ZIAUDDIN UNIVERSITY
EXAMINATION BOARD

RESOURCES FOR

"HSC-I PHYSICS"

ZUEB EXAMINATIONS 2021

PREFACE:

The ZUEB examination board acknowledges the serious problems encountered by the schools and colleges in smooth execution of the teaching and learning processes due to sudden and prolonged school closures during the covid-19 spread. The board also recognizes the health, psychological and financial issues encountered by students due to the spread of covid-19.

Considering all these problems and issues the ZUEB Board has developed these resources based on the condensed syllabus 2021 to facilitate students in learning the content through quality resource materials.

The schools and students could download these materials from www.zueb.pk to prepare their students for the high quality and standardized ZUEB examinations 2021.

The materials consist of examination syllabus with specific students learning outcomes per topic, Multiple Choice Questions (MCQs) to assess different thinking levels, Constructed Response Questions (CRQs) with possible answers, Extended Response Questions (ERQs) with possible answers and learning materials.

ACADEMIC UNIT ZUEB:

1. **Extended Response Questions (ERQs)**

HOW TO ATTEMPT ERQs:

- Write the answer to each Constructed Response Question/ERQs in the space given below it.
- Use black pen/pencil to write the responses. Do not use glue or pin on the paper.

SECTION C (LONG ANSWER QUESTIONS)

1. **Write notes on transport in a) Hydra b) Planaria and explain the double circuit plan.**

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<table>
<tr><th>S.NO</th><th>ERQ</th><th>ANSWER</th><th>CL</th><th>DL</th></tr>
<tr>
<td>1.</td>
<td>With the help of a diagram explain the working of Compound microscope. Drive an expression for magnifying ` of compound microscope.</td>
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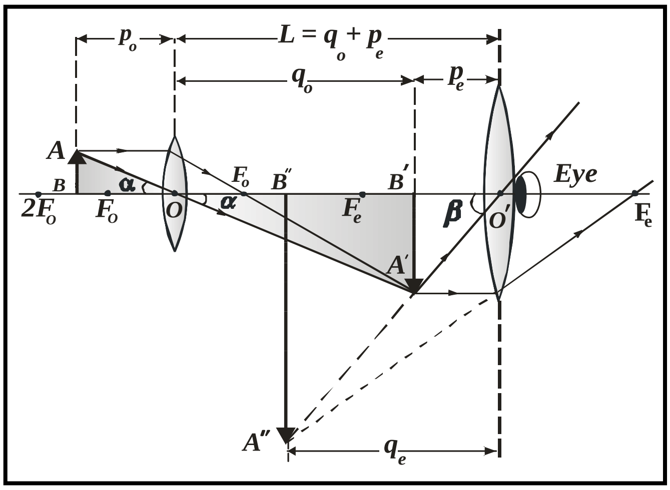
Definition: *"A compound microscope is an optical instrument used to see very small object such as germs and other microbes."*



Construction: *It consists of two converging lenses one is called object and other is called eye piece. Both object and eye piece are mounted at the end of the metallic tube which can slide into or out of each other.*

Objective: *The convex lens near the object is called objective. It is of short focal length and small aperture.*

Eye Piece: *The second convex lens near the eye is called eye piece. It is of long focal length and large aperture.*

Working: *If we placed the object **AB** just behind the focus of objective then it gives real, inverted and magnified image **A′B′**. Now we adjust eye piece such that image **A′B′** acts as object and inside the focus of eye piece this lens gives final image **A′B′** at least distance of distinct vision and it is virtual, inverted, and highly magnified as show in the ray diagram.*

Magnifying Power:

Magnifying power of compound microscope is the product of magnifying power of objective and magnifying power of eyepiece. Mathematically it can be expressed as:

$M = M_o \; M_e \qquad$ *Eq (i)*

Linear Magnification Of Objective:

Linear magnification of objective is the ratio of height of image to the height of object mathematically it can be expressed as:

