



WESLEY COLLEGE

By daring & by doing

**YEAR 12 MATHEMATICS SPECIALIST
SEMESTER TWO 2017
QUESTIONS OF REVIEW 5: Differentiation
with Applications**

Name: _____

Thursday 29th June

Time: 35 minutes

Mark

/30

CAS free, scientific calculator allowed.

1. [7 marks – 1, 3 and 3]

A curve is defined by the equation $y^2 = 3xy - \frac{5x^2}{4}$

a) Verify that $P(2,5)$ lies on the curve

b) Develop an expression for the gradient function $\frac{dy}{dx}$

c) Determine an equation for the normal to the curve at $P(2,5)$.

2. [4 marks]

A particle with displacement x has velocity $v = 3\sqrt{x}$.

Show that the acceleration is constant and evaluate this constant.

3. [6 marks – 3, 2 and 1]

A second charged particle in a magnetic field has velocity $v = 8\sqrt{x}$ cm/sec when it has travelled x cm from rest.

a) Show that, if ∂x and ∂v represent small changes in x and v respectively, $\partial v \approx \frac{32\partial x}{v}$

b) Estimate the percentage change in x needed to reduce v by 4%.

c) Explain whether this is a valid method to estimate the effect of a 50% change in x .

4. [8 marks – 4, 1, 1 and 2]

A damaged oil tanker is leaking oil into the sea. A current pushes the spreading oil into the shape of a sector of a circle, with radius r and sector angle θ . Both r and θ change with time.

The area of a sector is given by $A = \frac{1}{2} r^2 \theta$.

a) Show that $\frac{d\theta}{dt} = \frac{2}{r} \left(\frac{1}{r} \frac{dA}{dt} - \theta \frac{dr}{dt} \right)$

The radius of the oil spill is increasing at 2 m per minute and the area at $2\pi \text{ m}^2$ per minute.

When the oil spill has a radius of 6 m:

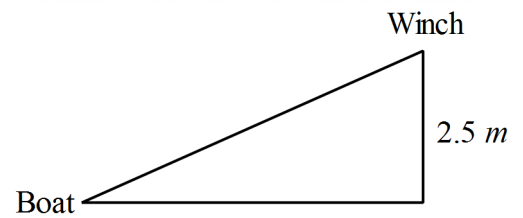
b) determine the area at this instant

c) find the exact value of θ at this instant

d) calculate the rate of change of θ at this instant.

5. [5 marks]

A small boat is being hauled towards a wharf by a winch mounted 2.5 m above water level. The winch is pulling the connecting rope at a rate of 0.06 m per second.



How fast is the boat moving horizontally when there is 6.5 of rope between the boat and the winch?