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| EGC_Black | **MATHEMATICS:SPECIALIST 3 & 4**  **SEMESTER 1 2016**  **TEST 3**  **Calculator Free** |

Reading Time: 2 minutes

Time Allowed: 17 minutes Total Marks: 16

**1.** [1, 1, 1, 3 marks]

A system of linear equations in , and has been partially reduced to the following form:

(a) Perform one further operation so that the coefficient of in is zero.

State, if possible, all the values of where by the system of equations will have

(b) no solutions

(c) many solutions

If *b* was given the value 2

(d) give the solution to this system of linear equations.

**2.** [1, 2, 2 marks]

Given that and

Determine

(a) the scalar product,

(b) the cross product,

(c) the vector equation of the line that is perpendicular to both and and passes through the point .

**3.** [5 marks]

In the quadrilateral shown below, , and . The points , , and are the midpoints of the sides shown in the diagram.

Show, using vectors , and that is parallel to .

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| EGC_Black | **MATHEMATICS:SPECIALIST 3 & 4**  **SEMESTER 1 2016**  **TEST 3**  **Calculator Assumed** |

Reading Time: 4 minutes

Time Allowed: 43 minutes Total Marks: 42

**4.** [3, 1 marks]

Sally has the ability to do jobs: window cleaning, aerobics coaching, and school teaching. She finds that she has only hours available to work. She knows that there is only half as much aerobics as teaching and window cleaning combined. She must do hours less aerobics than window cleaning.

(a) Write these restrictions as simultaneous equations.

(b) Solve this system of equations.

**5.** [5 marks]

A particle is moving in the plane such that its position at any time is given by

Determine the vector equation of the line that is perpendicular to the motion of the particle at the point when .

**6.** [2, 2, 3]

(a) An ellipse has vector equation .

Determine the Cartesian equation of the ellipse.

(b) Determine the acute angle between the lines with equations

and

(c) Points , and are such that and .

Determine the area, in terms of , of triangle .

**7.** [4, 2, 3 marks]

A particle is moving in a vertical plane such that its acceleration, , is given by m/s2 where is a horizontal unit vector in the plane, and is a vertical unit vector in the plane. Initially the particle is at the origin, travelling with velocity, m/s.

Point has coordinates .

(a) Given that the particle passes through point , determine the value for .

(b) Determine the speed of the particle when it passes through point .

Give your answer to one decimal place.

(c) Determine the maximum height of the particle, and its horizontal distance from the origin at that point.

**8.** [4, 3, 3 marks]

Consider two particles, and , that move along the lines defined by

and

(a) Show that the particles cross paths, *but do not meet*, at the point .

A sphere has Cartesian equation

(b) Determine the exact distance between the point at which the particles’ paths cross and the centre of the sphere,

(c) Determine the minimum distance that the particle gets to the centre of the sphere.

**9.** [7 marks]

The acceleration of a particle moving in the plane is , where is a constant. At time the particle leaves the point with position vector , with velocity

By integration, find expressions for the velocity and the position vector , of the particle, at time .

Deduce that the particle follows a path whose Cartesian equation is