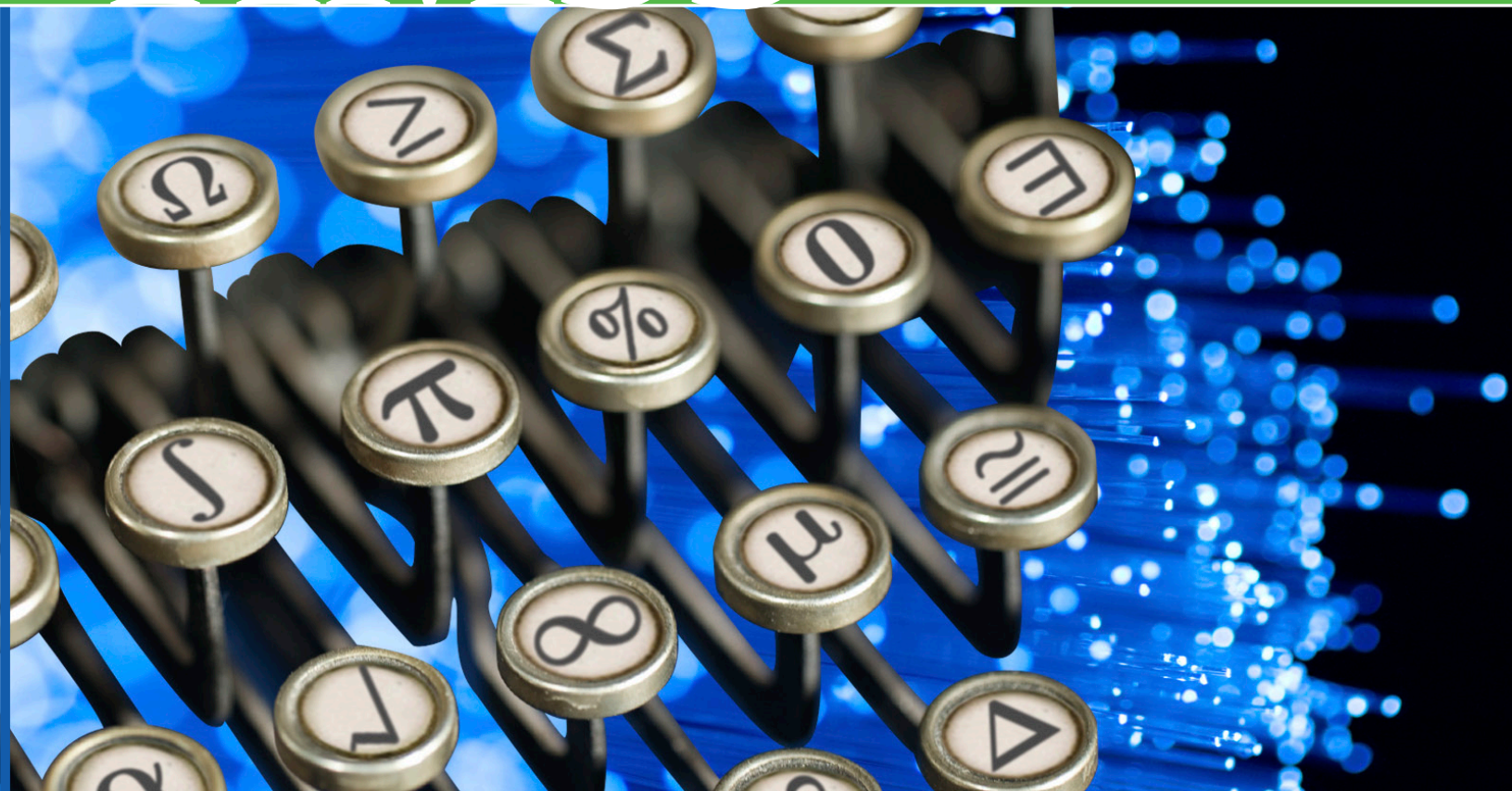


TRENDS IN INTERNATIONAL MATHEMATICS AND SCIENCE STUDY

# TIMSS



## TIMSS Advanced 2008 User Guide

for the International Database

# Released Items

## Advanced Mathematics



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International Study Center  
Lynch School of Education, Boston College

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Item ID	Subject	Block	Block Seq	Content Domain	Cognitive Domain	Maximum Points	Key
MA13001	Advanced Mathematics	M1	01	Algebra	Knowing	1	D
MA13002	Advanced Mathematics	M1	02	Algebra	Reasoning	1	A
MA13003	Advanced Mathematics	M1	03	Algebra	Reasoning	1	E
MA13004	Advanced Mathematics	M1	04	Calculus	Knowing	1	B
MA13006	Advanced Mathematics	M1	06	Calculus	Knowing	1	D
MA13007	Advanced Mathematics	M1	07	Geometry	Applying	1	A
MA13008	Advanced Mathematics	M1	08	Geometry	Reasoning	1	D
MA13009	Advanced Mathematics	M1	09	Algebra	Applying	1	C
MA13021	Advanced Mathematics	M3	01	Geometry	Knowing	1	A
MA13024	Advanced Mathematics	M3	04	Calculus	Knowing	1	B
MA13025A	Advanced Mathematics	M3	05	Calculus	Knowing	1	See scoring guide
MA13025B	Advanced Mathematics	M3	05	Calculus	Knowing	1	See scoring guide
MA13026A	Advanced Mathematics	M3	06	Geometry	Applying	1	See scoring guide
MA13026B	Advanced Mathematics	M3	06	Geometry	Applying	1	See scoring guide
MA13027	Advanced Mathematics	M3	07	Algebra	Reasoning	2	See scoring guide
MA13028	Advanced Mathematics	M3	08	Algebra	Knowing	1	See scoring guide
MA13029	Advanced Mathematics	M3	09	Geometry	Reasoning	2	See scoring guide
MA23069	Advanced Mathematics	M6	01	Algebra	Applying	1	D
MA23135	Advanced Mathematics	M6	02	Algebra	Applying	1	See scoring guide
MA23208	Advanced Mathematics	M6	03	Algebra	Reasoning	1	A
MA23165	Advanced Mathematics	M6	04	Calculus	Applying	1	See scoring guide
MA23039	Advanced Mathematics	M6	05	Calculus	Knowing	1	D
MA23159	Advanced Mathematics	M6	06	Calculus	Knowing	1	See scoring guide
MA23198	Advanced Mathematics	M6	07	Calculus	Reasoning	1	See scoring guide
MA23042	Advanced Mathematics	M6	08	Calculus	Knowing	1	B
MA23055	Advanced Mathematics	M6	09	Geometry	Knowing	1	D

Item ID	Subject	Block	Block Seq	Content Domain	Cognitive Domain	Maximum Points	Key
MA23080	Advanced Mathematics	M6	10	Geometry	Reasoning	1	A
MA23021	Advanced Mathematics	M6	11	Geometry	Applying	1	B
MA23004	Advanced Mathematics	M7	01	Algebra	Reasoning	1	B
MA23063	Advanced Mathematics	M7	02	Algebra	Applying	1	B
MA23141	Advanced Mathematics	M7	03	Algebra	Knowing	1	See scoring guide
MA23133	Advanced Mathematics	M7	04	Algebra	Knowing	1	D
MA23158	Advanced Mathematics	M7	05	Calculus	Applying	1	D
MA23151	Advanced Mathematics	M7	06	Calculus	Reasoning	1	C
MA23035A	Advanced Mathematics	M7	07	Calculus	Applying	1	See scoring guide
MA23035B	Advanced Mathematics	M7	07	Calculus	Applying	1	See scoring guide
MA23050	Advanced Mathematics	M7	08	Calculus	Knowing	1	B
MA23041	Advanced Mathematics	M7	09	Calculus	Knowing	1	A
MA23182	Advanced Mathematics	M7	10	Geometry	Applying	1	D
MA23170	Advanced Mathematics	M7	11	Geometry	Applying	1	See scoring guide

Item ID **MA13001**

Advanced Mathematics

Block\_Sequence **M1\_01****TIMSSAdvanced  
2008****Content Domain**

Algebra

**Cognitive Domain**

Knowing

**Maximum Points**

1

**Key**

D

The functions  $f$  and  $g$  are defined by  $f(x)=x-1$  and  $g(x)=(x+3)^2$ .