$$\therefore \qquad M_o = \frac{H_i}{H_o}$$

</td>
<td>K/A</td>
<td>A</td>
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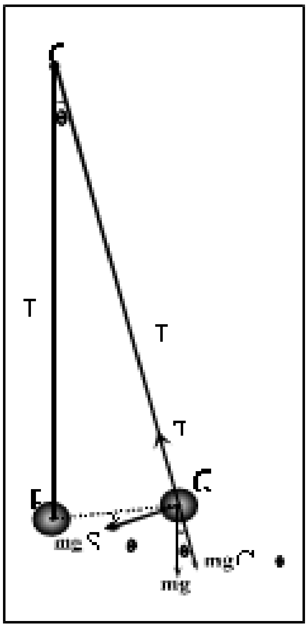
		$M_o = \frac{A'B'}{AB}$ *Eq. (ii)* *Since ΔAOB and ΔA′OB′ are similar to each other because both triangles are right angle triangle with one similar angle* $\Delta AOB \Longleftrightarrow \Delta A'OB'$ $\therefore \frac{A'B'}{AB} = \frac{B'O}{BO}$ $\frac{A'B'}{AB} = \frac{q_o}{p_o}$ *For highest magnification we replace* *P_o by f_o and q_o by L in above equation* $\frac{A'B'}{AB} = \frac{L}{f_o}$ *We put in Eq. (ii)* $M_o = \frac{L}{f_o}$ *Eq (iii)* ***Magnifying Power Of Eye Piece:*** *Since eye piece behave like simple microscope therefore magnifying power of eye piece can be expressed as:* $M_e = 1 + \frac{d}{f_e}$ *E q (iv)* *Using equation (iii) and (iv) equation (i) become* $M = \frac{L}{f_o}\left(1 + \frac{d}{f_e}\right)$ *This is ideal magnifying power of compound microscope.*		
2.	***Describe Young's double slit experiment and derive expression for the wave length.***	***Coherent Sources:*** *To obtain interference patterns in light, the coherent sources of light are necessary; Young's used a single source of light and converts it into two.* ***Construction*** *i) Consider a screen with slit "S_o", placed before the monochromatic light source.* *ii) Ray from slit, "S_o" fall on a screen having two slit "S_1" and "S_2" separated by a distance "d".* *iii) Coherent light from slit S_1 and S_2 falls on a screen at a distance "L". To observed the interference pattern.* *iv) Draw perpendicular **OR** from the midpoint of slit "S_1" and "S_2" on the screen.* *v) Consider a point "**P**" on the screen at a distance "y_n" from "**R**" where the "n^{th}" fringe is obtained.*	**K/A**	**B**

		Path Difference (P.D) *Light reaching from* S_2 *to* P (r_2) *cover greater path as compared to that reaching from* S_1 *to* P (r_1). *The path difference between* r_1 *and* r_2 *can obtain by drawing a perpendicular from* S_1 *on* S_2P *and is given by* $p.d = r_2 - r_1 = S_2Q$ ***In*** ΔQS_1S_2 $Sin\,\theta = \frac{P}{H} = \frac{S_2Q}{d} = \frac{p.d}{d}$ $d\,Sin\theta = p.d$ $p.d = d\,Sin\theta$ *In Young's double slit experiment "*θ*" is very small. Therefore we can replace* $Sin\,\theta$ *by* $tan\,\theta$ *in above equation* $p.d = d\,tan\theta$ ***In*** ΔROP $\quad tan\,\theta = \frac{P}{B} = \frac{y_n}{L}$ ***we put in above*** $p.d = d\,\frac{y_n}{L}$ ***Position Of Bright Fringes*** ***Or (Maxima)*** $p.d = n\,\lambda$ *Bright fringes on a screen is the result of constructive interference therefore,* *Here* $p.d = d\,\frac{y_n}{L}$ ***By comparing both, we get*** $d\,\frac{y_n}{L} = n$ $y_n = n\,\frac{\lambda\,L}{d}$ ***Position Of Dark Fringes*** ***Or (Minima)*** $p.d = \left(n + \frac{1}{2}\right)\lambda$ *Dark fringes on a screen is the result of destructive interference therefore,* ***Here*** $p.d = d\,\frac{y_n}{L}$ ***By comparing both, we get*** $d\,\frac{y_n}{L} = \left(n + \frac{1}{2}\right)\lambda$ $y_n = \left(n + \frac{1}{2}\right)\frac{\lambda\,L}{d}$ ***Fringe Spacing (***ΔX***)*** *"Fringe spacing is the distance between two consecutive bright or dark fringes. OR* *Fringe spacing is the width of a fringe"* ***For bright fringes:***		

		$\Delta x = y_1 - y_0$ $\Delta x = 1\frac{\lambda L}{d} - 0\frac{\lambda L}{d}$ $\Delta x = \frac{\lambda L}{d}$ ***For dark fringes:*** $\Delta x = y_1 - y_0$ $\Delta x = \left(1+\frac{1}{2}\right)\frac{\lambda L}{d} - \left(0+\frac{1}{2}\right)\frac{\lambda L}{d}$ $\Delta x = \frac{3}{2}\frac{\lambda L}{d} - \frac{1}{2}\frac{\lambda L}{d}$ $\Delta x = \frac{\lambda L}{d}$ This is the required expression for fringe ***Wave Length:*** *With the help of fringe spacing wave length of light is given by:* $\lambda = \frac{\Delta x\ d}{L}$		
3.	**Prove that motion of a simple pendulum is simple harmonic motion. When the angle of its swing is very small**	***Simple Pendulum*** *"Every rigid body which oscillates is called pendulum and such a pendulum whose mass lies at the end of the pendulum is called simple pendulum It consists of weightless, inextensible thread whose one end tightened with fixed support and the other end with a point mass.".*  ***Motion Of Simple Pendulum*** *If a pendulum of length **"L"** mass **"m"** displace from equilibrium position **"P"** to **"Q"** and then release the weight of a pendulum **"mg"** will resolve into two rectangular components **mgCosθ** and **mg Sinθ**, where **mg***	**K/A**	**C**

