Lab Final Quiz

Integral Calculus & Differential Equations (MAT120)

Time: 40 minutes, Total Marks: 20

Name: _____

Student ID: _____ Section: _____

MCQ:

Marks: 10 × 1

1. Which of the following is used to find derivatives of SymPy expressions?
   ◯ `sympy.derivative()` ◯ `sympy.differentiate()` ◯ `sympy.diff()` ◯ `sympy.dfdx()`

2. When Simpson's rule is used to approximate the definite integral, it is necessary that the number of points be —
   ◯ an odd number ◯ even number ◯ either an even or an odd number ◯ a multiple of 3

3. Suppose you need to create a NumPy Array for x in interval $[0, 1]$ with step-size, $h = 0.1$. Which of the following statements generates this?
   ◯ `numpy.arange(0, 1, 0.01)` ◯ `numpy.arange(0, 1, 0.1)`
   ◯ `numpy.arange(0, 1, 1)` ◯ `numpy.arange(0, 1, 10)`

4. Which one is the correct way to use `sympy.integrate()` to solve the integral $\int_0^\infty x^3 e^{-x} dx$?
   ◯ `integrate(x*3*exp(-x), (x, oo, 0))` ◯ `integrate(x**3*exp(-x), (x, 0, oo))`
   ◯ `integrate(x*3*exp(-x), (x, 0, oo))` ◯ `integrate(x**3*exp(-x), (x, oo, 0))`

5. Choose the correct way to define the dependent variable using sympy for this ODE: $y\frac{dm}{dn} + n^2 x = 0$
   ◯ `y = sympy.Function('y')(x)` ◯ `m = sympy.Function('m')(x)`
   ◯ `y = sympy.Function('y')(n)` ◯ `m = sympy.Function('m')(n)`

6. How many initial conditions are needed in a first-order ordinary differential equation?
   ◯ 1 ◯ 2 ◯ 3 ◯ 4

7.
```
f = 1 + sin(x) - cos(x)
roots = solveset(f, x, Interval(0, 2*pi))
```
   Which of the following can't be an element of roots?
   ◯ 0 ◯ $3\pi/2$ ◯ 2π ◯ 5π

8. In trapezoidal rule, if the step size is 0.1 ($h = 0.1$), the order of error of the integral $\int_0^1 x^x dx$ should be
   ◯ 10^{-1} ◯ 10^{-2} ◯ 10^{-3} ◯ 10^{-4}

9. Which Matplotlib function is used to show the labels of different plots in a graph?
   ◯ `pyplot.show()` ◯ `pyplot.label()` ◯ `pyplot.grid()` ◯ `pyplot.legend()`

10. Simpson's rule uses —in each sub-interval to approximate the curve.
    ◯ straight line ◯ parabola ◯ hyperbola ◯ exponential

Fill in the blanks

11. The following code part tries to solve the ODE $\frac{dy}{dx} = 0.1y/x^2$ with the initial condition $y(0) = 1$. Fill in the gaps with appropriate code parts. (2)

```
import numpy as np
def f(x,y): return ________
h       = 0.1
x       = np.arange(0, 10, 0.1)
y       = np.zeros(len(x))
y[0]    = ________
for i in range(0, len(t)-1):
    v[i + 1] = v[i] + h*f(t[i], v[i])
```

12. The following code part tries to generate the equation: $x^2 - y^2 = \frac{\tan(x)}{1-xy}$. Fill in the gaps with appropriate code parts. (2)

```
import sympy as sp
x, y = sp.symbols('x y')
equation   =    sp.Eq(  _____________  ,  _____________  )
```

Written Part

13. Write down the differential equation and the initial conditions which the following code tries to solve. (3)

```
from sympy import *
x, y, z = symbols('x y z')
v = symbols('v', cls = Function)(z)
ode = Eq(diff(v), z**2*x*y)
dsolve(ode, ics = {v.subs(z,0): 1})
```

14. See the table, the function $f(x)$ is continuous on the closed interval [0, 3] and has values as shown the table below. Using three subintervals, what is the approximation of $\int_0^3 f(x)dx$ found by using the Trapezoid rule? (3)

X	0	1	2	3
f(x)	1	0.5	0.2	0.1