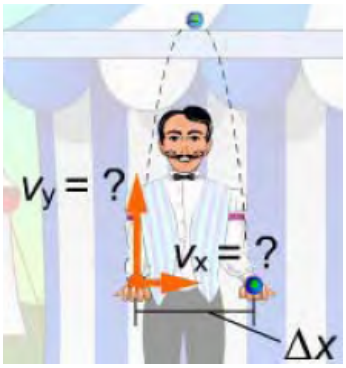
Solution Assignment 1: (Fall 2013)

PHYSICS (PHY101)
TOTAL MARKS: 30
Due Date: 28/11/2013

Question # 1



A juggler (as shown above) throws each ball so it hangs in the air for 1.60seconds before landing in the other hand, 75cm away. What are the initial vertical and horizontal velocity components? **Marks = 8**

Solution:

We rely on two concepts here, first the motion of a projectile is symmetrical so half of the elapse on the way up and the other half on the way down,

Second, the vertical velocity of a projectile is zero at its peak. Convert the 75cm in to MKS unit i.e. 0.75m as well.

$$v_f = v_i + at$$
$$v_{yf} = v_{yi} + a_y t$$ (Vertical velocity at peak is zero i.e. $v_{yf} = 0$)

$$0 = v_{yi} + a_y t$$
$$0 = v_{yi} + (-9.8)(0.8)$$
$$\Rightarrow v_{yi} = 7.84 m/s$$

Now we will find the horizontal velocity component

$v_x = \frac{\Delta x}{\Delta t} = \frac{0.75}{1.60} = 0.47 m/s$ (From our prospective the horizontal velocity of the ball when it is going from our left to our right is positive. From juggler's it is negative)

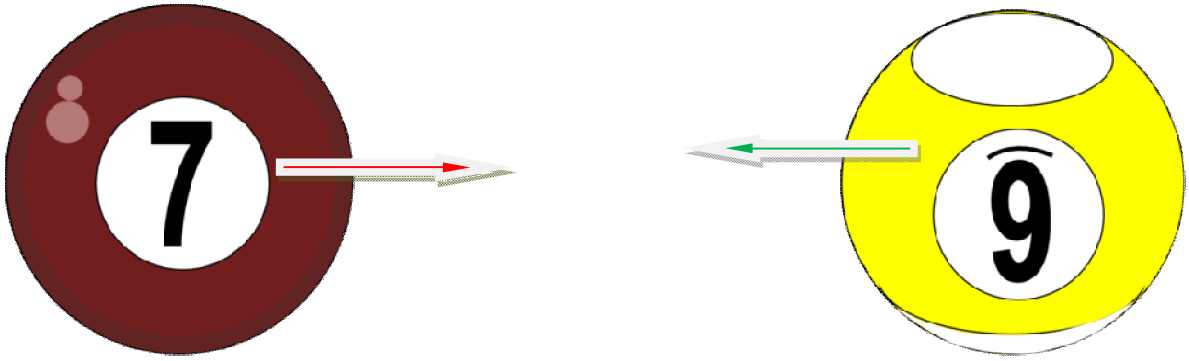
Question # 2

When do you usually drop a ball from a certain height it accelerates downward at 9.8 m/s^2? If you instead throw it downward, then its acceleration instantly after departure your hand, assuming no air resistance, is? **Marks = 4**

Solution:

It will be again at 9.8 m/s^2.

Question # 3



The 7- ball is traveling to the right above strikes the 9-ball, which is of equal mass and moving to the left with a smaller velocity. Which statement below is true? **Marks = 3+4 = 7**

a) Before the collision, the momentum magnitudes of the two balls are equal.
b) After the collision, the momentum magnitudes of the two balls are equal.
c) **The total amount of momentum before and after the collision is same.**
d) During the collision, the amount of force that the two balls apply to each other will be unequal.
e) The change in momentum of the two balls during the collision is different.

Write the reason of your above selected choice as well.

Solution:

The correct answer is c.

Reason:

The two billiard balls have different momentums just before the collision, and as result of the equal force between them during the collision, will have different momentums after the collision as well. The change in momentum of each ball is produced by the impulse they exert on each other, and equal impulses imply equal changes in momentum.

But the total momentum of the system will be constant before and after the collision according to the conservation of momentum:

$$\mathbf{P_{7i} + P_{9i} = P_{7f} + P_{9f}}$$

$$\mathbf{m_7 v_{7i} + m_9 v_{9i} = m_7 v_{7f} + m_9 v_{9f}}$$

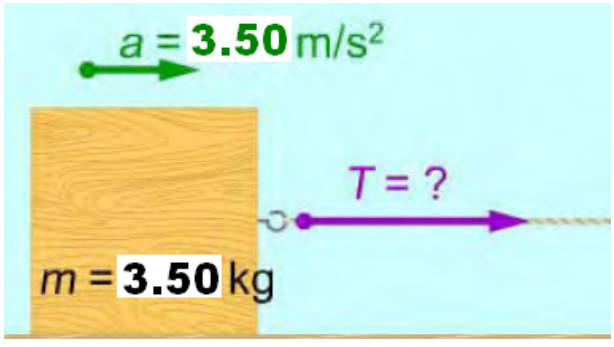
Question # 4

In which type of frame of reference Newton s laws holds. Give your opinion about the Earth, Either it is inertial or non inertial. **Marks = 4**

Solution:

Newton's laws hold in inertial frame of references. Thus the frames of reference in which Newton's laws of motion are observed are called Inertial Frames. For instance, the surface of the Earth is almost an example of an inertial frame of reference. Because it is moving with uniform motion and rotating with a very low speed. And secondly, as it is rotating, so are we rotating with it. But we cannot feel it.

Question # 5



The coefficient of kinetic friction is 0.300. What is the magnitude of the tension force in the rope (shown in the figure)? **Marks = 7**

Solution:

Since the surface is horizontal, the amount of normal force equals the weight of the block.

Note that

Variables	x-component	y-component
Normal force	0	$F_N = mg$
acceleration	$a = 3.50 m/s^2$	0
tension		0
Friction force		0
mass	3.50Kg	
Coefficient of kinetic friction	0.300	

Hence the net horizontal force is given by:

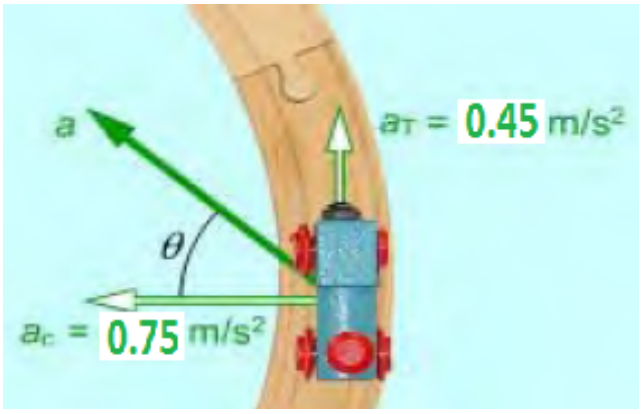
$$\Sigma F = T + (-f_k)$$
$$Since\ f_k = \mu_k F_N$$
$$\Sigma F = T - f_k$$
$$\Sigma F = T - \mu_k F_N$$
$$\Sigma F = T - \mu_k mg$$
$$But\ we\ know$$
$$\Sigma F = ma$$
$$ma = T - \mu_k mg$$
$$T = \mu_k mg + ma$$
$$T = m(\mu_k g + a)$$
$$T = 3.50\{(0.300)(9.8) + 3.50\}$$
$$T = 22.50N$$

<<<<<<<<<<<<<<<<.....Good Luck.....>>>>>>>>>>>

Solution Assignment 2: (Fall 2013)

PHYSICS (PHY101)
TOTAL MARKS: 35
Due Date: 09/12/2013

Question # 1



Find out the magnitude and direction of the overall acceleration in the fig shown? **Marks = 6**

Solution:

As We Know that, the magnitude of the resultant vector is given by

$$a = \sqrt{a_c^2 + a_T^2}$$
$$= \sqrt{(0.75)^2 + (0.45)^2}$$
$$= \sqrt{0.5625 + 0.2025}$$
$$= \sqrt{0.765}$$
$$= 0.875 m/s^2$$

For direction we use $\tan\theta$

$$\tan\theta = \frac{a_T}{a_c}$$
$$\tan\theta = \frac{0.45}{0.75}$$
$$\tan\theta = 0.6$$
$$\theta = \tan^{-1}(0.6)$$
$$= 30.96°$$

Question # 2

In its natural state, an average of 5.5×10^{6}Kg of water flowed per second over Niagara Falls, falling 55m. If all the work done by gravity could be converted into electric power as the water fall to the bottom, how much power would the falls generate? **Marks = 8**

Solution:

Given data is as under

$h = 55m$

Mass of water over falls per unit time $= m/t = 5.5\times10^{6}$ Kg / *s*(*This is the key point of this numerical*)

As we know that

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

Change in gravitional potential energy

$$\Delta PE = mg\Delta h$$

Change in gravitional potential energy

$$\Delta PE = mg\Delta h$$

As work done by the gravity (*negative sign*)

$$W = -\Delta PE$$

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

$$P = \frac{-\Delta PE}{\Delta t}$$

$$P = \frac{-(mg\Delta h)}{\Delta t} = \frac{-mg(h_f - h_i)}{\Delta t}$$

$$= \frac{mg(h_i - h_f)}{\Delta t}$$

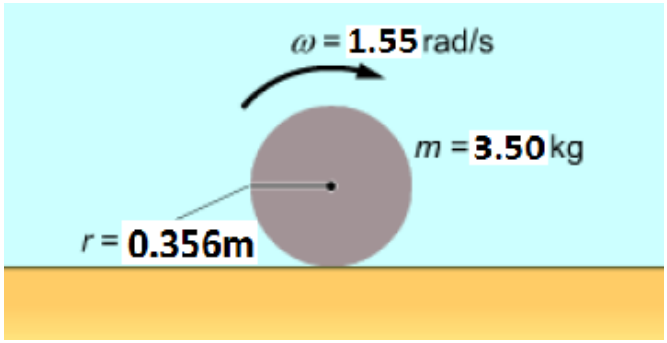
$As\ m/t = 5.5\times10^{6}\,\text{Kg/s}\ \ g = 9.8\text{m/s}^2\ h_i = 55\ h_f = 0$

Putting the valuse of $h, m/t$ *and* g *in above eq* (*note that* $h_f = 0$)

$= (5.5\times10^{6}\,\text{Kg/s})(9.8\text{m/s}^2)(55\text{m})$

$= 2.94\times10^{9}\,Watt$ (Thisis the maximum theoretical power that can be generated.)

