X

Unit 2 - Week 1: Vectors, linear independence, vector differentiation and transfomation

Assignment 1

1) The dimensionality of the vector space of all functions of a single variable $f(x)$ is **1 point**

- 1
- 2
- 3
- ∞

Accepted Answers:
∞

2) The gradient of $r = |\vec{r}|$, where $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$, is equal to **1 point**

- $\vec{r}$
- $\hat{i} + \hat{j} + \hat{k}$
- $\frac{\vec{r}}{r}$
- None of the above

Accepted Answers:
$\frac{\vec{r}}{r}$

3) Of the following sets of vectors, the set that can be used as a basis in 3D vector space is **1 point**

- (1,0,0), (0,1,0) and (1,1,1)
- (1,0,0), (0,1,0) and (1,1,0)
- (1,0,0), (0,1,0) and (2,1,0)
- All of the above

Accepted Answers:

(1,0,0), (0,1,0) and (1,1,1)

4) The divergence of $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$ is equal to **1 point**

- 0
- 3
- $x + y + z$
- None of the above

Accepted Answers:
3

5) Of the following pairs of functions, the one that has linearly dependent functions is **1 point**

- $\sin(x)$ and $\cos(x)$
- $\sin^2(x)$ and $\cos^2(x)$
- $\sin(x)$ and $\sin(x)\cos(x)$
- None of the above

Accepted Answers:
None of the above

6) An incompressible fluid is described by a velocity field $\vec{v}(x, y, z) = y\hat{i} + x\hat{j}$. The vorticity $\vec{\omega}(x, y, z)$ of this field is given by the curl $\vec{v}$. The vorticity is equal to **1 point**

- 0
- $\hat{i} + \hat{j}$
- $\hat{i} - \hat{j}$
- $2\hat{k}$

Accepted Answers:
0

7) A unit point charge located at the origin gives rise to an electric potential given by $V(r) = A/r$ where A is a constant and $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$ and $r = |\vec{r}|$. The force on a unit charge due this potential at the point (1,0,0) is equal to **1 point**

- $A/2\hat{i}$
- $A\hat{i}$
- $A\hat{k}$
- None of the above

Accepted Answers:

$A\hat{i}$

8) A quantum mechanical particle in a 3D box has a wavefunction given by $\psi(x,y,z) = A\sin(2\pi x)\sin(\pi y/2)\sin(\pi z)$ for a box from $0 \le x \le 2, 0 \le y \le 4, 0 \le z \le 1$. The value of *A* so that this wavefunction is normalized is equal to **1 point**

- $\sqrt{8}$
- 2
- 1
- None of the above

Accepted Answers:
1

9) The work done by the force $\vec{f}(x,y) = (\hat{i}+\hat{j})/(x^2+y^2)$ in moving a particle from (1,1) to (2,2) along a straight line path is given equal to **1 point**

- 0
- 1
- 2
- 1/2

Accepted Answers:
1/2

10) The force below that produces a path independent work is **1 point**

- $5x^2\hat{i} + 5x^2\hat{j}$
- $5y^2\hat{i} + 5x^2\hat{j}$
- $5xy^2\hat{i} + 5yx^2\hat{j}$
- None of the above

Accepted Answers:
$5xy^2\hat{i} + 5yx^2\hat{j}$