CHURCHLANDS SENIOR HIGH SCHOOL

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MATHEMATICS SPECIALIST 3, 4 TEST FOUR 2016
Year 12
Non Calculator Section
Chapters 6, 7, 8

Name_____

Time: 15 minutes
Total: 13 marks

1 [5 Marks]

a) Find the expression for $\frac{dy}{dx}$ given the relationship $e^{\cos(x)} + e^{\sin(y)} = e + 1$

(3)

b) Hence find $\frac{dy}{dx}$ at the point $x = 0$

(2)

2 **[8 Marks]**

a) Find the gradient of the tangent to the curve $xy^2 = 4 + 3yx^3, y > 0$ when $x = 1$ (4)

b) If $y = \sin(x^2)$, show that $\frac{d^2y}{dx^2} - \frac{1}{x}\frac{dy}{dx} + 4x^2y = 0$ (4)

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Time: 40 minutes
Total: 35 marks

3 [6 Marks]

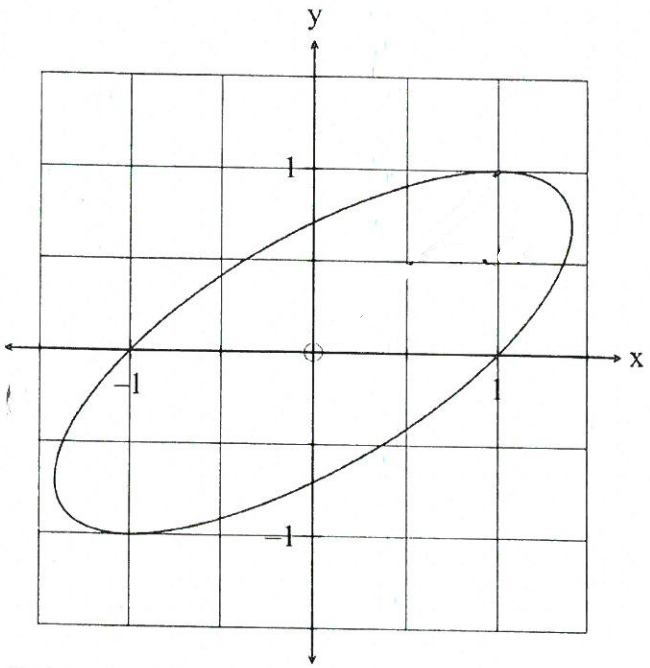
A person of height 1.8 m is walking directly toward a light pole at night. The light is 3 m above the ground, and the person is walking at 1.6 m/s on level ground. At what rate is

a) the length of the shadow decreasing? (4)

b) the tip of the shadow moving when the person is 4 m from the foot of the light pole? (2)

4 **[9 Marks]**

(a) The position vector of a particle travelling on an elliptical path, as shown on the graph below, is given by $r(t) = (sin(t) + cos(t))i + (cos(t))j$ for any time t.



(i) Find when the particle is at (-1, -1). (2)

(ii) Find the initial position of the particle. (1)

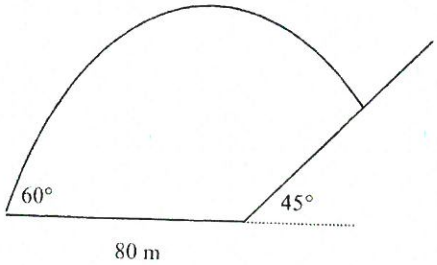
(iii) Find the velocity and acceleration of the particle at $t = 0$. (3)

(iv) Plot the acceleration vector on the graph at $t = 0$. (2)

(v) Determine the values of t such that $\boldsymbol{a}(t) = -\boldsymbol{r}(t)$. (1)

5 **[14 marks]**

A golfer is playing a shot on the moon 80 metres from the edge of a hill, which has a slope of 45° - as shown in the diagram below. Assume gravity is 1.2 m / sec2 downwards, and that the position in which the ball is struck is the origin.



He hits the ball with a velocity of 12 m/sec at an angle of 60°.

a) Show why the velocity of the ball at any time t, seconds, is given by

$$\mathbf{v}(t) = 6\mathbf{i} + (6\sqrt{3} - 1.2t)\mathbf{j}$$

(4)

b) Determine the position of the ball at any time t.

(2)

c) Determine the height of the ball when minimum speed is attained. (3)

d) Determine the Cartesian equation for the relationship between y and x for the position vector of the ball by considering the parametric equations for the x and y components.

(2)

e) Hence, or otherwise, determine the height of the hill at the position that the ball hits the hill. (Hint: Define y in terms of x for the equation of the hill first!) (3)

6 **[2 marks]**

Solve the following system of linear equations where possible. If there is more than one solution, or no solution state why clearly. If there is one solution, find it.

$$x + y + z = 2$$
$$x - 2y + 3z = 8$$
$$2x - y + 4z = 10$$

7 **[4 marks]**

A triangle's area is given by $A = \frac{ab}{2}\sin\theta$, where a and b are the lengths of two sides determining angle θ.

If the two sides of length 10cm and 12cm have an included angle θ increasing at 1^0 per minute, determine

a) $\frac{d\theta}{dt}$ in **radians** per minute exactly; (1)

b) A, in terms of θ only; (1)

c) exactly how fast the area of the triangle is changing with respect to time when the included angle is 120^0. (2)