Uses of Calculators

fx-50 FH and fx-50 FH II are two popular models of scientific calculators among HKDSE candidates. The following provides some tips on using these models of calculators that help candidates increase effectiveness in answering questions.

Radian Measures

When calculating the values of trigonometric functions, we need to be careful whether the calculator is set in degree or radian mode.

Example 1: Evaluate $4\cos\frac{\pi}{3}+2\cot^2\frac{\pi}{6}-3\csc^4\frac{\pi}{4}$.

Method 1:

1. Press [SHIFT] [MODE] 2 to change the calculator into radian mode.
2. Enter the expression according to the following key sequence: 4 [cos] [SHIFT] [EXP] [a b/c] 3 [)] + 2 [tan] [SHIFT] [EXP] [a b/c] 6 [)] [x^{-1}] [x^2] – 3 [sin] [SHIFT] [EXP] [a b/c] 4 [)] [x^{-1}] [^] 4 [EXE].
3. The screen will display –4. Therefore,

   $4\cos\frac{\pi}{3}+2\cot^2\frac{\pi}{6}-3\csc^4\frac{\pi}{4}=-4$.
4. Press [SHIFT] [MODE] 1 to change the calculator into degree mode if necessary.

Method 2:

We can use the command “ ^{r} ” (key sequence: [SHIFT] [ANS] 2) to indicate the angle is in radian measure regardless the mode of the calculator.

1. Enter the expression according to the following key sequence: 4 [cos] [SHIFT] [EXP] [SHIFT] [ANS] 2 [a b/c] 3 [)] + 2 [tan] [SHIFT] [EXP] [SHIFT] [ANS] 2 [a b/c] 6 [)] [x^{-1}] [x^2] – 3 [sin] [SHIFT] [EXP] [SHIFT] [ANS] 2 [a b/c] 4 [)] [x^{-1}] [^] 4 [EXE].
2. The screen will display –4. Therefore,

   $4\cos\frac{\pi}{3}+2\cot^2\frac{\pi}{6}-3\csc^4\frac{\pi}{4}=-4$.

Example 2: Let $f(x)=4x^2-\sin^2 2x$. Find $f\left(\frac{\pi}{8}\right)$ using a calculator.

Solution:

1. Press [SHIFT] [EXP] [a b/c] 8 [SHIFT] [RCL] [)] to store $\frac{\pi}{8}$ into the memory space X.
2. Enter and calculate $f(x)$ using the following key sequence: 4 [RCL] [)] [x^2] – [sin] 2 [RCL] [)] [SHIFT] [ANS] 2 [)] [x^2] [EXE].
3. The screen will display 0.116850275. Therefore, $f\left(\frac{\pi}{8}\right)\approx 0.1169$.

Command for Calculator Programs

Command	Keys
⌋	[a b/c]
?	[SHIFT] [3] [1]
→	[SHIFT] [3] [2]
:	[SHIFT] [3] [3] (or [EXE])
◢	[SHIFT] [3] [4]
Pol(	[SHIFT] [+]
Rnd(	[SHIFT] [0]
Abs(	[SHIFT] [)]
$^{-1}$	[x^{-1}]
Fix	[SHIFT] [MODE] [▶] [1]
Sci	[SHIFT] [MODE] [▶] [2]
Norm	[SHIFT] [MODE] [▶] [3]
⇒	[SHIFT] [3] [▶] [1]
=	[SHIFT] [3] [▶] [2]
≠	[SHIFT] [3] [▶] [3]
>	[SHIFT] [3] [▶] [▶] [1]
<	[SHIFT] [3] [▶] [▶] [2]
≥	[SHIFT] [3] [▶] [▶] [3]
≤	[SHIFT] [3] [▶] [▶] [4]
Goto	[SHIFT] [3] [▶] [▶] [▶] [1]
Lbl	[SHIFT] [3] [▶] [▶] [▶] [2]
While	[SHIFT] [3] [▶] [▶] [▶] [▶] [1]
WhileEnd	[SHIFT] [3] [▶] [▶] [▶] [▶] [2]
π	[SHIFT] [EXP]
^{r}	[SHIFT] [ANS] [2]
ᴇ	[EXP]
A	[ALPHA] [(–)] (or [RCL] [(–)])
B	[ALPHA] [° ' "] (or [RCL] [° ' "])
C	[ALPHA] [hyp] (or [RCL] [hyp])
D	[ALPHA] [sin] (or [RCL] [sin])
X	[ALPHA] [)] (or [RCL] [)])
Y	[ALPHA] [,] (or [RCL] [,])
M	[ALPHA] [M+] (or [RCL] [M+])

