21BDS0340

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Course Code: BMAT101P

Class Number: VL2021220106766

FAT Exam

Problem 1

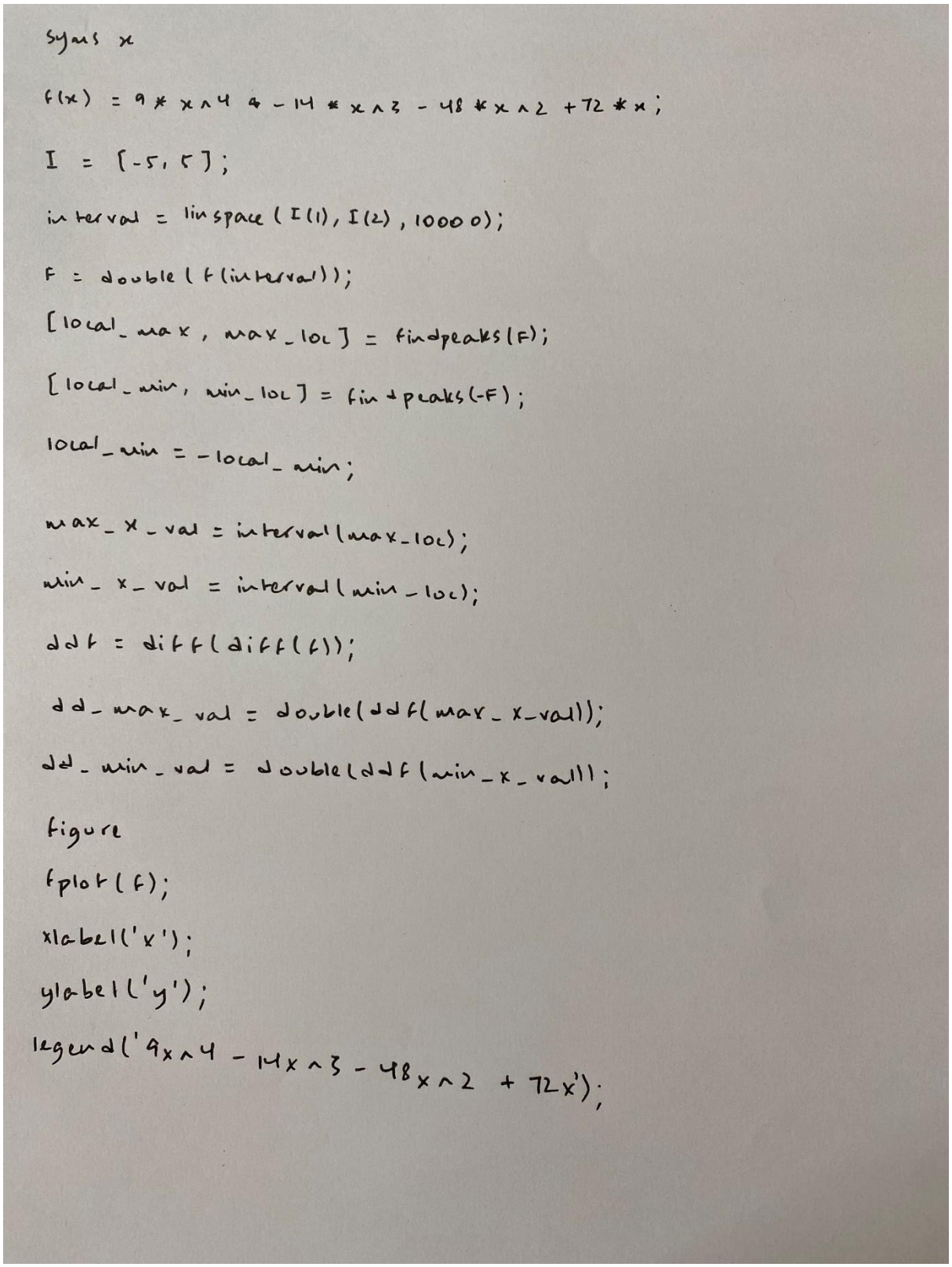
- Find the critical values of the function $f = 9x^4 - 14x^3 - 48x^2 + 72x$
- Find the values of the second derivative of $f(x)$ and check the sign of $f''(x)$ at the critical points
- Sketch the graph of the function $f(x)$ with necessary title, axis, etc.

