## PART 1 (Questions 1 to 10)

(75 marks)

### QUESTION 1 (5 marks)

(a) Find $\int \cos t \sin^2 t \, dt$.

Let $u = \sin t$

$\therefore \frac{du}{dt} = \cos t$

$\therefore \int \sin^2 t \cos t \, dt = \int u^2 . \frac{du}{dt} . dt$

$= \int u^2 \, du$

$= \frac{u^3}{3} + c$

$= \frac{\sin^3 t}{3} + c$

(2 marks)

(b) A building in a small town casts a shadow during daylight hours. The area of the shadow changes depending on the time of day. The rate of change of the area of the shadow can be modelled by the differential equation

$$\frac{dA}{dt} = -2t + 150 \cos t \sin^2 t$$

where $A$ is the area of the shadow in square metres and $t$ is the time in hours. At sunrise, $t = 0$ and $A = 375 \text{ m}^2$.

Solve the differential equation, and hence find an expression for the area of the shadow at time $t$.

(3 marks)