Question # 3



The solid uniform disk rolls without slipping. What is its kinetic energy as shown figure? **Marks =8**

Solution:

Use the fact that work done by gravity equals the negative of the change in gravitational potential energy

The solid uniform disk rolls without slipping

$$KE = \frac{1}{2}mv_{CM}^2 + \frac{1}{2}I\omega^2$$

$$V_{CM} = r\omega = (0.356)(1.55)$$

$$= 0.552 m/s$$

$$\Rightarrow \frac{1}{2}mv_{CM}^2 = (0.5)(3.50)(0.552)^2$$

$$\frac{1}{2}mv_{CM}^2 = 0.533J \text{.....} (I)$$

As we know that momnet of inertia of disck is

$$I = \frac{1}{2}mr^2 = (0.5)(3.50)(0.356)^2$$

$$= 0.222 Kgm^2$$

$$Now\ \frac{1}{2}I\omega^2 = (0.5)(0.222)(1.55)^2$$

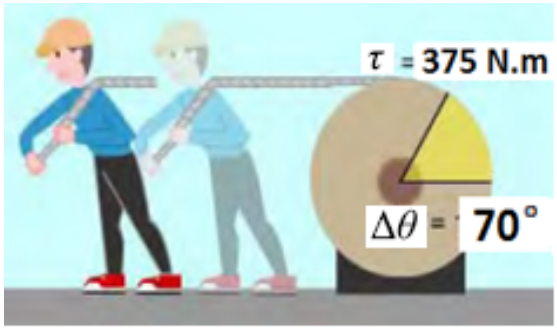
$$= 0.267 J \text{.....} (II)$$

$$K.E = \frac{1}{2}mv_{CM}^2 + \frac{1}{2}I\omega^2\ Putting\ the\ value\ from\ (I)\ \&\ (II)$$

$$= 0.533J + 0.267J$$

$$= 0.8J$$

Question # 4



How much work is done when the wheel rotates shown in the figure? **Marks = 6**

Solution:

As We Know that

$W = F\Delta x$.....(1)

Also we Know that

$$\tau = rF \Rightarrow F = \frac{\tau}{r}$$

In the fig shown ,the arc length is the radius of the speed times the angular displacement.

(Recall S = rθ : *Note*: For this relation θ must be in radian measure.

Here $\Delta x = r\theta$

Putting the value of Δx *and* F *in Eq* (1)

**Convert* deg *ree* int *o radian measure* 70° *i.e.*

$$70^{\circ} \times \frac{\Pi}{180^{\circ}} = 1.22 rad$$

$$W = (\frac{\tau}{r})(r\theta)$$

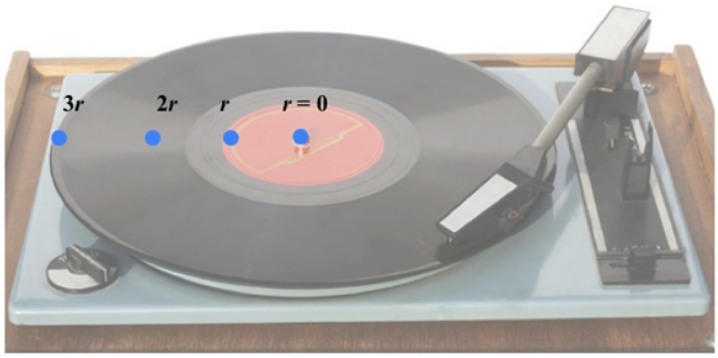
$$W = \tau\Delta\theta$$

$$W = \tau\Delta\theta$$

$$W = (375 N.m)(1.22 rad)$$

$$W = 458.33 J$$

Question # 5



The tunable shown above makes a record rotate at 33.3 revolutions per minute. If the linear speed of an ant located at radius r is v, what is the linear speed of a point on the outer edge of the record at radius 3r? **Marks = 3+4**

a. also v
b. 1\3v
c. 3v
d. 9v
e. 6v

Write the reason of your above selected choice as well.

Solution:

The correct answer is C.

Reason:

While the rotational speed- typically given in rotation per minute, or RPM- is the same everywhere, the linear speed of a point depends on the location of that point relative to the axis

of rotation. The linear speed is directly proportional to the radius: $v \propto r\omega$. Hence because the edge of the record is at 3r, the velocity v is three times the velocity of a point at r.

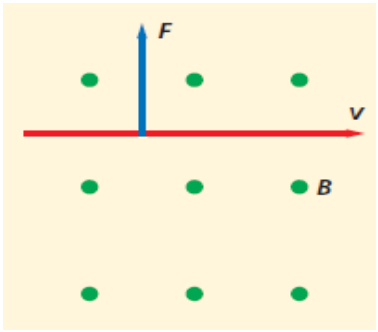
<<<<<<<<<<<<<<<.....Good Luck.....>>>>>>>>>>>>

Solution Assignment 3: (Fall 2013) Physics (PHY101)

Question# 1

A beam of electrons travels at 3.0×10^{6} m/s through a uniform magnetic field of 4.0×10^{-2} T at right angles to the field. How strong is the force acting on each electron? **Marks = 5**
(Value of charge on electron is -1.60×10^{-19}C)

Solution



As we know that

$$F = qv \times B$$

$$F = qvB \quad (As\ angle\ is\ 90°\ thus\ Sin90° = 1)$$

$$F = (-1.60\times10^{-19})(3.0\times10^{6})\ (4.0\times10^{-2})$$

$$F = 19.2\ \times10^{-19+6-2}$$

$$F = 19.2\ \times10^{-15}$$

$$F = 1.92\ \times10^{-14}\ N$$

Question# 2

A student of Physics is prying the field of a charge of unknown magnitude and sign. He first maps the field with a 2.0×10^{-6} C test charge, and then repeats his work with a 4.0×10^{-6} C test charge.

I. Would he find the same fields with the two test charges? Explain.
II. Would he measure the same forces with the two test charges? Explain. **Marks = 4+4 = 8**

Solution

I. **Yes,** he would divide the force by the strength of the test charge, so the results would be the same.

II. **No.** The force on the 4.0 μC charge would be twice that on the 2.0 μC charge.

Question# 3

The whole electrical technology revolves round the devices i.e. motor, generator, and transformer. Write your answer in a single line that under what relationship these devices came into existence. **Marks = 5**

Solution:

The relationship between magnetic fields and current makes possible the three keystone of electrical technology: motors, generators, and transformers.

Question# 4

Consider a 12-V battery in a circuit with three resistors connected in series.

I. If the resistance of one of the resistors increases, how will the series resistance change?
II. Will there be any change in the battery voltage?
III. What will happen to the current? **Marks = 2+2+2 = 6**

(Answer should not be more than a single line of above each part)

I. It will increase.

II. No. It does not depend on the resistance.

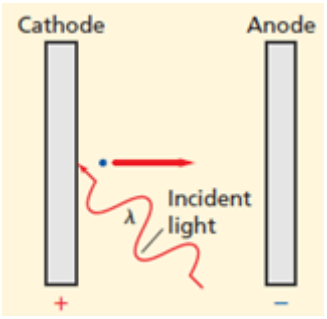
III. I = V/R so it will decrease.

Question# 5

The stopping potential of a certain photocell is 6.0 V. What is the kinetic energy given to the electrons by the incident light? Give your answer in both joules and electron volts. **Marks = 6**

Solution:

$q = (-1.60 \times 10^{-19} C)$ $\quad$ $K.E + W = 0 J$



K.E in J and eV ?

Solve for K.E

K.E = -W

$= -(qV_0)$

$= -(-1.60 \times 10^{-19} * 6)$

$= +9.6 \times 10^{-19} J$

Now convert the Joule int *o elctron volt*

$= 9.6 \times 10^{-19} (\frac{1eV}{1.60 \times 10^{-19}})$

$= 6.0eV$

:::::::::::::::::::::::::::::::: Wish you good luck::::::::::::::::::::::::::::::

PHYSICS (PHY101)

TOTAL MARKS: 30

Due Date: 09/05/2014

Question. No: 1

If a car can accelerate at 4m/sec^2, what acceleration can it attain if it is pulling another car of identical mass? **Marks 5**

Solution:

The same force on twice the mass produces half the acceleration, or 2 m/s^2.

$Suppose\,the\,given\,mass = m_1 = m$

$Given\,acceleration = a_1 = 4m/s^2$

$Force = F$

$Total\,mass\,of\,both\,cars$

$m_2 = m + m$

$m_2 = 2m$

$We\,have\,to$ find $a_2 = ?$

$According\,to\,given\,condition$

$F_1 = F_2$

$m_1 a_1 = m_2 a_2$

$$a_2 = \frac{m_1 a_1}{m_2}$$

$Putting$ values

$$a_2 = \frac{m * 4}{2m}$$

$a_2 = 2m/s^2$

Question. No: 2

Presume a ship cruises with a constant velocity when the thrust from its engines is a constant 10000N. What is the acceleration of the ship? What is the force of air resistance acting on the ship? **Marks 5**

Solution:

The acceleration must be zero because the velocity is not changing- velocity is constant. Since the acceleration is zero, it follows from a = F/m that the net force is zero. This means the force of air resistance must be equal the engine's thrust. The air resistance is 10000N, and it acts in the direction opposite to ship's motion.

Question. No: 3

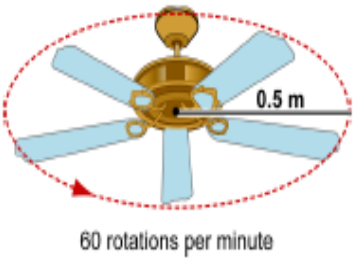
Two forces act on a book resting on a table, its weight and the support force from the table. Does the force of friction act as well? Justify your answer with an example. **Marks 6**

Solution:

No, not unless the book tends to slide or does slide across the table. For example, if it is pushed toward the left by another force, then friction between the book and table will act toward the right. Friction forces occur only when an object tends to slide or is sliding.

Question. No: 4

The blades on a ceiling fan spin at 60 rotation per minute as shown in the figure below. The fan has a radius of 50cm.Calculate the linear speed of a point at the outer edge of a blade in meter per second. **Marks 7**



Solution:

The blades spin at 60 rotations per minutes, so they make 60 rotations in 60 seconds. Therefore it takes one second to make one revolution. Also the given value of radius is in centimeter convert it into meter i.e. 50cm = 50/100 = 05m.

$$v = \frac{circumference}{time} = \frac{2\pi r}{t}$$

$$v = \frac{2(3.14)(0.5)}{1} = 3.14m/\sec$$

Alternate solution

$$V = r\omega = \frac{60 * 2\pi rad}{60\sec} * 0.5 = 3.14m/\sec$$

$$v = \frac{2(3.14)(0.5)}{1} = 3.14m/\sec$$

Question. No: 5

Mr Aslam has a mass of 80 kilograms. His apartment is on the second floor, 600cm up from ground level. How much work does he do against gravity each time he climbs the stairs to his apartment? **Marks 7**

Solution:

$Given\ that$

$Mass = m = 80Kg$

$Height = h = 600cm = 600/100 = 6m$

$acceleration\ due\ to\ gravity = g = 9.8m/\sec^2$

$This\ work\ appears\ \text{in t}he\ form\ of\ potential\ energy$

$Thus\ W = P.E = mgh$

$Work = 80*6*9.8 = 4704\ Joule$

:::::::::::::::::::::::::: Wish you good luck::::::::::::::::::::::

PHYSICS (PHY101)
TOTAL MARKS: 30
Due Date: 26/05/2014

Question. No: 1

A lift is filled with patients has a total mass of 2055 kg. As the lift begins to go up, the acceleration is 0.75 m/s^2. What is the tension in the rope that is lifting the lift? Validate your solution as well. **Marks 5**

Solution:

Apply Newton's 2nd law and insert all of the forces acting on the lift, then solve it for tension

$$\vec{F} = m\vec{a}$$
$$\vec{F_T} + \vec{F_g} = m\vec{a}$$
$$\vec{F_T} = -\vec{F_g} + m\vec{a}$$
$$\vec{F_T} = -(-mg) + m\vec{a}$$
$$\vec{F_T} = (2055)(9.8) + (2055)(0.75)$$
$$= 20139 + 1541.25$$
$$= 21680.25$$
$$\vec{F_T} = 2.2\times10^4\ N[up] \quad Direction: up$$

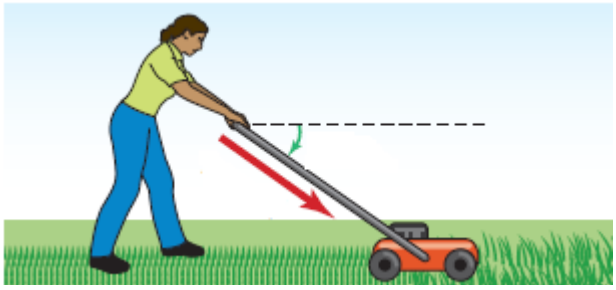
Validation of the solution:

The weight of the lift is w = mg = (2055) (9.8) = 20139 = 2.01 × 10^{4}N.