$g(f(x))$  is equal to

- (A)  $(x-1)(x+3)^2$
- (B)  $(x+3)^2-1$
- (C)  $(2x-2)^2$
- (D)  $(x+2)^2$
- (E)  $x^2+8$

MA13001



Item ID **MA13002**

Advanced Mathematics

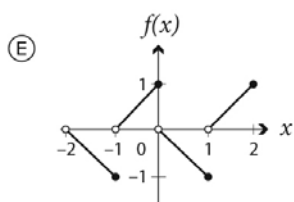
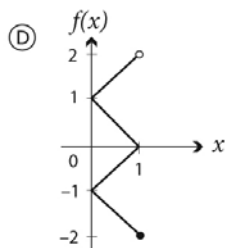
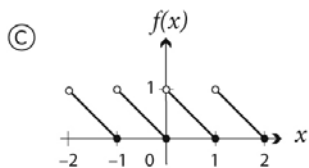
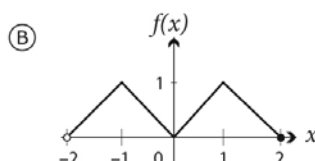
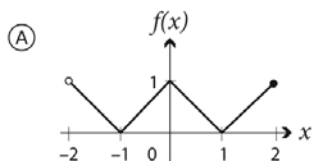
Block\_Sequence **M1\_02**A function  $f$  is defined by:

$$f(x) = -x - 1 \quad \text{if} \quad -2 < x \leq -1$$

$$f(x) = x + 1 \quad \text{if} \quad -1 < x \leq 0$$

$$f(x) = -x + 1 \quad \text{if} \quad 0 < x \leq 1$$

$$f(x) = x - 1 \quad \text{if} \quad 1 < x \leq 2$$

Which is the graph of  $f$ ?

MA13002

**TIMSS Advanced  
2008****Content Domain**

Algebra

**Cognitive Domain**

Reasoning

**Maximum Points**

1

**Key**

A

Item ID **MA13003**

Advanced Mathematics

Block\_Sequence **M1\_03**

Two mathematical models are proposed to predict the return  $y$ , in dollars, from the sale of  $x$  thousand units of an article (where  $0 < x < 5$ ). Each of these models, P and Q, is based on different marketing methods.

$$\begin{array}{ll} \text{model P:} & y = 6x - x^2 \\ \text{model Q:} & y = 2x \end{array}$$

For what values of  $x$  does model Q predict a greater return than model P?

- (A)  $0 < x < 4$
- (B)  $0 < x < 5$
- (C)  $3 < x < 5$
- (D)  $3 < x < 4$
- (E)  $4 < x < 5$

MA13003

## TIMSS Advanced 2008

### Content Domain

Algebra

### Cognitive Domain

Reasoning

### Maximum Points

1

### Key

E





Item ID **MA13004**

Advanced Mathematics

Block\_Sequence **M1\_04**

$\lim_{x \rightarrow +\infty} \frac{(2x+1)(x+1)}{3x^2-2}$  is equal to

- (A)  $-\frac{1}{2}$
- (B)  $\frac{2}{3}$
- (C) 1
- (D) 6
- (E)  $\infty$

MA13004

**TIMSSAdvanced  
2008****Content Domain**

Calculus

**Cognitive Domain**

Knowing

**Maximum Points**

1

**Key**

B



Item ID **MA13006**

Advanced Mathematics

Block\_Sequence **M1\_06****TIMSSAdvanced  
2008****Content Domain**

Calculus

**Cognitive Domain**

Knowing

**Maximum Points**

1

**Key**

D

The derivative with respect to  $x$  of  $\frac{4}{\sqrt{3x-4}}$  is

(A)  $12\sqrt{3x-4}$

(B)  $\frac{4}{\sqrt{3}}$

(C)  $\frac{-2}{(3x-4)^{\frac{3}{2}}}$

(D)  $\frac{-6}{(3x-4)^{\frac{3}{2}}}$

(E)  $6\sqrt{3x-4}$

MA13006



Item ID **MA13007**

Advanced Mathematics

Block\_Sequence **M1\_07**

One side of an equilateral triangle lies along the  $x$ -axis. The sum of the slopes of the three sides is

- (A) 0
- (B) -1
- (C) 1
- (D)  $2\sqrt{3}$
- (E)  $1+2\sqrt{3}$

MA13007

**TIMSSAdvanced  
2008****Content Domain**

Geometry

**Cognitive Domain**

Applying

**Maximum Points**

1

**Key**

A



Item ID **MA13008**

Advanced Mathematics

Block\_Sequence **M1\_08**

Triangle  $PQR$  is an isosceles right triangle with a right angle at  $P$ . If  $PT$  is a median of the triangle, then  $PT$  has the same length as

- (A)  $PR$
- (B)  $PQ$
- (C)  $QR$
- (D)  $QT$

MA13008

**TIMSS Advanced  
2008****Content Domain**

Geometry

**Cognitive Domain**

Reasoning

**Maximum Points**

1

**Key**

D



Item ID **MA13009**

Advanced Mathematics

Block\_Sequence **M1\_09**

How many points with integer coordinates are there on the graph of the function  $y = \frac{12}{x}, x > 0$ ?

- (A) 2
- (B) 4
- (C) 6
- (D) infinitely many

MA13009

**TIMSSAdvanced  
2008****Content Domain**

Algebra

**Cognitive Domain**

Applying

**Maximum Points**

1

**Key**

C

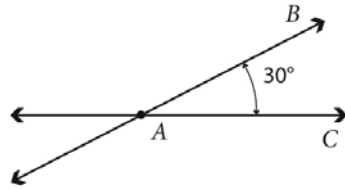


Item ID **MA13021**

Advanced Mathematics

Block\_Sequence **M3\_01**

As line  $AB$  rotates about line  $AC$  in space, keeping an angle of  $30^\circ$ , what figure is traced out by the line  $AB$ ?



- (A) a cone
- (B) a cylinder
- (C) a spiral
- (D) a circle
- (E) a sphere

MA13021

**TIMSSAdvanced  
2008****Content Domain**

Geometry

**Cognitive Domain**

Knowing

**Maximum Points**

1

**Key**

A

Item ID **MA13024**

Advanced Mathematics

Block\_Sequence **M3\_04**

$\int_1^2 \left( x - \frac{1}{x^2} \right) dx$  is equal to

(A)  $-3\frac{1}{8}$

(B) 1

(C)  $2\frac{5}{8}$

(D) 4

(E)  $4\frac{1}{2}$

MA13024

**TIMSS Advanced  
2008****Content Domain**

Calculus

**Cognitive Domain**

Knowing

**Maximum Points**

1

**Key**

B

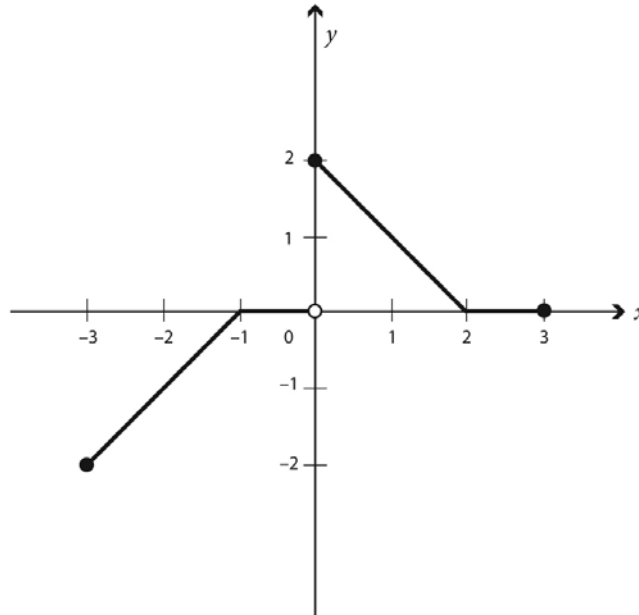


Item ID **MA13025A**

Advanced Mathematics

Block\_Sequence **M3\_05**

The function  $y = f(x)$ ,  $-3 \leq x \leq 3$ , is defined in the following graph



- A. For what value(s) of  $x$  in the interval  $-3 < x < 3$  is the function  $f$  NOT continuous?
- B. For what value(s) of  $x$  in the interval  $-3 < x < 3$  is the function  $f$  NOT differentiable?

