**

**MATHEMATICS:**

**SPECIALIST 3 & 4**

**SEMESTER 2 2019**

**TEST 5**

**Resource Free**

Reading Time: 2 minutes

Time Allowed: 15 minutes Total Marks: 15

**Question 1 (7 marks)**

The relationship is graphed below.

(a) Find an expression for for the given relationship. (3 marks)

(b) Determine the gradient of the graph at the point . (2 marks)

(c) Hence, determine the approximate value of when . (2 marks)

**Question 2 (3 marks)**

A function is defined parametrically by , .

Determine an equation for the gradient function, , simplifying your answer.

**Question 3 (5 marks)**

Determine a general solution (with in terms of ) to the following differential equations.

(a) (3 marks)

(b) (2 marks)



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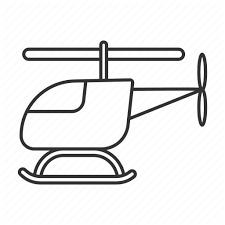
**Resource Assumed**

Reading Time: 2 minutes

Time Allowed: 35 minutes Total Marks: 28

**Question 4 (6 marks)**

An observer on the ground is watching a helicopter land on a landing pad. The landing pad is level with the observer and metres away. The helicopter is dropping vertically at a constant 3 metres per second.



Determine the rate at which the angle of elevation, , of the helicopter is changing when the helicopter is 50 metres above the landing pad.

Assume that the height of the observer is negligible.

Give your answer to three decimal places.

**Question 5 (9 marks)**



A first-order differential equation has a slope field as shown in the diagram below.

(a) Determine the general differential equation that would yield this slope field. (3 marks)

The slope field at point has a value of .

(b) Determine another point on the slope field that has a value of . (1 mark)

(c) Determine the equation of the curve containing point . (5 marks)

**Question 6 (13 marks)**

The MEG mobile phone company introduces a new phone into the market, the Spec H-P2. The marketing department in a capital city estimate that approximately million people use mobile phones. In order to get the new mobile phone out into the community the marketing department begins an advertising campaign that involves immediately giving away phones through prizes and give-aways on mainstream and social media.

Let the number of people who have the new Spec H-P2 phone weeks after it is released into the market. Research shows that the rate at which new customers are purchasing the new phone is given by the equation:

It is estimated that at the start of the advertising campaign, 740 people per week are buying the new phone.

(a) Show that *k* = 0.0000025. (2 marks)

(b) Six weeks after the new phone had been released it was estimated that approximately 17 000 people were using the phone. Using the incremental formula, determine the approximate number of people (to the nearest 10) who bought a Spec H-P2 in the first day of the seventh week. (3 marks)

(c) Given that , use the separation of variables technique to show that

(7 marks)

(d) What proportion of the mobile phone users in the city do the marketing team estimate will eventually be using the Spec H-P2? (1 mark)