Congratulations! You passed!

Grade received 100% Latest Submission Grade 100% To pass 80% or higher

Go to next item

1. In terms of the $\hat{x}_s$, $\hat{y}_s$, $\hat{z}_s$ coordinates of a fixed space frame {s}, the frame {a} has its $\hat{x}_a$-axis pointing in the direction $(0, 0, 1)$ and its $\hat{y}_a$-axis pointing in the direction $(1, 0, 0)$, and the frame {b} has its $\hat{x}_b$-axis pointing in the direction $(1, 0, 0)$ and its $\hat{y}_b$-axis pointing in the direction $(0, 0, -1)$. Draw the {s}, {a}, and {b} frames, similar to examples in the book and videos (e.g., Figure 3.7 in the book), for easy reference in this question and later questions. **1 / 1 point**

Write the rotation matrix R_{sa}. All elements of this matrix should be integers.

If your answer is

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$$

for example, you should just type

[[1,2,3],[4,5,6],[7,8,9]]

in the answer box below. (You can just modify the matrix that is currently written there.) Then click "Run." You will not get any immediate feedback; the grade will be given when you submit the whole quiz.

```
1  [[0,1,0],[0,0,1],[1,0,0]]
```

Run Reset

Correct

Good job!

2. Referring to your drawing from Question 1, write R_{sb}^{-1}. All elements of this matrix should be integers. **1 / 1 point**

If your answer is

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$$

you should just type

[[1,2,3],[4,5,6],[7,8,9]]

in the answer box below. (You can just modify the matrix that is currently written there.) Then click "Run." You will not get any immediate feedback; the grade will be given when you submit the whole quiz.

```
1  [[1,0,0],[0,0,-1],[0,1,0]]
```

Run Reset

Correct

Good job!

3. Referring to your drawing from Question 1, write R_{ab}. All elements of this matrix should be integers. **1 / 1 point**

Write your matrix in the answer box below, using the format mentioned in questions 1 and 2, and click "Run."

```
1  [[0,-1,0],[1,0,0],[0,0,1]]
```

Run Reset

Correct

Good job!

4. Referring back to Question 1, let $R = R_{sb}$ be considered as a transformation operator consisting of a rotation about $\hat{x}$ by $-90°$. Calculate $R_1 = R_{sa}R$, and think of R_{sa} as the representation of the initial orientation of {a} relative to {s}, R as a rotation operation, and R_1 as the new orientation of {a} after performing the rotation. The new orientation R_1 corresponds to the orientation of the new {a} frame relative to {s} after rotating the original {a} frame by $-90°$ about which **1 / 1 point**

axis?

- (●) The $\hat{x}_a$-axis of the {a} frame.
- ( ) The $\hat{x}_s$-axis of the {s} frame.

Correct

5. Referring back to Question 1, use R_{sb} to change the representation of the point $p_b = (1, 2, 3)^T$ (in {b} coordinates) to {s} coordinates. All elements of this vector should be integers. **1 / 1 point**

If your answer is

$$\begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$$

you should enter

[1,2,3]

in the text box below and click "Run."

```
1  [1,3,-2]
```

Run

Reset

Correct

Good job!

6. Referring back to Question 1, choose a point p represented by $p_s = (1, 2, 3)^T$ in {s} coordinates. Calculate $q = R_{sb}^T p_s$. Is q a representation of p in {b} coordinates? **1 / 1 point**

- (●) Yes.
- ( ) No.

Correct

7. Referring back to Question 1, an angular velocity w is represented in {s} as $\omega_s = (3, 2, 1)^T$. What is its representation ω_a? All elements of this vector should be integers. **1 / 1 point**

If your answer is

$$\begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$$

you should enter

[1,2,3]

in the text box below and click "Run."

```
1  [1,3,2]
```

Run

Reset

Correct

Good job!

8. Referring back to Question 1, calculate the matrix logarithm $[\hat{\omega}]\theta$ of R_{sa} by hand. (You may verify your answer with software.) Extract and enter the rotation amount θ in radians with at least two decimal places. **1 / 1 point**

```
1  2.0944
```

Run

Reset

Correct

Good job!

9. Calculate the matrix exponential corresponding to the exponential coordinates of rotation $\hat{\omega}\theta = (1, 2, 0)^{\mathsf{T}}$. The maximum allowable error for any matrix element is 0.01, so give enough decimal places where necessary. **1 / 1 point**

Write your matrix in the answer box below, using the format mentioned in questions 1 and 2, and click "Run."

```
1  [[-0.2938,0.6469,0.7037],[0.6469,0.6765,-0.3518],[-0.7037,0.3518,-0.6173]]
```

Run

Reset

Correct

Good job!

10. Write the 3×3 skew-symmetric matrix corresponding to $\omega = (1, 2, 0.5)^{\mathsf{T}}$. Confirm your answer using the function `VecToso3` in the given software. **1 / 1 point**

Write your matrix in the answer box below, using the format mentioned in questions 1 and 2, and click "Run."

```
1  [[0,-0.5,2],[0.5,0,-1],[-2,1,0]]
```

Run

Reset

Correct

Good job!

11. Use the function `MatrixExp3` in the given software to calculate the rotation matrix $R \in SO(3)$ corresponding to the matrix exponential of **1 / 1 point**

$$[\hat{\omega}]\theta = \begin{bmatrix} 0 & 0.5 & -1 \\ -0.5 & 0 & 2 \\ 1 & -2 & 0 \end{bmatrix}.$$

The maximum allowable error for any matrix element is 0.01, so give enough decimal places where necessary.

Write your matrix in the answer box below, using the format mentioned in questions 1 and 2, and click "Run."

```
1  [[0.6048,0.7963,-0.0118],[0.4683,-0.3436,0.8140],[0.6441,-0.4979,-0.5807]]
```

Run

Reset

Correct

Good job!

12. Use the function `MatrixLog3` in the given software to calculate the matrix logarithm $[\hat{\omega}]\theta \in so(3)$ of rotation matrix **1 / 1 point**

$$R = \begin{bmatrix} 0 & 0 & 1 \\ -1 & 0 & 0 \\ 0 & -1 & 0 \end{bmatrix}.$$

The maximum allowable error for any matrix element is 0.01, so give enough decimal places where necessary.

Write your matrix in the answer box below, using the format mentioned in questions 1 and 2, and click "Run."

```
1  [[0,1.2092,1.2092],[-1.2092,0,1.2092],[-1.2092,-1.2092,0]]
```

Run

Reset

Correct

Good job!