SURE WAY TUTORIALS

ABIA STATE UNIVERSITY UTURU

DEPARTMENT OF PHYSICS

2020/2021 FIRST SEMESTER

PHY 101: GENERAL PHYSICS 1

NUMBER 1A

Write down any 4 fundamental quantities and units

Note: Fundamental quantities are those quantities that are independent or does not depend on/any other quantity.

Their units are called fundamental units

ANSWERS

S/N	Fundamental Quantities	Units
1.	Length	Meter(m)
2.	Time	Seconds (S)
3.	Mass	Kilogram (kg)
4.	Current	Ampere (A)
5.	Temperature	Kelvin(K)

NUMBER 1B

What are the multiples of the following

i. Femto
ii. Pico
iii. Mega
iv. Tera

Hint: Read extensively in page 2 of the PHY 101 Textbook

While solving all quantities must be converted to it's S.I Unit

ANSWER

Prefix	**Multiple**
Femto -	10^{-15}
Pico -	10^{-12}
Mega -	10^{6}
Tera	10^{12}
Centi	10^{-2}

NUMBER 1C

Using dimensional analysis. Derive the unit of pressure

Hint: Dimension of a physical quantity shows the physical quantity is related to the fundamental quantities, MLT i.e mass, length and time respectively(Read Pg 4 of PHY 101).

ANSWER

Pressure $= \frac{\text{Force}}{\text{Area}}$

Dimension for force = MLT^{-2}

Dimension for area = LxL

Unit for force = $Kgms^{-2} \rightarrow N$

Unit for area $= M^2$

Hence unit of pressure will be $Kgm^{-1}S^{-2}$ or Nm^{-2}

SURE WAY TUTORIALS

NUMBER 2A

Define vector and scalar quantities and give 3 examples each

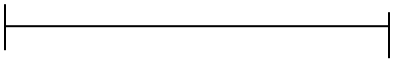
Answer

Vector quantities are those quantities with magnitude (numerical value) and direction

Examples

i. Displacement
ii. Velocity
iii. Acceleration

Scalar quantities that has magnitude but no direction



Examples

i. Distance
ii. Speed
iii. Mass

NUMBER 2B

If vector a = I + 2j – 3k and b = 2i = 3j + 4k. Find vector c such that 2a -3b + c = O

SOLUTION

This is a simple algebra, first you will find the magnitude of a and b, then we will substitute to get c

First step

a = i + 2j – 3k

= $\sqrt{12 + 22 - 32}$ = $\sqrt{1} + 4 + 9 = \sqrt{14}$ = 3.7

b = 2i – 3j + 4k

$=\sqrt{22-32+42}$ $=\sqrt{4+9+16}$ = $\sqrt{29}$ = 5.3

Hence

2a – 3b + c = 0

a = 3.7

b = 5.3

2(3.7) – 3(5.3) + C = 0

7.4 – 15.9 + C = 0

- 8.5 + C = 0

C = 0 + 8.5

C = 8.5

3Ai

What is the difference between average velocity and instantaneous velocity?

Answer

Average velocity/speed of a particle is defined as the ratio of the total distance/displacement travelled to the total time taken

While

Instantaneous velocity at any point on the curve at time "t" is the limit of the ratio Dx/Dt as Dt approaches zero mathematically

$V = \frac{change\ in\ displacement}{time\ taken} = \frac{Dx}{Dt}$

Read extensively in page 12 of PHY101 text

3Aii

A car travels with a certain average velocity in half a minute and covers 900m. find the average velocity

Answers

Average velocity = total displacement / total time take

Total displacement = 900m

Time taken = ½ of a minute = 30 seconds

$= \frac{900}{30}$ = 30m/s

Read extensively in page 13 of your phy 101. Also join our online tutorials

3b

A store is thrown with a velocity of $5ms^{-1}$ at an angle of 300 to the horizontal.

Calculate

i. Time of flight
ii. Maximum height attained
iii. Range (take g=10s-2)

Hints: Questions comes from projectile motion

In projectile motion we talk about 3 things

Time of flight = $\frac{2Usin\square}{g}$

Maximum height $= \frac{U^2 \sin^2 \theta}{2g}$

Range $= \frac{U^2 \sin 2\theta}{g}$

Where U is the velocity at which the particle is been projected

Read extensively in 22 of PHY Test. Also join our only tutorials for more understanding

Answers

U =5ms^{-1}, 0 = 30^0

Time of flight $= \frac{2U\sin\theta}{g} = \frac{2x5xsin30}{10} = 0.5sec$

Maximum height $= \frac{U^2 \sin^2 \theta}{2g} = \frac{52sin302}{2x10} = 0.625m$

Range $= \frac{U^2 \sin^2 \theta}{g} = \frac{52sin2(30)}{10} = 2.16m$

Number 4a

i. State the following laws
ii. Newton's second law
iii. Netwon's gravitational law

iv. Kepler's third law of planetary motion

ANSWERS

i. Newton's second law of motion states that "the applied force (f) is directly proportion to the rate of change of momentum and takes place in the direction in which the force acts

ii. Newton's gravitational law states that all object directly proportional to the product of the masses and inversely proportional to the square of the distance between it

iii. Kepler's third law of planetary motion states that "kepler formulated three laws known as keeplers laws of planetary motion

First law is "law of orbit" Each planetary moves in its own ellipitical orbit with the sun at one focus

Second law is the "Area law" the line joining any planet and sun sweeps out equal areas in equal interval of time.

Third law is the period law" which states that the square of the period of revolution of any planet about the sun is proportional to the cube of the planet mean distance from the sun

4b

A block of mass 20kg is pulled with force 10N. Find the acceleration of the block if

i. The block is pulled horizontally

ii. If the pulling force is acting at an angle 300 with the horizontal

Solution

Using F = ma

F = 10N, M = 20kg, a = ?

$10 = 20 \times a$, $a = \frac{10}{20} = 0.5ms^{-2}$

iii. At angle of 300

F = macosϴ, ϴ = 300

$a= \frac{F}{m\cos\square}$

$a = \frac{10}{20x\cos 30} = 0.577ms^{-2}$

5Ai

State the law of conservation of energy

Answer

Law of conservation of energy states that in a given or closed system, energy can neither be created nor destroyed, i.e (the total amount of energy is constant) but it can be converted from one form to another.

