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| EGC_Black | **MATHEMATICS:SPECIALIST 1 & 2**  **SEMESTER 1 2015**  **TEST 3**  **Resource Free** |

Time Allowed: 18 minutes Total Marks: 16

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

Given that the position of particles A and B are given by the equations

**r**A(t) = 3**i** – 5**j** + t(–2**i** + 4**j**) and **r**B(t) = 10**i** + **j** + t(2**i** + 3**j**), determine

(a) A**r**B(0) (b) B**v**A

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

A

B

C

D

A line drawn from a point A forms a tangent to a circle at B. A second line from A cuts through the same circle at point C and D.

(a) State a relationship between the lengths of the line segments AB, AD and AC.

(b) Hence prove that ΔABD ~ ΔACB.

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

Given vectors **m** = 5**i** – 2**j** and **n** = 4**i** + 3**j**, determine

(a) the scalar projection of **m** onto **n**.

(b) the vector projection of **m** onto **n**.

**5.** [6 marks]

O

A

B

C

M

Prove that the diagonals of a parallelogram bisect each other.

OABC is a parallelogram with = **a** and = **c**. The diagonals OB and AC meet at M.

If = h and = k, use the fact that to show that h = k = ½.

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| EGC_Black | **MATHEMATICS:SPECIALIST 1 & 2**  **SEMESTER 1 2015**  **TEST 3**  **Calculator Assumed** |

Time Allowed: 40 minutes Total Marks: 35

**6.** [3 marks]

To the rare Blue-breasted Speckled Mat bird, a similarly rare Red-breasted Speckled Mat bird appears to be flying at (-5**i** + 7**j**) m/s. However, to a nearby Yellow-breasted Speckled Mat bird, the Red-breasted Speckled Mat bird appears to be flying at (3**i** + 10**j**) m/s.

What would be the velocity of the Blue-breasted Speckled Mat bird according to it’s Yellow-breasted cousin?

**7.** [1, 1, 1 marks]

Calculate the following, given that **a** = 3**i** + 5**j**, **b** = 7**i** – 2**j**, and **c** = x**i** + 3**j**.

(a) **a**•**b**

(b) The angle between **a** and **b**

(c) The value of x such that **b** and **c** are perpendicular.

**8.** [2, 4 marks]

B

O

140°

A

C

D

*b*

*d*

(a) A circle centred at O has s∠AOC = 140°, as shown in the diagram. Determine the values of *b* and *d*. Justify your answers.

55°

S

T

O

x°

A

B

C

D

(b) A circle centred at O has a tangent ST as shown in the diagram. Given that s∠CDT = 55°, determine the value of x. Justify your answer.

**9.** [5 marks]

O

A

B

C

**a**

**b**

Prove that if the diagonals of a rectangle are perpendicular then the rectangle is a square.

O

A

B

C

X

Y

**b**

**a**

**10.** [2, 3 marks]

OABC is a parallelogram, X is the midpoint of AB and Y is such that = .

Let = **a** and = **b**.

(a) Express and in terms of **a** and/or **b**.

(b) Show that • = **a**•**b** + 8, given ⎪**a**⎪ = 3 and ⎪**b**⎪ = 2.

**11.** [2, 4 marks]

A football umpire (who is standing at the centre of Subiaco Oval at position (0, 0) notices a West Coast player at position (1, -9) metres, and running with velocity (2**i** + 4**j**) metres/second. At the same time he notices a Fremantle player at position (22, -16) metres, and running with velocity (-4**i** + 6**j**) metres/second.

(a) (i) Write an equation that gives the position of the West Coast player at any time, relative to the umpire, **r**WC(t).

(ii) Write an equation that gives the position of the Fremantle player at any time, relative to the umpire, **r**F(t).

(b) Determine how many seconds after the umpire first notices the two players that they collide, and how far (to 1 decimal place) from the umpire that the collision takes place.

**12.** [1, 4, 2 marks]

Stupendous Man is at position 5**i** + 4**j** m from Evil Babysitter Girl, running with velocity 5**i** – 2**j** m/s when she notices him. She immediately takes off with velocity 6**i** – **j** m/s in order to intercept him.

(a) Determine Stupendous Man’s velocity relative to Evil Babysitter Girl.

(b) Using the dot product method, determine the time at which Stupendous Man and Evil Babysitter Girl are closest.

(c) If Evil Babysitter Girl’s arms are 65 cm long, state whether or not she will be able to catch Stupendous Man. Justify your answer.