



**BAULKHAM HILLS HIGH SCHOOL**

**2016**  
**YEAR 11**  
**HALF YEARLY EXAMINATIONS**

# Mathematics Extension

## General Instructions

- Reading time – 5 minutes
- Working time – 90 minutes
- Write using black or blue pen  
Black pen is preferred
- Board-approved calculators may be used
- Show all necessary working in  
Questions 6 – 8
- Marks may be deducted for careless or  
badly arranged work

## Total marks – 50

**Section I** Pages 2 – 3

### 5 marks

- Attempt Questions 1 – 5
- Allow about 10 minutes for this  
section

**Section II** Pages 4 – 6

### 45 marks

- Attempt Questions 6 – 8
- Allow about 80 minutes for this  
section

## Section I

5 marks

Attempt Questions 1 – 5

Allow about 10 minutes for this section

Use the multiple-choice answer sheet for Questions 1 – 5

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1 Which of the following is **FALSE** ?

(A)  $\sin(90^\circ - \alpha) = \cos \alpha$

(B)  $\sin(90^\circ + \alpha) = \cos \alpha$

(C)  $\cos(90^\circ - \alpha) = \sin \alpha$

(D)  $\cos(90^\circ + \alpha) = \sin \alpha$

2 Which expression is equal to  ${}^n C_2$  ?

(A)  $\frac{n}{2}$

(B)  $\frac{n^2 - n}{2}$

(C)  $\frac{n^2 + n}{2}$

(D)  $n$

3 How many solutions does the equation  $x^{\frac{1}{3}} = |x - 2| - 3$  have ?

(A) 0

(B) 1

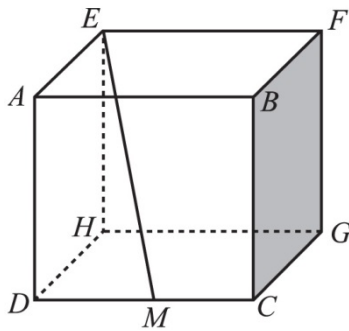
(C) 2

(D) 3

- 4 A test is administered with 15 questions.  
Students are allowed to answer any 10 questions.  
How many ways can a student get 9 out of 10 questions correct?

- (A) 30030
- (B) 5005
- (C) 3003
- (D) 15

- 5 The cube below has sides four metres long.  
 $M$  is the midpoint of  $DC$ .



The angle  $EMH$  is closest to

- (A)  $41.8^\circ$
- (B)  $48.2^\circ$
- (C)  $49.1^\circ$
- (D)  $54.7^\circ$

**END OF SECTION I**

## Section II

45 marks

Attempt Questions 6 – 8

Allow about 80 minutes for this section

Answer each question on the appropriate answer sheet. Each answer sheet must show your name. Extra paper is available.

All necessary working should be shown in every question.

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*Marks*

**Question 6** (15 marks) Use a *separate* answer sheet

- (a) Solve the inequation  $\frac{x-2}{x+5} < 2$  3
- (b) A class consists of 14 boys and 6 girls. 2  
4 students are selected. How many of these selections contain at least 2 girls?
- (c) If  $a = \frac{5-\sqrt{5}}{5+\sqrt{5}}$ , evaluate, showing all working:
- (i)  $a + \frac{1}{a}$  2
- (ii)  $a^2 + \frac{1}{a^2}$  2
- (d) 47271 is a five digit number whose digits sum to  $4 + 7 + 2 + 7 + 1 = 21$ . 3  
How many five digit numbers are there whose digits sum to 43?
- (e) On a number plane, shade the region where  $(x,y)$  satisfies both of the 3  
inequalities
- $$y < \sqrt{16-x^2} \quad \text{and} \quad y \leq x$$