**TIMSSAdvanced  
2008****Content Domain**

Calculus

**Cognitive Domain**

Knowing

**Maximum Points**

1

**Key**

See scoring guide

MA13025



Item ID **MA13025A**

Advanced Mathematics

Block\_Sequence **M3\_05**

Code	Response	Item: MA13025A
	<b>Correct Response</b>	
10	Correct answer: Only for $x = 0$ . Accept answers such as “in points (0, 0) and (0, 2)” as correct.	
	<b>Incorrect Response</b>	
79	<p>Incorrect (including crossed out, erased, stray marks, illegible, or off task)</p> <p><i>Examples:</i></p> <p>1. Any of the following answers:</p> <p>For <math>x = -1</math> OR For <math>x = 2</math> OR For <math>x = -1</math> and <math>x = 2</math></p> <p>2. For all values of <math>x</math> in the interval <math>0 \leq x \leq 2</math></p> <p><b>Note:</b> Use this code for all answers “interval with endpoints 0 and 2” no matter whether the interval is open or closed.</p> <p>3. For <u>no</u> values of <math>x</math>, that is, the function is continuous for all <math>x</math> in the interval <math>-3 &lt; x &lt; 3</math> (“Continuous” may be confused with “defined.”)</p> <p>4. <math>x</math> in <math>(-3, -1) \cup (0, 2)</math> OR <math>x</math> in <math>(-1, 0) \cup (2, 3)</math></p>	
	<b>Nonresponse</b>	
99	Blank	

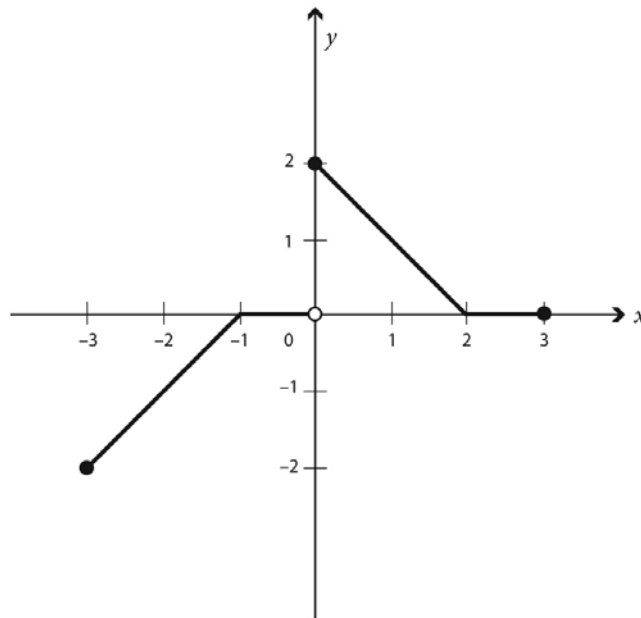
Code	Response	Item: MA13025B
	<b>Correct Response</b>	
10	<p>Correct answer: for <math>x = -1</math> and for <math>x = 0</math> and for <math>x = 2</math></p> <p><b>Note:</b> Accept answers that also include <math>x = -3</math> and/or <math>x = 3</math>. Accept answers shown as points in the plane instead of values of <math>x</math> (e.g., language such as “point <math>(-1, 0)</math>” instead of <math>x = -1</math>).</p>	
	<b>Incorrect Response</b>	
70	For $x = 0$	
71	<p>Any of the following answers:</p> <p>For <math>x = -1</math> OR For <math>x = 2</math> OR For <math>x = -1</math> and for <math>x = 2</math></p>	
72	For all values of $x$ in the interval $-1 \leq x \leq 0$ and $2 \leq x \leq 3$ (Misconception: “where $f$ is flat, it has no derivative.”)	
79	<p>Other incorrect (including crossed out, erased, stray marks, illegible, or off task)</p> <p><i>Examples:</i></p> <p>1. For <u>NO</u> values of <math>x</math> (i.e., the function is differentiable for all <math>x</math> in the interval <math>-3 &lt; x &lt; 3</math>)</p> <p>2. For <u>ALL</u> values of <math>x</math> in the interval <math>-3 &lt; x &lt; 3</math> (i.e., the function is nondifferentiable for every value of <math>x</math>).</p> <p>3. For <u>ALL</u> values of <math>x</math> in the interval <math>-1 \leq x \leq 0</math> or in the interval <math>2 \leq x \leq 3</math></p> <p>4. The question cannot be answered because we do not know the function <math>f'</math> or any similar expression.</p>	
	<b>Nonresponse</b>	
99	Blank	

Item ID **MA13025B**

Advanced Mathematics

Block\_Sequence **M3\_05**

The function  $y = f(x)$ ,  $-3 \leq x \leq 3$ , is defined in the following graph



- A. For what value(s) of  $x$  in the interval  $-3 < x < 3$  is the function  $f$  NOT continuous?
- B. For what value(s) of  $x$  in the interval  $-3 < x < 3$  is the function  $f$  NOT differentiable?

**TIMSSAdvanced  
2008****Content Domain**

Calculus

**Cognitive Domain**

Knowing

**Maximum Points**

1

**Key**

See scoring guide

MA13025

Item ID **MA13025B**

Advanced Mathematics

Block\_Sequence **M3\_05**

Code	Response	Item: MA13025A
	<b>Correct Response</b>	
10	Correct answer: Only for $x = 0$ . Accept answers such as “in points (0, 0) and (0, 2)” as correct.	
	<b>Incorrect Response</b>	
79	Incorrect (including crossed out, erased, stray marks, illegible, or off task) <i>Examples:</i> 1. Any of the following answers: For $x = -1$ OR For $x = 2$ OR For $x = -1$ and $x = 2$ 2. For all values of $x$ in the interval $0 \leq x \leq 2$ <b>Note:</b> Use this code for all answers “interval with endpoints 0 and 2” no matter whether the interval is open or closed. 3. For <u>no</u> values of $x$ , that is, the function is continuous for all $x$ in the interval $-3 < x < 3$ (“Continuous” may be confused with “defined.”) 4. $x$ in $(-3, -1) \cup (0, 2)$ OR $x$ in $(-1, 0) \cup (2, 3)$	
	<b>Nonresponse</b>	
99	Blank	

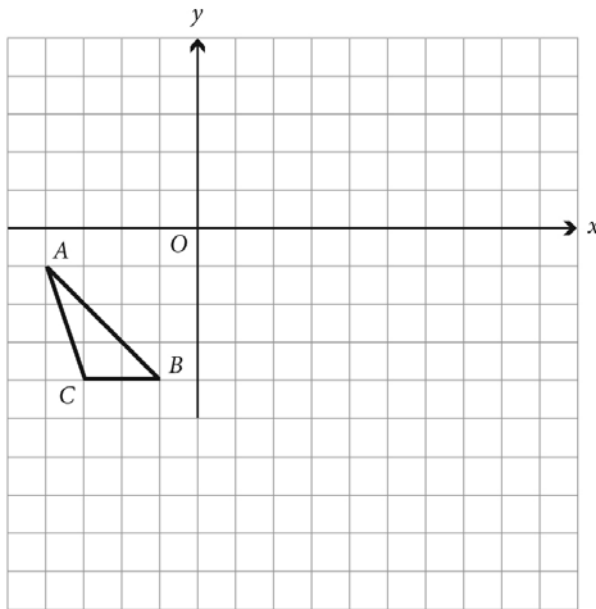
Code	Response	Item: MA13025B
	<b>Correct Response</b>	
10	Correct answer: for $x = -1$ and for $x = 0$ and for $x = 2$ <b>Note:</b> Accept answers that also include $x = -3$ and/or $x = 3$ . Accept answers shown as points in the plane instead of values of $x$ (e.g., language such as “point $(-1, 0)$ ” instead of $x = -1$ ).	
	<b>Incorrect Response</b>	
70	For $x = 0$	
71	Any of the following answers: For $x = -1$ OR For $x = 2$ OR For $x = -1$ and for $x = 2$	
72	For all values of $x$ in the interval $-1 \leq x \leq 0$ and $2 \leq x \leq 3$ (Misconception: “where $f$ is flat, it has no derivative.”)	
79	Other incorrect (including crossed out, erased, stray marks, illegible, or off task) <i>Examples:</i> 1. For <u>NO</u> values of $x$ (i.e., the function is differentiable for all $x$ in the interval $-3 < x < 3$ ) 2. For <u>ALL</u> values of $x$ in the interval $-3 < x < 3$ (i.e., the function is nondifferentiable for every value of $x$ ). 3. For <u>ALL</u> values of $x$ in the interval $-1 \leq x \leq 0$ or in the interval $2 \leq x \leq 3$ 4. The question cannot be answered because we do not know the function $f'$ or any similar expression.	
	<b>Nonresponse</b>	
99	Blank	

Item ID **MA13026A**

Advanced Mathematics

Block\_Sequence **M3\_06**

- A. Triangle  $ABC$  is reflected in the  $y$ -axis. On the diagram, draw and label triangle  $A'B'C'$ , the image of triangle  $ABC$  under this reflection.
- B. Triangle  $ABC$  is rotated through  $90^\circ$  anti-clockwise, centre  $O$ . On the diagram, draw and label triangle  $A''B''C''$ , the image of triangle  $ABC$  under this rotation.

