GOVERNMENT OF SAMOA

| STUDENT EDUCATION NUMBER | | | | | | | | | |
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# Samoa Secondary Leaving Certificate

# PHYSICS

# 2024

## 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 the last page.**

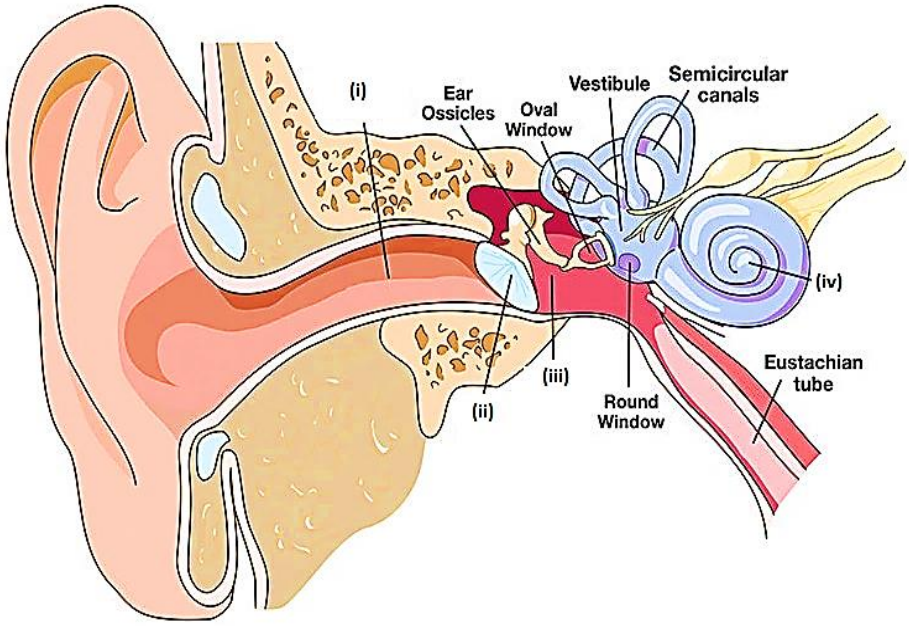
| STRANDS | | Pages | Time (min) | Weighting |
|---|---|---|---|---|
| **STRAND 1** | ENERGY | 2-6 | 45 | 25 |
| **STRAND 2** | ELECTRICITY | 7-11 | 45 | 25 |
| **STRAND 3** | MAGNETIC | 12-15 | 45 | 25 |
| **STRAND 4** | FORCES AND MOTION | 16-19 | 45 | 25 |
| **TOTAL** | | | **180** | **100** |

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.**

**For Questions 1 to 3, choose and write the LETTER of the correct answer in the box provided.**

1. Choose the **correct** choice for the labeled parts (i), (ii), (iii) and (iv) of the ear.




A. (i) cochlea; (ii) middle-ear; (iii) outer-ear carnal; (iv) ear drum.
B. (i) ear drum; (ii) middle-ear; (iii) cochlea; (iv) outer-ear carnal.
C. (i) middle-ear; (ii) outer-ear carnal; (ii) cochlea; (iv) ear drum.
D. (i) outer-ear carnal; (ii) ear drum; (iii) middle-ear; (iv) cochlea.

| | SL 1 |
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2. Choose the **incorrect** definition for refractive index

A. Velocity of light in vacuum/velocity of light in the medium.
B. Sine of the angle of incidence/sine of the refractive angle.
C. Wavelength of light in vacuum/wavelength of light in the medium.
D. Frequency of light in vacuum/frequency of light in the medium.

| | SL 1 |
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3. Which one of the following choices defines a displacement quantity?

A. 20 m/s West.
B. 20 m EAST.
C. 20 m.
D. 20 $m/s^{-2}$

| | SL 1 |
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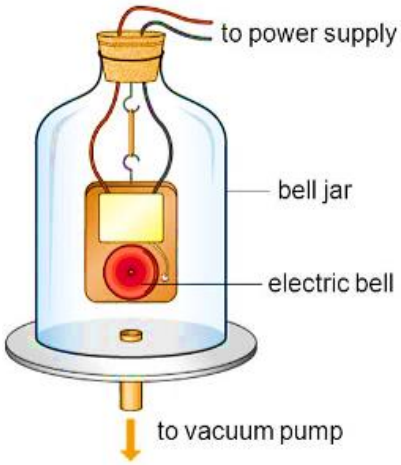
4. A setup to study the behavior of sound in air and in vacuum is given below.

