SCOTCH COLLEGE	Year 12 Mathematics Specialist
	TEST 2 – Vectors
DATE: 8 th March 2016	Name

Reading Time: 3 minutes

SECTION ONE: CALCULATOR FREE

TOTAL: 25 marks

EQUIPMENT: Pens, pencils, pencil sharpener, highlighter, eraser, ruler, SCSA formula sheet.

WORKING TIME: 25 minutes (maximum)

SECTION TWO: CALCULATOR ASSUMED

TOTAL: 28 marks

EQUIPMENT: Pens, pencils, pencil sharpener, highlighter, eraser, ruler, drawing instruments, templates, up to 3 Calculators,

1 A4 page of notes (one side only), SCSA formula sheet.

WORKING TIME: 25 minutes (minimum)

SECTION 1 Question	Marks available	Marks awarded	SECTION 2 Question	Marks available	Marks awarded
1	5		6	9	
2	6		7	7	
3	4		8	12	
4	6				
5	4				
Total	25			28	

[25 marks]

Section One: Calculator-free

This section has **five (5)** questions. Answer **all** questions. Write your answers in the spaces provided

Question 1 [5 marks]

A straight line passes through the points P(2, -3) and Q(5, 3).

(a) Find the vector equation of the line in the form $\mathbf{r} = \mathbf{a} + \lambda \mathbf{b}$. [2]

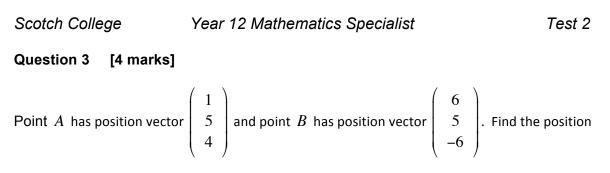
(b) Find the equation of the line through P and Q in parametric form. [1]

(c) Find the equation of the line through P and Q in Cartesian form. [2]

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Question 2 [6 marks]

The point A lies on the line with equation $\mathbf{r} = 2\mathbf{i} + \mathbf{j} + \lambda(2\mathbf{i} - \mathbf{j})$ and the point B has position vector $4\mathbf{i} - 5\mathbf{j}$. Use a method involving a dot product to determine the position vector of A so that the distance from A to B is a minimum. [6]



vector of the point P that divides AB internally in the ratio 2:3.

Question 4 [6 marks]

(a) Find a vector perpendicular to the two vectors:

$$\overrightarrow{OP} = \vec{i} - 3\vec{j} + 2\vec{k}$$
$$\overrightarrow{OQ} = -2\vec{i} + \vec{j} - \vec{k}$$
[3]

(b) If \overrightarrow{OP} and \overrightarrow{OQ} are position vectors for the points *P* and *Q*, use your answer to part (a), or otherwise, to find the area of the triangle *OPQ*. [3]

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Ques	tion 5 [4 marks]		
Points	P and Q have coor	dinates $(3,1,-2)$ and $(4,2,-1)$ respectively.	
(a)	Write a vector equa	tion for the line passing through P and Q .	[2]

(b) Show that the vector 2i - j - k is perpendicular to the line through P and Q. [1]

(c) Write down a vector equation of the plane containing P and Q with 2i - j - k as its normal vector. [1]

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TEST 2 – Vectors

Name:

Section Two: Calculator-assumed

[25 marks]

This section has **three (3)** questions. Answer **all** questions. Write your answers in the spaces provided

Question 6 [9 marks]

Two rockets are fired from different positions at the same time. Rocket 1 leaves from position -7i+9j-5k km at a velocity of 5i-4j+2k km/min and Rocket 2 leaves from position -6i-5j+2k km at a velocity of 9i+6j-3k km/min. Each rocket leaves a trail of smoke and, although the rockets do not collide, their smoke trails do intersect.

(a) Find the coordinates of the point at which the smoke trails intersect. [4]

(b) Find the position of Rocket 1 three minutes after firing. [1]

(c) Find the shortest distance of Rocket 1 from the smoke trail of Rocket 2, three minutes after firing. Give your answer to the nearest metre. [4]

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Question 7 [7 marks]

(a) The equation of a sphere is given by $x^2 + y^2 + z^2 - 6x + 4y + 8z = 153$. Determine the vector equation of the sphere. [3]

(b) Determine the position vector(s) of the points of intersection between the sphere and the line $r = -3i + 5j + k + \lambda(-2i + j - 2k)$. [4]

(b)

[2]

[2]

Question 8 [12 marks]

Let
$$r = \begin{pmatrix} 2t+5\\ -2t-1\\ t \end{pmatrix}$$
, $t \in R$, be an equation of line L .

The plane *P* has a normal vector $\begin{pmatrix} 3 \\ -4 \\ -1 \end{pmatrix}$ and passes through the point *A*(-1,0,4).

Show that the point B(9, -5, 2) lies on the line *L*. (a)

Give the normal vector equation of the plane P.

Find the shortest distance that plane P is from the origin. (C) [2] (d) Show that the line L meets the plane P at the point C(1, 3, -2). [3]

(e) Find the angle between the line *L* and the plane *P*. (Give your answer correct to 1 decimal place.) [3]