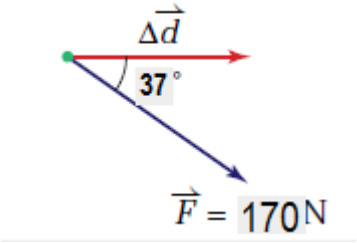
The tension in the cable must support the weight of the lift and exert an additional force to accelerate the lift. Therefore, you would expect the tension to be a little larger than the weight of the lift, which it is.

Question. No: 2

A man pushes a lawnmower with a force of 170 N at an angle of 37° down from the horizontal. The lawn is 12.0 m wide and requires 16 complete trips across and back. How much work does he do? **Marks 6**



Solution:



$\vec{F} = 170N$

$\theta = 37^o$

$Width\ of\ lawn = 12m\ and 16\ trips$

$First\ of\ all\ we\ \det erm\ in\ e\ the\ total\ displacement\ \Delta d = 2(12)(16) = 384m$

$W = F\Delta d\cos\theta$

$W = (170)(384)\cos 37^o$

$= 65280 * (0.7986)$

$= 52134.93J = 52135J = 5.21\times 10^4\ J$

Note:
For your concept

If the force had been horizontal, then the work done would have been 384*170, which equal s 65280J. Because the force is at angle to the direction of motion, the work done is less than this value.

Question. No: 3

A bus's tire rotates at an initial angular speed of 20.5 rad/s. The driver accelerates, and after 4.5 s the tire's angular speed is 29.0 rad/s. What is the tire's average angular acceleration during the 4.5 s time interval? **Marks 7**

Solution:

$$\omega_1 = 20.5 rad/s \; \omega_2 = 29.0 rad/s \; \Delta t = 4.5 s$$

$$Using \; the \; formula$$

$$\alpha_{average} = \frac{\omega_2 - \omega_1}{\Delta t}$$

$$\alpha_{average} = \frac{29 - 20.5}{4.5}$$

$$= 1.89 rad/s^2$$

Question. No: 4

An object's momentum depends upon the object's

a) mass, speed and acceleration.
b) mass, speed and direction of motion.
c) speed and acceleration.
d) velocity and direction of motion.
e) mass and acceleration.

Write the reason of your above selected choice as well. **Marks 3+3 = 6**

Solution:
Choice "b" is correct

Explanation:

The correct answer is “b”. Momentum is a vector quantity that is determined by calculating mass times velocity, where velocity is also vector quantity. The direction of the momentum is in the same direction as the velocity. Because velocity is vector that includes both a speed and direction, choice “b” above is the correct answer.

Question. No: 5

You drive a nail horizontally into a wall, using a 0.52 kg hammerhead. If the hammerhead is moving horizontally at 4.5 m/s and in one blow drives the nail into the wall a distance of 2.9 cm, determine the average force acting on

(a) the hammerhead
(b) the nail **Marks = 6**

Solution:

Given values:

Convert the 209cm into meter i.e. = 2.9/100 = 0.029m

$$m = 0.52kg \;\; v_i = 4.5m/s \;\; v_f = 0m/s \;\; \Delta d = 0.029m$$

(a) The force acting on the hammer, F_h by the nail?
(b) The force applied to the nail, F_n by the hammer?

Note that with only horizontal motion work done is equal to kinetic energy hence work done is equal to change in kinetic energy
W. D = K.E

$$\overrightarrow{F_h}\overrightarrow{\Delta d} = \Delta K.E$$

$$= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

$$\overrightarrow{F_h} = \frac{\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2}{\Delta d}$$

$$= \frac{\frac{1}{2}0.52(0) - \frac{1}{2}(0.52)(4.5)^2}{0.029}$$

$$= \frac{0-5.265}{0.029} = -181.552 = 182N \; or \; -1.82\times10^2 N$$

$$\overrightarrow{F_h} = -1.82\times10^2 N$$

(a) The average force exerted on the hammer by the nail was $1.82\times10^2 N$ (backward)

Now apply Newton s 3rd law to the forces between the hammer and the nail

$F_n = -F_h$

$F_n = - (-1.82\times10^2 N)$

$F_n = 1.82\times10^2 N$

(b) The force applied to the nail, F_n by the hammer was $F_n = 1.82\times10^2 N$ (forward)

Note for your concept:

Since the Kinetic energy must be transferred out the hammered, the force on the hammer must be in the opposite direction to its motion and so the force must be negative.

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:::::::::::::::::::::::::: Wish you good luck::::::::::::::::::::::

PHYSICS (PHY101)
TOTAL MARKS: 30
Due Date: 10/07/2014

Question. No: 1

A light bulb is connected to a 260V potential, and produces 120-Watts of light and heat. What is the resistance of the wire in the light bulb? **Marks 7**

Solution:

$$P = VI$$

$$I = \frac{P}{V} = \frac{120}{260} = 0.46A$$

Now use the Ohm 's law

V = IR

$$R = \frac{V}{I} = \frac{260}{0.46} = 563\Omega$$

Question. No: 2

Current decreases when passing through a resistor and then increases again upon exiting. Is it true or wrong explain in each case. **Marks 4**

Solution:

The above statement is wrong. The current before, in and after the resistor is the same.

Question. No: 3

A person walks by. And the person contains electrons. Therefore, there is a presence of current. Either yes or no justify this statement with reason. **Marks 5**

Solution:

No, the person is electrically neutral. Current is the flow of net charge. In this case, there is no movement of **net** charge and therefore no current. If the person were electrically charged, there would be a current as the person passed by.

Question. No: 4

A rubber balloon has a lot of extra electrons deposited on it, giving it a negative charge. When the balloon is brought near an uncharged metal sphere as shown in figure:

Select one the most closely related choice given below and write the reason of your selected choice as well. **Marks 3+4 = 7**

a) Electrons from the sphere will be attracted to the balloon and leap from the sphere to the balloon
b) Protons from the sphere will be attracted to the balloon and leap from the sphere to the balloon

c) The balloon will attract electrons in the sphere and repeal protons in the sphere, so the net force on the sphere is zero
d) The balloon will attract electrons in the sphere and attract protons in the sphere, so the net force on the sphere is zero
e) The balloon will cause a polarization of charge in the sphere

Solution:

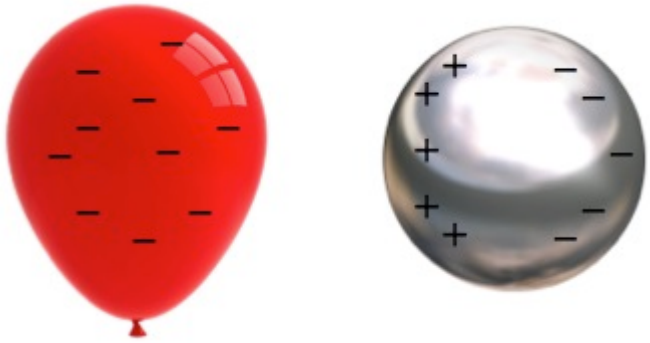
The correct answer is "e".

Justification:

The negatively-charged balloon will repel electrons in the sphere, causing many of them to move through the metal to the far side of the sphere, leaving behind the positive charge on the near side of the balloon. This process of creating oppositely charged regions in a conductor is called polarization.

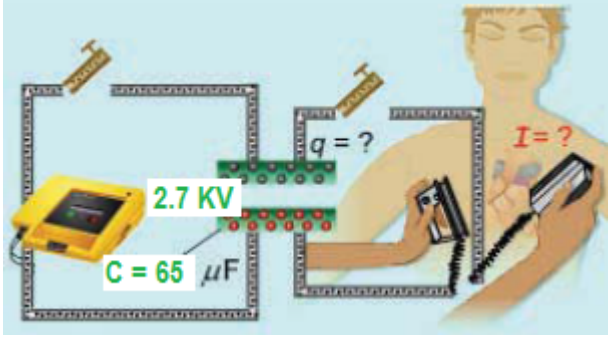
For your information:

Choice "d" is partly correct; although it turns out that there is a net force on the sphere from the balloon. Because the electrons in the balloon are closer to the attractive positive charges in the sphere, and farther away from the repelling negative charges, there is a net force of attraction between the balloon and the sphere.



Question. No: 5

The defibrillator capacitor discharges in 11 ms. How much current does it send through the heart? As shown below. **Marks 7**



Solution:

$$C = 65\mu F = 65\times10^{-6}\,F$$

$$\Delta V = 2.5KV = 2.5\times10^{3}V$$

$$time\,t = 11ms = 11\times10^{-3}\,s$$

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

$$= (65\times10^{-6}\,F)(2.5\times10^{3}V)$$

$$= 0.16C$$

$$As\ we\ know\ that$$

$$I = \frac{\Delta q}{\Delta t} = \frac{0.16C}{11\times10^{-3}\,s} = 14.54A$$

Solution Assignment 1: (Fall 2014)

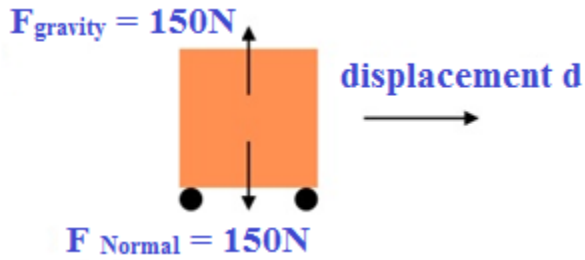
PHYSICS (PHY101)
TOTAL MARKS: 25
Due Date: 27/11/2014

Question. No: 1

A set of frictionless wheels are attached to the bottom of a box, which is then measured and found to have a mass of 6.0kg. The box is placed on the floor, and a student of Physics uses a brief horizontal force of 150N to push the box sideways, after which the box rolls across the floor with constant velocity. How much Work does the floor do on the box as it rolls along?

Marks 6

Solution:



Remember that the Work done on an object is found by multiplying the Force applied and the displacement of the object in the same direction as the Force that was applied.

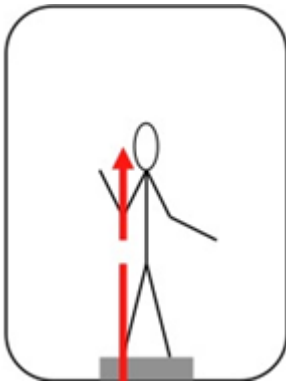
Hence, the Force acting on the box as it moves can be seen by drawing a free-body diagram of the box. Note that the Force applied by the floor-the Normal Force is upwards, while the displacement of the box is sideway. Because they are not in the same direction, there is no Work done by the floor on the box.

