Unit 7 - Week 6:

Assignment 6

1) The coefficient of x^2 in the Taylor expansion of the function $f(x)$ given by $f(x) = \frac{1}{\sqrt{1+x^2}}$ is equal to *1 point*

- 1
- 3
- 0
- None of the above

Accepted Answers:
1

2) The radial part of the wavefunction of the a 3d electron in the hydrogen atom is given by $R_{3d}(r) \propto r^2 \exp(-r/3a_0)$. The maximum value of the radial probability distribution, $P(r) = r^2(R_{3d}(r))^2$, is obtained at a value of r/a_0 of *1 point*

- 1
- 3
- 9
- None of the above

Accepted Answers:
9

3) The Van der Waals equation of state for a gas at some temperature relates the pressure p and molar volume v via *1 point*

$$(p + \frac{a}{v^2})(v - b) = \frac{4aR}{27b}$$

where a, b, R are positive constants. In this case, the number of extrema of in the p-v graph is

- 0
- 1
- 2
- 3

Accepted Answers:
3

4) Consider the Van der Waals equation of a gas at some temperature given by $(p + \frac{a}{v^2})(v - b) = \frac{8aR}{27b}$ where p is the pressure of the gas, v is the molar volume, and a, b, R are positive constants. The saddle point of this equation is obtained for a value of v of **1 point**

- 0
- b
- $3b$
- None of the above

Accepted Answers:
$3b$

5) Consider the Taylor series expansion of the function $\sin(xy)$ about the point (0,0). The coefficient of xy in the expansion is **1 point**

- 0
- 1
- 2
- 1/2

Accepted Answers:
1

6) Consider a two-dimensional potential energy surface of the form **1 point**

$$V(x, y) = xy - x^2y^2 + 0.25(x^2 + y^2) + 0.125(x^4 + y^4)$$

The point (1,1) is a

- maximum in all directions.
- minimum in all directions.
- saddle point.
- None of the above.

Accepted Answers:
saddle point.

7) The Hessian of the potential energy function $V(x, y) = xy - 0.25x^2y^2 + 0.25(x^2 + y^2)$ at (0,0) is equal to **1 point**

- -0.75
- -0.25
- 0
- None of the above

Accepted Answers:
-0.75

8) The maximum value of the function $f(x, y) = 2x - 3y$ on the circle $x^2 + y^2 = 13$ is equal to **1 point**

- 4
- 9
- 13
- None of the above

Accepted Answers:
13

9) The number of saddle points of the function $x^3 + y^2 - 3x - 3y$ is **1 point**

- 0
- 1
- 2
- 3

Accepted Answers:
2

10) The shape of a parallelopiped (sides a, b, c) with the maximum area ($2(ab + bc + ca)$) for a fixed perimeter $(4(a + b + c)$ is **1 point**

- a cube
- a square based cuboid but not a cube
- a cuboid with all three dimensions different
- something that cannot be determined from the above information

Accepted Answers:
a cube