Assignment 2

1) The correct statement about matrices of rotation about x--axis $R_x(\theta)$ and about y-axis $R_y(\phi)$ ***1 point*** for arbitrary angles θ and ϕ is

- The product of rotations is commutative i.e. $R_x(\theta)R_y(\phi) = R_y(\theta)R_x(\phi)$.
- The determinant of the product of rotation matrices is equal to 1.
- Each rotation preserves the length of the vector, but the product does not.
- None of the above.

Accepted Answers:
The determinant of the product of rotation matrices is equal to 1.

2) The correct statement regarding eigenvalues of the matrices of rotation $R_x(\theta)$ and $R_y(\phi)$ is ***1 point***

- Eigenvalues of $R_x(\theta)$ and $R_y(\phi)$ are real.
- All eigenvalues of $R_x(\theta)$ and $R_y(\phi)$are equal.
- Both $R_x(\theta)$ and $R_y(\phi)$ have one of the eigenvalues equal to 1.
- None of the above

Accepted Answers:
Both $R_x(\theta)$ and $R_y(\phi)$ have one of the eigenvalues equal to 1.

3) A 3-D vector given by (2,4,1) is rotated about the y--axis by an angle of 30 degrees, followed ***1 point*** by rotation about Z-axis by 180 degrees. The resulting vector is closest to

- (2.23,4,0.13)
- (1,4,0.23)
- (0.13,-4,2.13)
- (-2.23,-4,-0.13)

Accepted Answers:
(-2.23,-4,-0.13)

4) The eigenvalues of the matrix given by **1 point**

$$\begin{pmatrix} a & b & 0 & b \\ b & a & b & 0 \\ 0 & b & a & b \\ b & 0 & b & a \end{pmatrix}$$ are

- $a, b, a-b, a+b$
- $a+b, a, a, a-b$
- $a+2b, a, a, a-2b$
- $a+3b, a+b, a-b, a-3b$

Accepted Answers:
$a+2b, a, a, a-2b$

5) Consider the matrix given by **1 point**

$$\begin{pmatrix} a & b & 0 & 0 & 0 & b \\ b & a & b & 0 & 0 & 0 \\ 0 & b & a & b & 0 & 0 \\ 0 & 0 & b & a & b & 0 \\ 0 & 0 & 0 & b & a & b \\ b & 0 & 0 & 0 & b & a \end{pmatrix}$$

Given that both a and b are negative real numbers, the smallest eigenvalue is

- a
- $a+b$
- $a+2b$
- $a+3b$

Accepted Answers:
$a+2b$

6) **1 point**

$$\begin{pmatrix} a & ib & 0 & a+ib \\ ib & a+b & b & 0 \\ 0 & b & a-b & b \\ a+ib & 0 & b & a \end{pmatrix}$$

The matrix above for real a and b is

- symmetric but not Hermitian
- Not symmetric but Hermitian
- Both symmetric and Hermitian
- Neither symmetric nor Hermitian

Accepted Answers:
symmetric but not Hermitian

7) **1 point**

The matrix below

$$\frac{1}{\sqrt{3}}\begin{pmatrix} 1 & 1 & 1 \\ 1 & \frac{-1+i\sqrt{3}}{2} & \frac{-1-i\sqrt{3}}{2} \\ 1 & \frac{-1-i\sqrt{3}}{2} & \frac{-1+i\sqrt{3}}{2} \end{pmatrix}$$

is

- Hermitian but not Unitary
- Not Hermitian but Unitary
- Both Hermitian and Unitary
- Neither Hermitian nor Unitary

Accepted Answers:
Neither Hermitian nor Unitary

8) For a Hermitian matrix with distinct eigenvalues ***1 point***

- The largest eignenvalue has to be real, but other eigenvalues may be real or complex.
- Eigenvectors are orthogonal.
- Eigenvectors must have only real components.
- None of the above

Accepted Answers:
Eigenvectors are orthogonal.

9) The correct statement regarding eigenvalues of an arbitrary symmetric 2X2 matrix is ***1 point***

- Both the eigenvalues are real
- Eigenvalues need not be real, they have to be complex conjugates of each other
- Eigenvalues need not be real but one has to be negative of the other
- None of the above

Accepted Answers:
None of the above

10)The inverse of the matrix below ***1 point***

$$\begin{pmatrix} 1 & 4 & 3 \\ 4 & 2 & 1 \\ -5 & 8 & 8 \end{pmatrix}$$

is

- The inverse does not exist
- $$\begin{pmatrix} 1 & 1/4 & -1/5 \\ 1/4 & 1/2 & 1/8 \\ 1/3 & 1 & 1/8 \end{pmatrix}$$
- $$\begin{pmatrix} 1 & 1/4 & 1/5 \\ 1/4 & 1/2 & 1/8 \\ 1/3 & 1 & 1/8 \end{pmatrix}$$
- None of the above

Accepted Answers:
None of the above