**TIMSSAdvanced  
2008****Content Domain**

Geometry

**Cognitive Domain**

Applying

**Maximum Points**

1

**Key**

See scoring guide

MA13026



Item ID **MA13026A**

Advanced Mathematics

Block\_Sequence **M3\_06**

Code	Response	Item: MA13026A
	<b>Correct Response</b>	
10	Correct answer: $(x, y) \rightarrow (-x, y) \frac{1}{2}$ $A'(4, -1)$ $B'(1, -4)$ $C'(3, -4)$	
	<b>Incorrect Response</b>	
70	$A'B'C'$ is the image of triangle $ABC$ under reflection in the $x$ -axis. $A'(-4, 1)$ $B'(-1, 4)$ $C'(-3, 4)$	
71	Image $A'B'C'$ has correct shape and position but is incorrectly labeled	
79	Other incorrect (including sides of a triangle not drawn or vertices not labeled, crossed out, erased, stray marks, illegible, or off task) <i>Example:</i> $A'B'C'$ is the image of triangle $ABC$ under the central symmetry with center $O$ , the origin. $A'(4, 1)$ $B'(1, 4)$ $C'(3, 4)$	
	<b>Nonresponse</b>	
99	Blank	

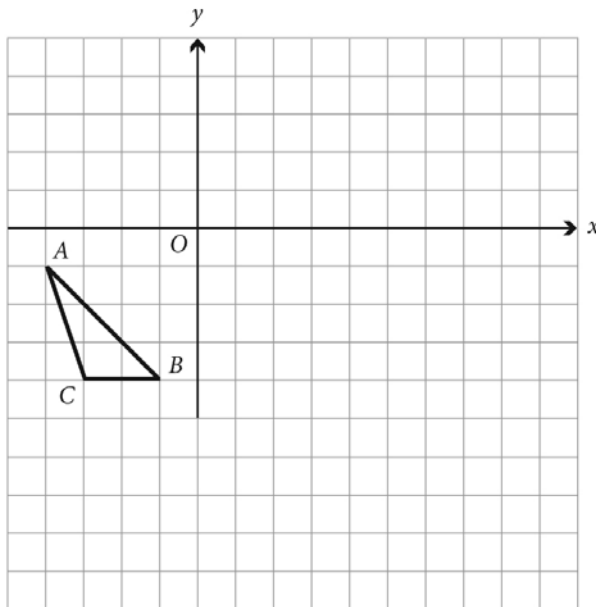
Code	Response	Item: MA13026B
	<b>Correct Response</b>	
10	Correct answer: $(x, y) \rightarrow (-y, x)$ $A''(1, -4)$ $B''(4, -1)$ $C''(4, -3)$	
	<b>Incorrect Response</b>	
70	$A''B''C''$ is the correct image of triangle $A'B'C'$ (NOT $ABC$ ), as shown in response to Part A, under the rotation $90^\circ$ counterclockwise with center $O$ .	
71	$A''B''C''$ is the image of triangle $ABC$ under a clockwise $90^\circ$ rotation with center $O$ . $A''(-1, 4)$ $B''(-4, 1)$ $C''(-4, 3)$	
72	Image $A''B''C''$ has correct shape and position but is incorrectly labeled	
79	Other incorrect (including sides of a triangle not drawn or vertices not labeled, crossed out, erased, stray marks, illegible, or off task) <i>Examples:</i> 1. $A''B''C''$ is the image of triangle $ABC$ under reflection in the $x$ -axis. $A''(-4, 1)$ $B''(-1, 4)$ $C''(-3, 4)$ 2. $A''B''C''$ is the image of triangle $ABC$ under the central symmetry with center $O$ ; OR, equivalently, under the rotation of $180^\circ$ around $O$ . $A''(4, 1)$ $B''(1, 4)$ $C''(3, 4)$	
	<b>Nonresponse</b>	
99	Blank	

Item ID **MA13026B**

Advanced Mathematics

Block\_Sequence **M3\_06**

- A. Triangle  $ABC$  is reflected in the  $y$ -axis. On the diagram, draw and label triangle  $A'B'C'$ , the image of triangle  $ABC$  under this reflection.
- B. Triangle  $ABC$  is rotated through  $90^\circ$  anti-clockwise, centre  $O$ . On the diagram, draw and label triangle  $A''B''C''$ , the image of triangle  $ABC$  under this rotation.

**TIMSSAdvanced  
2008****Content Domain**

Geometry

**Cognitive Domain**

Applying

**Maximum Points**

1

**Key**

See scoring guide

MA13026



Item ID **MA13026B**

Advanced Mathematics

Block\_Sequence **M3\_06**

Code	Response	Item: MA13026A
	<b>Correct Response</b>	
10	Correct answer: $(x, y) \rightarrow (-x, y) \frac{1}{2}$ $A'(4, -1)$ $B'(1, -4)$ $C'(3, -4)$	
	<b>Incorrect Response</b>	
70	$A'B'C'$ is the image of triangle $ABC$ under reflection in the $x$ -axis. $A'(-4, 1)$ $B'(-1, 4)$ $C'(-3, 4)$	
71	Image $A'B'C'$ has correct shape and position but is incorrectly labeled	
79	Other incorrect (including sides of a triangle not drawn or vertices not labeled, crossed out, erased, stray marks, illegible, or off task) <i>Example:</i> $A'B'C'$ is the image of triangle $ABC$ under the central symmetry with center $O$ , the origin. $A'(4, 1)$ $B'(1, 4)$ $C'(3, 4)$	
	<b>Nonresponse</b>	
99	Blank	

Code	Response	Item: MA13026B
	<b>Correct Response</b>	
10	Correct answer: $(x, y) \rightarrow (-y, x)$ $A''(1, -4)$ $B''(4, -1)$ $C''(4, -3)$	
	<b>Incorrect Response</b>	
70	$A''B''C''$ is the correct image of triangle $A'B'C'$ (NOT $ABC$ ), as shown in response to Part A, under the rotation $90^\circ$ counterclockwise with center $O$ .	
71	$A''B''C''$ is the image of triangle $ABC$ under a clockwise $90^\circ$ rotation with center $O$ . $A''(-1, 4)$ $B''(-4, 1)$ $C''(-4, 3)$	
72	Image $A''B''C''$ has correct shape and position but is incorrectly labeled	
79	Other incorrect (including sides of a triangle not drawn or vertices not labeled, crossed out, erased, stray marks, illegible, or off task) <i>Examples:</i> 1. $A''B''C''$ is the image of triangle $ABC$ under reflection in the $x$ -axis. $A''(-4, 1)$ $B''(-1, 4)$ $C''(-3, 4)$ 2. $A''B''C''$ is the image of triangle $ABC$ under the central symmetry with center $O$ ; OR, equivalently, under the rotation of $180^\circ$ around $O$ . $A''(4, 1)$ $B''(1, 4)$ $C''(3, 4)$	
	<b>Nonresponse</b>	
99	Blank	

Item ID **MA13027**

Advanced Mathematics

Block\_Sequence **M3\_07****TIMSS Advanced  
2008****Content Domain**

Algebra

**Cognitive Domain**

Reasoning

**Maximum Points**

2

**Key**

See scoring guide

A regular polygon of  $n$  sides is inscribed in a circle of radius 1.

What is the value of the limit of the perimeter of the polygon as the number of sides  $n$  increases to infinity?

MA13027





Item ID <b>MA13027</b>		Advanced Mathematics	Block_Sequence <b>M3_07</b>
Code	Response	Item: MA13027	
	Correct Response		
20	Any of 2 pi, $2\pi$ , 6.28, 6.3, or $2\pi = 6.28$		
	Partially Correct Response		
10	$\lim_{n \rightarrow \infty} 2n \sin \frac{\pi}{n}$ <b>Note:</b> Accept also $\lim_{n \rightarrow \infty} 2n \sin \frac{180}{n}$		
11	2 pi r or $2\pi r$ or makes a statement such as “The value of the limit is equal to the circumference of the circle.”		
	Incorrect Response		
70	$\pi$ or pi or 3.14		
71	$\infty$ or “infinity” or “the limit does not exist” or equivalent statement		
79	Other incorrect (including crossed out, erased, stray marks, illegible, or off task) <i>Examples:</i>  1. $\lim_{n \rightarrow \infty} 2n \sin \frac{2\pi}{n}$ or $\lim_{n \rightarrow \infty} 2n \cos \frac{\pi}{n}$ or similar formula containing error  2. 1  3. “Almost a circle” or similar answers in words, not numerical values, stating that the shape of the polygon will become very close to that of a circle.		
	Nonresponse		
99	Blank		

Item ID **MA13028**

Advanced Mathematics

Block\_Sequence **M3\_08****TIMSS Advanced  
2008****Content Domain**

Algebra

**Cognitive Domain**

Knowing

**Maximum Points**

1

**Key**

See scoring guide

For every natural number  $n$ ,  $1^2 + 3^2 + \dots + (2n-1)^2 = \frac{n(4n^2-1)}{3}$

To prove this by MATHEMATICAL INDUCTION, what are the essential steps that will need to be carried out? (Do not do the actual proof.)