Describe how the speed of sound changes as air is slowly pumped out of the bell jar.

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| SL 2 |
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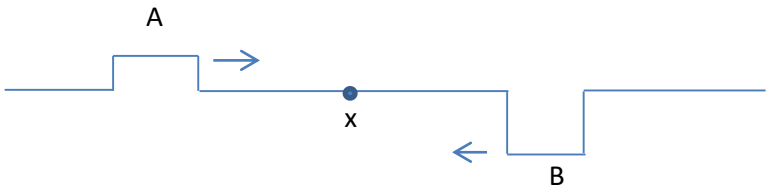
5. Two rectangular pulses, A and B, are moving toward each other and wholly superimposed at point, x. The amplitude of pulse A is 1 unit and pulse B is 2 units. Draw the resultant shape of the two pulses at point X.




| SL 2 |
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6. If two wavelengths pass a given point each second, and the distance between wave crests is 3m, what is the wave speed?

| SL 2 |
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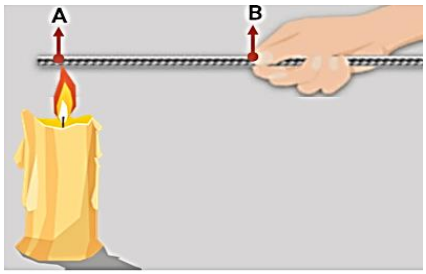
7. A piece of metal rod is heated at point A.




Compare and describe the behavior of particles at point A and at point B of the metal rod.

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| SL 2 |
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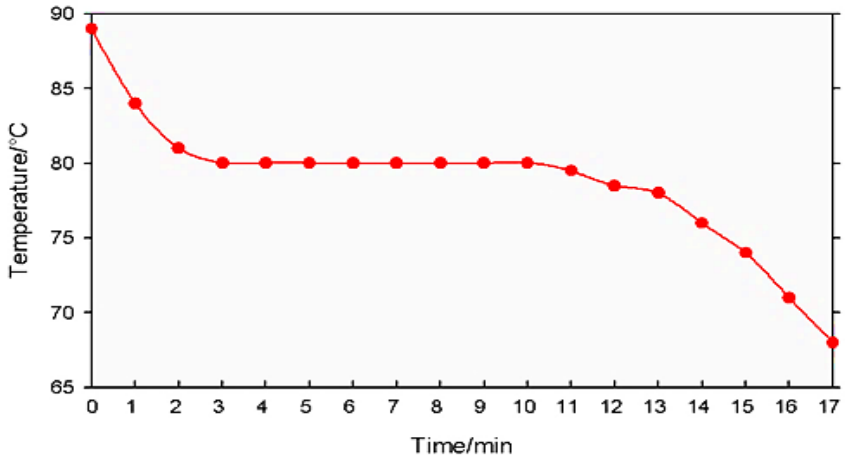
8. The diagram given below shows the cooling curve of a 1 kg wax from 89°C to 67°C in 17 minutes. In the first minute of cooling, the cooling rate of wax is – 5°C/minute. If 13,500 J heat energy is given off during the first minute of cooling, what is the specific heat capacity of the wax?

HINT: (Use $Q = mC\Delta T$).




| SL 3 |
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9. Pressure, volume and temperature are 3 variables that determine the behavior of an ideal gas. Use the ideal gas law to explain why the pressure of the gas is inversely proportional to its volume when the temperature is held constant.

| SL 3 |
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10. An electric jug contains 1.5 kg of water at 21°C. If the power rating of the electric jug is 2000 W. Calculate the time it takes to boil water at 100°C. Assume that there is no energy lost to the environment, and the specific heat capacity of water is 4200 J/kg°C.

| SL 4 |
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11. Samoan families use polystyrene chilly bins to airfreight frozen food to their families abroad. Explain how the chilly bins prevent frozen food from heat, which is transferred from the environment by conduction, convection and radiation.

| SL 4 |
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12. Give **ONE** example of a device that stores electricity.