Code:

```
syms x

% <----- a ----->
f(x) = 9*x^4 - 14*x^3 - 48*x^2 + 72*x;
I = [-5, 5];
interval = linspace(I(1), I(2), 10000);
F = double(f(interval));
[local_max, max_loc] = findpeaks(F);
[local_min, min_loc] = findpeaks(-F);
local_min = -local_min;

disp('(a). The critical values for maxima are:')
disp(local_max)
disp('(a). The critical values for minima are:')
disp(local_min)

% <----- b ----->
max_x_val = interval(max_loc);
min_x_val = interval(min_loc);
ddf = diff(diff(f));
double_der_val_max = double(ddf(max_x_val));
double_der_val_min = double(ddf(min_x_val));

disp('(b). The double derivitive value for maxima is:')
disp(double_der_val_max)
disp('(b). The double derivitive value for minima is:')
disp(double_der_val_min)

% <----- c ----->
figure
fplot(f);
xlabel('x');
```

```
ylabel('y');
legend('9x^4 - 14x^3 - 48x^2 + 72x');
title('Graph of function f(x)')
```

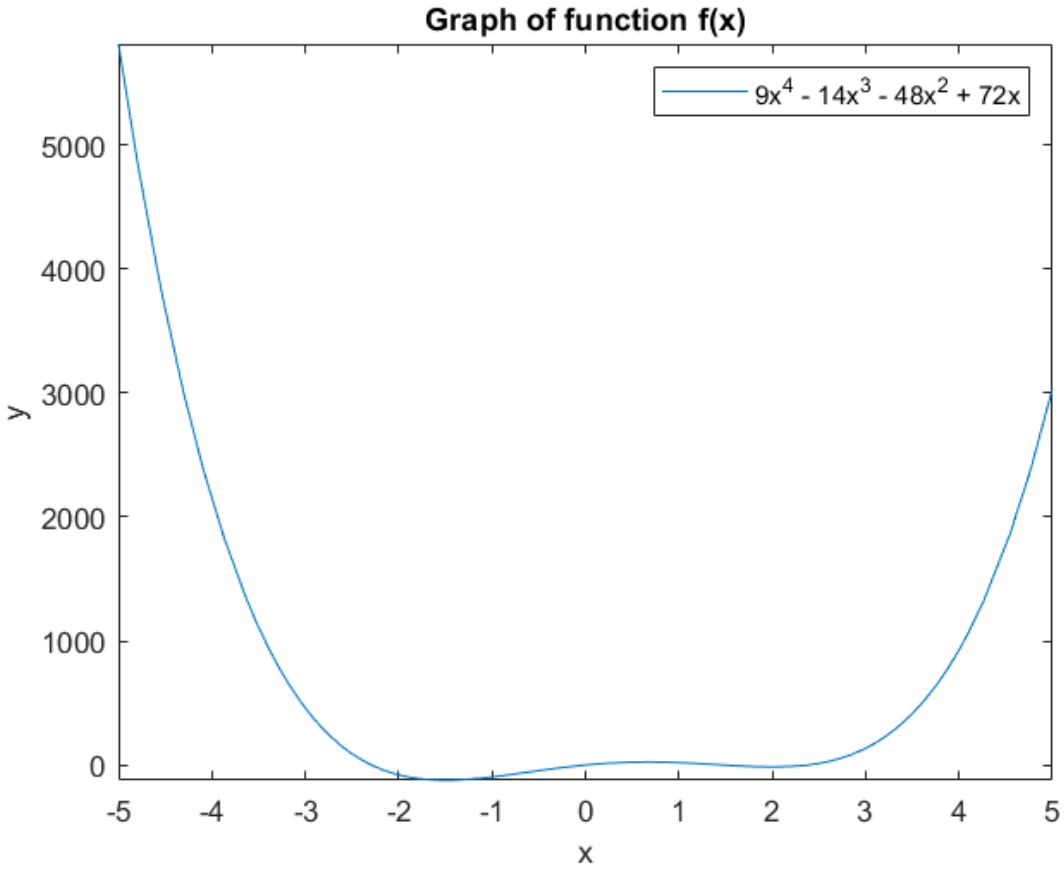
Written Code:



```
syms x

f(x) = 9*x^4 - 14*x^3 - 48*x^2 + 72*x;

I = [-5, 5];

interval = linspace(I(1), I(2), 10000);

F = double(f(interval));

[local_max, max_loc] = findpeaks(F);

[local_min, min_loc] = findpeaks(-F);

local_min = -local_min;

max_x_val = interval(max_loc);

min_x_val = interval(min_loc);

ddf = diff(diff(f));

dd_max_val = double(ddf(max_x_val));

dd_min_val = double(ddf(min_x_val));

figure

fplot(f);

xlabel('x');

ylabel('y');

legend('9x^4 - 14x^3 - 48x^2 + 72x');
```