Question. No: 2

A student of Physics with a mass of 60Kg performs an experiment by taking a scale into an elevator, setting it into floor, and standing on it. At first the scale indicates a weight of about 600Newtons, but then the elevator starts to accelerate downwards at $5m/s^2$.Calculate the value of weight indicated on the scale during this period of acceleration?

Taking acceleration due to gravity (g) = $10m/s^2$. **Marks 5**

Solution:



To determine exactly what the scale reads, we need to figure out the force that it is pushing up on the student with (sometimes called the Normal force). We can anticipate that the net Force is downwards because the acceleration is downwards.

$$\mathbf{F = ma}$$

$$\mathbf{F_{Normal} - F_{gravity} = ma}$$

$$\mathbf{F_{Normal} - mg = ma}$$

$$\mathbf{F_{Normal} = ma + mg}$$

$$\mathbf{F_{Normal} = (60)\ (-5m/s^2) + (60)\ (10m/s^2).}$$

$$\mathbf{F_{Normal} = -300 + 600 = 300N}$$

Question. No: 3

An astronaut standing on the moon holds a large, heavy rock and a small, light stone, and then releases them from the same height. Which object reaches the moon‘s surface first?

Note: Select the best choice given below according to your best of knowledge, and also write the reason of your selected choice as well.

a) The rock, because it‘s heavier and accelerate faster
b) The rock, because it has a greater force of gravity acting on it.
c) The stone, because there is less air frication acting on it.
d) They reach on the surface at the same time because their acceleration due to gravity is equal.
e) Both the rock and stone will just float there when released-there is no gravity on the moon.

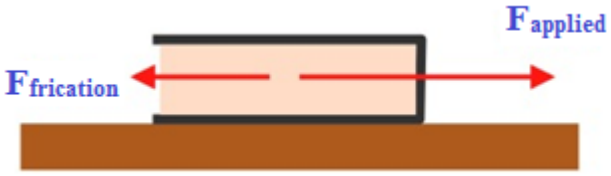
Marks 3+4 = 7

Solution:

The correct answer is "d". The two objects experience the same acceleration when they are released-about 1/6 of the Earth's acceleration of g = 9.8m/s^2 and so they reach surface at the same time.

Note that choice "b" states that the rock has a greater force of gravity acting on it, and this part of the answer is true. The force of gravity acting on something, also called its weight, is calculated using W = mg. But the same mass makes the rock weigh more also make it harder to move that rock, it has more inertia.

Question. No: 4



A large 1.5Kg book rests on the surface of a rough table, and a horizontal force of 60N (to the right in the sketch shown above) is applied to it. If a frication force of 35Newtons opposes the motion of the book, determine the value of acceleration with which book will accelerate?

Marks 7

Solution:

The net force acting on the book is to the right, which causes the mass of the book to accelerate according to Newton's Second law of motion.

$F_{net} = ma$

$F_{applied} - F_{frication} = ma$

$60 - 35 = 1.5a$

$25 = 1.5a$

$a = 25/1.5 = 16.67 m/s^2$

:::::::::::::::::::::::::: Wish you good luck::::::::::::::::::::

Solution Assignment 2 (Non-graded): (Fall 2014)

PHYSICS (PHY101)
TOTAL MARKS: 25
Due Date: 10/12/2014

Question. No: 1

The freefall acceleration rate, g, does not depend on the mass that is falling. It was proved by Galileo. Can you further explain this argument by using the formulae of Simple harmonic motion (motion of pendulum?). Either it has proved by SHM formulae or not. Either yes or no, explain in each case. **Marks 8**

Solution:

Yes it explain the phenomena, as we know that for motion of simple pendulum executing SHM, when amplitude is small,

$$T = \frac{2\pi}{\omega} = \frac{1}{f} = 2\pi\sqrt{\frac{L}{g}}$$

$$f = \frac{\omega}{2\pi} = T = \frac{1}{2\pi}\sqrt{\frac{g}{L}}$$

Note that the above expressions do not involve the mass of the particle. This is because the restoring force, a component of the particle's weight, is proportional to m. Thus the mass appear on both sides of $\Sigma\vec{F} = m\vec{a}$ and cancels out. **This is the same Physics that explains why bodies of different masses fall with the same acceleration in a vacuum**.

Question. No: 2

a) Explain the concept of black hole?
b) Is escape velocity depends on mass or not explain it. **Marks 4 +5 = 9**

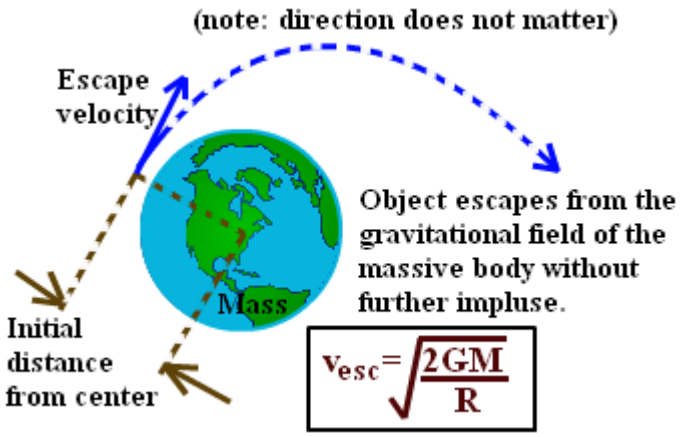
Solution:

(a) Concept of Black hole:

Neutron stars are very dense and their core contains neutrons only. These stars speedily revolve and emit light whereas the black holes are known by their extreme gravity. Their gravity is so much that even light cannot escape from them. The existence of black holes was predicted well before the 20th century. About a hundred years after Newton worked out his theory of gravitation, the English astronomer John Michell recognized in 1784 the possibility that the gravity of a very large star might be so great that nothing, not even light, could escape it.

(b) Escape Velocity:

Escape velocity is defined as a minimum velocity with which a body should be projected so that it overcomes the gravitational pull of the earth.



$$\frac{1}{2}mv^2 = \frac{GMem}{R}$$

$$v^2 = \frac{2GMe}{R} \quad As\ GMe = gR^2$$

$$v = \sqrt{\frac{2gR^2}{R}}$$

$$v = \sqrt{2gR}$$

But $GM = gR^2$ (Accelerations due to gravity)

Hence it is proved that escape velocity does not depend on the mass of the object.

Question. No: 3

The members of a marching band are lined up four in a row and marching along a street to the west as shown in the figure. As the band reaches in intersection and turns left (north), which statement is true? **Marks 3+5 = 8**

Note: Select the best choice given below according to your best of knowledge, and also write the reason of your selected choice as well.

a) The marchers on the left will have a greater rotational velocity than the marchers on the right.
b) The marchers on the left will have a lesser rotational velocity than the marchers on the right.
c) The marchers on the left will have a greater linear velocity than the marchers on the right.
d) The marchers on the left will have a lesser linear velocity than the marchers on the right.
e) The linear velocity of the marchers on the left and the right will be equal.

Solution:

The correct answer is **"d"**. In order to negotiate the turn, the marches on the left will have to slow down, and/or the marches on the right will have to speed up. The marches on the right have a greater radius, and thus will have a greater linear velocity to be able to navigate the turn.

:::::::::::::::::::::::::: Wish you good luck::::::::::::::::::::

Assignment 1: (Fall 2011) Physics

PHYSICS (PHY101)

TOTAL MARKS: 20

Due Date: 31/10/2011

Question #

A hand holding the apple lifts it upwards, applying a force of 10N. If the mass of the apple is 250g has a weight of 2.5N. Find the acceleration of the apple. **Marks = 5**

Solution

The acceleration of the apple can be determined by drawing a free body diagram, and using Newton' s 2nd law, and considering the net force acting on the apple. Converting given mass 250g into kilogram by dividing it by 1000 i.e. 0.25Kg

As we know that from 2nd law of motion.

$$\Sigma F = ma$$

$$F_{hand} - F_{gravity} = ma$$

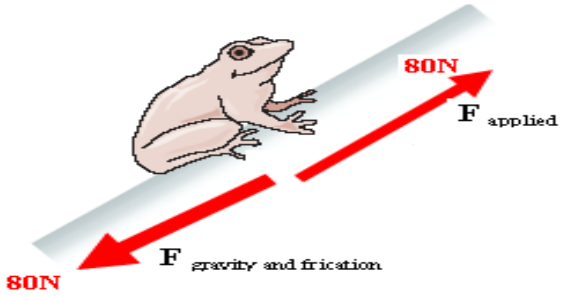
$$10N - 2.5N = (0.25Kg)(a)$$

$$7.5 = (0.25)(a)$$

$$a = \frac{7.5}{0.25}$$

$$\Rightarrow a = 30m/s^2 Upwards$$

Question # 2



A frog applies a constant force of 80N while pushing him up a hill, while gravity and legs friction cause a constant 80N force in the opposite direction. In this situation

a. the frog applied force of 80N means the frog must be accelerating
b. the net force on the frog is 0N, which means the frog is not accelerating
c. the combined force of gravity and legs friction means the frog must be decelerating
d. the frog can't be moving up the hill, because the forces on it are balanced.

Write the detail of your above choice as well. **Marks = 5**

Solution

The correct answer is b. The net force on the frog is 0, so with no net external force, the frog will continue in straight-line motion at constant speed- it will not be accelerating.

Question # 3

If a motorcyclist is moving at 70 km/h and it rounds a corner, also at 70 km/h, does it maintain a constant speed, or a constant velocity? Explain your answer. **Marks = 5**

Solution

It does maintain a constant speed of 70 km/h. Speed doesn't depend on direction. It does not maintain a constant velocity. Because, velocity is a vector quantity thus depends on magnitude and direction. Since acceleration is the change in velocity over time, the motorcyclist undergoes acceleration when rounding a corner. This means a net force was applied to the motorcyclist to change its direction. The force comes from the road pushing (somewhat) sideways on the motorcyclist in response to turned wheels.

Question # 4

A Pakistani satellite moves in a straight line towards the north with a speed of 3×10^4m/s.It has subjected to different frictional forces (like air frication, gravity etc) acting on it. During a 5m displacement, the total work done on the satellite is

(I) zero

(II) positive

(III) negative

(IV) insufficient information provided in question.

Justify your above selected choice as well. **Marks = 5**

Solution

The correct answer is (I). The satellite has constant velocity, so its acceleration is zero and (by Newton' second law) the net force on the satellite is also zero. Therefore the total work done by all the forces (equal to the work done by the net force) must be zero as well.

$$F = ma$$
$$= m\frac{dv}{dt} \sin ce\, no\, change\, in\, velocity\, i.e\, dv = 0$$
$$dv = v_2 - v_1 = 3\times10^4 - 3\times10^4 = 0$$
$$\Rightarrow F = 0$$
$$W = F.d$$
$$\Rightarrow W = 0J$$

<<<<<<<<<<<< Wish you good luck>>>>>>>>>>>

Solution Assignment 2: (Fall 2011) Physics

PHYSICS (PHY101)

TOTAL MARKS: 20

Due Date: 10/11/2011

Question # 1 **Marks = 12**

A worker pushes 25Kg crate a distance of 5m along a level floor at constant velocity by pushing horizontally on it. The coefficient of kinetic frication between the crate and the floor is 0.23.