| SL 1 |
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13. Draw the electrical symbols for the following electrical components in the box provided.

| | Electrical component | Electrical symbol |
|---|---|---|
| 1 | a bulb | |
| 2 | an open switch | |
| 3 | a battery | |
| 4 | a variable resistor | |
| 5 | ammeter | |

| SL 1 |
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14. Electric field lines are used to define the electric force from a charge object. On the negative charge object, as given in the diagram, draw the electric field lines.


| SL 1 |
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15. If the negative charge in Question 14, is -200 μC. Calculate the electric field strength of the electric field lines at a distance 1m from the negative charge.

| SL 2 |
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16. Describe how the charges are stored in capacitors.

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| SL 2 |
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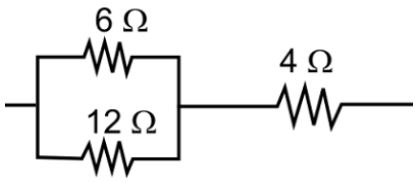
17. Calculate the total resistance of the circuit given below.




| SL 2 |
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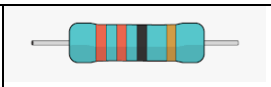
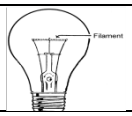
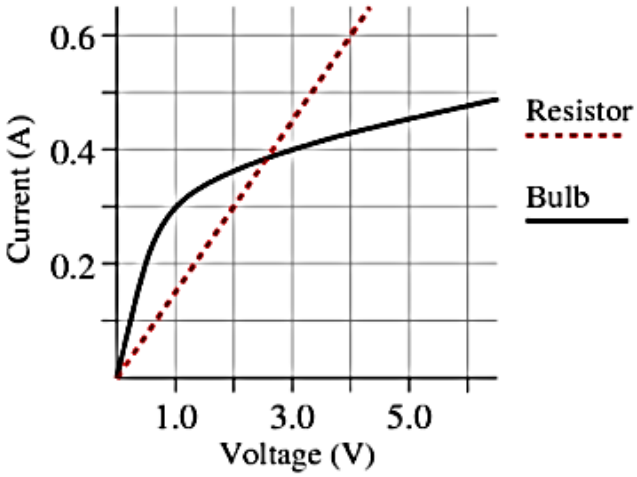
18. The able and the graph show the electrical current at different voltage for a resistor and a bulb.

| |  Resistor | |  Filament Bulb | |
|---|---|---|---|---|
| | Voltage (V) | Current (A) | Voltage (V) | Current (A) |
| 1 | 1.0 | 0.15 | 1.0 | 0.30 |
| 2 | 2.0 | 0.30 | 2.0 | 0.35 |
| 3 | 3.0 | 0.45 | 3.0 | 0.40 |
| 4 | 4.0 | 0.60 | 4.0 | 0.42 |
| 5 | 5.0 | 0.75 | 5.0 | 0.45 |




In term of resistance (R), describe and interpret the behavior of the bulb relative to the resistor at different voltages. (HINT: Use R = V/I)

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| SL 3 |
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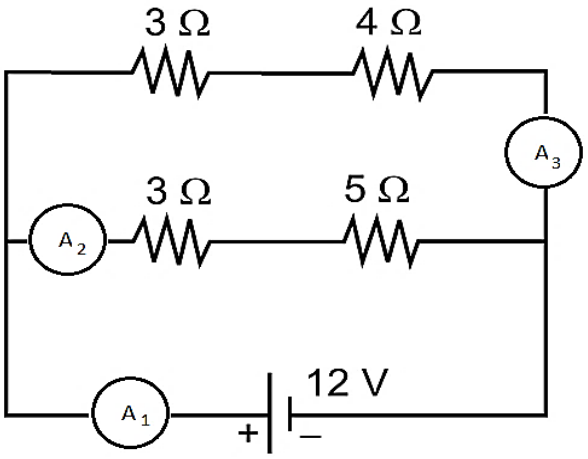
19. Use Ohm's Law to calculate the current through ammeter $A_1$, $A_2$ and $A_3$ located at different parts of the circuit given below.




| SL 3 |
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20. Explain how the temperature affects the electrical resistance of a wire filament bulb.