		Cosθ *cancel with the tension in a string **"T"** therefore resultant force with which a pendulum move toward mean position is given by* $F = m g \sin\theta$ ***But*** $F = m a$ ***By Comparing both equations*** $\cancel{m} a = \cancel{m} g \sin\theta$ $a = g \sin\theta$ ***………… Eq. (i)*** ***Calculation Of Sin*** θ ***If*** θ ***is very small then,*** $\sin\theta = \theta$ $\sin\theta = \frac{S}{r}$ $\sin\theta = \frac{x}{L}$ ***we put in Eq. (i)*** $a = g \frac{x}{L}$ *Since **"a"** is always toward mean position and is away from the mean position therefore, above equation can be expressed as* $a = \frac{g}{L}(-x)$ $a = -\frac{g}{L}x$ ***(Acceleration of S.H.M)*** $a = -$ ***Constant*** x $\boxed{a \propto -x}$ *This is the condition of simple harmonic motion so; we say that motion of a simple pendulum is S.H.M.*		
4.	***What is Doppler's effect . Obtain an expression for the change of frequency of sound due to***	***Introduction*** *In 1842 German-born Austrian physicist Christian Johann Doppler studies the apparent change in the frequency of sound and he state that:* ***Statement*** *"Whenever a source of sound or a listener or both source of sound and listener are moving towards or away from each other then frequency of sound does not remain same this effect of change of frequency called Doppler effects".*	**K/A**	**B**

relative motion b/w the source and observer.

A s s u m p t i o n s

1) Source of sound and a listener are moving along the line joining there centers

2) The velocity of source and the listener is less than the velocity of sound.

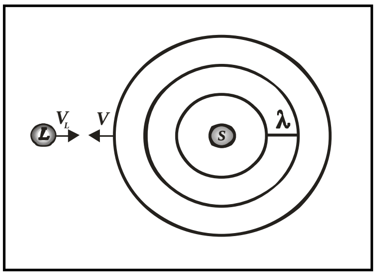
<u>CASE I</u> ***a) Listener move towards a stationary source.***

*Suppose the source emitting sound waves of frequency **"f"** and speed **"v"** then wavelength of sound heard by a listener is given by:*

$$\lambda = \frac{v}{f} \quad \ldots\ldots\ldots \quad Eq\ (i)$$

*If listener is moving towards the stationary source with the velocity **"V_L"** then speed of sound heard by a listener will be **$V + V_L$** and the frequency of sound heard by listener is given by:*

$$f' = \frac{V + V_L}{\lambda} \qquad \text{Using eq (i)}$$



$$f' = \frac{V + V_L}{\frac{v}{f}}$$

$$f' = \frac{f}{v}\,[V + V_L]$$

$$f' = f\left[\frac{\cancel{V}}{\cancel{V}} + \frac{V_L}{V}\right]$$

$$f' = f\left[1 + \frac{V_L}{V}\right]$$

With the help of above equation we can conclude that :"Frequency of sound will increases with the velocity of listener"

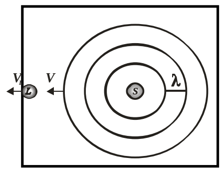
b)Listener move away from a stationary source.

*Suppose the source emitting sound waves of frequency **"f"** and speed **"v"** then wavelength of sound heard by a listener is given by:*

$$\lambda = \frac{v}{f} \quad \ldots\ldots\ldots \quad Eq\ (i)$$

*If listener is moving away from the stationary source with the velocity **"V_L"** then speed of sound heard by a listener will be **$V - V_L$** and the frequency of sound heard by listener is given by:*

$$f' = \frac{V - V_L}{\lambda}$$



$$f' = \frac{f}{v}\,[V - V_L]$$

$$f' = f\left[\frac{\cancel{V}}{\cancel{V}} - \frac{V_L}{V}\right]$$

$$f' = f\left[1 - \frac{V_L}{V}\right]$$

With the help of above equation we can conclude that:

"Frequency of sound will decreases with the velocity of listener"