5Aii

i. Light energy
ii. Heat energy (thermal energy)
iii. Mechanical energy

5b

Determine the kinetic energy of a girl of mass 40kg running with a velocity of $3ms^{-1}$

Answer

K.E = ½ MV^2

M=40kg , V= $3ms^{-1}$

K.E = ½ MV^2

M = 40kg, V = $3ms^{-1}$

K.E = ½ x 40 x 30 = 60J

5C

A block and tackle pulley system with velocity ratio 4 is 20% efficient. Calculate

i. The mechanical advantage

ii. The effort that can support a load of 80N

Answer

i. Mechanical advantage of a machine is the ratio of the load to be lifted by a machine to the applied effort

$$M.A = \frac{\text{Load}}{\text{effort}}$$

Efficiency of a machine (E) = mechanical advantage/ velocity ratio x 100/1

Tence E = 20%

M.A = ?

V.R = 4

$$\frac{20}{1} = \frac{M.A}{4} \text{ X } \frac{100}{1}$$

$$\frac{20}{1} = \frac{100M.A}{4}$$

$$M.A = \frac{80}{100} = 0.8$$

ii. The effort that can support a load of M.A = 0.8 M.A = Load/Effort

Load = 80N

Effort = ?

$$0.8 = \frac{80N}{Effort}$$

Effort =100N

6ai

Define the center of mass of a solution

iii. Locate the centre of mass of three particles M1= 5.0kg, M2= 7kg and M3=10kg. located (4,3), (2.5) and (-1, 2) respectively. Coordinate in meter.

Answers

Centre of mass vector "xcm" is weighted average of the individual position vectors and it can be described as the average position of all the mass in a system.

6aii

Using

Xm = m1x1+m2x2+m3x3/ m1 + m2 + m3

Xm = 5(4) + 7 (2) + 10 (-1) / 5 + 7 + 10 / 20 + 14 -10/22 = 1.09m

Ym = m1y1 + m2y2 + m3y3/ m1 + m2 + m3

= 5(3) + 7 (5) + 10 (2) / 5 + 7+ 10 = 15 + 35 + 20/ 20 = 3.18m

The point (xm, ym)

Read extensively in page 75 of the physics 101 text book

Also join our online tutorials

6bi

State the law of conservation of linear momentum

ii

A car of mass 1200kg travelling at $10ms^{-1}$ collides with a stationary car of mass 1000kg. if the cars lock together, find their combined speed

Answers

The law of conservation of linear momentum states that in a system of isolated bodies, momentum is conserved (momentum collision is equal to momentum after collision)

6bii

$M1U1 + M2U2 = M1 + M2 (V)$

$M1 = 1200kg$

$U1 = 10MS^{-1}$

$M2 = 1000kg$

$U2 = OMs^{-1}$

$U = ?$

$1200 \times 10 + 1000 \times 0 = 1200 + 1000(U$

$1200 = 2200V$

$V = \frac{1200}{2200} = 5.45ms^{-1}$

Read extensively in page 52 of this physics 101 text book

Also join our online tutorials

7ai

State the conditions for a body to be in equilibrium

Answers

i. A body will be at equilibrium when the algebra sum of moment around. It is equal to zero
ii. A body will also be at equilibrium when all the force acting around it is equal to zero

ii

Give two examples of structures that are said to be in static equilibrium

i. A cone resting on its base
ii. A bottle or bell resting on its base

7b

Define friction, write down three advantages of friction and two different ways friction can be reduced

Answer

Friction is defined as any force that acts in the direction as to oppose motion

Advantages of friction

i. Walking and running are possible because of friction
ii. It is utilized in the fan belts used over wheels or pulleys in machine
iii. When we apply our brakes on moving vehicles, friction is brought into play to stop the movement
iv. Friction assists in sharpening of knives and tools
v. Nails hold piece of wood together because of friction existing between the nail and the wood

Ways to reduce friction

i. By application of grease and oily/wary substances
ii. By use of ball bearings

8ai

Write down two differences between weight and mass

Answers

S/N	Weight	Mass
1.	Force of attraction of earth on every body	Quantity of matter in a body
2.	Weight is a vector quantity	Mass is a scalar quantity
3.	Measured in Newton (N)	Measured in Kg

8Aii

What is the weight of 78kg object on earth ($g = 9.8ms^{-2}$) and on the moon? ($g = 1.7ms^{2}$)

Answer

On earth W = mg = 78 x9.8 = 76.4N

On Moon mg = 78 x 1.7 = 132.6N

8b

Conservation force fields are

i. Gravitational field
ii. Electric field

They are called conservation field because work done in the field depends only on position but not on the path.

8bii

A car of mass 500kg moving with a forward acceleration of $6ms^{-2}$ is acted upon by a constant resistive force of 800N. calculate the force exerted from the engine to maintain this forward acceleration.

Solution

Let F be the force of the engine hence resultant force action on the car = F-800

A= $6ms^{-2}$, M = 500kg

We have

F – 800 = 500 x 6

F = 3000 + 800 = 3800N

Read extensively in page 51 of the PHY 101 text book

9A

Write down the mathematical expression of the following (i)Hooke's law (ii) Tensile stress (iii) Tensile strain (iv) Calculate the force constant of a rubber stretched 15cm with a force of 12N

9A

Hooke's law, F = Ke

Tensile Stress S = $\frac{F}{A}$

Tensile strain = $\frac{e}{l_o}$

V. F = Ke

F = 12N, e = 15cm = 0.15m, K=?

12 = 0.15k

K = $\frac{12}{0.15}$ = $80Nm^{-1}$

9b

Define impulse and momentum

Answer

Impulse is defined as the change in momentum of a body or the product of force and time of a body in motion, it is a vector quantity measured in NS or Kilogram/ meter per second / $kgms^{-1}$

Momentum is a vector quantity which is defined as the product of mass and velocity of a body measured in $Kgms^{-1}$

9bii

A body of mass 6kg moving with a speed of $20ms^{-1}$ is suddenly hit by another body moving in the same direction thereby changing the speed of the former to $50ms^{-1}$. What is the impulse received by the body.