| SL 3 |
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21. Fuel tankers build up electric charges upon the surface of the vehicle, after a long journey. Therefore, before refilling, fuel trucks and fuel tanks are grounded first to avoid fire. Use the structure of an atom to explain how a fuel truck charged up electrostatically from a long journey.

| SL 3 |
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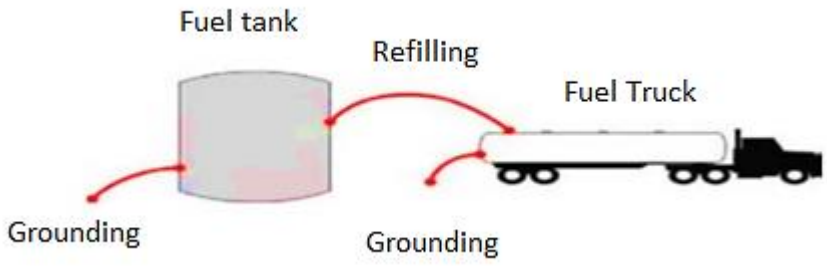


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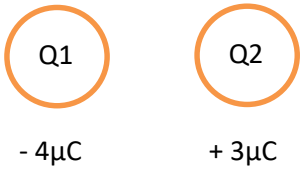
22. Two electric charges of $Q_1$ and $Q_2$, are placed 0.4 m away from each other. Determine the magnitude and direction of the electrostatic force on charge $Q_1$ and charge $Q_2$. ($Q_1$= -4μC and $Q_2$ = +3μC).




| SL 4 |
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23. There are several ways to increase the strength of an electromagnet.
State **ONE** way.

| SL 1 |
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24. State Lenz's law

| SL 1 |
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25. In testing the Rutherford's model of atom, deflection of radioactive particles were observed. What is deflection?

| SL 1 |
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26. How did the deflection of radioactive particles confirm the Rutherford's model of an atom?

| SL 2 |
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27. Use the Rutherford's model of atom to describe the atomic structure of Calcium element (Ca), which has an atomic number of 20.

(**HINT**: Your response should include the following key words, nucleus, protons, electrons and neutrons, mass number, atomic number.)

| SL 2 |
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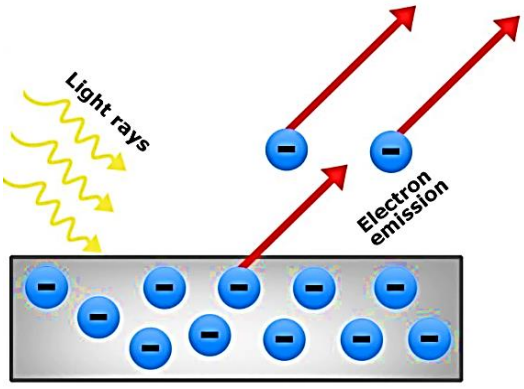
28. In photoelectric effect phenomenon, different metal surfaces require different amount of light energy, E=hf, to emit electrons from their surfaces. This minimum amount of energy, $\Phi$, is known as the work function of the material as seen in the table given below.

| Element | ϕ (eV) |
|---|---|
| Potassium | 2.30 |
| Sodium | 2.75 |
| Aluminum | 4.28 |
| Tungsten | 4.55 |
| Copper | 4.65 |
| Iron | 4.70 |
| Gold | 5.10 |




Describe why different materials have different work function.

| SL 2 |
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29. Explain how nuclear radiation is very harmful to living things.

| SL 3 |
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30. Complete the following equations by writing the correct mass number and atomic number, based on the type of radiation emitted.

| Type of radiation | |
|---|---|
| Alpha | $^{238}_{92}U \rightarrow {}^{[\ ]}_{[\ ]}Th + {}^{4}_{2}He$ |
| Beta | $^{137}_{[\ ]}Cs \rightarrow {}^{[\ ]}_{56}Ba + {}^{0}_{-1}e$ |
| Gamma | $^{64}_{28}Cs \rightarrow {}^{64}_{[\ ]}Ba + {}^{[\ ]}_{0}\gamma$ |

| SL 3 |
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31. Compare and discuss the **three types of nuclear radiation** from nuclear radioactive material.