(a) What magnitude of force must the worker apply?

(b) How much work is done on the crate by this force?

(c) How much work is done on the crate by frication?

(d) How much work is done on the crate by normal force?

(e) How much work is done on the crate by the gravity?

(f) What is the total work done on the crate?

Solution

$Mass\ of\ the\ crate\ m = 25Kg$

$Dis\tan ce\ moved\ d = 5m$

$Coeficent\ of\ kinetic\ frication\ f_k = 0.23$

$As\ the\ crate\ is\ moving\ with\ cons\tan t\ velocity, the\ sum\ of$

$forces\ acting\ uponisequals\ zero. The\ only\ force\ acting\ on$

$the\ crate\ is\ the\ frictional\ force\ in\ the\ opposite\ direction\ to$

$the\ motion\ of\ the\ crate. So\ the\ magnitude\ of\ the\ frictional\ force\ is,$

$a)\ f_k = \mu_k mg$

$= (0.23)(25)(9.8)$

$= 56.35N$

Thus the wor ker *has to apply aforce of* $56.35N$

b) The work done by the above force on the crate is

$W_F = F \times d$

$= 56.35 \times 5$

$= 281.75J$

c) The work done by the frictional force on the crate is

$W_F = f_k \times d$

$= -56.35 \times 5$

$= -281.75J$

Since the frictional force is in the opposite to the direction of the displacement, the W.D by the frictional is negative.

d) The work done by the normal force on the crate is

$W_N = N \times d$

$= Nd \cos 90^\circ$

$As \cos 90^\circ = 0$

$= 0J$

e) The work done by the gravity is

$W_g = F_g \times d$

$= F_g d \cos 90^\circ$

$As \cos 90^\circ = 0$

$= 0J$

$f)\ Total\ W.D\ on\ the\ crate\ is$

$$W_{total} = W_F + W_f + W_N + W_g$$
$$= 281.75J + (-281.75J) + 0 + 0$$
$$= 0J$$

Question # 2 **Marks = 8**

The flywheel of a prototype car engine is under test. The angular position θ of the flywheel is given by θ = (3.0rad/s^3) t^3 and the diameter of the flywheel is 36cm.

(a)Find the distance that a particle on the rim moves during that time interval.

(b) Find the angle θ, in radians and in degree, at times t_1 = 3.0s and t_2 = 6.0s.

(c) Find the average angular velocity, in rad/s and in rev/min, between t_1 = 3s and t_2 = 6s.

(d) Find the instantaneous angular velocity at time t_1 = 3.0s and t_2 = 6.0s.

Solution

We need to find the value θ_1 and θ_2 of the angular position at times t_1 and t_2, the angular displacement Δθ between t_1 and t_2, the distance traveled and the average angular velocity between t_1 and t_2 and the instantaneous angular velocity at t_1 and t_2. As we are given the angular position θ as a function of time so we can easily find our first two target values θ_1 and θ_2.

$b)$

$We\ substitute\ the\ value\ t\ \text{in}\ the\ given\ eq$

$$\theta = \left(3.0\text{rad}/\text{s}^3\right)\text{t}^3$$
$$t_1 = 3s$$
$$\theta_1 = \left(3.0\text{rad}/\text{s}^3\right)3^3\text{s}^3$$
$$= 81rad$$
$$= 81\times\frac{360^\circ}{2\pi} = 4639.09^\circ$$

$t_2 = 6s$

$\theta_2 = \left(3.0\text{rad}/\text{s}^3\right)6^3\text{s}^3$

$= 648rad$

$= 648 \times \frac{360^\circ}{2\pi} = 37112.73^\circ$

$\Delta\theta = \theta_2 - \theta_1 = 648 - 81 = 567rad$

(a)Diameter = 36cm $\Rightarrow$ radius = 36 / 2 =18cm = 0.18m

$S = r\Delta\theta$

$= 567 \times 0.18 = 102.06m$

The angle must be expressed in radian.

We drop 'radians' from the unit for S

because θ is really a dimensionless pure number,

S is a distance and is measured in meter the unit as r.

(c)Now let us find, Average angular velocity.

$\omega_{ave} = \frac{\theta_2 - \theta_1}{t_2 - t_1}$

$\omega_{ave} = \frac{648 - 81}{6 - 3} = \frac{567}{3} = 189rad/\sec$

$(d)Ins\tan tan eos\ Angular\ velocity\ at\ t = 3$

$\omega_{inst1} = \frac{d\theta}{dt} = \frac{d\left(3.0\text{rad}/\text{s}^3\right)\text{t}^3}{dt}$

$diff\ w.r.t.t$

$\omega_{inst1} = \left(9.0\text{rad}/\text{s}^3\right)\text{t}^2$

$putting\ t = 3s\ we\ have$

$\omega_{inst1} = \left(9.0\text{rad}/\text{s}^3\right)(3s)^2$

$\omega_{inst1} = 81rad/s$

$Ins\ \tan\tan\ eos\ Angular\ velocity\ at\ t=6$

$$\omega_{inst\,2}=\frac{d\theta}{dt}=\frac{d\left(3.0\text{rad}/\text{s}^3\right)\text{t}^3}{dt}$$

$diff\ \ w.r.t.t$

$$\omega_{inst\,2}=\left(9.0\text{rad}/\text{s}^3\right)\text{t}^2$$

$putting\ t=6s\ we\ have$

$$\omega_{inst\,2}=\left(9.0\text{rad}/\text{s}^3\right)(6s)^2$$

$$\omega_{inst\,2}=324rad/s$$

<<<<<<<<<<<< Wish you good luck>>>>>>>>>>>

Solution Assignment 3 (Phy101) (Fall 2011)

PHYSICS (PHY101)

TOTAL MARKS: 20

Q # 1

Where does an electron go when it is free to move: to a location of higher or lower potential? Give reason in each case.

Solution:

It will travel towards a location of higher potential. Electrons tend to move toward positive charges and away from negative charges, which means they move toward regions of higher electric potential, minimizing the electric potential energy. A positive test charge (or proton) would do the opposite, moving toward a region of lower potential, which also minimizes the electric potential energy

Q # 2

Assume that a proton has a mass of 3.34×10^{-27}Kg and a charge of +e. It travels in a circular path with a radius 6.96mm in a magnetic field with magnitude 2.50T.

a) Find the time required for it to make half a revolution.
b) Find the speed of the proton.
c) Through what potential difference would the proton have to be accelerated to acquire this speed?

Solution

Mass of the proton, $m = 3.34 \times 10^{-27} Kg$

charge of proton, $q = +e = 1.6 \times 10^{-19} c$

Radius of circular path, $R = 6.96\ mm = 6.96 \times 10^{-3} m$

Strength of megnatic field, $B = 2.50\ T$

First of all we will find velocity v inorder to find time T

We know that the equation of motion of charge particle is

F = qvB

Also the the centripetal force is $F = mv^2$

Comparing the above two forces

$$qvB = \frac{mv^2}{R}$$

$$qvB = \frac{mv^2}{R}$$

$$qB = \frac{mv}{R}$$

$$\Rightarrow v = \frac{qBR}{m} = \frac{1.602\times10^{-19}\times2.50\times6.96\times10^{-3}}{3.34\times10^{-27}}$$

$$v = 8.34\times10^{5}\, m/s$$

Time required for $(½)$ half revolution $T = \dfrac{\text{distance travelled}}{\text{speed}}$

$$T = \frac{\pi R}{v} = \frac{3.14\times6.96\times10^{-3}}{8.34\times10^{5}}$$

$$= 2.62\times10^{-8}\, s$$

Kinetic energy of the proton is

$$K.E = \frac{1}{2}mv^2 = 0.5\times3.34\times10^{-27}\times(8.34\times10^{5})^2$$

$$K.E = 1.16\times10^{-15}\, J$$

If accelerating potential is V then $K = eV$

$$V = \frac{K}{e} = \frac{1.16\times10^{-15}}{1.6\times10^{-19}} = 7.25KV$$

Q # 3

What is your opinion about the radio signals and light waves? Is there any difference between them or a same thing? Justify it.

Solution

How Radio signal and light waves are different?

Radio signals and light waves are fundamentally different because the wavelength and frequency of radio transmissions and light are significantly different, and humans can see light, but not radio waves.

How Radio signal and light waves are similar?

Radio signals and light waves are fundamentally similar because both are forms of electromagnetic radiation, and both move at the speed of light.

Q #1

Light strikes water in a placid lake at an angle of 30° from the horizontal. Is it correct to say this, that its incident angle is 30°? If yes prove it, if not explain it.

Solution

No, the incident angle is 60°. It is measured between the incident ray and the interface's **normal line**. This line is perpendicular to the interface.

Q #2

Most computers today contain a CD-ROM drive and many contain a DVD drive. A CD or DVD can hold a great quantity of information. The drive relies on important phenomena of Physics called interference to

"read" the disc. Discuss the Physics of interference in CD and DVD. Also explain why DVD can store more data than CD.

Note: Your answer shouldn't be more than 500 words

Solution

Most computers today contain a CD-ROM drive and many contain a DVD drive. A CD or DVD can hold a great quantity of information. The drive relies on the principles of interference to "read" the disc. A CD or DVD contains a long spiral track with pits in it. These pits are formed in a disc by an injection molding process, and represent some of the smallest mechanically manufactured objects. A thin layer of metal such as silver or aluminum covers the pits. This layer in turn is covered by a thin layer of plastic. The pits are created on the top of the CD or DVD but the disc is read using a laser that is projected up from the bottom. From the bottom of the disc, the pits appear to be raised areas. Non-pitted areas of the disc are called land. (An incidental fact: The pits are nearer the top of the disc than the bottom, so scratches on its top are more likely to damage the CD than scratches the bottom, or "reading" side!) CDs or DVDs created by burners do not create pits in the fashion described above, but rather change the color of a layer within the disc. The CD or DVD reader contains a laser diode that emits a beam of light that reflects off the disc. The intensity of the reflected light varies as the disc rotates and the light reflects off pits and land. The intensity is measured and interpreted as a series of ones and zeros (digital information) by photodetectors. This information is then relayed to other systems that interpret it. How does interference factor in? The laser beam reflects off of the CD. If the entire beam hits a land or a pit, then the path length difference back to the photodetector is essentially the same, and the result is constructive interference: bright light. You see this case in Fig 1. On the other hand, when the disc moves and laser light is half on a pit, and half on the land, the path length difference is significant. The two parts of the laser beam have a total path length difference of one-half a wavelength, and the result is destructive interference: darkness. You see this in Fig 2, where we emphasize "sides" of the same laser beam, and how one side reflects off of a pit and the other off a land. DVDs contain more data than CDs and employ a variety of strategies to do so. For instance, DVD drives use lasers with shorter wavelengths. A shorter wavelength means smaller pits are possible, and these smaller pits can be placed more closely together, allowing more data to be stored.

