Question 01 (Vectors)

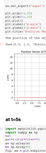
What are (a) the x component and (b) the y component of vector m in xy plane if its direction is 250° counterclockwise from the positive direction of the x axis and its magnitude is 7.2 m?

```
In [0]: import math
        import matplotlib.pyplot as plt
        import numpy as np
        import cmath
        m=7.2*(cmath.rect(1,
        math.radians(250)))
        print("Magnitude",m,sep=sep)
        print("The x component is",m.real,"and the magnitude of the y component is",m.imag)
        sep=" "
        x=m.real
        y=m.imag
        x1=0;y1=0;x2=x;y2=y
        fig, ax = plt.subplots()
        ax.quiver(x1,y1,x2,y2,angles='xy',scale_units='xy',scale=1.5)
        ax.set(xlim=(-10,10),ylim=(-10,10))
        plt.grid(True)
        plt.title('Vector and its components representation')
        plt.show()
        print("The magnitude of x component is",x,"and the magnitude of the y component is",y,"Vector and its components representation")
```

Question 02 (Dot product and Cross Product)

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

```
In [1]: import math,cmath,pylab as plt
        import numpy as np
        import cmath
        m=np.array([3,3])
        n=np.array([3,4])
        print("The dot product of the given vectors",n*m)
        sep=" "
        k=np.dot(m,n)
        x=m.real
        y=n.real
        fig, ax = plt.subplots()
        ax.quiver(0,0,m[0],m[1],angles='xy',scale=1)
        ax.quiver(0,0,n[0],n[1],angles='xy',scale=1)
        plt.grid(True)
        ax.set_aspect('equal')
        plt.show()
        plt.xlim(-5,5)
        plt.ylim(-5,5)
        plt.axhline(y=0)
        plt.axvline(x=0)
        plt.grid(True)
        plt.title('Vector representation of Vector A and B')
        plt.show()
        print("The dot product of the given vectors is",k)
```

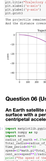


Question 03 (Motion in 1D)

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 s (b) t= 5 s

at t=4s

```
In [2]: import math,cmath,pylab as plt
        import numpy as np
        import cmath
        t=4
        t=t*(cmath.rect(1,
        math.radians(0)))
        x=3*t-4*(t**2)+2*(t**3)
        print("The position of the object after t= 4",x,"m")
        sep=" "
        ax.set_aspect('equal')
        plt.show()
        plt.xlim(-5,5)
        plt.ylim(-5,5)
        plt.axhline(y=0)
        plt.axvline(x=0)
        plt.grid(True)
        plt.title('Position Vector of Particle')
        plt.show()
        print("The position of the object after t= 4 m")
```



at t=5s

```
In [3]: import math,cmath,pylab as plt
        import numpy as np
        import cmath
        t=5
        t=t*(cmath.rect(1,
        math.radians(0)))
        x=3*t-4*(t**2)+2*(t**3)
        print("The position of the object after t= 5",x,"m")
        sep=" "
        ax.set_aspect('equal')
        plt.show()
        plt.xlim(-5,5)
        plt.ylim(-5,5)
        plt.axhline(y=0)
        plt.axvline(x=0)
        plt.grid(True)
        plt.title('Position Vector of Particle')
        plt.show()
        print("The position of the object after t= 5 m")
```

Question 04 (Motion in 2D)

The floor of a railroad flatcar is loaded with loose crates having a coefficient of static friction of 0.20 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 [4]: Mass=20
        g=9.8;u=0.20;v=48
        v=v/3.6
        a=u*g;s=(v**2)/(2*a)
        print("The distance which which the train will stop",s,"distance,")
        sep=" "
        The distance after which the train will stop is 38.09137415329755 m
```

Question 05 (Projectile Motion)

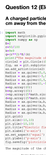
A projectile is fired horizontally from a gun that is 45.0 m above flat ground, emerging from the gun with a speed of 250 m/s. (a) How long does the projectile remain in the air?(b) At what horizontal distance from the firing point does it strike the ground?

```
In [5]: import math,cmath,pylab as plt
        import numpy as np
        import math as
        sep=" "
        Vinit=250
        Hinit=45
        Vfinal=0
        Hfinal=0
        import math,cmath,numpy
        g=9.8;Vinit=250
        t=(Vinit-Vfinal)/g
        print("The projectile remained in the air for",t,"included the distance covered",s,distance,"m")
        sep=" "
        s=t*Hinit/Vinit
        print("The horizontal distance at which the projectile strikes the ground",s,"m")
        import numpy as np
        import matplotlib.pyplot as plt
        x = np.linspace(0, 10, 100)
        y = x**2
        plt.plot(x, y)
        plt.title("Trajectory of projectile")
        plt.xlabel('Time')
        plt.ylabel('Y axis')
        plt.show()
        The projectile remained in the air for 5.102040816326532 sec
        And the distance covered is 727.2244081632653 m
```

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 99.0 min. What are (a) the speed and (b) the magnitude of the centripetal acceleration of the satellite?

```
In [6]: import math,cmath,pylab as plt
        import numpy as np
        import math as
        import numpy as np
        Hinit=640000;Vinit=0
        g=9.8;Vfinal=0
        speed=(Vmax0.pi/Hinit)*Vfinal_period
        print("The speed",speed,"m/s")
        print("The speed of the satellite is ",speed,"m/s")and the magnitude of the centripetal acceleration is",ac,"m/s")
        import math,cmath,numpy,pylab,matplotlib.pyplot as plt
        Vinit=0
        Vfinal=0
        g=9.8
        Hinit=640000
        Vmax=(Hinit*2.pi)/Vfinal
        print("The magnitude of the body's acceleration is",speed,"m/s")
        sep=" "
        ac=(speed*speed)/Hinit
        print("The centripetal acceleration is",ac,"m/s")
        import numpy as np
        import matplotlib.pyplot as plt
        import numpy as np
        import matplotlib.pyplot as plt
        x = np.linspace(0,2,100)
        y = x**2
        plt.plot(x, y)
        plt.title("Trajectory of projectile")
        plt.xlabel('Time')
        plt.ylabel('Y axis')
        plt.show()
        The speed of the satellite is 7400.0952380952381 m/s
        And the magnitude of the centripetal acceleration is 0.8598461225760 m/s)
```



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 [7]: import math,cmath,numpy
        import math as
        import numpy as
        import math
        import numpy
        import numpy as np
        import cmath,numpy,matplotlib,pylab,matplotlib.pyplot as plt
        import numpy,matplotlib,pylab,
        import numpy,matplotlib,pylab,
        import numpy,matplotlib,pylab,
```

```
import matplotlib.pyplot as plt
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
```

In [ ]:

In [ ]: