Question 1

(a) (i) $|a-b|=|a+b|$

$\Rightarrow (a-b)\cdot(a-b)=(a+b)\cdot(a+b)$ (M1)

$\Rightarrow |a|^2-2a\cdot b+|b|^2=|a|^2+2a\cdot b+|b|^2$ A1

$\Rightarrow 4a\cdot b=0 \Rightarrow a\cdot b=0$ A1

therefore a and b are perpendicular R1

Note: Allow use of 2-d components.

Note: Do not condone sloppy vector notation, so we must see something to the effect that $|c|^2=c\cdot c$ is clearly being used for the M1.

Note: Allow a correct geometric argument, for example that the diagonals of a parallelogram have the same length only if it is a rectangle.

(ii) $|a\times b|^2=(|a||b|\sin\theta)^2=|a|^2|b|^2\sin^2\theta$ M1A1

$|a|^2|b|^2-(a\cdot b)^2=|a|^2|b|^2-|a|^2|b|^2\cos^2\theta$ M1

$=|a|^2|b|^2(1-\cos^2\theta)$ A1

$=|a|^2|b|^2\sin^2\theta$

$\Rightarrow |a\times b|^2=|a|^2|b|^2-(a\cdot b)^2$ AG

[5 marks]

(b) (i) area of triangle $=\dfrac{1}{2}|\overrightarrow{AB}\times\overrightarrow{AC}|$ (M1)

$=\dfrac{1}{2}|(b-a)\times(c-a)|$ A1

$=\dfrac{1}{2}|b\times c+b\times-a+-a\times c+-a\times-a|$ A1

$b\times-a=a\times b\,;\ c\times a=-a\times c\,;\ -a\times-a=0$ M1

Hence, area of triangle is $\dfrac{1}{2}|a\times b+b\times c+c\times a|$ AG

(ii) D is the foot of the perpendicular from B to AC

area of triangle $ABC=\dfrac{1}{2}|\overrightarrow{AC}||\overrightarrow{BD}|$ A1

therefore

$\dfrac{1}{2}|\overrightarrow{AC}||\overrightarrow{BD}|=\dfrac{1}{2}|\overrightarrow{AB}\times\overrightarrow{AC}|$ M1

hence, $|\overrightarrow{BD}|=\dfrac{|\overrightarrow{AB}\times\overrightarrow{AC}|}{|\overrightarrow{AC}|}$ A1

$=\dfrac{|a\times b-b\times c-c\times a|}{|c-a|}$ AG

[7 marks]

Total [15 marks]

Ib Math Hl Paper 22

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Ib Math Hl Paper 22:

   Learning and Understanding National Research Council,Division of Behavioral and Social Sciences and Education,Center for Education,Committee on Programs for Advanced Study of Mathematics and Science in American High Schools,2002-08-06 This book takes a fresh look at programs for advanced studies for high school students in the United States with a particular focus on the Advanced Placement and the International Baccalaureate programs and asks how advanced studies can be significantly improved in general It also examines two of the core issues surrounding these programs they can have a profound impact on other components of the education system and participation in the programs has become key to admission at selective institutions of higher education By looking at what could enhance the quality of high school advanced study programs as well as what precedes and comes after these programs this report provides teachers parents curriculum developers administrators college science and mathematics faculty and the educational research community with a detailed assessment that can be used to guide change within advanced study programs   *The Manuscripts of the House of Lords: 1708-1710 (H.L. 40)* Great Britain. Parliament. House of Lords,Great Britain. Royal Commission on Historical Manuscripts,1923   **Mathematics in Population Biology** Horst R. Thieme,2018-06-05 The formulation analysis and re evaluation of mathematical models in population biology has become a valuable source of insight to mathematicians and biologists alike This book presents an overview and selected sample of these results and ideas organized by biological theme rather than mathematical concept with an emphasis on helping the reader develop appropriate modeling skills through use of well chosen and varied examples Part I starts with unstructured single species population models particularly in the framework of continuous time models then adding the most rudimentary stage structure with variable stage duration The theme of stage structure in an age dependent context is developed in Part II covering demographic concepts such as life expectation and variance of life length and their dynamic consequences In Part III the author considers the dynamic interplay of host and parasite populations i e the epidemics and endemics of infectious diseases The theme of stage structure continues here in the analysis of different stages of infection and of age structure that is instrumental in optimizing vaccination strategies Each section concludes with exercises some with solutions and suggestions for further study The level of mathematics is relatively modest a toolbox provides a summary of required results in differential equations integration and integral equations In addition a selection of Maple worksheets is provided The book provides an authoritative tour through a dazzling ensemble of topics and is both an ideal introduction to the subject and reference for researchers   **Proceedings of a Conference, Lowell, Massachusetts, U.S.A., July 6-9, 1976: Joint, parallel and papers sessions** ,1976   **The Manuscripts of the House of Lords: 1704-1706 (H.L. 142)** Great Britain. Royal Commission on Historical Manuscripts,1912   Backpacker ,2001-03 Backpacker brings the outdoors straight to the reader s doorstep inspiring and enabling them to go more places and enjoy nature more often The authority on active

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