pojyhm Python Project (Last Checkpoint: 3 hours ago, Unsaved)

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Question 01 (Vectors)

What are (a) the x component and (b) the y component of vector m in xy plane if its direction is 250° counterclockwise from the positive direction of the x axis and its magnitude is 7.2 m?

```
In [1]: import math
        import matplotlib.pyplot as plt
        import numpy as np
        import sympy
        from sympy import *
        from sympy.vector import *
        from sympy.vector.vector_extensions import
        print("Magnitude(mag), dir(angle)")
        mag, ang = input("Enter the magnitude(mag) and the angle(ang) of the m component:\n").split
        # mag = int(mag)
        # ang = int(ang)
        x = np.array(mag)
        y = np.array(ang)
        plt.ioff()
        fig, ax = plt.subplots()
        ax.quiver(0,0,x,y,angles='xy',scale='xy',scale=1,
        ax.set_xlim(-1,1)
        ax.set_ylim(-1,1)
        ax.grid(True)
        ax.set_aspect('equal')
        plt.ioff()
        plt.title('Vector and its components representation')
        plt.show()
        print("The magnitude of m component is ",x.STRFTIMEFTIP and the magnitude of the y component is ,y.STRFTIMEFTIP)
Out[1]: Text(0.5, 1.0, 'Vector and its components representation')
```

Question 02 (Dot product and Cross Product)

Two vectors are presented as a=3i+5j b=2i+4j. Find a.b

```
In [2]: import matplotlib.pyplot as plt
        import numpy as np
        import sympy
        from sympy.vector.vector_extensions import
        print("Enter the product of the given vectors (a*b,a*b)
        a = int(input())
        b = int(input())
        # a = np.array(a)
        # b = np.array(b)
        fig, ax = plt.subplots()
        ax.quiver(0,0,a,b,angles='xy',scale='xy',scale=1,
        ax.set_xlim(-1,1)
        ax.set_ylim(-1,1)
        ax.grid(True)
        ax.set_aspect('equal')
        plt.ioff()
        plt.title('Vector representation of Vector A and B')
        plt.show()
        print("The product of the given vectors is ")
Out[2]: Text(0.5, 1.0, 'Vector representation of Vector A and B')
```

Question 03 (Motion in 1D)

The position of an object moving along an x axis is given by x=3t-4t²+2t³, where x is in meters and t in seconds. Find the position of the object at the following values of t: (a) t= 4 (b) t= 5 s

at t=4s

```
In [3]: import matplotlib.pyplot as plt
        import numpy as np
        import sympy
        from sympy.vector.vector_extensions import
        fig, ax = plt.subplots()
        ax.quiver(0,0,x,y,angles='xy',scale='xy',scale=1
        ax.set_xlim(-1,1)
        ax.set_ylim(-1,1)
        ax.grid(True)
        ax.set_aspect('equal')
        plt.ioff()
        plt.title('Position Vector of Particle')
        plt.show()
        print("The position of the object after t= 4 is ")
Out[3]: Text(0.5, 1.0, 'Position Vector of Particle')
```

at t=5s

```
In [4]: import matplotlib.pyplot as plt
        import numpy as np
        import sympy
        from sympy.vector.vector_extensions import
        fig, ax = plt.subplots()
        ax.quiver(0,0,x,y,angles='xy',scale='xy',scale=1
        ax.set_xlim(-1,1)
        ax.set_ylim(-1,1)
        ax.grid(True)
        ax.set_aspect('equal')
        plt.ioff()
        plt.title('Position Vector of Particle')
        plt.show()
        print("The position of the object after t= 5 is ")
Out[4]: Text(0.5, 1.0, 'Position Vector of Particle')
```

Question 04 (Motion in 2D)

The floor of a railroad flatcar is loaded with loose crates having a coefficient of static friction of 0.25 with the floor. If the train is initially moving at a speed of 48 km/h, in how short a distance can the train be stopped at constant acceleration without causing the crates to slide over the floor?