MA13028



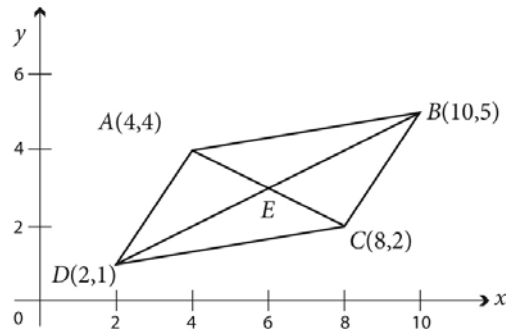
Item ID <b>MA13028</b>		Advanced Mathematics	Block_Sequence <b>M3_08</b>
Code	Response	Item: MA13028	
	Correct Response		
10	Correct description of the two steps involved in the proof (i.e., verbal or symbolic statements) equivalent to: Step 1: Prove that the statement is true for $n = 1$ . Step 2: Prove if the statement is true for any natural number $n = k$ , then it also is true for $n = k + 1$ .		
	Incorrect Response		
70	<u>Describes</u> Step 2 correctly but omits Step 1 or describes it incorrectly (e.g., “prove for $n = 0$ ”, or “we must prove it for some small number”)		
71	Gives correct proof of statement by induction with or without general statement of the induction method, or <u>performs</u> Step 2 correctly but omits Step 1, or describes Step 1 incorrectly		
72	<u>Describes</u> Step 2: Prove that if the statement is true for any natural number $n = k$ , where $k$ is greater than 1, then it also is true for $n = k - 1$ with an appropriate Step 1.		
79	Other incorrect (including crossed out, erased, stray marks, illegible, or off task)		
	Nonresponse		
99	Blank		

Item ID **MA13029**

Advanced Mathematics

Block\_Sequence **M3\_09**

In the quadrilateral  $ABCD$  below, diagonals  $AC$  and  $BD$  intersect at point  $E$ .  
 PROVE that  $E$  is the midpoint of  $AC$  and  $BD$ . Show all your work.

**TIMSSAdvanced  
2008****Content Domain**

Geometry

**Cognitive Domain**

Reasoning

**Maximum Points**

2

**Key**

See scoring guide

MA13029

Item ID <b>MA13029</b>		Advanced Mathematics	Block_Sequence <b>M3_09</b>
Code	Response	Item: MA13029	
	Correct Response		
20	Any completely correct proof (e.g., showing diagonals have the same midpoint; proving that $ABCD$ is a parallelogram and hence diagonals have the same midpoint; proving that $ABCD$ is a parallelogram and hence diagonals bisect each other).		
	Partially Correct Response		
10	Method that is partially completed (e.g., shows that point $E(6, 3)$ is midpoint of only $AC$ or $BD$ ; or correct proof with step missing or one or two reasons incorrect or missing)		
	Incorrect Response		
79	Incorrect (including crossed out, erased, stray marks, illegible, or off task) <i>Example:</i> <i>States that “From the diagram, it is obvious that <math>ABCD</math> is a parallelogram, and hence its diagonals must bisect each other” or an equivalent statement</i>		
	Nonresponse		
99	Blank		

Item ID **MA23069**

Advanced Mathematics

Block\_Sequence **M6\_01****TIMSSAdvanced  
2008****Content Domain**

Algebra

**Cognitive Domain**

Applying

**Maximum Points**

1

**Key**

D

An infinite geometric series has the first term 3 and the third term  $\frac{1}{3}$ . All the terms of the series are positive. What is the sum of the series?

- (A)  $\frac{27}{8}$
- (B)  $\frac{10}{3}$
- (C)  $\frac{9}{4}$
- (D)  $\frac{9}{2}$

MA23069



Item ID **MA23135**

Advanced Mathematics

Block\_Sequence **M6\_02**

MA23135

$$\frac{x+1}{x-2} > 1$$

For which values of  $x$  is the inequality shown above satisfied?

Answer: \_\_\_\_\_

**TIMSS Advanced  
2008****Content Domain**

Algebra

**Cognitive Domain**

Applying

**Maximum Points**

1

**Key**

See scoring guide



Item ID	<b>MA23135</b>	Advanced Mathematics	Block_Sequence <b>M6_02</b>
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Code	Response	Item: MA23135
	<b>Correct Response</b>	
<b>10</b>	$x > 2$	
	<b>Incorrect Response</b>	
<b>79</b>	Incorrect (including crossed out, erased, stray marks, illegible, or off task)	
	<b>Nonresponse</b>	
<b>99</b>	Blank	

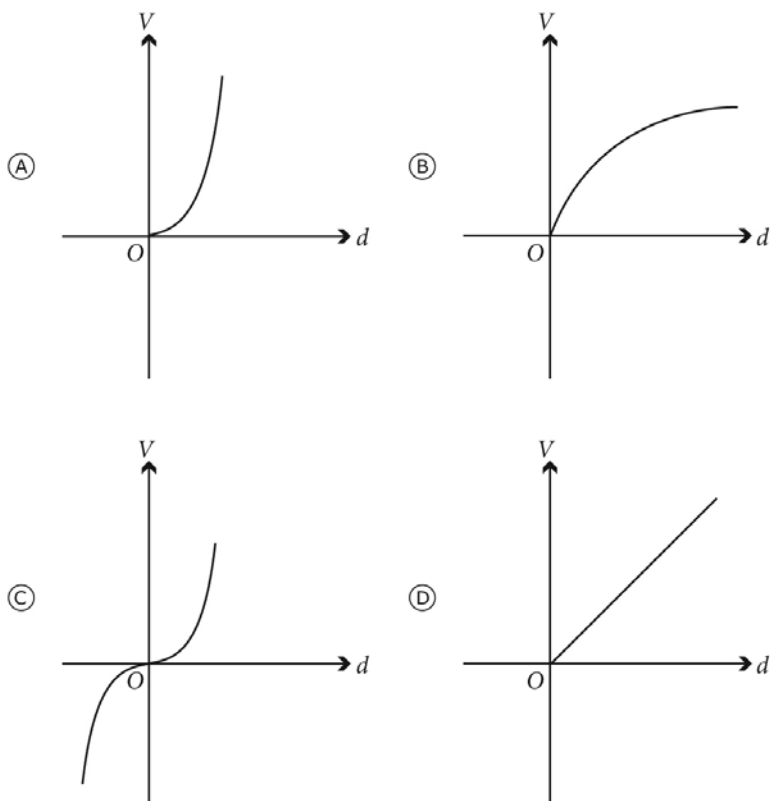


Item ID **MA23208**

Advanced Mathematics

Block\_Sequence **M6\_03**

A spherical balloon is blown up. Which graph shows the volume  $V$  as a function of the diameter  $d$ ?



MA23208

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**TIMSSAdvanced  
2008**

**Content Domain**

Algebra

**Cognitive Domain**

Reasoning

**Maximum Points**

1

**Key**

A



**TIMSS & PIRLS**  
International Study Center  
Lynch School of Education, Boston College

Item ID **MA23165**

Advanced Mathematics

Block\_Sequence **M6\_04**

Determine  $\lim_{x \rightarrow 1} \frac{x^2 + x - 2}{x^2 - 1}$ .

Show your work.