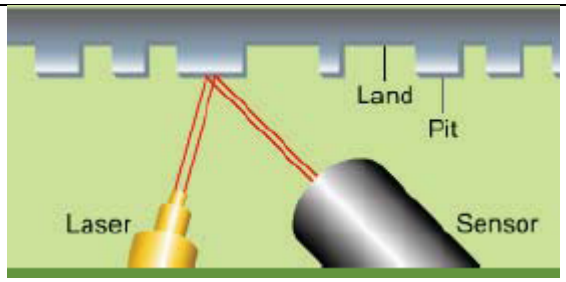


Fig 1:CDs and DVDs Laser shines light onto track of CD, DVD Discs have "pits" in surface Sensor reads signal from laser

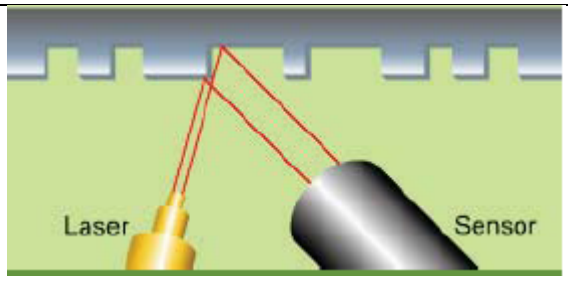


Fig 2: The signal Interference pattern depends on where light strikes Sensor receives brighter or dimmer light.

Q # 3

Fluorescent light often use an inductor, called a ballast, to limit the current through tubes or energy saver. Why is it better to use an inductor rather than a resistor for this purpose, although resistor is even economically better than an inductor?

Solution

It is better to use in inductor rather than resistor to limit the current in fluorescent lights through tubes, because it is the property of inductor to oppose the change in current either increase or decrease in current by producing an induced emf across its terminal which opposes the supply voltage and whose value is given by

$$\varepsilon = -L\frac{di}{dt}$$

Negative sign shows opposite direction of induces emf

Since induced emf is directly proportional to the rate of change in current so as current increases induced emf also increases to decrease the current since resistor does not posses such type of characteristics.

Solution Assignment 1: (Spring 2012) Physics

PHYSICS (PHY101)

TOTAL MARKS: 20

Due Date: 19/04/2012

Question # 1

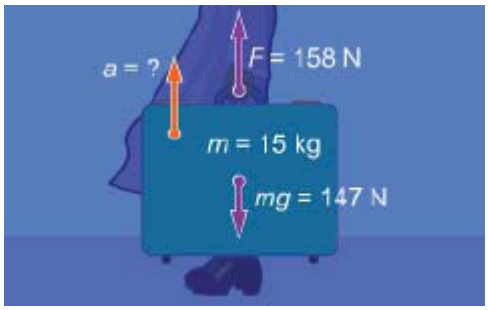
a) Can an object with zero acceleration have velocity? If no give a proof if yes give an example.
b) Can an object with zero velocity have acceleration? If no give a proof if yes give an example.
Marks = 3+3

Solution

a. Yes! A train barreling down the tracks at 160 km/h has velocity. If that velocity is not changing, the train's acceleration is zero.

b. Yes again: a ball thrown straight up has zero velocity at the top of its path, but its acceleration at that instant is -9.80 m/s^2.

Question # 2



Look on the above figure and answer the following question. What is the suitcase's acceleration?
Marks = 6

Solution

$\Sigma F = ma$

$F + (-mg) = ma$

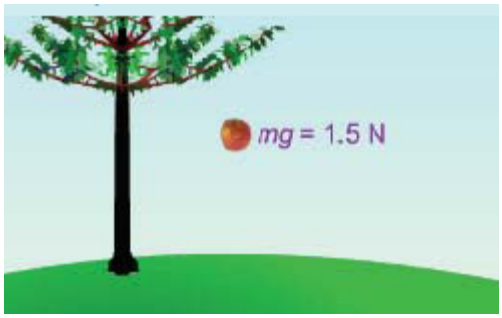
$a = (F - mg)/m$

$a = (158\ N - 147\ N)/ (15\ kg)$

$a = 11/15$

$a = 0.73\ m/s^2$ (upward)

Question # 3



Look on the above figure and answers the following questions.

a. The weight of the apple is 1.5 N. What force does the apple exert on the Earth? Also indicate which Newton law is applicable here?
b. If the forces on the apple and the Earth are equal in strength, do they cause them to accelerate at the same rate? **Marks = 3+5**

Solution

a. The Earth's gravitational force pulls an apple toward the ground and the apple pulls upward on the Earth with an equally strong gravitational force. These pairs of forces are called action-

reaction pairs, and Newton's third law is often called the action-reaction law. Thus it is concluded that 1.5 N upward force acts on the apple in the fig shown

b. Newton's second law enables us to answer this question, first, objects accelerate due to a net force, and the force of the apple on the Earth is minor compared to other forces, such as those of the Moon or Sun. But, even if the apple were exerting the sole force on the Earth, its acceleration would be very, very small because of the Earth's large mass. The forces are equal, but the acceleration for each body is inversely proportional to its mass.

<<<<<<<<<<<< Wish you good luck>>>>>>>>>>>

Solution Assignment 2: (Spring 2012) Physics

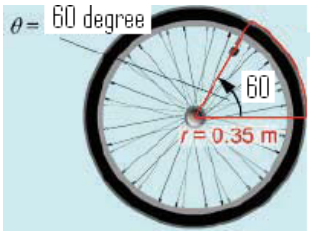
PHYSICS (PHY101)

TOTAL MARKS: 20

Due Date: 03/05/2012

Question # 1

What is the value of arc length in the shown figure below? **Marks 3**



Radius = 0.35m

Solution

First of all convert the given angle into radian measure i.e. 60˚= π/3rad

Now apply the formula S = rθ

S = rθ

= 0.35* π/3

= 0.35*22÷7*3

= 0.37m

Question # 2

In the fig shown below, at 12:10, the initial angular position of the minute hand is 60˚. After 15 minutes have passed, what is the minute hand's angular displacement? **Marks 5**

Solution:

Angular displacement in the counterclockwise direction is positive, where as clockwise it is taken as negative.

$\Delta\theta = \theta_f - \theta_i$

$= (-\pi/3\text{rad}) - (\pi/6\text{rad})$

$= -\pi/2\text{rad}$

Question # 3

Give your opinion on the following statement,

"Wave speed in a string is a function of frequency, so if anyone increases the wave frequency, the wave speed will increase, too." If yes give an example, if no explain it.

Solution

No. The speed of a wave in a string is fixed by the tension and linear density of the string. Increasing wave frequency will cause a decrease in wavelength, but no change in wave speed.
Marks = 6

Question # 4

Suppose that a rocket provides 58 N·m of torque for 3.0 s. What is the amount of change in the Satellite's angular momentum? **Marks = 6**

Solution:

As we know that

τΔt = ΔL

ΔL = (58)*(3)

= 174kg.m^2/s

>>>>>>>>>>>>>>>>>>>>>>>>Good Luck>>>>>>>>>>>>>>>>>>>>>>>>>>

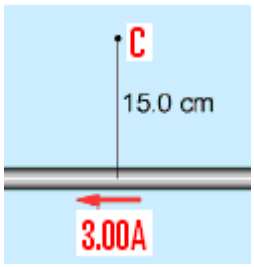
Solution Assignment 3: (Spring 2012) Physics

PHYSICS (PHY101)

TOTAL MARKS: 20

Due Date: 14/06/2012

Q # 1



Constant $\mu_0 = 4\pi \times 10^{-7}$ N/A^2

What is the magnetic field strength and direction at point C, shown in above figure?

Marks = 6

Solution

$$B = \frac{\mu_o I}{2\pi R}$$

$$B = \frac{(4\pi \times 10^{-7})(3.00)}{2\pi(0.150)}$$

$$= 4.0 \times 10^{-6} T$$

$$Field\ point\ into\ screen\ at\ point\ C$$

Q # 2

Is it true or false that any magnetic field induces an emf in a loop of wire? If true give a proof, if false explain it. **Marks = 4**

Solution

No, only a **changing** magnetic field induces an emf in such a loop. A uniform, constant magnetic field alone induces no net emf in a loop of wire. However, a potential difference can be induced across a segment of wire by moving it through a magnetic field.

Question # 3

Differentiate among linear charge density, surface charge density and volume charge density.
Marks = 5

Solution

The linear, surface, or volume **charge density** is the amount of electric charge in a line, surface, or volume, respectively. It is measured in coulombs per meter (C/m), square meter (C/m^2), or cubic meter (C/m^3), respectively,

Linear charge density:

Linear charge density for a uniformly charged line of length *L* and total charge *Q*, the linear charge density is given by

$$\lambda = \frac{Q}{L}$$

Surface charge density:

Surface charge density for a uniformly charged plane of area *A* and total charge *Q*, the surface charge density is *given by*

$$\sigma = \frac{Q}{L}$$

Volume charge density:

Volume charge density for a uniformly charged space of volume *V* and total charge *Q*, the volume charge density is given by

$$\rho = \frac{Q}{L}$$

Question # 4

During brushing your hairs results in electrons being removed from your hairs and deposited on the hairbrush. Which of the following statement is false? **Marks = 5**

a) After brushing, your hair has a positive charge.

b) After brushing, hairbrush has a negative charge.

c) After brushing, your hair is attracted by the hairbrush.

d) The process of brushing causes the destruction of electrons in your hairs.

e) The number of electrons removed from your hairs is equal to the number of electrons deposited on the brush.

Write the reason of your above selected choice as well.

Solution

The correct answer is d.

Detail reason:

When charges are transferred from one object to an other, the electrons are not destroyed- they are just being moved. We say change is conserved.

Conservation of charge is one of the fundamental laws of the universe. We have never observed an event in the universe in which the total amount of charge before and after an event is not the same.

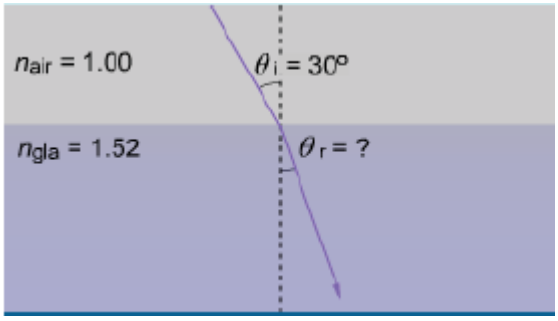
Solution Assignment 4: (Spring 2012) Physics

PHYSICS (PHY101)

TOTAL MARKS: 20

Due Date: 27/06/2012

Question # 1



What is the angle of refraction here, shown in above fig? **Marks = 5**

Solution

$n_{air} = 1.00$

$n_{gla} = 1.52$

$\theta_i = 30^0$

$Find$

$\theta_r = ?$

$n_i Sin\theta_i = n_r Sin\theta_r$

$\frac{Sin\theta_r}{Sin\theta_i} = \frac{n_{air}}{n_{gla}}$

$Sin\theta_r = Sin30^0 \frac{n_{air}}{n_{gla}}$

$= \frac{(0.5)(1)}{1.52}$

$= Sin^{-1}0.33$

$\theta_r = 19.21^0 \approx 19^0$

Question # 2

A radio transmitting station operating at a frequency of 120MHz has two identical antennas that radiate in phase. Antenna B is 9.00m to the right of A. Consider point P between the antennas and along the line connecting them, a horizontal distance x to the right of antenna A. For what values of x will constructive interference occur at point P?