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| SL 3 |
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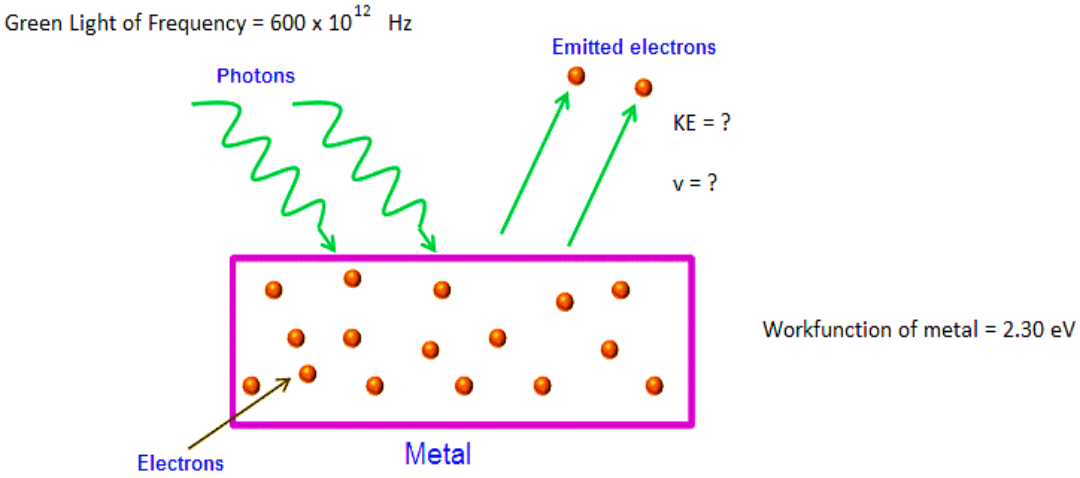
32. In photoelectric effect both the emitted photoelectrons and incoming photons possess momentum and energy.

Incident on a metal plate is a green light that has a frequency of 600 x $10^{12}$ Hz. If 2.30 eV of light energy is absorbed at the surface, what are the kinetic energy and the velocity of an emitted electron? (HINT: 1eV = 1.6 x $10^{-19}$ J)




| SL 3 |
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33. A radioactive material has a half-life of 4 hours. If the original material has 366 particles, how many particles remain after 20 hours?

| SL 4 |
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34. What is the difference between displacement and distance?

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| SL 1 |
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35. Convert 0.000023s into microseconds.

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| SL 1 |
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36. What is a momentum of an object?

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| SL 1 |
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37. A daily delivery truck travels 60 kilometres in the first hour, 80 kilometres in the second hour, and 50 kilometres in the third hour.

Calculate the average daily speed of the delivery truck.

| SL 2 |
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38. A car travelled 5 km due North, 10 km due West, and then 5 km due South.
Use the scale of 1 km = 1 cm to find the total displacement of the car.

| SL 2 |
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39. How much is $0.002m^3$ volume of water in $cm^3$?

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| SL 2 |
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40. Which of the following quantities listed below are vector quantities?
(Circle the correct choices).

Distance, Displacement, Velocity, Speed, Torque, Work, Force.

| SL 2 |
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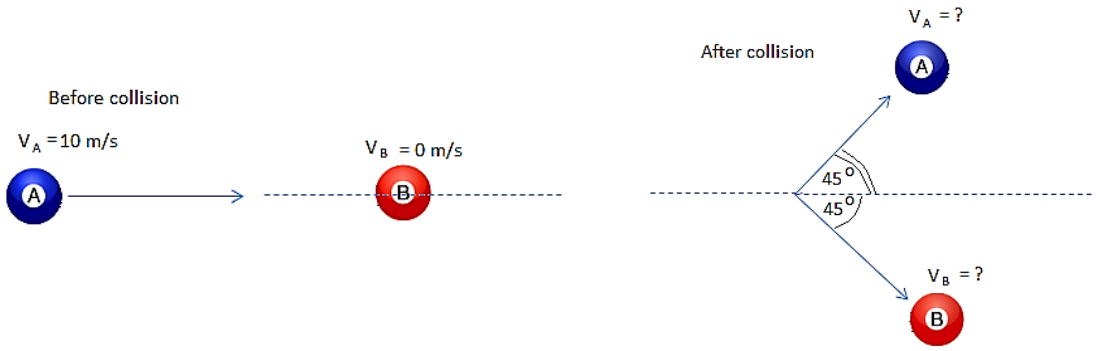
41. On a pool table, the billiard ball A with a velocity, $v_A$ = 10.0 m/s hit ball B that was initially at rest, $v_B$ = 0 m/s. The two balls were observed to move-off at 45° angle as seen in the diagram. Assume that ball A has the same mass as ball B, $m_A = m_B$.