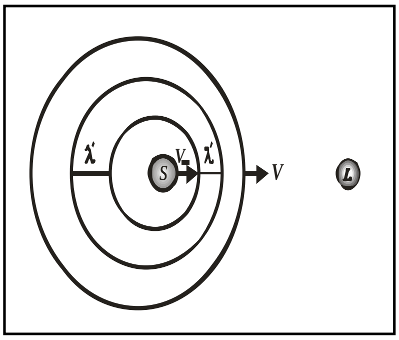
<u>CASE II</u>

(a) Source move towards a stationary listener

When the source of sound move towards a stationary listener with the velocity ***"V_S"*** *then wavelength of sound heard by a listener will be* ***($VT - V_ST$)*** *and the frequency of sound heard by a listener is given by:*

$$f' = \frac{V}{VT - V_ST}$$

$$f' = \frac{1}{T}\left[\frac{V}{V - V_S}\right]$$



$$f' = f\left[\frac{V}{V - V_S}\right]$$

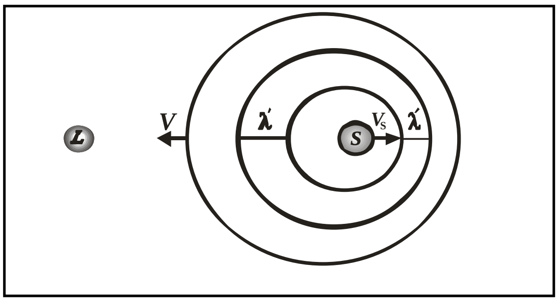
$$f' = \frac{f\,V}{V - V_S}$$

With the help of above equation we can conclude that

"Frequency of sound will increases with increase of speed of source of sound"

<u>CASE Ii</u> (b) Source move away from a stationary listener

When the source of sound move away from a stationary listener with the velocity ***"V_S"*** *then wavelength of sound heard by a listener will be* ***($VT + V_ST$)*** *and the frequency of sound heard by a listener is given by:*



$$f' = \frac{V}{V\ T + V_S\ T}$$

$$f' = \frac{1}{T}\left[\frac{V}{V + V_S}\right]$$

$$f' = f\left[\frac{V}{V + V_S}\right]$$

$$f' = \frac{f\ V}{V + V_S}$$

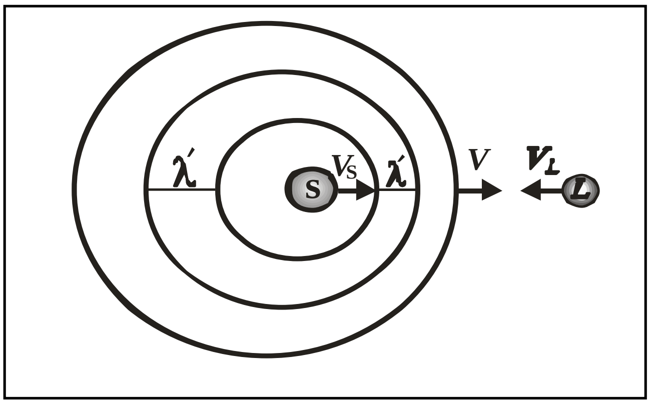
With the help of above equation we can conclude that "Frequency of sound will decreases with speed of the source of sound".

<u>CASE IIi</u>(a) Source and listener both move towards each other

*When the source of sound move towards listener with the velocity **"V_S "** then wavelength of sound heard by a listener will be*

$(V\ T - V_S\ T)$

*When listener move towards the source with the velocity **"V_L"** then speed of sound heard by a listener will be **$V + V_L$** and the frequency of sound heard by listener is given by:*



$$f' = \frac{V + V_L}{V\,T - V_S\,T}$$

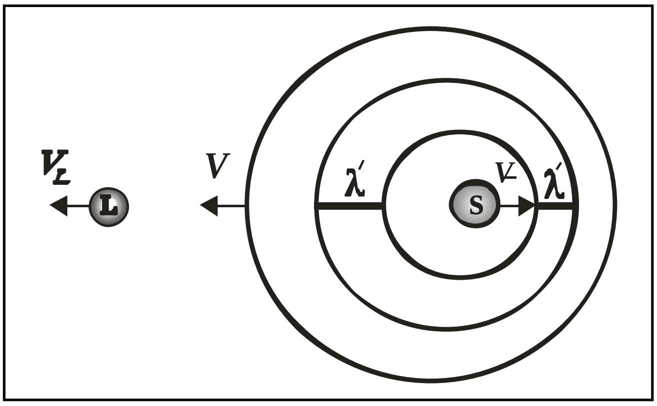
$$f' = \frac{1}{T}\left[\frac{V + V_L}{V - V_S}\right]$$

$$f' = f\left[\frac{V + V_L}{V - V_S}\right]$$

With the help of above equation we can conclude that:
"Frequency of sound will increases with the velocity of source and the velocity of listener"