MA23165

**TIMSS Advanced  
2008****Content Domain**

Calculus

**Cognitive Domain**

Applying

**Maximum Points**

1

**Key**

See scoring guide



Item ID **MA23165**

Advanced Mathematics

Block\_Sequence **M6\_04**

Code	Response	Item: MA23165
	<b>Correct Response</b>	
<b>10</b>	$\frac{3}{2}$ or equivalent; by algebraic manipulations <i>Examples:</i> $1) \lim_{x \rightarrow 1} \frac{x^2 + x - 2}{x^2 - 1} = \lim_{x \rightarrow 1} \frac{(x+2)(x-1)}{(x+1)(x-1)} = \lim_{x \rightarrow 1} \frac{x+2}{x+1} = \frac{3}{2}$ $2) \text{ Let } x = h + 1, \text{ then } \lim_{h \rightarrow 0} \frac{(h+3)}{(h+2)} = \frac{3}{2}$	
<b>11</b>	$\frac{3}{2}$ or equivalent; numerical approximation; substitution of value of $x$ close to 1 <i>Example:</i> $\text{Let } x = 1.001$ $\frac{x^2 + x - 2}{x^2 - 1} = \frac{1.00201 + 1.001 - 2}{1.00201 - 1} = \frac{0.003}{0.002}$ <i>Limit is 3/2</i>	
<b>12</b>	1.5 using a graphing or symbolic calculator	
	<b>Incorrect Response</b>	
<b>70</b>	Calculator used—answer incorrect or explanation inadequate	
<b>71</b>	$\frac{3}{2}$ or equivalent; no method or wrong method given	
<b>79</b>	Other incorrect (including crossed out, erased, stray marks, illegible, or off task)	
	<b>Nonresponse</b>	
<b>99</b>	Blank	

Item ID **MA23039**

Advanced Mathematics

Block\_Sequence **M6\_05****TIMSSAdvanced  
2008****Content Domain**

Calculus

**Cognitive Domain**

Knowing

**Maximum Points**

1

**Key**

D

$$f(x) = e^{\cos x}$$

What is  $f'(x)$ ?

- (A)  $e^{\cos x}$   
(B)  $e^{-\sin x}$   
(C)  $e^{\cos x} \cdot \sin x$   
(D)  $-e^{\cos x} \cdot \sin x$

MA23039



Item ID **MA23159**

Advanced Mathematics

Block\_Sequence **M6\_06**

MA23159

Find  $f'(x)$ , when  $f(x) = \frac{3x+2}{x-1}$ .

Show your work.

**TIMSS Advanced  
2008****Content Domain**

Calculus

**Cognitive Domain**

Knowing

**Maximum Points**

1

**Key**

See scoring guide



Item ID **MA23159**

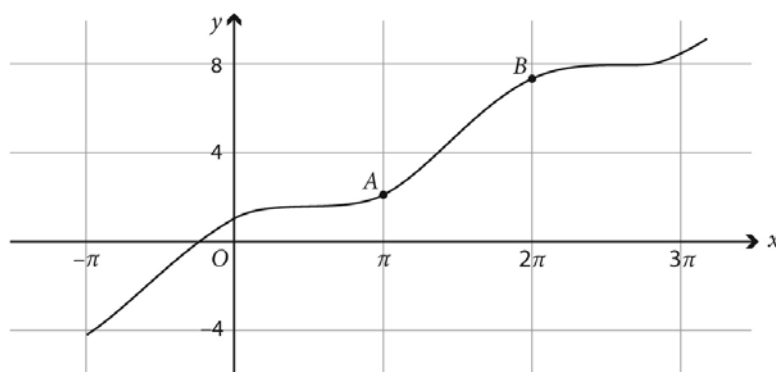
Advanced Mathematics

Block\_Sequence **M6\_06**

Code	Response	Item: MA23159
	<b>Correct Response</b>	
<b>10</b>	Using quotient rule $\left(\frac{u}{v}\right)' = \frac{(u'v - uv')}{v^2}$ or, product rule $(uv)' = u'v + uv'$ , obtains  $f'(x) = \frac{-5}{(x-1)^2}$	
<b>11</b>	Correct expression using calculator	
	<b>Incorrect Response</b>	
<b>70</b>	Calculator used—answer incorrect or explanation inadequate	
<b>71</b>	Correct answer but no method shown	
<b>72</b>	Using quotient rule but not completing with correct answer	
<b>73</b>	Using product rule but not completing with correct answer	
<b>79</b>	Other incorrect (including crossed out, erased, stray marks, illegible, or off task)	
	<b>Nonresponse</b>	
<b>99</b>	Blank	

Item ID **MA23198**

Advanced Mathematics

Block\_Sequence **M6\_07**

Sophia is studying the graph of the function  $y = x + \cos x$  shown above. She says that the slope at point  $A$  is the same as the slope at point  $B$ . Explain why she is correct.

MA23198

**TIMSS Advanced 2008****Content Domain**

Calculus

**Cognitive Domain**

Reasoning

**Maximum Points**

1

**Key**

See scoring guide

Item ID	<b>MA23198</b>	Advanced Mathematics	Block_Sequence <b>M6_07</b>
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Code	Response	Item: MA23198
	<b>Correct Response</b>	
10	Explanation involving differentiating and showing the gradient is the same at $x = \pi$ and $x = 2\pi$ ; or using the nature of the cosine function to establish that the gradient is the same at $x = \pi$ and $x = 2\pi$	
11	Correct answer using calculator with adequate explanation	
	<b>Incorrect Response</b>	
70	Calculator used—answer incorrect or explanation inadequate	
71	Differentiates correctly but does not give adequate explanation of why slopes are equal	
79	Other incorrect (including crossed out, erased, stray marks, illegible, or off task)	
	<b>Nonresponse</b>	
99	Blank	



Item ID **MA23042**

Advanced Mathematics

Block\_Sequence **M6\_08**

MA23042

What is  $\int \frac{x^2+2}{x} dx$ ? ( $x > 0$ )

- Ⓐ  $\frac{1}{2}x^2 - \frac{2}{x^2} + C$
- Ⓑ  $\frac{1}{2}x^2 + 2 \ln x + C$
- Ⓒ  $\frac{1}{2}x^2 + \ln 2x + C$
- Ⓓ  $\frac{4}{3}x^3 + 4x^3 + C$

**TIMSS Advanced  
2008****Content Domain**

Calculus

**Cognitive Domain**

Knowing

**Maximum Points**

1

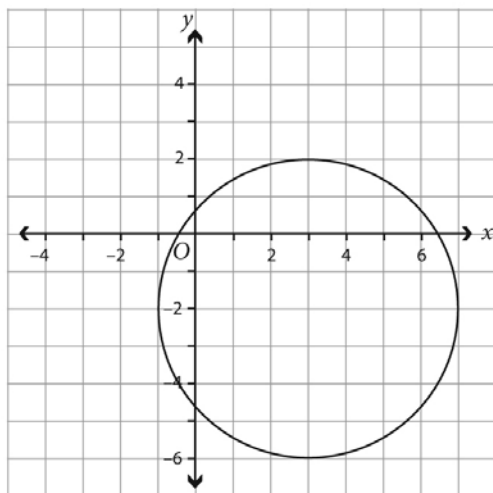
**Key**

B



Item ID **MA23055**

Advanced Mathematics

Block\_Sequence **M6\_09**

What is the equation of the circle shown above?

- Ⓐ  $x^2 + y^2 - 6x + 4y - 9 = 0$   
 Ⓑ  $x^2 + y^2 + 6x - 4y + 9 = 0$   
 Ⓒ  $x^2 + y^2 + 6x - 4y - 3 = 0$   
 Ⓓ  $x^2 + y^2 - 6x + 4y - 3 = 0$

MA23055

## TIMSS Advanced 2008

### Content Domain

Geometry

### Cognitive Domain

Knowing

### Maximum Points

1

### Key

D

Item ID **MA23080**

Advanced Mathematics

Block\_Sequence **M6\_10**

How many solutions does the equation  $\sin x + \cos x = 2$  have in the interval  $0$  to  $8\pi$ ?

- (A) 0
- (B) 2
- (C) 4
- (D) 8

MA23080

**TIMSSAdvanced  
2008****Content Domain**

Geometry

**Cognitive Domain**

Reasoning

**Maximum Points**

1

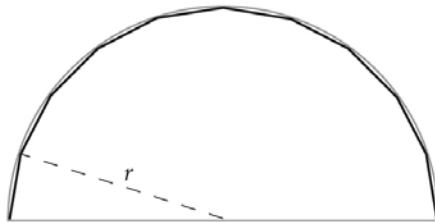
**Key**

A



Item ID **MA23021**

Advanced Mathematics

Block\_Sequence **M6\_11**

The figure shows a semicircular room seen from above. An architect is placing 10 flat windows in the room as shown. If the radius of the circle is  $r$ , which of the following equations would allow the architect to determine the width of each window?