Marks = 10

Solution

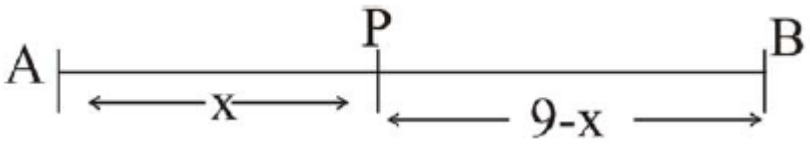
Given that

The frequency of the radio transmitting station is $(f) = 120$ MHz

The velocity of light in air is$(c) = 3\times10^{8}$ m/s

The wavelength of the wave is $(\lambda) = \frac{c}{f}$

$= 2.5$m



Given that AB = 9m

And now consider from the above figure AP = x

For constructive interference at P path difference $= m\lambda$

From the figure PB $= 9 - x$

For constructive interference

$$(9-x)-x = m\lambda,\ 0<x<9$$

$$9-2x = m\lambda$$

For m $= 0$, $x = 4.5$m

For m $= 1$, $9-2x = 2.5$m i.e . $x = 3.25$m

For m $= 2$, $9-2x = 5$ i.e . $x = 2$m

For m $= 3$, $9-2x = 7.5$ i.e . $x = 0.75$m

i.e. For $x = 4.5$m , 3.25m , 2 m and 0.75 m, constructive interference will occur

Question # 3

How is it possible to determine the direction of the polarizing axis of a single polarizer?

Marks = 5

Solution

The direction of the polarizing axis of a single polarizer can be determined by passing plane polarized light through it. On rotating the polarizer, when we get maximum intensity, the axis of polarizer will be parallel to the polarization direction of the polarized light and when we get minimum intensity, the axis is perpendicular to the polarization direction

Solution Assignment 1 (Phy101) (Spring 2011)

PHYSICS (PHY101)

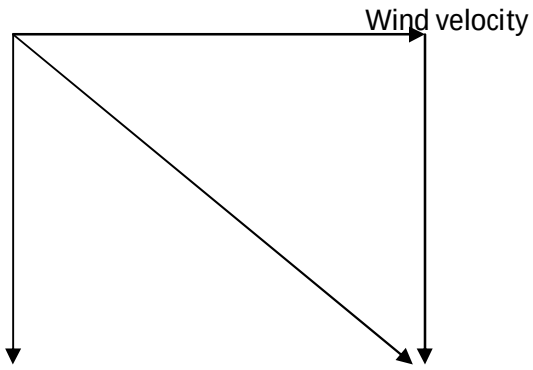
TOTAL MARKS: 20

Question # 1

If you have an umbrella, suddenly you have to face a rain storm with a strong wind, what determines the best position in which to hold an umbrella? **Marks = 3**

Solution

The best position to hold an umbrella is in the direction of the resultant velocity.



Resultant velocity

Rain fall velocity

Question # 2

Does Newton's second law hold true for an observer in a car as it speeds up, slows down or rounds a corner? **Marks = 5**

Solution

Newton's second law $\vec{F} = m\vec{a}$ does not hold true as such for an observer in a speeding up or slowing down a van. The observer, under consideration is in non inertial frame of reference where Newton's second law in a modified form is valid.

Question # 3

A dripping water faucet steadily releases drops 1.0 s apart. As these drops fall, will the distance between them increase, decrease, or remain the same? Prove your answer.

Mark 5

Solution

Let time taken by first drop to fall through distance is 4 second. When the first drop falls 'S' distance, one is about to fall. The second and third drops are in the air between the fall point and the distance 'S'.

According to problem the drops are falling at a regular interval i.e. 1 sec a part.

Therefore time difference between 1^{st} and 2^{nd} drop = time difference between 2^{nd} and 3^{rd} drop = time difference between 3^{rd} and 4^{th} drop. When the first drop has fallen for a time 4 s, second drop has fallen for a time 3s, third drop fallen at time 2s. While the faith on is just to drop.

Height through which first drop has fallen $s_1 = \frac{1}{2} g(t)^2$

Here time $t_1 = 4s$

$$= \frac{1}{2} g(4s)^2$$
$$= (8s^2)g$$

Height through which first drop has fallen $s_2 = \frac{1}{2} g(t)^2$

Here time $t_2 = 3s$

$$= \frac{1}{2} g(3s)^2$$
$$= (4.5s^2)g$$

Height through which first drop has fallen $s_3 = \frac{1}{2} g(t)^2$

Here time $t_3 = 2s$

$$= \frac{1}{2} g(2s)^2$$
$$= (2s^2)g$$

Thus when the first drop falls '8g' distance the second drop falls '(4.5)g' and third drop falls '2g' distance while the fourth drop is about to drop.

That is the distance between the drops increases.

Question # 4

The fastest measured pitched baseball left the pitcher's hand at a speed of 55.0m/s. if the pitcher was in contact with the ball over a distance of 2.0m and produce constant acceleration, (a) what acceleration did he give the ball, and (b) how much time did it take him to pitch it?

Marks = 7

Solution

Initial speed of baseball V_i = 0 m/s

Final speed of baseball V_f = 55 m/s

Initially the distance between baseball and pitcher hand S = 2m

From third equation of motion

$$2as = v_f^2 - v_i^2$$

$$a = \frac{v_f^2 - v_i^2}{2s}$$

$$a = \frac{(55)^2 - (0)^2}{2(2)}$$

$$a = 756.25 m/s^2$$

Acceleration given by pitcher to the baseball a = $756.25 m/s^2$

We know that

$$v_f = v_i + at$$
$$at = v_f - v_i$$
$$t = \frac{v_f - v_i}{a}$$
$$t = \frac{55 - 0}{756.25}$$
$$= 0.0727s$$

Time taken him to pitch it $= 0.073\text{sec}$

Solution Assignment 2 (Phy101) (Spring 2011)

PHYSICS (PHY101)

TOTAL MARKS: 20

Q # 1

A compact disc stores lectures Physics (PHY101) in a coded pattern of tiny pits 10^{-7}m deep. The pits are arranged in a track that spirals outward toward the rim of the disc; the inner and outer radii of this spiral are 20.0mm and 50.0mm, respectively. As the disc spins inside a CD player, the track is scanned at a constant linear speed of 1.5m/s.

(a) What is the angular speed of the CD when the innermost part of the track is scanned the outermost part of the track?

(b) The maximum playing time of a CD is 75.0m. What would be the length of the track on such a maximum duration CD if it were stretched out in a straight line?

(c) What is the average angular acceleration of a maximum duration CD during its 75.0m playing time? Take the direction of rotation of the disc to be positive.

Marks = 15

Solution

Linear and angular velocities are related by the relation $V = r\omega$

$$\text{Linear speed} = 1.5\text{m/s}$$
$$\text{Inner radii} = 20.0\text{mm}$$
$$\text{Outer radii} = 50.0\text{mm}$$

Linear and angular velocities are related by the relation $V = r\omega$

Or $\omega = \frac{V}{r}$

$$\omega_i = \frac{1.5}{20\times10^{-3}} = 75 rad/s$$

$$\omega_f = \frac{1.5}{50\times10^{-3}} = 30 rad/s$$

(a) The angular speed of the CD when the innermost part of the track is scanned

$\omega = \frac{V}{r}$ = $\omega_i = \frac{1.5}{20\times10^{-3}} = 75 rad/s$

The angular speed of the CD when the outermost part of the track is scanned

$$\omega_f = \frac{1.5}{50\times10^{-3}} = 30 rad/s$$

(b) Length of the track is given by $S = Vt$

Thus $S = Vt = 1.5\times75\times60 \quad as\ 1\min = 60s$

$= 6750 m\ or\ 6.75 km$

(c) Average angular acceleration

$$\alpha = \frac{\omega_f - \omega_i}{t}$$

$$= \frac{30-75}{75\times60} = -0.01 rad/s^2$$

Q #2

The flywheel of a gasoline engine is required to give up 550J of kinetic energy while its angular velocity decreases from 790 rev/min to 730rev/min. What moment of inertia is required?

Solution

As we know that

$K = \frac{1}{2} I\omega^2$ Convert ω in rad/s

1 rev/min = 2π/60 K = - 550J (Give up)

ω_i = 790*2π/60 = 82.76rad/s ω_f = 730*2π/60 = 76.48rad/s

$$I = \frac{2K}{\omega_f^2 - \omega_i^2} = \frac{2(-550)}{(76.48)^2 - (82.76)^2}$$
$$= 1.1 kg.m^2$$

<<<<<<<<<<Good Luck>>>>>>>>>>

Solution Assignment 3: (Spring 2011) PHYSICS (PHY101)

TOTAL MARKS: 20

Due Date: 09/05/2011

Q # 1

When a 0.850kg mass oscillates on an ideal spring, the frequency is 1.43Hz. What will the frequency be if 0.320Kg is added to the original mass and (b) subtracted from the original mass? Try to solve this problem without finding the force constant of the spring.

Marks = 7

Solution

Relation between mass and frequency is $f = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$

$f\sqrt{m} = \frac{\sqrt{k}}{2\pi} = \text{Constant}$

So $f_1\sqrt{m_1} = f_2\sqrt{m_2}$

m_1 =0.850 kg

f_1 =1.43 Hz

m_2 =0.850+0.320 kg=1.17 kg

$f_2 = f_1\sqrt{\frac{m_1}{m_2}}$

=1.43($\sqrt{\frac{0.850}{1.17}}$) = (1.43)0.852

f_2 =1.22 Hz

(b)

m_2 =0.850-0.320 kg=0.53 kg

$f_2 = f_1\sqrt{\frac{m_1}{m_2}}$

$f_2 = 1.43\sqrt{\frac{0.850}{0.530}}$ = (1.43)1.27

f_2 =1.81 Hz

It means when the mass increases the frequency decreases and when the mass decreases the frequency increases.

Q # 2

Are you familiar the procedure used by astronaut to "weigh" in space? Let us discuss it in a problem and try to find the mass of astronaut. A 45.5Kg chair is attached to a spring and allowed to oscillate. When it is empty, the chair takes 1.45 s to make one complete vibration. But with an astronaut sitting in it, with her feet off the floor, the chair takes 3.5s for one cycle. What is mass of astronaut? **Marks = 8**

Solution

Mass m = 45.5 kg and T =1.45 sec applying

$T = 2\pi\sqrt{\frac{m}{k}}$ Use the information about the empty chair to calculate k

$$k = \frac{4\pi^2 m}{T^2}$$

$$= \frac{4\times(3.14)^2\times 45.5}{(1.45)^2}$$

$$k = 853.48 N/m$$

With person in chair

$$T = 2\pi\sqrt{\frac{m}{k}}$$

$$m = \frac{T^2 k}{4\pi^2}$$

$$= \frac{(3.5)^2\times 853.48}{4(3.14)^2}$$

$$m = 265kg$$

Mass of the astronaut $m_{astronaut} = 265 - 45.5 = 219.5kg$

Thus we can say for the same spring, when the mass increases, the period increases

Q # 3

The tip of a tuning fork goes through 540 complete vibrations in 0.800s. Find the angular frequency and the period of the motion. **Marks = 5**

Solution

Here frequency

$$f = \frac{540}{0.800} Hz$$
$$f = 675 Hz$$

As we know that Angular frequency

$$\omega = 2\pi f$$
$$= 2 \times 3.14 \times 675$$
$$= 4.24 \times 10^{3} rad/\mathrm{s}$$

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

$$= \frac{1}{675} = 1.5 \times 10^{-3} s$$

<<<<<<<<<Good luck>>>>>>>>>

Solution Assignment 4 (Phy101) (Spring 2011)

PHYSICS (PHY101)

TOTAL MARKS: 20

Question No 1

A parallel plate air capacitor of capacitance 245pF has a charge of magnitude 0.148μC on each plate. The plates are 0.328mm apart.

