Given if $x_1, x_2, \frac{x_1+x_2}{2} \in S$ then $\frac{3}{4}x_1 + \frac{1}{4}x_2 \in S$. Is this a true statement?

- ○ Yes
- ○ No

Which of the following is a convex function? **1 point**

- ☐ $f(x) = ax + b$ over R where $a, b \in$ R
- ☐ $f(x) = e^{ax}$ over R where $a \in$ R
- ☐ $f(x) = x^2$ over R
- ☐ $f(x) = x^3$ over R

What is the value of a, the function f : R $\rightarrow$ R, $f(x, y) = ax^4 + 8y$ is a convex function **1 point**

- ○ $a > 0$
- ○ $a < 1$
- ○ $a \geq 1$
- ○ None of these

Which of the following hessian matrix corresponds to the convex function? **1 point**

- ○ $\begin{bmatrix} -2 & 2 \\ 2 & -2 \end{bmatrix}$
- ○ $\begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix}$
- ○ $\begin{bmatrix} -2 & 2 \\ 2 & 0 \end{bmatrix}$

- [ ] $\begin{bmatrix} -2 & 2 \\ 2 & 2 \end{bmatrix}$

Function $f : \mathrm{R}^d \rightarrow \mathrm{R}, f(x) = x^T A x$ is a convex function if **_1 point_**

- [ ] A is positive definite matrix
- [ ] A is positive semi-definite matrix
- [ ] A is negative definite matrix
- [ ] A is negative semi-definite matrix

A twice differentiable function $f : \mathrm{R}^n \rightarrow \mathrm{R}$ is convex if and only if for all $x, y \in \mathrm{R}^n$ **_1 point_**

- [ ] Hessian matrix is positive definite
- [ ] Hessian matrix is positive semi-definite
- [ ] Hessian matrix is negative definite
- [ ] Hessian matrix is negative semi-definite

Given a function $f : \mathrm{R}^n \rightarrow \mathrm{R}$, the linear approximation of a function f at the point $(x + \epsilon d)$ is: **_1 point_**

- [ ] $f(x) + \epsilon\, d^T \nabla f(x)$
- [ ] $f(x) + \epsilon\, \nabla f(x)$
- [ ] $f(x) + d^T \nabla f(x)$
- [ ] None of these

A function in one variable is said to be convex function if it has: **_1 point_**

- [ ] Positive curvature
- [ ] Negative curvature

- [ ] Non-positive curvature
- [ ] Non-negative curvature

What is the relationship between eigenvalues of the hessian matrix of twice differentiable convex function? ***1 point***

- ○ All eigenvalues are non-negative
- ○ Eigenvalues are both positive and negative
- ○ All eigenvalues are non-positive
- ○ There is no relationship

A batch of cookies requires 4 cups of flour, and a cake requires 7 cups of flour. What would be the constraint limiting the amount of cookies(a) and cakes(b) that can be made with 50 cups of flour. ***1 point***

- ○ $4a + 7b \leq 50$
- ○ $7a + 4b \leq 50$
- ○ $11(a + b) \leq 50$
- ○ $4a.7b \leq 50$

If objective function which is to be minimised is $f(x, y, z) = x + z$ and the constrained equation is $g(x, y, z) = x^2 + y^2 + z^2 = 1$. The point where minimum value occurs will be ***1 point***

- ○ $(\frac{1}{\sqrt{2}}, 0, \frac{-1}{\sqrt{2}})$
- ○ $(\frac{-1}{\sqrt{2}}, 0, \frac{1}{\sqrt{2}})$
- ○ $(\frac{-1}{\sqrt{2}}, 0, \frac{-1}{\sqrt{2}})$
- ○ $(\frac{1}{\sqrt{2}}, 0, \frac{1}{\sqrt{2}})$

If objective function which is to be maximized is $f(x,y,z) = x + z$ and the constrained equation is $g(x,y,z) = x^2 + y^2 + z^2 = 1$. The point where maximum value occurs will be **1 point**

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Find the points on the surface $y^2 = 1 + xz$ that are closest to the origin. **1 point**

- ○ $(0, -1, 0)$
- ○ $(1, 1, 1)$
- ○ $(0, 0, 0)$
- ○ $(0, 2, 0)$
- ○ $(1, 2, 0)$

The absolute minimum value of the function $f(x,y) = xy^2$ on the circle $x^2 + y^2 = 1$ is _______

(Note: Enter answer upto two decimal points)

1 point

The minimum value of the function $f(x,y) = xy^2$ on the circle $x^2 + y^2 = 1$ occurs at the below points: **1 point**

- ☐ $(\sqrt{3}/3, \sqrt{6}/3,)$
- ☐ $(-\sqrt{3}/3, \sqrt{6}/3)$
- ☐ $(\sqrt{3}/3, -\sqrt{6}/3)$
- ☐ $(-\sqrt{3}/3, -\sqrt{6}/3)$