

Unit 6 - Week 5

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Assignment 5

The due date for submitting this assignment has passed.  
As per our records you have not submitted this assignment.

Due on 2020-10-21, 23:59 IST.

1) Which of the following is NOT a convex set? 1 point

- ☐  $\{(x,y) \in \mathbb{R}^2 : x^2 + 2y^2 \leq 2\}$
- ☐  $\{(x,y) \in \mathbb{R}^2 : y^2 \geq x\}$
- ☐  $\{(x,y) \in \mathbb{R}^2 : x - 2y \geq 4\}$
- ☐  $\{(x,y) \in \mathbb{R}^2 : x^2 \leq 4y\}$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$\{(x,y) \in \mathbb{R}^2 : y^2 \geq x\}$

2) Determinant of the Hessian matrix of the function  $f : \mathbb{R}^2 \rightarrow \mathbb{R}$ , 1 point

$f(x,y) = 3x^2 - x^2y + 2y^3 - 3x + 5y$  at  $P(-1,1)$  equals

- ☐ 20
- ☐ 44
- ☐ 60
- ☐ 64

No, the answer is incorrect.

Score: 0

Accepted Answers:

44

3) Let  $f, g : \mathbb{R}^3 \rightarrow \mathbb{R}$  be defined as  $f(x,y,z) = x^3y + y^2z + zx$ ,  $g(x,y,z) = 3xy^2z$ . Then,  $(\nabla f)^T \nabla g$  at  $Q(1,1,-1)$  equals 1 point

- ☐ 2
- ☐ 3
- ☐ 6
- ☐ 12

No, the answer is incorrect.

Score: 0

Accepted Answers:

6

4) Which of the following is a convex function? 1 point

- ☐  $f(x) = x^3 - 2x; x \in [-2,2]$
- ☐  $g(x) = \cos x; x \in [\pi, 2\pi]$
- ☐  $h(x) = e^{-x}; x \in (-\infty, \infty)$
- ☐  $l(x) = \ln(x); x \in [2,6]$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$h(x) = e^{-x}; x \in (-\infty, \infty)$

5) The matrix  $A = \begin{bmatrix} k & 0 & 1 \\ 0 & 2 & -1 \\ 1 & -1 & 3 \end{bmatrix}$ ,  $k \in \mathbb{R}$  is positive definite for all 1 point

- ☐  $k > 0$
- ☐  $k > \frac{1}{3}$
- ☐  $k > \frac{2}{5}$
- ☐  $k > \frac{2}{3}$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$k > \frac{2}{5}$

6) The direction of most rapid increase for the function  $f : \mathbb{R}^3 \rightarrow \mathbb{R}$ ,  $f(x,y,z) = 2x^2y + z^2$  at the point  $P_0(-1,1,1)$  is 1 point

- ☐  $-\frac{2}{\sqrt{6}}\hat{i} + \frac{1}{\sqrt{6}}\hat{j} + \frac{1}{\sqrt{6}}\hat{k}$
- ☐  $\frac{2}{\sqrt{6}}\hat{i} - \frac{1}{\sqrt{6}}\hat{j} - \frac{1}{\sqrt{6}}\hat{k}$
- ☐  $\frac{2}{\sqrt{6}}\hat{i} + \frac{1}{\sqrt{6}}\hat{j} + \frac{1}{\sqrt{6}}\hat{k}$
- ☐  $-\frac{2}{\sqrt{6}}\hat{i} - \frac{1}{\sqrt{6}}\hat{j} - \frac{1}{\sqrt{6}}\hat{k}$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$-\frac{2}{\sqrt{6}}\hat{i} + \frac{1}{\sqrt{6}}\hat{j} + \frac{1}{\sqrt{6}}\hat{k}$

7) The function  $g(x) = \sin x$  satisfies  $g(x) - g(y) \geq (x - y)^T \nabla g(y)$  for all  $x, y$  in the interval 1 point

- ☐  $[0, \pi]$
- ☐  $[\pi, 2\pi]$
- ☐  $[0, 2\pi]$
- ☐  $[0, \pi/2]$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$[\pi, 2\pi]$

8) Let  $A = [a_{ij}]$  denote the Jacobian of  $x = u^3 + v^3$ ,  $y = uv^2 - u^2v$ ,  $z = uv$ . Then, at  $(u,v) = (1,-1)$ , value of  $a_{11} + a_{22} + a_{32}$  equals 1 point

- ☐ 0
- ☐ 1
- ☐ 3
- ☐ 6

No, the answer is incorrect.

Score: 0

Accepted Answers:

1

9) Let  $f : \mathbb{R}^2 \rightarrow \mathbb{R}$ ,  $f(x,y) = x^3 - 12xy + 8y^3$ ,  $\mathbf{u} = (1,2)^T$ ,  $\mathbf{v} = (0,1)^T$ . Then, which of the following statements is TRUE? 1 point

- ☐  $\nabla^2 f(\mathbf{u})$  is positive definite and  $\nabla^2 f(\mathbf{v})$  is negative definite
- ☐  $\nabla^2 f(\mathbf{u})$  is positive definite and  $\nabla^2 f(\mathbf{v})$  is indefinite.
- ☐  $\nabla^2 f(\mathbf{u})$  is indefinite and  $\nabla^2 f(\mathbf{v})$  is negative definite.
- ☐ Both  $\nabla^2 f(\mathbf{u})$  and  $\nabla^2 f(\mathbf{v})$  are indefinite.

No, the answer is incorrect.

Score: 0

Accepted Answers:

$\nabla^2 f(\mathbf{u})$  is positive definite and  $\nabla^2 f(\mathbf{v})$  is indefinite.

10) The directional derivative of  $f(x,y,z) = x^2y - yz^3 + z$  at  $(1,2,0)$  in the direction of  $\vec{u} = 2\hat{i} + 2\hat{j} - \hat{k}$  is 1 point

- ☐ -3
- ☐ -2
- ☐ 2
- ☐ 3

No, the answer is incorrect.

Score: 0

Accepted Answers:

3