Answer

Impulse = change in momentum

$I = m(V-U)$

$I = ?$, $M = 6kg$, $V = 50ms^{-1}$, $U = 20ms^{-1}$

$I = 6 (50-20)$

$= 6(30) = 180Ns$ or $180kgms^{-1}$

SURE WAY TUTORIALS

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DEPARTMENT OF PHYSICS

2019/2020 FIRST SEMESTER EXAMINATION COMPILE BY EMPEROR SOLUTIONS

1a

Write the multiple of the following Nano, Exa, Atto, Pico, Hector, Tera

Answers

Prefixes	**Unit**
Nano	10^{-9}
Hecto	10^{2}
Exa	1018
Atto	10-18
Tera	1012

1b

Define the following (i) average speed (ii) instantaneous acceleration (iii) SI unit

Answers

i. Average speed of a particle is defined as the ratio of the total distance travelled to the total time taken

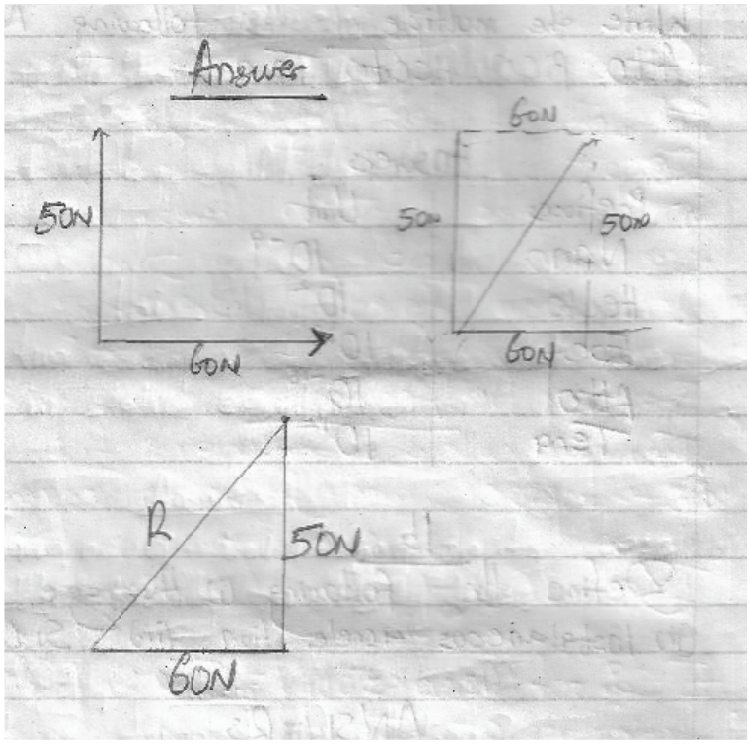
ii. Instantaneous acceleration: This is the limit of the ratio $\frac{DV}{Dt}$ at Dt approaches zero

iii. SI unit (system international unit): This is the current unified system of measurement generally accepted internationally for measurement of quantities

1C

Suppose two vectors P and Q with magnitude 50N and 60N are acting at right angles to each other, find the magnitude and direction of the resultant vector

Answer



Using Pythagoras theorem

$R^2 = 50^2 + 60^2$

$R\ \sqrt{50^2 + 60^2} = \sqrt{2500 + 3600} = \sqrt{6100} = 78N$

To calculate for the direction

$\text{Tan}\Theta = \frac{P}{Q} = \frac{50}{60}$

$\Theta = \text{Tan}^{-1}\left(\frac{50}{60}\right) = 39.80$

Resultant force = 78.1N, direction $\Theta = 39.80$

1di

Law of inertia is the Newton first law of motion which states that "An object will continue in its state of ret or uniform motion unless it is acted upon by an external force.

1dii

A block of 20kg mass is pulled horizontally by a force of 10N along a frictionless floor. Find the acceleration of the body

Answer

F= ma
F= 10N, M=20kg, a=?
10 = 20 x a
$a = \frac{10}{20} = 0.5\text{ms-2}$

C

Write 4 forms of energy and state the principle of conservation of linear momentum

Answers

1. Light energy
2. Heat energy
3. Chemical energy
4. Mechanical energy

1g

Principle of conservation of linear momentum states that in a system of isolated bodies, momentum is conserved (i.e momentum before collision is equal to momentum after collision

Repeated question check 2020/2021
Write down the mathematical expression of the law in two dimension (x and y)

Answer

MiVix + M2U2x = M1v1x + M2V2x

M1v1g + M2U2g = M1U1g + M2V2g

1hi

Give two example of structure that are said to be in static equilibrium

Answers

A cone or a bell resting on its base
A bottle restin on its base

1hii

What is damped oscillation?
Damped oscillation is an oscillation where the amplitude gradually becomes smaller and smaller with time as a result of dissipation of smaller energy arising from the viscosity of air.

Read extensively from page 104 of the physics text book. Also join our online tutorial.

1i

Write down the mathematical expression of efficiency, hooke's law, co-efficient of restitution. Calculate the force constant of a rubber stretched 0.15m with a force of 12N

Answer

Hooke's law states the force on an elastic material is directly proportion to the length extended provided the elastic limit is not exceeded

Mathematically

Fα e, F =ke where k is a constant called elastic constant or elastic stiffness in Nm-1(Newton per meter)
F is the force used for extortion in Newton (N)
E is the length extended in m

Newtons law of restitution states the relation between the velocities after collision V1 and V2 of two colliding bodies and their velocities U1 and U2 before collision is given as:
V2 – V2 = -e(V1 – U2) where e is for elastic collision

F = Ke
F= 12N e = 0.15
K?

