

1.11.10

AI25BTECH11008  
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Find the direction cosines of the line joining points

$$P(4, 3, -5) \quad \text{and} \quad Q(-2, 1, 8).$$

# Theoretical Solution

The points are  $P(4, 3, -5)$  and  $Q(-2, 1, 8)$ .

$$\mathbf{PQ} = \mathbf{Q} - \mathbf{P} = \begin{pmatrix} -2 - 4 \\ 1 - 3 \\ 8 - (-5) \end{pmatrix} = \begin{pmatrix} -6 \\ -2 \\ 13 \end{pmatrix}$$

$$|\mathbf{PQ}| = \sqrt{(-6)^2 + (-2)^2 + (13)^2} = \sqrt{36 + 4 + 169} = \sqrt{209}$$

$$\cos \alpha = \frac{-6}{\sqrt{209}}, \quad \cos \beta = \frac{-2}{\sqrt{209}}, \quad \cos \gamma = \frac{13}{\sqrt{209}}$$

Therefore, the direction cosines are  $\left( \frac{-6}{\sqrt{209}}, \frac{-2}{\sqrt{209}}, \frac{13}{\sqrt{209}} \right)$ .

 (1)

# C Code

```
#include <stdio.h>
#include <math.h>

int main() {
    // Step 1: Define points P and Q
    double P[3] = {4, 3, -5};
    double Q[3] = {-2, 1, 8};

    // Step 2: Direction vector PQ = Q - P
    double PQ[3];
    PQ[0] = Q[0] - P[0]; // -6
    PQ[1] = Q[1] - P[1]; // -2
    PQ[2] = Q[2] - P[2]; // 13

    // Step 3: Magnitude of PQ
    double mag = sqrt(PQ[0]*PQ[0] + PQ[1]*PQ[1] + PQ[2]*PQ[2]);
}
```

```
// Step 4: Direction cosines
```

```
double cos_alpha = PQ[0] / mag;
```

```
double cos_beta = PQ[1] / mag;
```

```
double cos_gamma = PQ[2] / mag;
```

```
// Output
```

```
printf(Vector PQ = (%.0f, %.0f, %.0f)\n, PQ[0], PQ[1], PQ[2])  
    ;
```

```
printf(|PQ| = sqrt(209) = %.4f\n, mag);
```

```
printf(Direction cosines:\n);
```

```
printf(cos(alpha) = %.4f\n, cos_alpha);
```

```
printf(cos(beta) = %.4f\n, cos_beta);
```

```
printf(cos(gamma) = %.4f\n, cos_gamma);
```

```
return 0;
```

```
}
```

# Python Code

```
import numpy as np
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D

# Define the points
P = np.array([4, 3, -5])
Q = np.array([-2, 1, 8])

# Generate line PQ
t = np.linspace(0, 1, 100)
line = np.outer(1-t, P) + np.outer(t, Q)

# Plot
fig = plt.figure(figsize=(8, 6))
ax = fig.add_subplot(111, projection='3d')

# Plot line PQ
ax.plot(line[:, 0], line[:, 1], line[:, 2], 'b-', label='$PQ$')
```

# Python Code

```
# Plot points P and Q
ax.scatter(P[0], P[1], P[2], color='red', s=60, label='P(4,3,-5)')
ax.scatter(Q[0], Q[1], Q[2], color='green', s=60, label='Q(-2,1,8)')

# Annotate points
ax.text(P[0]+0.3, P[1]+0.3, P[2], 'P(4,3,-5)', fontsize=10, color='red')
ax.text(Q[0]+0.3, Q[1]+0.3, Q[2], 'Q(-2,1,8)', fontsize=10, color='green')

# Set labels
ax.set_xlabel('X-axis')
ax.set_ylabel('Y-axis')
ax.set_zlabel('Z-axis')
```

```
# Title
ax.set_title(Line joining P(4,3,-5) and Q(-2,1,8))

# Grid and legend
ax.grid(True, linestyle='--', alpha=0.6)
ax.legend()

# Save and show
plt.savefig(fig1.png, dpi=300, bbox_inches=tight)
plt.show()
```



# Plot

Line joining  $P(4,3,-5)$  and  $Q(-2,1,8)$

