

1. Find the cosine of the angle between the two vectors  $\begin{pmatrix} 3 \\ 4 \end{pmatrix}$  and  $\begin{pmatrix} -2 \\ 1 \end{pmatrix}$ . (Total 6 marks)

2. The vectors  $\vec{i}$ ,  $\vec{j}$  are unit vectors along the  $x$ -axis and  $y$ -axis respectively.  
The vectors  $\vec{u} = -\vec{i} + 2\vec{j}$  and  $\vec{v} = 3\vec{i} + 5\vec{j}$  are given.

- (a) Find  $\vec{u} + 2\vec{v}$  in terms of  $\vec{i}$  and  $\vec{j}$ .

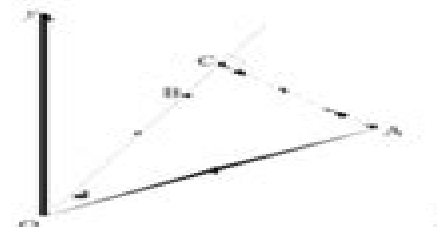
A vector  $\vec{w}$  has the same direction as  $\vec{u} + 2\vec{v}$ , and has a magnitude of 26.

- (b) Find  $\vec{w}$  in terms of  $\vec{i}$  and  $\vec{j}$ . (Total 4 marks)

3. The following diagram shows the point  $O$  with coordinates  $(0, 0)$ , the point  $A$  with position vector  $\vec{a} = 12\vec{i} + 5\vec{j}$ , and the point  $B$  with position vector  $\vec{b} = 6\vec{i} + 8\vec{j}$ . The angle between  $(OA)$  and  $(OB)$  is  $\theta$ .

Find

- (i)  $|\vec{a}|$ ;  
(ii) a unit vector in the direction of  $\vec{b}$ ;  
(iii) the exact value of  $\cos\theta$  in the form  $\frac{p}{q}$ , where,  $p, q \in \mathbb{Z}$ . (6 marks)



4. The circle shown has centre  $O$  and radius 6.  $\overrightarrow{OA}$  is the vector  $\begin{pmatrix} 6 \\ 0 \end{pmatrix}$ ,  $\overrightarrow{OB}$  is the vector  $\begin{pmatrix} -6 \\ 0 \end{pmatrix}$  and  $\overrightarrow{OC}$  is the vector  $\begin{pmatrix} 5 \\ \sqrt{11} \end{pmatrix}$ .

- (a) Verify that  $A$ ,  $B$  and  $C$  lie on the circle. (3)  
(b) Find the vector  $\overrightarrow{AC}$ . (2)  
(c) Using an appropriate scalar product, or otherwise, find the cosine of angle  $OAC$ . (3)  
(d) Find the area of triangle  $ABC$ , giving your answer in the form  $a\sqrt{11}$ , where  $a \in \mathbb{N}$ . (4)



(Total 12 marks)

5. The quadrilateral  $OABC$  has vertices with coordinates  $O(0, 0)$   $A(5, 1)$   $B(10, 5)$  and  $C(2, 7)$ .

- (a) Find the vectors  $\overrightarrow{OB}$  and  $\overrightarrow{AC}$ .  
(b) Find the angle between the diagonals of the quadrilateral  $OABC$ . (Total 4 marks)

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**Shlomi Arnon, John Barry, George  
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## **Table of Contents Ib Math Sl Paper 2009**

1. Understanding the eBook Ib Math Sl Paper 2009
  - The Rise of Digital Reading Ib Math Sl Paper 2009
  - Advantages of eBooks Over Traditional Books
2. Identifying Ib Math Sl Paper 2009
  - Exploring Different Genres
  - Considering Fiction vs. Non-Fiction
  - Determining Your Reading Goals
3. Choosing the Right eBook Platform
  - Popular eBook Platforms
  - Features to Look for in an Ib Math Sl Paper 2009
  - User-Friendly Interface
4. Exploring eBook Recommendations from Ib Math Sl Paper 2009
  - Personalized Recommendations
  - Ib Math Sl Paper 2009 User Reviews and Ratings
  - Ib Math Sl Paper 2009 and Bestseller Lists
5. Accessing Ib Math Sl Paper 2009 Free and Paid eBooks
  - Ib Math Sl Paper 2009 Public Domain eBooks
  - Ib Math Sl Paper 2009 eBook Subscription Services

- Ib Math SL Paper 2009 Budget-Friendly Options
- 6. Navigating Ib Math SL Paper 2009 eBook Formats
  - ePub, PDF, MOBI, and More
  - Ib Math SL Paper 2009 Compatibility with Devices
  - Ib Math SL Paper 2009 Enhanced eBook Features
- 7. Enhancing Your Reading Experience
  - Adjustable Fonts and Text Sizes of Ib Math SL Paper 2009
  - Highlighting and Note-Taking Ib Math SL Paper 2009
  - Interactive Elements Ib Math SL Paper 2009
- 8. Staying Engaged with Ib Math SL Paper 2009
  - Joining Online Reading Communities
  - Participating in Virtual Book Clubs
  - Following Authors and Publishers Ib Math SL Paper 2009
- 9. Balancing eBooks and Physical Books Ib Math SL Paper 2009
  - Benefits of a Digital Library
  - Creating a Diverse Reading Collection Ib Math SL Paper 2009
- 10. Overcoming Reading Challenges
  - Dealing with Digital Eye Strain
  - Minimizing Distractions
  - Managing Screen Time
- 11. Cultivating a Reading Routine Ib Math SL Paper 2009
  - Setting Reading Goals Ib Math SL Paper 2009
  - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Ib Math SL Paper 2009
  - Fact-Checking eBook Content of Ib Math SL Paper 2009
  - Distinguishing Credible Sources
- 13. Promoting Lifelong Learning
  - Utilizing eBooks for Skill Development
  - Exploring Educational eBooks
- 14. Embracing eBook Trends

- Integration of Multimedia Elements
- Interactive and Gamified eBooks

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