Output:

```
>> Question1
(a). The critical values for maxima are:
   24.2963

(a). The critical values for minima are:
 -123.1875  -16.0000

(b). The double derivitive value for maxima is:
 -104.0060

(b). The double derivitive value for minima is:
  272.8572  167.8956
```



Problem 2

- Find the gradient of the scalar function $f(x, y) = (x^2 + y^2)^{1/2}$
- Plot the vector field of the gradient and show the scalar function using contour curves
- In the domain $-3\pi \leq x \leq 3\pi$, plot $y = sinx$. On the same graph, superimpose the curve $y = cosx$ with a different colour. Indicate the x-label, y-label, title of the graph and legend

Code:

```
syms x y

% <----- a ----->
f(x, y) = sqrt(x^2 + y^2);
xgrad(x, y) = diff(f, x);
ygrad(x, y) = diff(f, y);
grad = [xgrad, ygrad];
disp('(a). The gradient of the function is:')
disp(grad)

% <----- b ----->
figure
a = linspace(1, 5, 21);
[X, Y] = meshgrid(a, a);
U = xgrad(X, Y); V = ygrad(X, Y);
quiver(X, Y, U, V);
hold on
fcontour(f, [1 5])
xlabel('x')
ylabel('y')
legend('Quiver of gradient', 'Contour of function')
title('Quiver of gradient and Contours of function')

% <----- c ----->
figure
a = linspace(-3*pi, 3*pi, 10000);
f1(x) = sin(x); f2(x) = cos(x);
F1 = f1(a); F2 = f2(a);
plot(a, F1);
hold on
plot(a, F2);
xlabel('x')
ylabel('y')
legend('sin(x)', 'cos(x)')
title('Graph of sin(x) and cos(x)')
```

Written Code:

```
syms x y
f(x,y) = sqrt(x^2 + y^2);
xgrad = diff(f, x);
ygrad = diff(f, y);
disp([xgrad, ygrad]);
figure
a = linspace(1, 5, 21);
[x, y] = meshgrid(a, a);
u = xgrad(x, y);
v = ygrad(x, y);
quiver(x, y, u, v);
hold on
contour(f, [1 5]);
xlabel('x'); ylabel('y');
legend('quiver', 'contour');
title('quiver of grad and contour of f');
figure
a = linspace(-3*pi, 3*pi, 10000);
f1(x) = sin(x); f2(x) = cos(x);
F1 = f1(a); F2 = f2(a);
plot(a, F1);
hold on
plot(a, F2);
xlabel('x'); ylabel('y'); legend('sinx', 'cosx');
title('Graph of sinx and cosx');
```

Output:

```
>> Question2
(a). The gradient of the function is:
[x/(x^2 + y^2)^(1/2), y/(x^2 + y^2)^(1/2)]
symbolic function inputs: x, y
```