R = K x 0.5
K = 24Nm^{-1}

Read extensively from page 141 and Newton's law of motion in the PHY 101 Textbook also join our online tutorial

1J

Defined density. Write down the characteristics pressure in liquids

Answer

Density (p) is the mass of a substance per unit volume of an object

Mathematically =

Density =$\frac{mass}{volume}$

It is a scalar quantity measured in kgm^{-3}

Characteristics of pressure in liquids

Pressure: Height x density x acceleration due to gr
P = pgh

1. The pressure in liquid increases in direct proportion to the depth of the liquid
2. The pressure in different liquids at the same depth varies directly with density
3. The pressure at any point in the liquid acts equally in the directions
4. The pressure at all points at the same level within a liquid is the same

1K

Write down the categories of equilibrium of an object

Answers

i. Stable equilibrium: this occurs when the torques or forces that arise from a small displacement of the object urges on brings the object back towards its equilibrium position
ii. Unstable equilibrium: This occurs when the forces or torques that arise from small displacement of the object back towards its equilibrium position
iii. Neutral equilibrium: this occur when there is no torque or force that moves it either back to its original position

2A

State 3 applications of dimensional analysis

ANSWER

1. Verification of corrections of physical equation by method of dimension
2. Derivation of units of quantities by method dimension
3. Derivation of exact form of a relation between measured quantities using dimension

Read extensively from page 5 of the PHY 101 text

2b

Consider a small ball of radius falling through a viscous liquid of viscosity n with a velocity V. derive the exact form of relation between the viscous force F experienced by the ball and r, n and v given that:

$$F = kr^x \eta^y v^z$$

Where K is a dimensionless constant

Answer

The dimension of F is MLT^{-2}, N = $ML^{-1}T^{-1}$, r =L and V=L T^{-1}

Substituting in the above equation we get
$MLT^{-2} = My\ (Lx \times L^{-y} \times L^z)\ T^{-y} \times T^{-z}$

$MLT^{-2} = My.\ Lx^{-y+z}.\ T^{-y-z}$

Equating the powers

For $\frac{M}{Y} = 1$, For $\frac{L}{1} = x - y + Z$ for $\frac{T}{-2} = -Y-Z$

$-2 = -(1) - Z$
$-Z = -1$, $Z = 1$, $Y = 1$, $X = 1$

The correction equation is $F = Kr\eta v$

3a

Given two vectors; a=i + 2j – 3x , b=2i – 3j + 4k
Calculate (i) a – b (ii) (3a + 2b)

i. a= i + 2j – 3k
b = 2i + 3j + 4k

(a-b) = (i + 2j – 3k) – (2i + 3j + 4k)
= i + 2j – 3k – 2i – 3j – 4k
= -i + 5j – 7k

ii. 3a + 2

iii. 3 (i + 2j – 3k) + 2 (2i + 3j + 4k)

=3i + 6j -9k + 4i + 6j + 8k

=7i –k

3b

A stone is thrown with a velocity of $5ms^{-1}$ at an angle of 300 to the horizontal. Calculate the time of flight, maximum height H. Range(take g = $10ms^{-2}$).

Repeated question

Solution

Check 2020/2021 pass questions(repeated question)

T. time of flight = $\frac{2U\sin\theta}{g}$

U= 5m5, Ɵ = 300

$= \frac{2X5XSin30}{10} = 0.55$

Maximum height = $\frac{U^2\sin^2\theta}{2g}$

$=\frac{52x(\sin30)^2}{2x10}$

$=\frac{25\ x\ 0.25}{20} = 0.3125m$

Range = $\frac{U^2\sin^2\theta}{g}$

$=\frac{52x\sin^2 x\ 30}{10} = 25\ x\ \frac{sin60}{10} = 2.16m$

Check 2020/2021 repeated

4a

Mathematically define most of a couple
Moment of a couple r =Fd

Read extensively from page 51 of the physics textbook

4b

A car of mass 4kg undergoes a constant horizontal acceleration of $3ms^{-2}$.
Calculate the resultant horizontal force acting on the body.
What will be the resultant force on the body when it moves with a uniform velocity of $6ms^{-1}$?

Solution

a= $3ms^{-2}$, m=4kg

Newton's second equation

f =ma, f =12N

If the body moves with uniform velocity, it means that it is not accelerating i.e a=0, therefore resultant force on the body is zero

Read extensively from pag 51 of the phy101 text book

4C

Define the following: (i) perfectly elastic collision (ii) center of gravity (iii) work (iv) mechanical advantage (v) impulse

Solution

i. **Perfectly elastic collision:** This is a type of collision where the two bodies moves at different direction after collision. Both momentum and kinetic energy are conserved

ii. **Center of gravity:** Centre of gravity of a body is defined as the point through which resultant weight acts
iii. **Work:** work is done when a body of mass is pulled along a horizontal plane by a constant force F and moves a distance S measured in Nm or joules(J)
iv. **Mechanical advantage:** The mechanical advantage of a machine is the ratio of head to be lifted or overcome to the effort applied
v. **Impulse:** Impulse is the change in momentum of a body or the product of force and time of a moving body. It is a vector quantity measured Ns or $kgms^{-1}$

5a

State 3 advantage of friction
Repeated question check 2020/2021 question

i. Walking and running are possible because of friction
ii. It is utilized in fan/belts over wheels or pulleys in machine
iii. When we apply our brakes on moving vehicles friction is brought into play to stop the movement
iv. Friction assists in sharpening of knives and tool
v. Nails hold pieces of wood together because of friction between the nail and the wood

READ EXTENSIVELY FROM PAGE 128 OF THE PHYSICS 101 TEXT BOOK

5B

A mass of 2kg is attached to the end of a vertical wire of length 2m and diameter 2mm extend the wire by 1mm.
Calculate the young modules of the wire ($g=10ms^{-2}$)

Solution

Young modules $= \frac{stress}{strain}$

Young module = ?

Stress $= \frac{force}{area}$

F= mg= 2x10 = 20N
Area =πr2

Diameter = 2mm, 0.002m

Radius = $\frac{0.002}{2}$ = 0.001m

Area = $\frac{22}{7}$ x 0.0012 = 3.14 x 10-6 m^2

Stress = $\frac{20}{3.14x10-6}$ = 6366197.7Nm^2 = $6.366x10^5$

Strain = $\frac{\text{extension}}{\text{initial length}}$ = $\frac{0.001}{2}$ = $5x10^{-4m}$

Young modules = $\frac{6.3x10\ -5}{1.26x109Nm-2}$

5C

List the energy transformation in (i) refrigerator (ii) moving vehicle

5C

Electric energy ⟶ heated light energy
Moving vehicle

Chemical energy ⟶ kinetic energy

6a

Circular motion is a type of motion of a body along a circular path such that the force of the motion acts towards the center of the circle. In circular motion, velocity of the body is changing as a result of constant change in direction of the body while the speed remain constant.