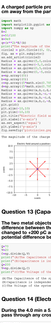
```
In [5]: Mass=20
        Gravity=9.8
        Mass
        acceleration=(48/3.6)
        Force=Mass*acceleration
        print("The distance after which the train will stop 1F,Distance,%")

        The distance after which the train will stop is 26.2517613132390 m
```

Question 05 (Projectile Motion)

A projectile is fired horizontally from a gun that is 45.0 m above flat ground, emerging from the gun with a speed of 250 m/s. (a) How long does the projectile remain in the air?(b) At what horizontal distance from the firing point does it strike the ground?

```
In [6]: import matplotlib.pyplot as plt
        import numpy as np
        import math
        import sympy
        height=45
        Gravity=9.8
        Speed=250
        import math
        angle=math.radians(0)
        Vertical=Speed*math.sin(angle)
        Horizontal=Speed
        Time=(Vertical+(Vertical**2+2*Gravity*height)**0.5)/Gravity
        print("Enter the angle(in degree)")
        angle=int(input())
        angle=math.radians(angle)
        Vertical=Speed*math.sin(angle)
        Horizontal=Speed*math.cos(angle)
        Time=(Vertical+(Vertical**2+2*Gravity*height)**0.5)/Gravity
        print("Enter the distance(in m)")
        distance=int(input())
        Time=distance/Horizontal
        print("The time remain in the air for,%")
        print("The horizontal distance at which the projectile strikes the ground,%")
        fig, ax = plt.subplots()
        ax.quiver(0,0,x,y,angles='xy',scale='xy',scale=1,
        ax.set_xlim(-1,1)
        ax.set_ylim(-1,1)
        ax.grid(True)
        ax.set_aspect('equal')
        plt.ioff()
        plt.title('Trajectory of projectile')
        plt.show()
        print("The time remained in the air for,%")
        The time remained in the air for,0.5309750230950 sec
        And the distance covered is 707.0000000000000,%
```



Question 06 (Uniform Circular Motion)

An Earth satellite moves in a circular orbit 640 km (uniform circular motion) above Earth's surface with a period of 98.0 min. What are (a) the speed and (b) the magnitude of the centripetal acceleration of the satellite?

```
In [7]: import matplotlib.pyplot as plt
        import numpy as np
        import math
        radius_of_earth =6.37e6
        radius_of_satellite=radius_of_earth+640000
        time_period=98*60
        print("Enter the speed of the satellite(time_period
        omega=pi*2/time_period
        print("Enter the radius of earth ")
        print("Enter the radius of satellite ")
        centripetal_acceleration=omega**2*radius_of_satellite
        print("The speed of the satellite is omega,%")
        print("The centripetal acceleration is ",centripetal_acceleration,"m/s^2")
        print("The magnitude of the centripetal acceleration is ",centripetal_acceleration,"m/s^2")
        fig, ax = plt.subplots()
        ax.quiver(0,0,x,y,angles='xy',scale='xy',scale=1,
        ax.set_xlim(-1,1)
        ax.set_ylim(-1,1)
        ax.grid(True)
        ax.set_aspect('equal')
        plt.ioff()
        plt.title('Vector and radius of the satellite (or) representation of minimum/max time')
        plt.show()
        print("The speed of the satellite is omega,%")
        The speed of the satellite is 7890.0000000000000 m/s
        The centripetal acceleration is ,0.0294000000000000 m/s^2
        The magnitude of the centripetal acceleration is ,0.0294000000000000 m/s^2
```

Question 07 (Newton's laws)