CASE II (b) Source and listener both move away from each other

*When the source of sound move away from the listener with velocity **"V_S"** then wavelength of sound heard by a listener will be **($V\,T + V_S\,T$)***
*When listener move away from the source with the velocity **"V_L"** then speed of sound heard by a listener will be **$V - V_L$** and the frequency of sound heard by listener is given by:*



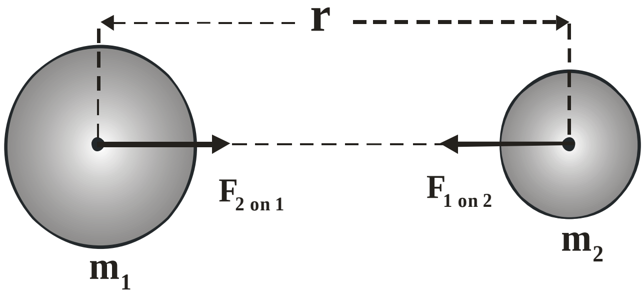
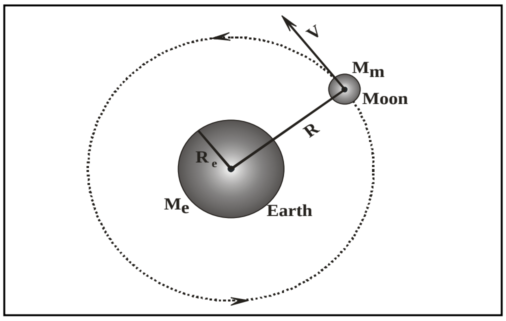
$$f' = \frac{V - V_L}{V\,T + V_S\,T}$$

$$f' = \frac{1}{T}\left[\frac{V - V_L}{V + V_S}\right]$$

$$f' = f\left[\frac{V - V_L}{V + V_S}\right]$$

With the help of above equation we can conclude that:
"Frequency of sound will decreases with the velocity of source and the velocity of listener"

Applications Of Doppler's Principle

		i)*Doppler's principle helps us to determine the speed of an approaching submarine* ***ii)****Doppler's principle helps us to determine distance, location and also the velocity of an aero plane by determining the frequency shift.* ***iii)****Doppler's principle helps us to determine the movement of a thief near the safe*		
5.	**State and explain Newton's law of Gravitation?**	  **STATEMENT:** *"Every body in this Universe attracts every other body with same magnitude of force which is directly proportional to the product of their masses and inversely proportional to the square of the distance between them and directed along the line joining their centers"* **EXPLANATION:** *If* m_1 *,* m_2 *be the mass of two bodies.* **'r'** *represents distance between them. Then mathematically Newton's law of gravitation is given by:* $F \propto \frac{m_1 m_2}{r^2}$ $F = G \frac{m_1 m_2}{r^2}$ Here **'G'** is the gravitational constant. In M. K. S. system its value is $6.67 \times 10^{-11}\ N\ m^2 / Kg^2$ **PROOF"** Since moon revolves around the earth in circular orbit and take **27.3 days** to complete one revolution around the earth. So centripetal acceleration of moon is given by:	**K/A**	**C**

$$a_m = \frac{4\pi^2 R}{T^2} \qquad \ldots \; Eq.\ (i)$$

Here $R = 3.84 \times 10^8 \; m$

$T = 27.3 \; days = 27.3 \times 24 \times 60 \times 60 = 2358720 \quad Sec$

$\pi = 3.1428$ *We put in Eq. (i)*

$$a_m = \frac{4 \times (3.1428)^2 \times 3.84 \times 10^8}{(2358720)^2}$$

$$a_m = 2.727 \times 10^{-3}$$

Dividing both the side by g_e

$$\frac{a_m}{g_e} = \frac{2.727 \times 10^{-3}}{9.8}$$

$$\frac{a_m}{g_e} = 2.78 \times 10^{-4} \qquad \ldots \; Eq.\ (ii)$$

But $\frac{R_e^{\,2}}{R^2} = \left(\frac{R_e}{R}\right)^2$

$$\frac{R_e^{\,2}}{R^2} = \left(\frac{6.4 \times 10^6}{3.84 \times 10^8}\right)^2$$

$$\frac{R_e^{\,2}}{R^2} = 2.78 \times 10^{-4} \quad \ldots \; Eq.\ (iii)$$

By comparing Eq (ii) and Eq. (iii) we get:

$$\frac{a_m}{g_e} = \frac{R_e^{\,2}}{R^2}$$

$$a_m = \frac{g_e R_e^{\,2}}{R^2}$$

$$a_m = \frac{const}{R^2}$$

$$a_m \; \alpha \; \frac{1}{R^2} \qquad \ldots\ldots\ \ldots \qquad \textbf{(A)}$$

