Describe the process of electrolysis.

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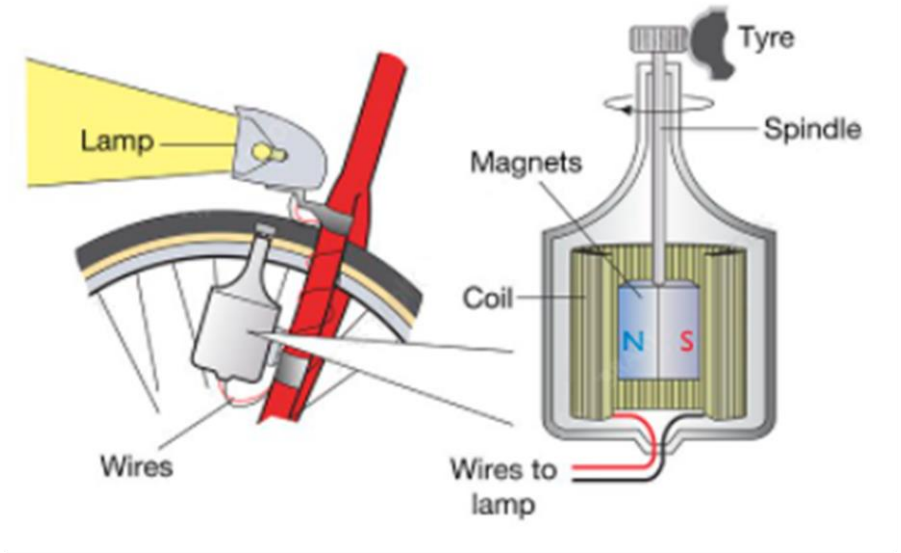
_____
_____

SL 2

45. Draw the magnetic field lines around a solenoid. *(Label the direction of the current, and the magnetic poles clearly).*

SL 3

46. Use the principles of electromagnetism to explain how a bicycle dynamo operates.



SL 3

PHYSICS EQUATIONS SHEET

Kinematics

v = u + at

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

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

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

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

$p = mv$

$\Delta p = p_f - p_i$

$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$

$\tau = BANI \cos\theta$

Light and Waves

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

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

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

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

$v = f\lambda$ $E_k = \frac{1}{2}mv^2$

Circular Motion

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

$F = \frac{mv^2}{r}$ $E_p = \frac{1}{2}kx^2$

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

Electricity and Magnetism

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

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

V = ΔE/q

V = IR

P = VI

PV =nRT

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

F = Bqv

F = IBL

P = ΔE/ t

V = Bvl

Energy and Mechanics

W = Fd

E = mgh

E = hf

F = k x

$F = k\frac{Q_1Q_2}{r^2}$

List of constants

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

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

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

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

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

1 atm = 101.3 *kPa*

R = 0.08205 *L atm /mol K*

mass of the proton = 1.67 x 10^{-27} kg

h = 6.6 x 10^{-34} Js

STUDENT EDUCATION NUMBER									

PHYSICS

2021

(For Scorers only)

STRANDS		Weighting	Scores	Check Scorer	AED check
SECTION A	MULTIPLE CHOICE	16			
STRAND 1	MEASUREMENTS	8			
STRAND 2	WAVES	15			
STRAND 3	MECHANICS	22			
STRAND 4	ELECTROMAGNETISM	23			
STRAND 5	NUCLEAR PHYSICS	8			
STRAND 6	ELECTRICITY	8			
	TOTAL	**100**			