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|  | **Mathematics Department**  **11 Maths Methods Test 7 Odd**  **Applications of Differentiation, Exponential Functions and Antidifferentiation** | |
| **Name** |  |

**Section 1 – Resource Free – Students can have the formula sheet**

**Marks : 18 Time: 18 minutes (maximum)**

**1:** **[2, 2, 3, 3 = 10 marks]**

Find the anti-derivative of the following:

a)  b) 

c)  d) 

**2**. **(4 marks)**

Find *y* as a function of *x* given = 4*x*3 +15*x*2 – 14*x* and *y* = 1 when *x* = 1

**3**. **(4 marks)**

$*C* is the cost of producing *x* units of a product. If *C* ’(*x*) = 200 – 4*x* find the extra cost incurred by producing 40 units rather than 20.



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**Section 2 – Resource Rich – calculators, formula sheet and 1 page of notes**

**Marks : 39 Time: 40 minutes (minimum)**

**1. [2, 4 = 6 marks]**

A piece of heavy cardboard, measuring 600cm x 300cm, is to be made into an open box. This is to be done by removing a square from each corner and folding up the resulting flaps to form the box.

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| a) If x is the length of the side of the square cut out of the box, find an expression for the volume of the box in the form V = ax3 + bx2 + cx + d |  |

b) Use calculus techniques to find the maximum possible volume of this box (to the nearest litre).

**2. [1, 3, 4, 1, 1 = 10 marks]**

The displacement s (in metres) at time *t* (in seconds) of a particle moving in a horizontal straight line is given by

s(t) = (t - 3)(2t + 3)(t – 6).

Find:

a) the initial displacement of the particle

b) Use calculus to determine when the particle changes direction.

c) The total distance travelled in the first 5 seconds (to the nearest metre).

d) The velocity of the particle when t = 5

e) The average speed of the particle over the first five seconds.

**3. [3, 1, 2 = 6 marks]**

Palaeontologists establish the age of artefacts by the process of carbon dating. They use the fact that the half-life of Carbon C14 is about 5600 years and that C14 decays at an exponential rate. [Half life is the time it takes to go from 100% to 50% of the original amount]

a) Find an equation, in the form P = a rt , to represent the percentage of C14 remaining, with respect to time. (give r accurate to 6 decimal places)

b) Do a sketch to represent the amount of C14 remaining over time.

After testing an artefact, they found that the mass of C14 still present was 12% of the original amount.

c) What (to the nearest 1000 years) was the age of the artefact?

**4. [1, 1, 2, 2, 2, 2 = 10 marks]**

The population of swans nesting in Carine Glades was recorded at the beginning of September every year, starting in 2010. It is found that the population satisfies the function:

S (t) = 800 + 395t - 2.5t2 (t is the number of years, after 2010).

a) How many swans were counted in 2010?

b) How many were counted in 2012?

c) What was the average rate of change in the population over these two years?

d) What was the instantaneous rate of change when t = 2?

e) After how many years will the population be a maximum?

f) If there are no unforeseen disturbances to the area, for how many years will there be swans at Carine Glades?

**5. [3, 2, 1, 2 = 8 marks]**

The melting point of gold is 1062°C. After being poured into an ingot block, the gold is placed into a cool room which is kept at a constant temperature of 30°C.

After a minute the temperature of the ingot is 900°C and decreasing exponentially.

a) Write a formula to find the temperature of the ingot at any time t.

b) When will the temperature of the ingot get down to 40°C (the temperature that they will be able to pick it up by hand and move it)?

c) If left in the room, when will the temperature of the ingot reach 28°C?

d) Draw a sketch graph to represent the cooling temperature of the ingot over time.

**2.** **[1, 3, 2 = 6 marks]**

Annette buys 1000 shares of Coles/Myer stock.

The expected price per share over the next two weeks is given by **P(t) = 4 + 18t2 - 2t3** cents, where **t** is the number of days from purchase (ie. 0 ≤ t ≤ 14).

a) How much does Annette pay for her shares altogether?

b) When should she sell them in order to make the best profit?

c) What profit can she expect to make at best?