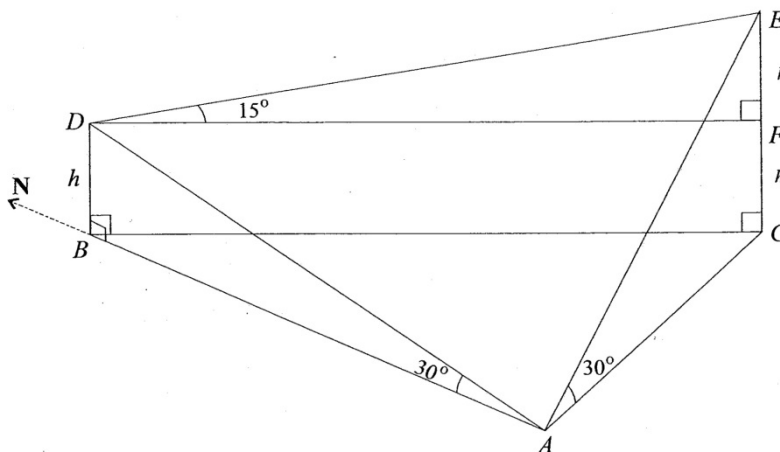
**Question 7** (15 marks) Use a *separate* answer sheet

- (a) How many ways can 8 people be arranged in a line if:
- (i) there are no restrictions? 1
  - (ii) Lance and Vinuja must be together? 2
  - (iii) Duvaraha must be at the beginning and Arpita must be at the end? 2

- (b) Given that  $3\sin^2 x + 2\sin x = 6\cos x + 9\sin x \cos x$  and  $-90^\circ < x < 90^\circ$ , find the possible values of  $\tan x$ . 3

- (c) How many distinct arrangements of all of the letters of the word **MISSISSIPPI**, are there if:
- (i) there are no restrictions? 1
  - (ii) all four I's do not come together? 2

- (d) The diagram below shows two vertical towers  $BD$  and  $CE$  of heights  $h$  and  $2h$  respectively, on a horizontal plane  $ABC$ . Point  $A$  is due south of point  $B$ , and the angles of elevation of the tops of the towers from  $A$  are both  $30^\circ$ . The angle of elevation of  $E$  from  $D$  is  $15^\circ$



- (i) Show that  $BC = h \tan 75^\circ$  1
- (ii) Find similar expressions for both  $AB$  and  $AC$  1
- (iii) Hence find the bearing of the taller tower from point  $A$  2

**Question 8 (15 marks)** Use a *separate* answer sheet

- (a) 4 female and 4 male students are to be seated around a circular table. 2  
 In how many ways can this be done if the males and females must alternate?

(b) Solve

(i)  $\frac{x}{3x-4} \leq \frac{1}{x-1}$  3

(ii)  $x^2 - |x| - 3 = 2x + |x|$  3

(c) In this question  $f^2(x)$  denotes  $f(f(x))$ ,  $f^3(x)$  denotes  $f(f(f(x)))$ , and so on.

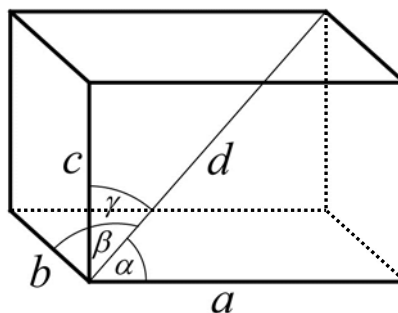
If  $f(x) = \frac{x + \sqrt{3}}{1 - x\sqrt{3}}$ ;

(i) find  $f^2(x)$  in terms of  $x$  1

(ii) show that  $f^3(x) = x$  1

(iii) find  $f^{2016}(x)$  1

(d) A rectangular box has edges of lengths  $a$ ,  $b$  and  $c$  units.  
 A diagonal of length  $d$  is drawn through the box between opposite corners as shown.  
 The three different angles between this diagonal and the three edges  $a$ ,  $b$  and  $c$  of the box are labelled  $\alpha$ ,  $\beta$  and  $\gamma$  respectively.



(i) Express  $d$  in terms of  $a$ ,  $b$  and  $c$ . 2

(ii) Hence, or otherwise, show that the angles  $\alpha$ ,  $\beta$  and  $\gamma$  satisfy the identity 2

$$\cos^2 \alpha + \cos^2 \beta + \cos^2 \gamma = 1$$

**End of paper**