According to Newton’s second law of motion:

$$F_m \; \alpha \; a_m \qquad \ldots\ldots\ \ldots \qquad \textbf{(B)}$$

$$F_m \; \alpha \; M_m \qquad \ldots\ldots\ \ldots \qquad \textbf{(C)}$$

Similarly $F_e \; \alpha \; M_e \qquad \ldots\ldots\ \ldots \qquad$ **(D)**

According to Newton’s third law of motion:

$$F_m = F_e \qquad \ldots\ldots\ \ldots \qquad \textbf{(E)}$$

Combining all we get:

$$F_m \; \alpha \; \frac{M_m M_e}{R^2}$$

Similarly $F_e \; \alpha \; \frac{M_m M_e}{R^2}$

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<td>Derive the relation for variation in g with depth .</td>
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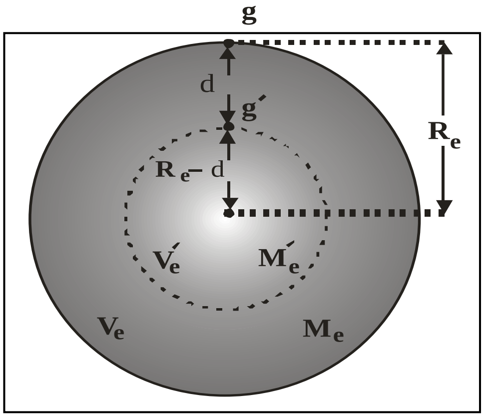
If g and g’ be the acceleration due to gravity at the surface of the earth and at depth d below earth surface then we can write:



$g = \dfrac{G M_e}{R_e{}^2}$ ….. Eq. (i)

$g' = \dfrac{G M'_e}{\left(R_e - d\right)^2}$ …. Eq. (ii)

Dividing Eq. (ii) by Eq. (i)

$\dfrac{g'}{g} = \dfrac{\dfrac{G M'_e}{\left(R_e - d\right)^2}}{\dfrac{G M_e}{R_e{}^2}}$

$\dfrac{g'}{g} = \dfrac{\cancel{G} M'_e}{\left(R_e - d\right)^2} \times \dfrac{R_e{}^2}{\cancel{G} M_e}$

$\dfrac{g'}{g} = \dfrac{M'_e}{M_e} \; \dfrac{R_e{}^2}{\left(R_e - d\right)^2}$ … Eq. (iii)

As we know that density of the earth is the ratio of mass of earth to the volume of earth. Mathematically it can be expressed as

$\rho_e = M_e / V_e$

$M_e = \rho_e V_e = \rho_e \dfrac{4}{3} \pi R_e{}^3$ ... Eq. (iv)

$M'_e = \rho_e V'_e = \rho_e \dfrac{4}{3} \pi \left(R_e - d\right)^3$ … Eq. (v)

By Dividing Eq(iv) by Eq(v)

$\therefore \dfrac{M'_e}{M_e} = \dfrac{\cancel{\rho_e} \cancel{\dfrac{4}{3}} \cancel{\pi} \left(R_e - d\right)^3}{\cancel{\rho_e} \cancel{\dfrac{4}{3}} \cancel{\pi} \; R_e{}^3}$

$\dfrac{M'_e}{M_e} = \dfrac{\left(R_e - d\right)^3}{R_e{}^3}$ We put in Eq(iii)
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$$\frac{g'}{g} = \frac{\cancel{(R_e - d)}^3}{\cancel{R_e}^3} \times \frac{\cancel{R_e}^2}{\cancel{(R_e - d)}^2}$$

$$\frac{g'}{g} = \frac{R_e - d}{R_e}$$

$$\frac{g'}{g} = \frac{\cancel{R_e}}{\cancel{R_e}} - \frac{d}{R_e}$$

$$g' = g\left[1 - \frac{d}{R_e}\right]$$

This shows that acceleration due to gravity decreases with depth.

<u>At The Center Of The Earth</u>

Acceleration due to gravity at the centre of the earth can obtained by replacing **d** *by* R_e *in above equation.*

$$g' = g\left[1 - \frac{R_e}{R_e}\right]$$

$$g' = g\,[\,1 - 1\,]$$

$$\boxed{g' = 0}$$

This shows that acceleration due to gravity at the centre of the earth is zero.

