Problem 1.1

Given ℓ, ν

Saught $\bar{a}$

1 Position

$$\bar{r} = 2\ell\sin(2\nu t)\bar{e}_x - 5\ell\nu^2t^2\bar{e}_y \tag{1}$$

2 Velocity

$$\bar{v} = \frac{\mathrm{d}\bar{r}}{\mathrm{d}t} \overset{(1)}{=} 4\ell\nu\cos(2\nu t)\bar{e}_x - 10\ell\nu^2t\bar{e}_y \tag{2}$$

3 Acceleration

$$\bar{a} = \frac{\mathrm{d}\bar{v}}{\mathrm{d}t} \overset{(2)}{=} -8\ell\nu^2\sin(2\nu t)\bar{e}_x - 10\ell\nu^2\bar{e}_y$$

Answer

$$\bar{a} = -8\ell\nu^2\sin(2\nu t)\bar{e}_x - 10\ell\nu^2\bar{e}_y$$

Python solution

```
# Access module SymPy for symbolic calculation, including its submodule
# for vector calculation
from sympy import *
from sympy.vector import *

# Create coordinate system `N', such that `N.i', `N.j' and `N.k' denote
# the basis vectors in the x, y and z direction, respectively.
N = CoordSys3D('N')

# Declare constants and variables
nu, l = symbols('nu, l', positive = True)
t = symbols('t', real = True)

# Express position vector `r_'. Herein, the underscore symbol is used to
# to indicate vector-valued expressions.
r_ = 2*l*sin(2*nu*t)*N.i - 5*l*nu**2*t**2*N.j

# Calculate velocity and acceleration vectors through differentiation
```

```
# with respect to time `t'.
v_ = diff(r_, t)
a_ = diff(v_, t)

# Print the acceleration vector
print(f'a_ = {a_}')
```

```
a_ = (-8*l*nu**2*sin(2*nu*t))*N.i + (-10*l*nu**2)*N.j
```