- (A)  $w = r \sin 9^\circ$
- (B)  $w = 2r \sin 9^\circ$
- (C)  $w = r \cos 18^\circ$
- (D)  $w = 2r \sin 18^\circ$

MA23021

**TIMSS Advanced  
2008****Content Domain**

Geometry

**Cognitive Domain**

Applying

**Maximum Points**

1

**Key**

B

Item ID **MA23004**

Advanced Mathematics

Block\_Sequence **M7\_01**

A sheet of paper 0.01 cm thick is cut in two, and one piece is placed on top of the other. The two sheets of paper are then cut in two and made into a pile of 4 sheets. If this process could be repeated 8 more times, how thick would the pile of papers be?

- (A) 0.2 cm
- (B) 10.24 cm
- (C) 20.48 cm
- (D) 32.0 cm

MA23004

**TIMSSAdvanced  
2008****Content Domain**

Algebra

**Cognitive Domain**

Reasoning

**Maximum Points**

1

**Key**

B



Item ID **MA23063**

Advanced Mathematics

Block\_Sequence **M7\_02****TIMSSAdvanced  
2008****Content Domain**

Algebra

**Cognitive Domain**

Applying

**Maximum Points**

1

**Key**

B

If  $x = -1 + \frac{1}{2}i$ , which of the following is equal to  $\frac{5}{x}$ ?

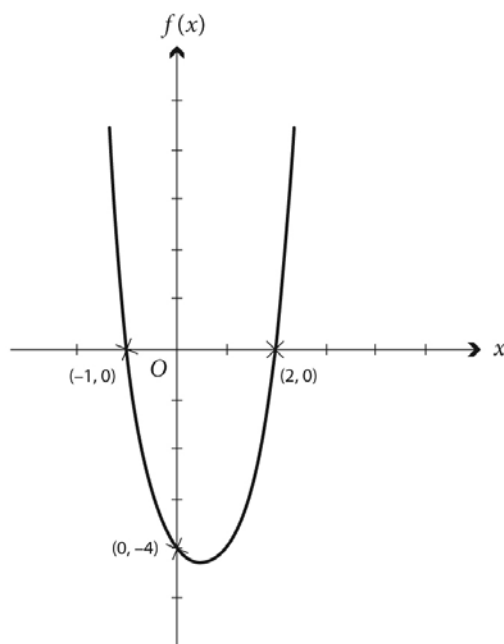
- (A)  $-5 + i$
- (B)  $-4 - 2i$
- (C)  $-4 + 2i$
- (D)  $4 + 2i$

MA23063



Item ID **MA23141**

Advanced Mathematics

Block\_Sequence **M7\_03**

The graph of the function  $f$  is shown above. The equation of the function  $f$  is given by  $f(x) = ax^2 + bx + c$ . Find the values of  $a$ ,  $b$ , and  $c$ .

Show your work.

MA23141

**TIMSS Advanced  
2008****Content Domain**

Algebra

**Cognitive Domain**

Knowing

**Maximum Points**

1

**Key**

See scoring guide

Item ID	<b>MA23141</b>	Advanced Mathematics	Block_Sequence <b>M7_03</b>
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Code	Response	Item: MA23141
	<b>Correct Response</b>	
10	All values correct: $a = 2$ , $b = -2$ , $c = -4$ , or equivalently giving the full function Method used: factorization	
11	All values correct: $a = 2$ , $b = -2$ , $c = -4$ , or equivalently giving the full function Method used: solving three simultaneous equations	
12	All values correct: $a = 2$ , $b = -2$ , $c = -4$ , or equivalently giving the full function Method used: solving three simultaneous equations by calculator	
13	All values correct: $a = 2$ , $b = -2$ , $c = -4$ , or equivalently giving the full function Method used: quadratic regression by calculator	
19	All values correct: $a = 2$ , $b = -2$ , $c = -4$ , or equivalently giving the full function Other correct method used	
	<b>Incorrect Response</b>	
70	Calculator used—answer incorrect or explanation inadequate (e.g., trial or error method)	
71	All values correct: $a = 2$ , $b = -2$ , $c = -4$ , or equivalently giving the full function. No correct method shown.	
72	$c = -4$ with values of $a$ and $b$ either missing or incorrect.	
79	Other incorrect (including crossed out, erased, stray marks, illegible, or off task)	
	<b>Nonresponse</b>	
99	Blank	



Item ID **MA23133**

Advanced Mathematics

Block\_Sequence **M7\_04**

The function  $f$  is given by  $f(x) = x^2 + 4$ . Another function  $g$  is given by  $g(u) = \sqrt{2u - 1}$ . Determine the minimum value of  $g(f(x))$ .

- (A) 0
- (B)  $\sqrt{3}$
- (C)  $\sqrt{\frac{7}{2}}$
- (D)  $\sqrt{7}$

MA23133

**TIMSS Advanced  
2008****Content Domain**

Algebra

**Cognitive Domain**

Knowing

**Maximum Points**

1

**Key**

D



Item ID **MA23158**

Advanced Mathematics

Block\_Sequence **M7\_05****TIMSSAdvanced  
2008****Content Domain**

Calculus

**Cognitive Domain**

Applying

**Maximum Points**

1

**Key**

D

A car starts braking as it approaches a road junction. After braking for  $t$  seconds, the car has traveled a distance of  $s(t)$  meters, where  $s(t) = -t^2 + 20t$ . How far does the car travel from the time the brakes are applied until it stops?

- (A) -20 m  
(B) 10 m  
(C) 50 m  
(D) 100 m

MA23158



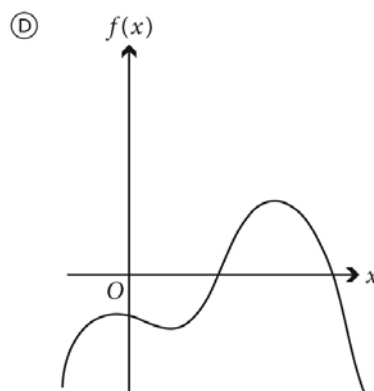
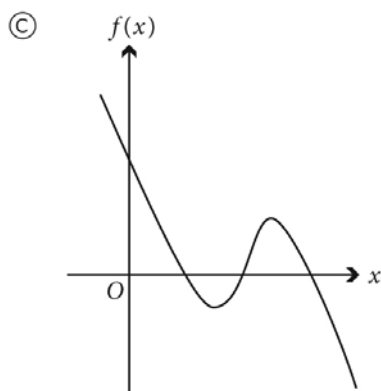
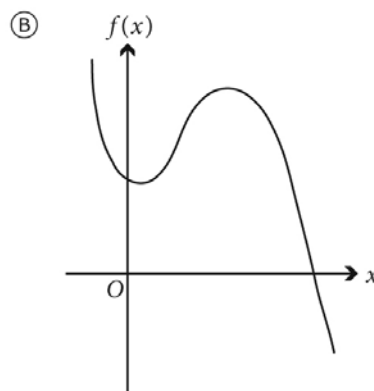
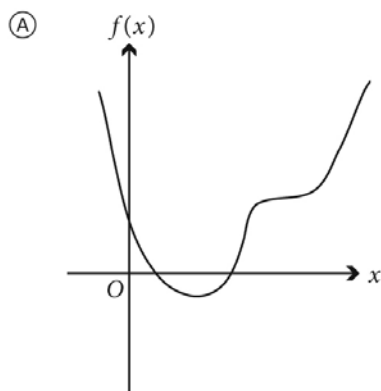
Item ID **MA23151**

Advanced Mathematics

Block\_Sequence **M7\_06**

Which one of the graphs below has all of the following properties?

$$f(-1) > 0, f(3) < 0, f'(5) = 0, f''(5) < 0$$



MA23151

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**TIMSS Advanced  
2008****Content Domain**

Calculus

**Cognitive Domain**

Reasoning

**Maximum Points**

1

**Key**

C



**TIMSS & PIRLS**  
International Study Center  
Lynch School of Education, Boston College

Item ID **MA23035A**

Advanced Mathematics

Block\_Sequence **M7\_07**

$$f(x) = x^4 - 2x^2$$

- A. What are the values of  $x$  at the points of intersection of the graph of  $f(x)$  with the  $x$ -axis?

$x =$  \_\_\_\_\_

- B. What are the maximum and minimum points of the graph of  $f(x)$ ?