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<td>7.</td>
<td>A body is projected with the velocity V_o and by making an angle θ with horizontal then derive an expression for i)Time taken to reach the highest point ii) Total time of flight iii) Maximum height reached. iv) Horizontal range</td>
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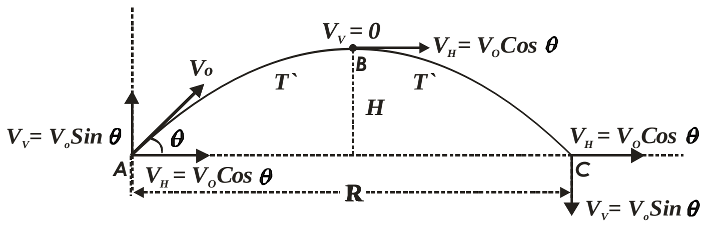

Principle:

The motion of a projectile is a two dimensional motion horizontal motion as well as vertical motion both motion take place independent of each other.

Characteristics:

If a body projected with the velocity V_o and by making an angle θ with horizontal then velocity of a body can be resolved into two rectangular component, horizontal component and vertical component.

Horizontal Component:

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<td>B</td>
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Horizontal component of a velocity $\boldsymbol{V_o \, Cos\, \theta}$ *remain unchanged throughout projectile motion.*

Vertical Component:

Vertical component of a velocity $\boldsymbol{V_o \, Sin\, \theta}$ *continuously effected by the force of gravity and it will decreases when a body moves upward and it become zero at extreme height after this the projectile reverse its vertical direction and returns to the earth striking the ground as the initial speed of the projectile.*

Vertical Motion A to B :

$V_i = V_o Sin\theta$

$V_f = 0$

$a = -g$

$t = T'$ *(Time required to reach maximum height)*

$S = H$ *(Maximum height)*

Time Required to Reach Maximum Height " T′ "

According to the first equation of motion

$V_f = V_i + a\,t$

$0 = V_o Sin\theta + (-g)\,T'$

$g\,T' = V_o Sin\theta$

$$T' = \frac{V_o\, Sin\theta}{g}$$

Time of Flight " T " :

It is the total time taken by the projectile to return to the same level from where it was thrown, it is equal to twice the time taken by the projectile to reach the maximum height.

$T = 2\,T'$

$$T = 2\,\frac{V_o\, Sin\theta}{g}$$

Maximum Height or Vertical Range " H " :

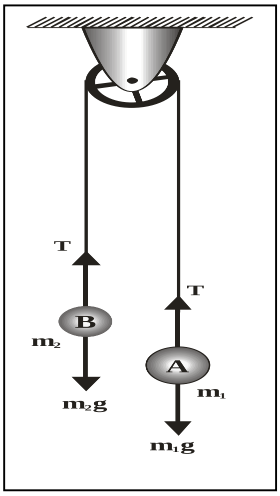
According to third equation of motion

$2\,a\,S = V_f^2 - V_i^2$

$2\,(-g)\,H = (0)^2 - (V_o Sin\,\theta)^2$

$-2\,g\,H = 0 - V_o^2\, Sin^2\theta$

		$H = \dfrac{-V_o^2 \sin^2\theta}{-2g}$ => $H = \dfrac{V_o^2 \sin^2\theta}{2g}$ ***Range OR Horizontal Range:*** *Range is the total horizontal distance. In order to calculate horizontal range we shall consider horizontal motion of the projectile.* $\therefore$ $S = V\,t$ ***Here*** $V = V_o \cos\theta$ ***If*** $S = R$ ***Then*** $t = T = \dfrac{2V_o \sin\theta}{g}$ ***We put in above*** $R = V_o \cos\theta \left(\dfrac{2V_o \sin\theta}{g}\right)$ $R = \dfrac{V_o^2\ 2\sin\theta\cos\theta}{g}$ ***Since*** $2\sin\theta\cos\theta = \sin 2\theta$ ***We put in above*** $\boxed{R = \dfrac{V_o^2 \sin 2\theta}{g}}$ ***Maximum Range:*** *For a given velocity of projection and at a given place, the value of R will be maximum when the value of $\sin 2\theta$ is maximum i.e. 1.* $R = R_{max}$ ***If*** $\sin 2\theta = 1$ $2\theta = \sin^{-1}(1)$ $2\theta = 90°$		

		$\theta = \dfrac{90°}{2} = 45°$		
8.	***Derive an expression for tension in the string and the acceleration of the system when two bodies move vertically?***	***Construction:*** *Consider two bodies **A** and **B** of mass m_1 and m_2 respectively are connected by a string which passes over a frictionless pulley if $m_1 > m_2$ then body **A** move downwards and body **B** move upwards with same acceleration as shown in fig*  ***Downward motion:*** *If **F** is the amount of force with which the body **A** move down wards then according to Newton's second law of motion:* $F = m_1 a$ *But* $F = m_1 g - T$ *By Comparing both we get* $m_1 a = m_1 g - T$ …… ***Eq. (i)*** ***Upward motion:*** *If **F** is the amount of force with which the body **B** move upward then According to Newton's second law of motion:* $F = m_2 a$ *But* $F = T - m_2 g$ *By Comparing both we get* $m_2 a = T - m_2 g$ …… ***Eq. (ii)*** ***Calculation o f "a":***	**K/A**	**B**