Example of circular motion includes; merry go round, motion of fan blade, motion of car tyre etc

Simple harmonic motion is the to and fro motion along a straight line under the influence of force so that its acceleration towards a fixed point (or equilibrium) is proportional to its distance or displacement from that point

6b

A pump is used to spray water from a pool to form a fountain. Determine the minimum power of the pump if it ejects 60kg of water per minute and the spray reaches an average vertical height of 5m(Assume mass of 1cm3 of water = 1kg, g = $10ms^{-2}$)

Solution

Power = mass x acceleration due to gravity x height / time

Mass = 60kg
g = $10ms^{-2}$
h=5m
t=1min =60s
Power = $\frac{60x10x5}{60}$ = 50watts

Read extensively from page 66 of the physics 101 text book

Also make sure you join our online tutorials

6c

What is the weight of a 85kg astronaut on earth (g =$10m/s^{-2}$) b. on the moon (g =$1.7ms^{-2}$)

Hint: repeated question in 2020

Answer

Weight on earth g =$10ms^{-2}$
85x10 m=85kg
W=850N

Weight on the moon g = $1.7ms^{-2}$
W= 85 x 1.7 = 144.5N

6D

Define machine

Answer 9

Machine is a device by mens of which an effort (E) applied on one point can be used to overcome a load (L) at some other points

Or

A machine can also be said to be a device which enables a large weight or resistance to be overcome by a small effort
Examples are, pully systems. Car lifting jacks

Read extensively from page 66 of the physics text book

7a

A particle of mass 0.4kg is subjected to two forces F1 = 2i – 4j and F2 = -2.6i + 5j in newton. If the particle starts from rest at the origin at t = O. find its position and velocity at t = 1.6 s

Solution

The net force acting on the particle is the vector sum of the two forces in newton

Fnet = F1+ F2 (2i – 4j) + (-2.6i + 5j) = - 0.6i + 1.0j

The acceleration

$a = \frac{Fnet}{} = -06i + \frac{1.0j}{0.4}$

$= (1.5i + 2.5j)\frac{m}{s^2}$

Hence ax = $\frac{1.5\text{m}}{s^2}$ ay = $\frac{2.5m}{s^2}$

Since the particle starts from rest of the origin O, its x and y co-ordinates at t=1.6s are
X= ½ ax t2 = ½ (-1.5 x 1.62) = - 1.92m

Y= ½ ayt2 = ½ (2.5 x 1.62) = 3.30m

The x and y components of particle velocity at t = 1.6s are
Vx = ax t = (-1.5 x 1.6) = - 2.40m/s
Vy = ay = (2.5 x 1.6) = 4.0om/s

In vector notation the velocity in m/s of the particle at t =1.6s is

V=(-2.40i + 4.00j) $\frac{m}{s}$

7b
Write the velocity ratio of the following types of machines (i) wheels and axle (ii) incline plane (iii) hydraulic press (iv) screw

Solution
The velocity ratio VR is defined as

VR = Distance moved by effort/ distance moved by load

Each machine has each own velocity

i. Wheel and axle

VR = $\frac{a}{b}$ - $\frac{\text{radius of the wheel}}{\text{radius of the axle}}$

ii. Incline plane

$$V.R = \frac{1}{\sin\square}$$

While Ɵ is the angle of inclination on the plane

iii. Hydraulic press

$$V.R = \frac{R2}{r2} = \frac{\text{Radio of large piston}}{\text{radius of small piston}}$$

iv. Screw

$$V.R = \frac{2\pi a}{p} = \frac{\text{Radius of the screw}}{\text{Pitch}}$$

1. Define fundamental and derived unit. Give 3 examples for each

Answer

Fundamental quantity are those quantity which are independent of other quantities or does not depend of any other quantity. They mass length and time

Fundamental unit are the unit of fundamental quantities. They are independent of other units. They metre, seconds, kilogramme

Example

Mass – Kilogram (kg)
Length – Metre (m)
Time – Seconds

2. Arrange the following prefixes in descending order and write down their value (i) micro (ii) femto(iii) giga (iv) centi (v) pico]

Answer

Prefixes	Multiple
Giga (G)	10^{9}
Centi (C)	10^{-2}
Micro (U)	10^{-6}
Pico(p)	10^{-12}
Femto (F)	10^{-13}

3i

State 3 applications of dimensional analysis

Answers

i. Verification of correctness of a physical equation by method of dimension
ii. Derivation of units of quantities by method of dimensions
iii. Derivation of exact form of a relation between measured quantities using dimensions

3ii

Using the method of Dimension derive the unit of viscosity

Solution

$$\text{Viscosity} = \frac{\text{force}}{\text{area x velocity gradient}}$$

$$= \frac{MLT-2}{L2LT-1L-1} = ML^{-1}T$$

The unit of viscosity is therefore $kgm^{-1}s^{-1}$

4

Suppose the period of oscillation T of a simple pendulum depends on the mass. "M" of the pendulum bob, the Length L of the thread and acceleration due to gravity "g" use the method of dimension to find the correct relations.