Maximum point(s): \_\_\_\_\_

Minimum point(s): \_\_\_\_\_

MA23035

## TIMSS Advanced 2008

### Content Domain

Calculus

### Cognitive Domain

Applying

### Maximum Points

1

### Key

See scoring guide



Item ID	<b>MA23035A</b>	Advanced Mathematics	Block_Sequence <b>M7_07</b>
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Code	Response	Item: MA23035A
	<b>Correct Response</b>	
<b>10</b>	All three of $-\sqrt{2}$ , 0, and $\sqrt{2}$ . Accept $(-\sqrt{2}, 0)$ , $(0, 0)$ , $(\sqrt{2}, 0)$ . $\sqrt{2}$ may be given as 1.41, 1.42, or a value between these.	
	<b>Incorrect Response</b>	
<b>70</b>	Any two of $-\sqrt{2}$ , 0, and $\sqrt{2}$ , or $(-\sqrt{2}, 0)$ , $(0, 0)$ , $(\sqrt{2}, 0)$ . $\sqrt{2}$ may be given as 1.41, 1.42, or a value between these.	
<b>79</b>	Incorrect (including crossed out, erased, stray marks, illegible, or off task)	
	<b>Nonresponse</b>	
<b>99</b>	Blank	

Code	Response	Item : MA23035B
	<b>Correct Response</b>	
<b>10</b>	Maximum $(0, 0)$ , Minimum $(-1, -1)$ and $(1, -1)$	
	<b>Incorrect Response</b>	
<b>70</b>	Any two of the above correctly identified as maximum or minimum	
<b>71</b>	$x$ values only given (i.e., maximum 1, minimum $-1$ and $1$ )	
<b>79</b>	Incorrect (including crossed out, erased, stray marks, illegible, or off task)	
	<b>Nonresponse</b>	
<b>99</b>	Blank	

Item ID **MA23035B**

Advanced Mathematics

Block\_Sequence **M7\_07**

$$f(x) = x^4 - 2x^2$$

- A. What are the values of  $x$  at the points of intersection of the graph of  $f(x)$  with the  $x$ -axis?

$x =$  \_\_\_\_\_

- B. What are the maximum and minimum points of the graph of  $f(x)$ ?

Maximum point(s): \_\_\_\_\_

Minimum point(s): \_\_\_\_\_

MA23035

**TIMSS Advanced  
2008****Content Domain**

Calculus

**Cognitive Domain**

Applying

**Maximum Points**

1

**Key**

See scoring guide



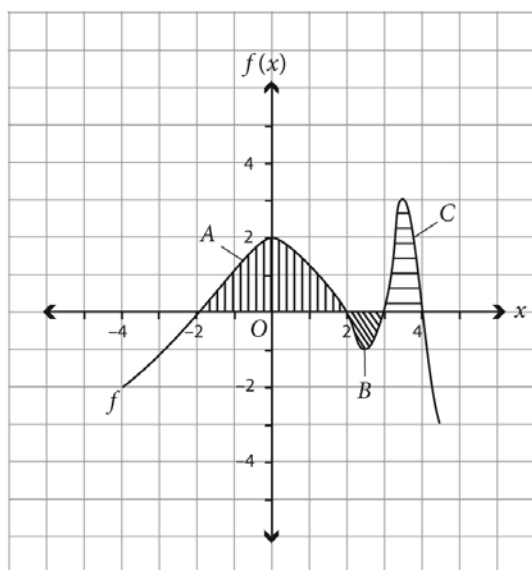
Item ID	<b>MA23035B</b>	Advanced Mathematics	Block_Sequence <b>M7_07</b>
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Code	Response	Item: MA23035A
	<b>Correct Response</b>	
10	All three of $-\sqrt{2}$ , 0, and $\sqrt{2}$ . Accept $(-\sqrt{2}, 0)$ , $(0, 0)$ , $(\sqrt{2}, 0)$ . $\sqrt{2}$ may be given as 1.41, 1.42, or a value between these.	
	<b>Incorrect Response</b>	
70	Any two of $-\sqrt{2}$ , 0, and $\sqrt{2}$ , or $(-\sqrt{2}, 0)$ , $(0, 0)$ , $(\sqrt{2}, 0)$ . $\sqrt{2}$ may be given as 1.41, 1.42, or a value between these.	
79	Incorrect (including crossed out, erased, stray marks, illegible, or off task)	
	<b>Nonresponse</b>	
99	Blank	

Code	Response	Item : MA23035B
	<b>Correct Response</b>	
10	Maximum $(0, 0)$ , Minimum $(-1, -1)$ and $(1, -1)$	
	<b>Incorrect Response</b>	
70	Any two of the above correctly identified as maximum or minimum	
71	$x$ values only given (i.e., maximum 1, minimum $-1$ and $1$ )	
79	Incorrect (including crossed out, erased, stray marks, illegible, or off task)	
	<b>Nonresponse</b>	
99	Blank	

Item ID **MA23050**

Advanced Mathematics

Block\_Sequence **M7\_08**

For the areas between the graph of  $f(x)$  and the  $x$ -axis shown above, area  $A = 4.8$  units, area  $B = 0.8$  units, and area  $C = 2$  units.

What is the value of the definite integral  $\int_{-2}^4 f(x)dx$ ?

- (A) 5.6
- (B) 6.0
- (C) 6.8
- (D) 7.6

## TIMSS Advanced 2008

### Content Domain

Calculus

### Cognitive Domain

Knowing

### Maximum Points

1

### Key

B

MA23050



Item ID **MA23041**

Advanced Mathematics

Block\_Sequence **M7\_09**What is  $\int e^{1+4x} dx$ ?

- (A)  $\frac{1}{4} e^{1+4x} + C$
- (B)  $e^{1+4x} + C$
- (C)  $4e^{1+4x} + C$
- (D)  $e^{x+2x^2} + C$

MA23041

**TIMSSAdvanced  
2008****Content Domain**

Calculus

**Cognitive Domain**

Knowing

**Maximum Points**

1

**Key**

A



Item ID **MA23182**

Advanced Mathematics

Block\_Sequence **M7\_10**

$$\sin 2x = \frac{1}{2}$$

What are the possible values for  $x$  between  $0^\circ$  and  $360^\circ$ ?

- (A)  $30^\circ, 150^\circ$
- (B)  $195^\circ, 345^\circ$
- (C)  $30^\circ, 150^\circ, 210^\circ, 330^\circ$
- (D)  $15^\circ, 75^\circ, 195^\circ, 255^\circ$

MA23182

**TIMSSAdvanced  
2008****Content Domain**

Geometry

**Cognitive Domain**

Applying

**Maximum Points**

1

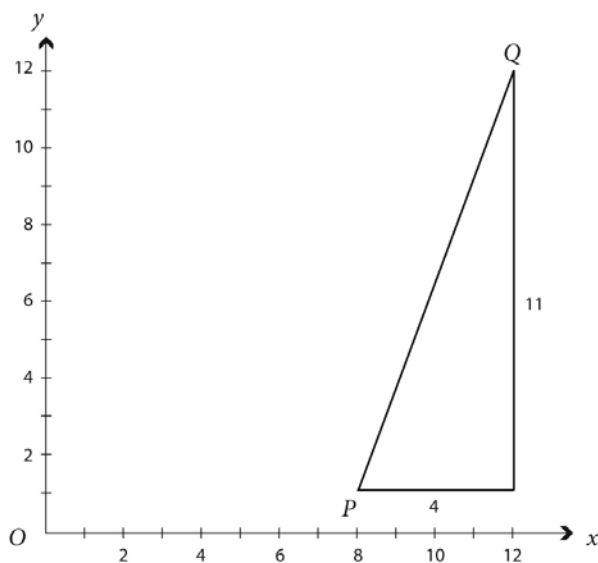
**Key**

D



Item ID **MA23170**

Advanced Mathematics

Block\_Sequence **M7\_11**

A straight line  $l$  passes through the points  $A(1, -2)$  and  $B(3, 4)$ .  
Is the line  $l$  parallel with  $PQ$ ?

Give a reason to support your answer.

MA23170

**TIMSS Advanced  
2008****Content Domain**

Geometry

**Cognitive Domain**

Applying

**Maximum Points**

1

**Key**

See scoring guide

Item ID <b>MA23170</b>		Advanced Mathematics	Block_Sequence <b>M7_11</b>
Code	Response	Item: MA23170	
	Correct Response		
10	No, with correct work showing gradients are different, and leading to conclusion that $l$ and $PQ$ are not parallel.		
11	No, with correct work leading to conclusion that $l$ and $PQ$ are not parallel using method other than showing gradients are different. For example, shows angle between the lines is not $0^\circ$		
	Incorrect Response		
70	No, with no correct reason		
71	Yes, with or without reason		
79	Other incorrect (including crossed out, erased, stray marks, illegible, or off task)		
	Nonresponse		
99	Blank		





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