Only two horizontal forces act on a 3.0 kg body that can move over a frictionless floor. One force is 9.0 N, acting due east, and the other is 6.0 N, acting 62 degree north of west.What is the magnitude of the body's acceleration?

```
In [8]: import matplotlib.pyplot as plt
        import numpy as np
        import math
        import sympy
        import sympy.vector.vector_extensions import
        import math
        import sympy
        angle=math.radians(62)
        Vertical=6*math.sin(angle)
        Horizontal=9+6*math.cos(angle)
        Force=(Vertical**2+Horizontal**2)**0.5
        print("Enter the mass of the body")
        mass=int(input())
        acceleration=Force/mass
        print("The magnitude of the body's acceleration is ",acceleration,"m/s^2")
        ax.quiver(0,0,x,y,angles='xy',scale='xy',scale=1,
        ax.set_xlim(-1,1)
        ax.set_ylim(-1,1)
        ax.grid(True)
        ax.set_aspect('equal')
        plt.ioff()
        plt.title('A representation of forces acting on the body(F1 in red(F2 in blue)direction of acceleration in green')
        plt.show()
        The magnitude of the body's acceleration is ,2.0222000723400 m/s^2
Out[8]: Text(0.5, 1.0, 'A representation of forces acting on the body(F1 in red(F2 in blue)direction of acceleration
        in green')
```


Question 08 (Simple Harmonic Motion)

An object undergoing simple harmonic motion takes 0.25 s to travel from one point of zero velocity to the next such point. The distance between those points is 36 cm. Calculate the (a) period, (b) frequency, and (c) amplitude of the motion.

```
In [9]: import matplotlib.pyplot as plt
        import numpy as np
        import math
        import sympy
        import sympy.vector.vector_extensions import
        import math
        import sympy
        time_period=0.25
        print("Enter the distance(in m)")
        distance=int(input())
        print("Enter the time period")
        time_period=int(input())
        print("The time period ",time_period,"\nThe frequency is",frequency,"\n\nThe amplitude is",amplitude,"m")
        ax.quiver(0,0,x,y,angles='xy',scale='xy',scale=1,
        ax.set_xlim(-1,1)
        ax.set_ylim(-1,1)
        ax.grid(True)
        ax.set_aspect('equal')
        plt.ioff()
        plt.title('This is the graph of displacement')
        plt.show()
        ax.quiver(0,0,x,y,angles='xy',scale='xy',scale=1,
        ax.set_xlim(-1,1)
        ax.set_ylim(-1,1)
        ax.grid(True)
        ax.set_aspect('equal')
        plt.ioff()
        plt.title('This is the graph of velocity')
        plt.show()
        ax.quiver(0,0,x,y,angles='xy',scale='xy',scale=1,
        ax.set_xlim(-1,1)
        ax.set_ylim(-1,1)
        ax.grid(True)
        ax.set_aspect('equal')
        plt.ioff()
        plt.title('This is the graph of acceleration')
        plt.show()
        The time period is 0.5 s
        The frequency is 2.0 Hz
        The amplitude is 18.0 m
```

Question 09 (Damped Oscillation)

For the damped oscillator system, with m = 250 g, k = 85 N/m, and b = 70 g/s, b=0.34k what is the ratio of the oscillation amplitude at the end of 20 cycles to the initial oscillation amplitude?

```
In [10]: import math
         import matplotlib.pyplot as plt
         import numpy as np
         import math
         import sympy
         m=70/1000
         k=85
         magnitude=m*k*(-0.5*70/(2*m))
         print("Enter the mass(in g)")
         print("The ratio of oscillation amplitude at the end of 20 cycles to the
         initial oscillation amplitude is ",magnitude,"%")
         The ratio of oscillation amplitude at the end of 20 cycles to initial oscillation amplitude is 0.4767500000000
```

Question 10 (Waves Motion)

If a wave y(x, t) =(6.0 mm) sin(kx + (600 rad/s)t) travels along a string, how much time does any given point on the string take to move between displacements y=+3.0 mm and y=-3.0 mm?

```
In [11]: import math
         import matplotlib.pyplot as plt
         import numpy as np
         import math
         import sympy
         phase=
         phase=0
         phase=0.0000
         y1=6*math.sin(k*x1+0.0000)
         y1=6*math.sin(k*x1+0.0000)
         y2=6*math.sin(k*x2+0.0000)
         y2=6*math.sin(k*x2+0.0000)
         y1=6*math.sin(k*x1+0.0000)
         y2=6*math.sin(k*x2+0.0000)
         # relationship between y and x
         print("The time taken by the wave to reach from y1 to y2 is",time_difference,"s")
         The time taken by the wave to reach from y1 to y2
         is 0.0000000000000000 s
```