Assume

$T= KM^xL^Yg^2$

Where K is a dimensionless constant

Answer

$T = Km^{x}L^{y}(LT^{-2})Z$
$T = Km^{x}LY+2\ T^{-2}Z$

$M_oL_0T_1 = KM^{x}L^{Y}+Z\ T^{-2}Z$

Equating the powers

For $M_{x} = O$
For $L_{y+z} = 0$
For $T_{-2z} = 1$

X=O, $y = \frac{1}{2}$, $Z = -\frac{1}{2}$

Therefore $T = K(\frac{1}{g})$ ½ which is the relation between T, L and g

5

The distance covered by a car at a time "t"

Is given by
$X = 10_t + 8_{t4}$

6

Define the following (i) kinetics (ii) dynamic (iii) average speed (iv) displacement (v) velocity

Answer

i. Kinetics is the study of motion of object without recourse to force responsible for the motion
ii. Dynamics is the study of motion give special consideration to the fore causing the motion

iii. Average speed: Average speed of a particle is defined as the ratio of the distance travelled to the total time

iv. Displacement: This is the distance covered in a specified direction. It is a vector quantity measured in M

7

A stone is thrown with a velocity of Nms^{-1} at an angle of 450 to the horizontal. Calculate the (i) time of flight (ii) maximum height attained (iii) range(take $g=10sm^{-2}$)

Solution

T. time of flight $= \frac{2U\sin\theta}{g}$

$U=10ms^{-1}$ $\Theta = 45^{o}$

$T = \frac{2x10sin45}{10} = \frac{1.4}{s}$

Maximum height $= \frac{U^2\sin^2\theta}{2g}$

$=\frac{10^2 x \sin 45^2}{2x10} = 2.5m$

Range $= \frac{U^2\sin^2\theta}{10g} = 10m$

8

An electron enters a region with a speed 5x106m/s and is slowed down at the rate of -1.25x1014ms^2. How far does the electron travel and what is the total time taken?

Solution

a. Using V2 = U2 + 2as

V= 0ms-1, U = 5x106ms^{-1}, a = -1.25x1014ms^{-2}

02 = (5x106)^2 + 2 x (-1.25 x 1014) x s

S = (5x106) $\frac{2}{2}$ x (1.25x1014) = 0.1m

b. V = u + at
U = 5x106ms^{-1}
a= -1.25 x 1014 t=?

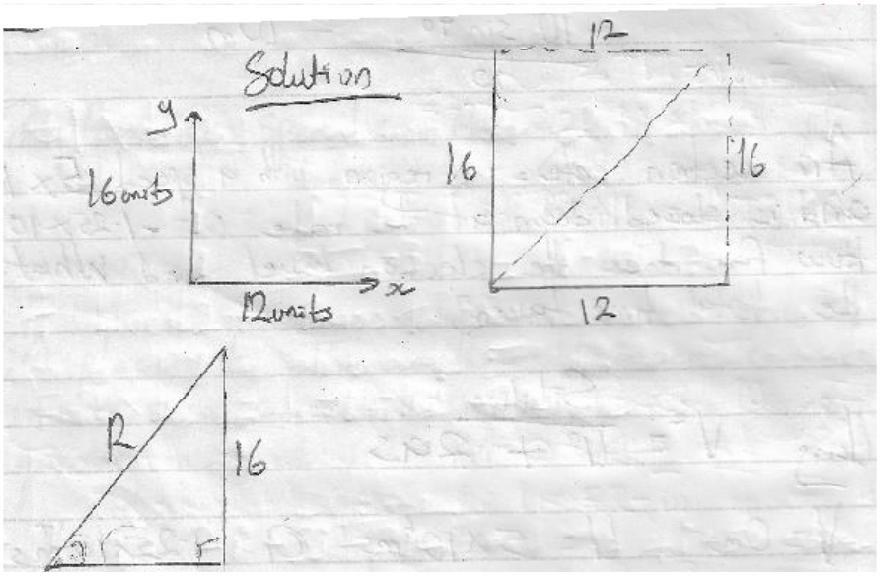
0 = 5 x106 + (-1.25 x1014) x t

T = $\frac{5x106}{1.25x1014}$ = 4.48 x10^{-8} s

9

A vector lying in the x-y plane has x – component of 12 units and y – component of 16 units. What is the magnitude of the vector and the angle it made with the horizontal

Solution



Using Pythagoras theorem

$R2 = 122 + 162$
$R= 144 + 256$
$R2 = 400$

$R= \sqrt{400} = 20$ units

For the angle made

$\text{Tan } \Theta = 16/12 = 1.3$

$\Theta = \tan^{-1}(1.3) = 52.430$

10. Given three vectors a= 2i – 3j + 4k, b = I + 2j – 3k and C=3i + 6j – 4k

Calculate

i. a + b+c
ii. (a+b).c

Solution

a+b+c = (2i-3j+4k) + (i-2j-3k) + (3i+6j-4k
=2i – 3j + 4k + i-2j – 3k + 3i + 6j – 4k
=2i +i+3i-3j-2j+6j+4k-3k-4k
=6i + j – 3k

a+b+c = 6i –j – 3j

ii. (a+b).C
=(2i-3j+4k) + (i+2j-3k) = 3j-j+k
(a+b).c = (3i-j+k). (3i+6j -4k)

=9i -6j -4k

11. Give two vectors a=I +2j-3k. b=2i –3j + 4k. find (i) 3a + 2b (ii) a x b

Solution

a= i+ 2j – 3k
b= 2i +3j – 4k
3a + 2b
3(i+2j -3k) + 2(2i+3j-4k)
3i+6j -9k+ 4i +6j – 3k
=3i + 4i + 6j + 6j – 9k – 8k
= 7i + 12j – 17k

ii. a x b

I	j	K	
1	2	-3	
2	-3	4	= -i-10j-7k

a x b = -1 – 10j – 7k

12. If p = 7i -3j + 2k and q=4i + 5j – 3k
Find (i) The scalar product (p.q)(ii) the cosine of angle between p and q

Answer
The scalar product p.q (7x4) + (-3 x5) + 2x(-3) = 28-15-6 = 7

$\text{Cos } \Theta = \frac{a.b}{/a/b/}$

$\text{Cos } \Theta = \frac{7}{7.9X7.1} = \frac{7}{56} = \frac{1}{8}$

13. what is the weight of a 75kg astronaut (a) on earth g= 10ms^2 and (b) in the moon g=1.7ms^{-2}

Repeated question check 2020/2021

Answer

On earth g = 10ms^{-2}
W= mg = 75 x 10 = 750N

On moon g= 1.7ms^{-2}
W= mg = 75 x 1.7 = 127.5N

14. Define the following terms (i) impulse (ii) inertia of a body (iii)

Answer

i. Impulse is the change in momentum of a body or can be defined as the product of force and time of a moving body. It is a vector quantity measured in kgms^{-1} or Ns