Calculate the velocities, $v_A$ and $v_B$ of the two billiard balls, A and B, after collision.




| SL 3 |
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42. A teacher accidentally knocked a mug of coffee off her desk. If the mug flew off the desk with a velocity of 0.3m/s and the desk is 0.70 m tall. Calculate the final velocity of the mug just before it hit the floor.


| SL 3 |
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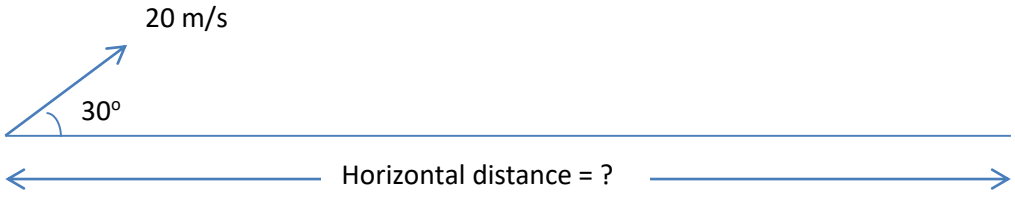
43. Calculate the horizontal distance travelled by a projectile mass that was launched from an angle of 30° above the horizontal at a speed of 20 m/s.




| SL 4 |
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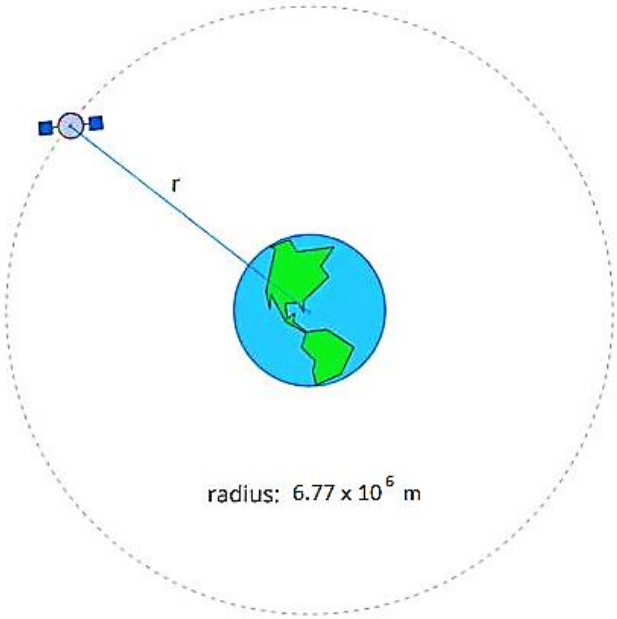
44. A satellite orbits the earth completely in 48 hours. The distance between the satellite and the center of the planet earth is $6.77 \times 10^6$ m. Calculate the centripetal acceleration on the satellite.




| SL 4 |
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# 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

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

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

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

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

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

$1\ atm = 101.3\ kPa$

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

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

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

## 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

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

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

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

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

$v = f\lambda$

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

$p.d = d\sin\theta = n\lambda \quad (n = 0, \pm1, \pm2, \ldots.)$

$p.d = d\sin\theta = \left(n - \frac{1}{2}\right)\lambda \quad (n = 0, \pm1, \pm2, ..)$

## Heat

$Q = mC\Delta T$

$H = mL$

$C_{water} = 4{,}200$ 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 | | | | | | | | | |
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# SSLC PHYSICS

## 2024

*(For Scorers only)*

| STRANDS | | Weighting | Scores | Check Scorer | AED check |
|---|---|---|---|---|---|
| **STRAND 1** | ENERGY | 25 | | | |
| **STRAND 2** | ELECTRICITY | 25 | | | |
| **STRAND 3** | MAGNETISM | 25 | | | |
| **STRAND 4** | FORCES AND MOTION | 25 | | | |
| | **TOTAL** | **100** | | | |