Question 11 (Electric Forces)

What must be the distance between point charge q1 =26.0 μC and point charge q2=47.0 μC for the electrostatic force between them to have a magnitude of 5.70 N?

```
In [12]: import math
         import matplotlib.pyplot as plt
         import numpy as np
         q1=26*10^-6
         q2=47*10^-6
         F=5.70
         distance=sqrt(q1*q2/F)
         print("The distance between the two charges is ",distance,"m")
         The distance between the two charges is 1.0000000000000000 m
```

Question 12 (Electric Fields)

A charged particle produces an electric field with a magnitude of 2.0 N/C at a point that is 50 cm away from the particle. What is the magnitude of the particle's charge?

```
In [13]: import matplotlib.pyplot as plt
         import numpy as np
         import math
         E=2
         distance=50
         q=E*r^2/k
         print("The magnitude of the charge q,%")
         print("Enter the distance(in m)")
         fig, ax = plt.subplots()
         ax.quiver(0,0,x,y,angles='xy',scale='xy',scale=1,
         ax.set_xlim(-1,1)
         ax.set_ylim(-1,1)
         ax.grid(True)
         ax.set_aspect('equal')
         plt.ioff()
         plt.title('Electric field sensed a positive charge',fontsize=15
         plt.show()
         ax.set_xlim(-1,1)
         ax.set_ylim(-1,1)
         ax.grid(True)
         ax.set_aspect('equal')
         plt.ioff()
         The magnitude of the charge is 5.0000000000000000e-11 C
```


Question 13 (Capacitor)

The two metal objects have net charges of +70 pC and -70 pC, which result in a 20 V potential difference between them. a)What is the capacitance of the system? (b) If thecharges are increased to +200 pC and -200 pC, what does the capacitancebecome? (c) What does the potential difference become?

```
In [14]: q=70
         Deep.Gitlab.Q;
         print("The Capacitance of the system is",q,"pF")
         print("Capacitance is independent of Q if this remain same")
         q=200
         Deep.Gitlab.Q;
         print("The Capacitance of the system becomes",q,"Pico")

         ==> The Capacitance of the system is 70 pF
         Capacitance is independent of Q if this remain same
         ==> The Capacitance of the system becomes 200 Pico
```

Question 14 (Electric Current)

During the 4.0 min a 5.0 A current is set up in a wire, how many (a) coulombs and (b) electrons pass through any cross section across the wire's width?

```
In [15]: import math
         import matplotlib.pyplot as plt
         import numpy as np
         import math
         q=4*60
         Deep.Gitlab.Q;
         print("Enter the time(in s) On ON
         electrons_passing_through_a_cross_section_per_second=q/5 ==> ",%"Enter the number of electrons that passed through
         a cross section per second")

         ==> Enter number of electrons that passed through the cross sec 12000 C
         ==> Enter number of electrons that passed through the cross sec 1.5e+21
```

Question 15 (Ohm's Law)

Thermal energy is produced in a resistor at a rate of 100 Watts when the current is 3.00 A.What is the resistance?

```
In [16]: import math
         import matplotlib.pyplot as plt
         import numpy as np
         import math
         import sympy
         import sympy.vector.vector_extensions import
         import math
         import sympy
         import sympy.vector.vector_extensions import
         import math
         import sympy
         import sympy.vector.vector_extensions import
```

```python
import numpy as n
P=100
I=3
R=np.divide(P,I**2)
print("The resistance of the system is",R,"Ohms")
```

```
The resistance of the system is 11.11111111111111 Ohms
```