		To calculate the acceleration 'a' adding eq. (i) and (ii) we get: $m_1a = m_1g \cancel{-T}$ $m_2a = \cancel{T} - m_2g$ $m_1a + m_2a = m_1g - m_2g$ $a(m_1 + m_2) = (m_1 - m_2)g$ $a = \dfrac{(m_1 - m_2)g}{(m_1 + m_2)}$ *This is required expression of acceleration.* ***Calculation of "T":*** *Tension in the string can be calculated by dividing Eq.(i) by (ii)* $\dfrac{m_1a}{m_2a} = \dfrac{m_1g - T}{T - m_2g}$ $m_1(T - m_2g) = m_2(m_1g - T)$ $m_1T - m_1m_2g = m_1m_2g - m_2T$ $m_1T + m_2T = m_1m_2g + m_1m_2g$ $T(m_1 + m_2) = 2m_1m_2g$ $T = \dfrac{2m_1m_2g}{m_1 + m_2}$ *This is required expression of tension.*		
9.	**Define scalar product. Give example and property.**	**<u>Scalar Product</u>** *"The product of two vectors in which result become a scalar quantity called scalar product or dot product"* *"It is the product of the magnitude of the first vector and projection of second vector on to the direction of first vector".* **<u>Explanation:</u>** If we have two vectors $\vec{A}$ ***and*** $\vec{B}$ which make an angle θ with respect to each other then scalar product or dot product can be defined as: $\vec{A} \bullet \vec{B} = \lvert \vec{A} \rvert B_A$ *eq (i)* Here ***"B_A"*** denotes the projection of vector $\vec{B}$ along the directionofvector $\vec{A}$ .To obtain ***"B_A"*** we draw a perpendicular from the terminal point of vector $\vec{B}$ to vector $\vec{A}$ at point ***"Q"***.As shown in fig	**K/A**	**B**

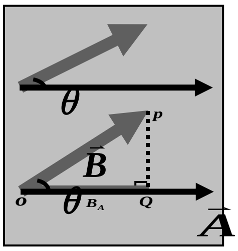
$$Cos\theta = \frac{Base}{Hyp}$$

$$Cos\theta = \frac{B_A}{|\vec{B}|}$$

$$|\vec{B}|Cos\theta = B_A$$

$B_A = |\vec{B}|Cos\theta$ *We put in e.q (1)*

$$\vec{A} \bullet \vec{B} = |\vec{A}||\vec{B}|Cos\theta$$



Example:

I) The product of two vectors Force ($\vec{F}$) and displacement ($\vec{d}$) is equal to work which is a scalar quantity.

$$\vec{F} \cdot \vec{d} = w$$

/ii) The product of two vectors Force ($\vec{F}$) and Velocity ($\vec{V}$) is equal to power ($\vec{P}$) which is a scalar quantity.

$$\vec{F} \cdot \vec{V} = P$$

iii) The product of two vectors Electric intensity ($\vec{E}$) and displacement ($\vec{d}$) is equal to potential difference ΔV which is a scalar quantity.

$$\vec{E} \cdot \vec{d} = \Delta V$$

Properties:

$\vec{A} \cdot \vec{B} = AB$ *If θ= 0°*

$\vec{A} \cdot \vec{B} = O$ *If θ= 90°*

$\vec{A} \cdot \vec{B} = -AB$ *If θ= 180°*

$\vec{A} \cdot \vec{A} = A^2$ ***and*** $\vec{B} \cdot \vec{B} = B^2$

$\vec{A} \cdot \vec{B} = \vec{B} \cdot \vec{A}$ *(Commutative property)*

$\vec{A} \cdot (\vec{B} + \vec{C}) = \vec{A} \cdot \vec{B} + \vec{A} \cdot \vec{C}$

(Distributive property)

$$n\vec{A} \cdot m\vec{B} = nm\,\vec{A} \cdot \vec{B}$$

(m and n are any numbers)

$$\hat{i} \cdot \hat{i} = \hat{j} \cdot \hat{j} = \hat{k} \cdot \hat{k} = 1$$

$$\hat{i} \cdot \hat{j} = \hat{i} \cdot \hat{k} = \hat{j} \cdot \hat{i} = \hat{j} \cdot \hat{k} = \hat{k} \cdot \hat{i} = \hat{k} \cdot \hat{j} = 0$$

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