This is a repeated question check 2020/2021 past questions

ii. Inertia of a body: Inertia is the tendency of a body to remain or continue in its state of rest or uniform motion

Newton first law of motion is called law of inertia
This law states that a body will continue in its state of rest or uniform motion, unless it is been acted upon by an external force

iii. **Friction:** This is the force that that acts on the direction as to oppose motion

A repeated question on 2020/2021

10

A block of mass 20kg is pulled with a force 10N at an angle 300 with the horizontal. Find the acceleration of the block

Solution

F= Macos0
F= 10N, m=20kg, 0=300

$A = \frac{F}{mcos\theta} = \frac{10}{20x0.86} = \frac{10}{17.32}$

$a=0.57ms^2$

16a

State the law of conservation of linear momentum

Answer

Law of conservation of linear momentum states that in system isolated or colliding bodies, momentum is conserved (momentum between collision is same to the momentum after collision

16a

The coefficient of restitution is defined as

A boy pulled a load of mass M. 20m along a horizontal plane with a constant force of 10N applied (i) parallel to the plane (ii) in the direction of angle 600

2020/2021 FIRST SEMESTER

PHY 101: GENERAL PHYSICS 1

NUMBER 1A

Write down any 4 fundamental quantities and units

Note: Fundamental quantities are those quantities that are independent or does not depend on/any other quantity.

Their units are called fundamental units

ANSWERS

S/N	Fundamental Quantities	Units
6.	Length	Meter(m)
7.	Time	Seconds (S)
8.	Mass	Kilogram (kg)
9.	Current	Ampere (A)
10.	Temperature	Kelvin(K)

NUMBER 1B

What are the multiples of the following

v. Femto
vi. Pico
vii. Mega

viii. Tera

Hint: Read extensively in page 2 of the PHY 101 Textbook

While solving all quantities must be converted to it's S.I Unit

ANSWER

Prefix	**Multiple**
Femto -	10^{-15}
Pico -	10^{-12}
Mega -	10^{6}
Tera	10^{12}
Centi	10^{-2}

NUMBER 1C

Using dimensional analysis. Derive the unit of pressure

Hint: Dimension of a physical quantity shows the physical quantity is related to the fundamental quantities, MLT i.e mass, length and time respectively(Read Pg 4 of PHY 101).

ANSWER

Pressure $= \frac{\text{Force}}{\text{Area}}$

Dimension for force = MLT^{-2}

Dimension for area = LxL

Unit for force = $Kgms^{-2} \rightarrow N$

Unit for area $= M^2$

Hence unit of pressure will be $Kgm^{-1}S^{-2}$ or Nm^{-2}

ABIA STATE UNIVERSITY, UTURU
DEPARTMENT OF PHYSICS

2018/ 2019 FIRST SEMESTER EXAMINATION
PHY 101: GENERAL PHYSICS 1

INSTRUCTION: ANSWER ALL QUESTIONS TIME: 2HRS

1. Define fundamental and derived units. give 3 examples for each
2. arrange the following prefixes in descending order and write down their values (i) micro (ii) femto(iii) giga (iv) centi (v) pico
3. (i) State 3 applications of dimensional analysis (ii) using the method of dimension derive the unit of viscosity
4. suppose the period of oscillation T of a sample pendulum depends on the mass M, of the pendulum bob, the length L of the thread and the acceleration due to gravity g, use the method of dimension to find the correct relations. assume
   $t= Km_x l_y g_z$

   Where k is a dimensionless constant
5. The distance covered by a car at a tie time t is given by
   $x=10_t + 8_{t4}$

   Where x in meters and t in seconds, calculate the instantaneous velocity and acceleration after 2 seconds
6. define the following : (i) kinetics (ii) dynamics (iii) average speed (iv) displacement (v) velocity
7. A stone is thrown with a velocity of $10ms^{-1}$ at the angle of 45^o to the horizontal. calculate the (i) time of flight (ii) maximum height attained and (iii) range (take g =$10m/s^2$)
8. An electron enters a region with a speed 5x106m/s and is slowed down at the rate of - 1.25x1014/s^2. how far does the electron travel and what is the total time take?
9. a vector lying in the x-y plane has x- component of 12 units and y-component of 16 units what is the magnitude of the vector and the angle if made with the horizontal

10. given two vectors: a =2j – 3k, b =2i – 3j + 4j. find (i) 3a + 2b (ii) a x b
11. if p = 7i – 3j + 2k and q = 4i + 5j – 3k. find (i) the scalar product (p.q) (ii) the cosine of angle between p and q
12. what is the weight of 75kg astronaut (a) on earth g = $10/s^2$ and(b) in the moon g= $1.7m/s^2$
13. define the following terms: (i) impulse (ii) inertia of a body (iii) friction
14. a block of mass 20kg is pulled with the force 10N at an angle 300 with the horizontal. find the acceleration of the block
15. (a) state the law of conservation of linear momentum (b) the co-efficient of restitution is defined as
16. (a) A boy pulled a load of mass M, 20m along a horizontal plane with a constant force of 10N applied (i) paralled to the plane (ii) in the direction of angle of 600 to the horizontal. calculate the work done in each case
    b. State the principle of conservation of mechanical energy

17. (a) List 4 forms of energy (b) a block and tackle pulley system with velocity ratio is 20% efficient. calculate (i) the mechanical advantage (ii) the effort that can support a load of 80N

18. State the formula for calculating the velocity ratio of each of the following: (a) block and tackle pulley (b) incline plane(c) hydraulic press (d) wheel and axle (e) screw

19. A 5.0kg object travelling at 1.0m/s collides head on with 10.0kg object initially at rest. Determine the velocity of each after the impact if the collision is elastic