(a) What is the potential difference between the plates?

(b) What is the area of each plate?

(c) What is the electric field magnitude between the plates?

(d) What is the surface charge density on each plate?

The value of ($\in_0$) = $8.854\times10^{-12}\,C^2N.m^2$

Solution:

Magnitude of charge on each plate is (Q) = 0.148 uC = 0.148×10^{-6} C

Capacitance of capacitor is (C) =245 pF = 245×10^{-12} F

Distance between plates (d) is=0.328 mm = 0.328×10^{-3} m

The value of ($\in_0$) = $8.854\times10^{-12}\,C^2N.m^2$

(a) Potential difference between the capacitor plates is

$$V_{ab}=\frac{Q}{C}$$
$$=\frac{0.148\times10^{-6}}{245\times10^{-12}}$$
$$=604V$$

(b) The area of each plate is

$$A=\frac{Cd}{\in_0}$$
$$=\frac{245\times10^{-12}\times0.328\times10^{-3}}{8.854\times10^{-12}\,C^2N.m^2}$$
$$=9.08\times10^{-3}m^2$$

(c) Electric field magnitude between the plates can be calculated as

$$V_{ab} = Ed$$
$$E = \frac{V_{ab}}{d}$$
$$= \frac{604V}{0.328\times10^{-3}}$$
$$= 1.84\times10^{6} V/m$$

(d) Surface charge density on each plate of capacitor is

$$\sigma = \frac{Q}{A}$$
$$= \frac{0.148\times10^{-6}}{9.08\times10^{-3}}$$
$$= 16.3\mu C/m^2$$

Or it can also be calculated as

$$E = \frac{\sigma}{\in_0}$$
$$\sigma = E \in_0$$
$$= 1.84\times10^{6} V/m * 8.854\times10^{-12} C^2 N.m^2$$
$$= 16.3\mu C/m^2$$

Question No 2.

A cylindrical copper cable 1.50Km long is connected across a 220.0V potential difference.

(a) What should be its diameter so that it produces heat at a rate of 50.0W?

(b) What is the electric field inside the cable under these conditions?

Solution:

As we know that rate of heating (power) in the cable depends on the potential difference across the cable and the resistance of the cable.

Power $p = \frac{V^2}{R}$ and $R = \frac{\rho L}{A}$ so

$$P = \frac{\pi r^2 V^2}{\rho L}$$

$$r = \sqrt{\frac{P\rho L}{\pi V^2}}$$

$$= \sqrt{\frac{50 \times 1.72 \times 10^{-8} \times 1500}{\pi (220)^2}}$$

$$r = 9.21 \times 10^{-5} m$$

Diameter D= 2r

$$D = 0.184 mm$$

(b) The electric field inside the cable is equal to the potential difference across its ends divided by the length of the cable

$$E = \frac{V}{L}$$

$$E = \frac{220}{1500}$$

$$E = 0.147 V/m$$

Question No 3:

A person with body resistance between his hands of 10KΩ accidently grasps the terminal of a 14-KV power supply.

(a) If the internal resistance of the power supply is 2000Ω, what is the current through the person's body?

(b) What is the power dissipated in his body?

(c) If the power supply is to be made safe by increasing its internal resistance, what should the internal resistance be for the maximum current in the above situation to be 1.00mA or less?

Solution:

(a) The total resistance is the resistance of the person plus the internal resistance of the power supply. Thus the current through the person's body is

$$V = IR$$
$$I = \frac{V}{R}$$
$$I = \frac{14\times10^{3}}{10\times10^{3}+2000}$$
$$I = 1.17A$$

(b) Power dissipated in body is

$$P = I^{2}R$$
$$= (1.17)^{2}\times10\times10^{3}$$
$$= 1.37\times10^{4}W$$
$$= 13.7KW$$

(c)

$$R_{total} = \frac{V}{I}$$
$$= \frac{14\times10^{3}}{1.0\times10^{-3}}$$
$$= 14\times10^{6}\Omega$$

The resistance of the power supply would need to be

$$14\times10^{6}\Omega - 10\times10^{3}\Omega = 13.99M\Omega \cong 14M\Omega$$

Q B

A parallel plate air capacitor of capacitance 245pF has a charge of magnitude 0.148μC on each plate. The plates are 0.328mm apart.

(a) What is the potential difference between the plates?

The value of ($\in_0$) = $8.854\times10^{-12}\,C^2N.m^2$ Marks 3

A parallel plate air capacitor of capacitance 245pF has a charge of magnitude 0.148μC on each plate. The plates are 0.328mm apart. The value of ($\in_0$) = $8.854\times10^{-12}\,C^2N.m^2$

(a) What is the area of each plate?

(b) What is the surface charge density on each plate? Marks 5

Marks 5

A parallel plate air capacitor of capacitance 245pF has a charge of magnitude 0.148μC on each plate. The plates are 0.328mm apart. The value of ($\in_0$) = $8.854\times10^{-12}\,C^2N.m^2$. What is the electric field magnitude between the plates?

Marks 3

A cylindrical copper cable 1.50Km long is connected across a 220.0V potential difference.

What should be its diameter so that it produces heat at a rate of 50.0W? Marks = 5

A cylindrical copper cable 1.50Km long is connected across a 220.0V potential difference.

What is the electric field inside the cable under these conditions?

A person with body resistance between his hands of 10KΩ accidently grasps the terminal of a 14-KV power supply.

(a) If the internal resistance of the power supply is 2000Ω, what is the current through the person's body?

(b) What is the power dissipated in his body?

Solution Assignment 5 PHY101: (Spring 2011)

PHYSICS (PHY101)

TOTAL MARKS: 20

Q # 1

Measuring wavelengths with a CD, A LASER beam of wavelength λ = 632.8nm shines at normal incidence on the reflective side of a compact disc. The track of tiny pits in which information is coded onto the CD are 1.60μm apart. For what angles of reflection (measured from normal) will the intensity of light be maximum? **Marks = 7**

Solution

Given that wavelength of a laser beam is (λ) = 632.8nm = $632.8\times10^{-9}m$

Information stored on the CD is at distance (d) = 1.6×10^{-6}m = $1600\times10^{-9}m$

For maximum intensity

$$d\sin\theta = m\lambda$$

$$\sin\theta = \frac{m\lambda}{d}$$

$$d\sin\theta = m\lambda$$

$$\sin\theta = \frac{m\times632.8\times10^{-9}m}{1600\times10^{-9}m}$$

$$= 0.395m$$

For

` m=1, $\theta = 23.3^0$

m=2, $\theta = 52.3^0$

$\theta = 23.3^0$, $\theta = 52.28^0$ .There are no other maxima.

The reflective surface produces the same interference pattern as a grating with slit separation d.

Q # 2

The plate on the back of a certain computer scanner says that the unit draws 0.34A of current from a 120V, 60Hz line. Find (a) the root mean square current (b) the current amplitude (c) the average current (d) the average square current. **Marks = 8**

Solution

Current drawn = 0.34A
Voltage = 120V
Frequency of supply = 60Hz

a) The current given is the rms value

$I_{rms} = 0.34\text{A}$

$= \boxed{0.34\text{A}}$

b) The current amplitude (I) is given by,

$I = \sqrt{2}\, I_{rms}$

$= \sqrt{2}\,(0.34\text{A})$

$= 0.4808\,\text{A}$

c) The average of any sinusoidal alternating current over any whole number of cycles is $\boxed{\text{zero}}$

d) The average square of the current is

$i_{av}^2 = I_{rms}^2$

$= (0.34\text{A})^2$

$= 0.1156\text{A}^2$

$= \boxed{0.1156\text{A}^2}$

Q # 3

Give several examples of electromagnetic waves that are encountered in everyday life. How are they all alike? How do they differ? **Marks = 5**

Solution

The following are several examples of electromagnetic waves that are encountered in normal wave that are encountered in normal use

(1) Microwaves in microwave ovens
(2) Visible light
(3) X-rays – in pathology
(4) Radio waves in radio transmission etc.

All these waves are electromagnetic, only difference in their frequency and wavelength.

<<<<<<<< .....Good Luck..... >>>>>>>>>

Solution Assignment 6 Physics: (Spring 2011)

PHYSICS (PHY101)

TOTAL MARKS: 20

Q # 1

A cube of cooper 2.00cm on a side is suspended by a string. The cube is heated with a burner from 20.0°C to 90.0°C. The air surrounding the cube is atmospheric pressure (1.01×10^5Pa). Find

a) The increase in volume of the cube;
b) The mechanical work done by the cube to expand against the pressure of the surrounding air;
c) The amount of heat added to the cube;
d) The change in internal energy of the cube. **Marks = 11**

Note: For Copper $\beta = 5.1 \times 10^{-5}\ (C^{\circ})^{-1}$ Cp = 390J/Kg.K & ρ (Rho) = 8.90×10^3Kg/m^3

Solution

a)

$$\Delta V = \beta V_0 \Delta T$$
$$= 5.1\times10^{-5}\times70\times(2\times10^{-2})^3$$
$$\Delta V = 2.86\times10^{-8} m^3$$

Lets β = 5.1 × 10^{-3} $(C^{\circ})^{-1}$ Then $\Delta V = 2.86\times10^{-6} m^3$

b)

$$W = p\Delta V$$
$$W = 2.88\times10^{-3} J$$

c)

$$Q = mc_p\Delta T = \rho V_0 c_p \Delta T$$
$$= 8.9\times10^{3}\times8.0\times10^{-6}\times390\times70$$
$$= 1944 J$$

d)

Here

$$\Delta U = Q = 1944 J$$

Q # 2

A freezer has a coefficient of performance of 2.40. The freezer is to convert 1.80Kg of water at 25.0°C to 1.80kg of ice at -5.0°C in hour. **Marks = 9**

a) What amount of heat must be removed from the water at 25.0 °C to convert it to ice at -5.0°C?
b) How much electrical energy is consumed by the freezer during this hour?
c) How much wasted heat is delivered to the room in which the freezer sits?

Note that for water C_w = 4190J/Kg.K, L_f = 3.34 × 10^5J/Kg.K & C_{ice} = 2010J/Kg.K

Solution

a)

$$Q = mc_{ice}\Delta T_{ice} - mL_f + mc_w\Delta T_w$$
$$Q = 1.8kg\times2010 J/kg.K\times(-5.0C^0) - 3.34\times10^5 J/kg + 4190 J/kg.K\times(-25C^0)$$
$$Q = -8.08\times10^5 J$$

Q is negative for the water since heat is removed from it.

b)

$$W = \frac{|Q_c|}{K}$$

$$W = \frac{8.08 \times 10^5}{2.4}$$

$$W = 3.37 \times 10^5 \, J$$

c)

$$|Q_H| = 8.08 \times 10^5 \, J + 3.37 \times 10^5 \, J$$

$$|Q_H| = 1.14 \times 10^6 \, J$$

The End

<<<<<<<<Good Luck>>>. >>>>.