ABIA STATE UNIVERSITY, UTURU
DEPARTMENT OF PHYSICS
2020/2021 FIRST SEMESTER EXAMINATION
PHY 101: GENERAL PHYSICS 1

INSTRUCTIONS: ATTEMPT ANY SEVEN(7) QUESTIONS

1.a) Write down any 4 fundamental quantities and their units
(b) What are the multiples of the following (i) Femto (ii) pico (iii) mega (iv) tera
(c) Using dimensional analysis, derive the unit of pressure

2a. Define vector and scalar quantities and give 3 examples for each
b. If vector a=i+2j-3k and b=2i-3j+4k, find vector c such that 2a-3b+c=0
(3.a)i. What is the difference between average velocity and instantaneous velocity?
(ii). A car travels with a certain average velocity in half a minute and covers 900m. find the average velocity
b) A stone is thrown with a velocity of $5ms^{-1}$ at an angle of 300 to the horizontal. calculate the (i) time of flight (ii) maximum height attended (iii) range (take $g=10m/s^2$)
4.a) State the following laws (i) Newton's second law (ii) Newton's gravitational law (iii) kepler's third law of planetary motion
(b) A block of mass 20kg is pulled with a force 10N; Find the acceleration of the block if (i) the block is pulled horizontally (ii) if the pulling force is acting at an angle of 300 with the horizontal
5.(a)i) State the law of conservation of energy(i) write down 3 forms of energy
b. Determine the kinetic energy of a girl mass 40kg running with a velocity of 3m/s
c)(b) A Block and tackle pulley system with ratio 4 is 20% efficient. calculate (i) the mechanical advantage (ii) the effort that can support a load of 80N
6.a)i. Define the centre of mass of a system.(ii) Locate the centre of mass of three particles m1 =5.0kg, M2 = 7kg and M3=10kg located at (4,3), (2,5) and (-1, 2) respectively, coordinates in meters
b)i. State the law of conservation of linear momentum (ii) A Car of mass 120kg travelling at 10ms-1 collides with a stationary car of mass 1000kg. If the cars lock together find their combined speed

7.a)(i) State the conditions for a rigid body to be in equilibrium (ii) Give two examples of structure that are said to be in static equilibrium

b. Define friction, write the three advantages of friction and two different ways friction can be reduced

8.(a)i. Write down 2 difference between weight and mass (ii) what is the weight of 78kg object on earth($g=9.8ms^{-2}$) and on the moon? ($g=1.7ms^{-2}$)

b)i. Give two examples of a conservative force field (ii) A car of mass 500kg moving with a forward acceleration of $6m/s^2$ is to maintain this forward acceleration.

9.a)i. Write down the mathematical expression of the following (i) Hooke's law (ii) tensile stress (iii) tensile strain. calculate the force constant of a rubber stretched 15cm with a force of 12N

b.i. Define impulse and momentum. (ii) A body of mass 6kg moving with a speed of 20m/s is suddenly hit by another body moving in the same direction thereby changing the speed of the former body to 50m/s. what is the impulse received by the first body?

SURE WAY TUTORIALS

ABIA STATE UNIVERSITY, UTURU
DEPARTMENT OF PHYSICS
2019/2020 FIRST SEMESTER EXAMINATION
PHY 101: GENERAL PHYSICS

INSTRUCTIONS: Answer question one and any other four questions

1.a Write the multiple of the following, Nano, Atto, Pico, Tera
b) Define the following: (i) Average speed (iv)instantaneous acceleration (v) SI Unit (c) Suppose two vectors P and Q with magnitudes 50 and 60N are acting at right angles to each other find the magnitude and direction of the resultant vector.
d)i) State the law of inertia (ii) A block of 20kg mass is pulled horizontally by a force of 10N along a frictionless floor. find the acceleration of the body.
e) Write 4 forms of energy and state the principle of conservation of energy
g) State the principle of conservation of linear momentum. write down the mathematical expression of this law in two dimension(x and y).
h)(i) Give two examples of structures that are said to be in static equilibrium(ii) what is damped oscillation
i. Write down the mathematical expression of efficiency. Hookes law, coefficient of restitution. calculate the force constant of a rubber stretched 0.15m with force of 12N
j. Define Density. write down two characteristics pressure in liquids
k. Write down three categories of equilibrium of an object
(b)Consider a small ball of radius falling through a viscous liquid of viscosity ŋ with a velocity V. Derive the exact form of relation between the viscous force F experienced by the ball and r, ŋ and v given that

$F = Kr_z \eta_y V_z$

where K is a dimensionless constant
3. (a) Given two vectors: a = i + 2j – 3k, b= 2i -3j + 4k

calculate (i) a – b (ii) 3a+2b
b. A stone is thrown with a velocity of $5s^{-1}$ at an angle of 300 to the horizontal. calculate the time of flight T, maximum height H and range R(take $g = 10ms^{-2}$)
4. (a) Mathematically define moment of couple

b) A car of mass 4kg undergones a constant horizontal acceleration of $3m/s^2$. Calculate the resultant horizontal force acting on the body. What will the resultant force on the body when it moves with a uniform velocity of 6m/s
c) Define the following terms (i) perfectly elastic collision (ii) centre of gravity (iii) work (iv) mechanical advantage (c) impulse
5.(a) State 3 advantages of friction
b) A mass of 2kg is attached to the end of a vertical write of length 2m and diameter 2mm extend the wire by 1mm. Calculate the Young's modulus of the wire
c) List the energy transformation in (i) a refrigerator (ii) moving vehicle
6.(a) What is the difference between circular and harmonic motion
(b) A pump is used to spray water from a pool to form a fountain. determine the minimum power of pump if it ejects 60kg of water per minute and the spray reaches an average vertical height of 5m (Assume mass of $1cm^3$ of water = 1kg; $g=10m/s^2$
(c) What is the weight of 85kg astronaut (a) on earth (g = 10m/s2) and b) on the moon ($g=1.7m/s^2$)
d) Define a machine
7.a) A particle of mas+s 0.4kg is subjected to two forces F1 =2i - 4j and F2 = -2.6i
+ 5j in Newton. if the particles starts from the rest at the origin at t=0, find its position and velocity at t=1.6s
b) Write the velocity ratio of the following types of machines (i) wheel and axle (ii) inclined plane (iii) hydraulic press (iv) screw