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MATHEMATICS Extended Part
Module 2 (Algebra and Calculus)

Mock Exam 1
Question-Answer Book

(2½ hours)
This paper must be answered in English

INSTRUCTIONS

(1) After the announcement of the start of the examination, you should first write your Candidate Number in the space provided on Page 1 and stick barcode labels in the spaces provided on Pages 1, 3, 5, 7, 9 and 11.

(2) This paper consists of TWO sections, A and B.

(3) Attempt ALL questions in this paper. Write your answers in the spaces provided in this Question-Answer Book. Do not write in the margins. Answers written in the margins will not be marked.

(4) Graph paper and supplementary answer sheets will be supplied on request. Write your Candidate Number, mark the question number box and stick a barcode label on each sheet, and fasten them with string INSIDE this book.

(5) Unless otherwise specified, all working must be clearly shown.

(6) Unless otherwise specified, numerical answers must be exact.

(7) The diagrams in this paper are not necessary drawn to scale.

(8) No extra time will be given to candidates for sticking on the barcode labels or filling in the question number boxes after the 'Time is up' announcement.

Please stick the barcode label here.

Candidate Number									

	Marker's Use Only	Examiner's Use Only
Question No.	Marks	Marks
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
Total		

FORMULAS FOR REFERENCE

$\sin(A \pm B) = \sin A \cos B \pm \cos A \sin B$	$\sin A + \sin B = 2\sin\dfrac{A+B}{2}\cos\dfrac{A-B}{2}$
$\cos(A \pm B) = \cos A \cos B \mp \sin A \sin B$	$\sin A - \sin B = 2\cos\dfrac{A+B}{2}\sin\dfrac{A-B}{2}$
$\tan(A \pm B) = \dfrac{\tan A \pm \tan B}{1 \mp \tan A \tan B}$	$\cos A + \cos B = 2\cos\dfrac{A+B}{2}\cos\dfrac{A-B}{2}$
$2\sin A \cos B = \sin(A+B) + \sin(A-B)$	$\cos A - \cos B = -2\sin\dfrac{A+B}{2}\sin\dfrac{A-B}{2}$
$2\cos A \cos B = \cos(A+B) + \cos(A-B)$	
$2\sin A \sin B = \cos(A-B) - \cos(A+B)$	

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Section A (50 marks)

1. Find $\dfrac{d}{dx}\left(\sin\dfrac{x}{3}\right)$ from first principles. (4 marks)

Answers written in the margins will not be marked.

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Section B (50 marks)

10. Define $f(x) = \dfrac{x^2 + 7}{x + 3}$, where $x \neq -3$. Denote the graph of $y = f(x)$ by G.

(a) Find $f'(x)$. (2 marks)

(b) Prove that the maximum value and the minimum value of $f(x)$ are -14 and 2 respectively. (4 marks)

(c) Write down the asymptote(s) of G. (2 marks)

(d) Sketch G. (2 marks)

(e) Find the area of the region bounded by G and the horizontal line $y = 11$. (3 marks)

Mock Exam 2

Section A

1. **(a)** $(1-6x+9x^2)^n$

$= [(1-3x)^2]^n$

$= (1-3x)^{2n}$

$= 1 - 3C_1^{2n}x + 9C_2^{2n}x^2 - 27C_3^{2n}x^3 + \ldots$ 1M

$9n(2n-1) = 252$ 1M

$2n^2 - n - 28 = 0$

$n = 4$ or $-\dfrac{7}{2}$ (rejected) 1A

(b) $\left(1-\dfrac{1}{x}\right)^3 = 1 - \dfrac{3}{x} + \dfrac{3}{x^2} - \dfrac{1}{x^3}$

$\therefore$ Constant term

$= 1 - 3(-3)C_1^8 + 9(3)C_2^8 - 27(-1)C_3^8$ 1M

$= 2341$ 1A

2. **(a)** $\lim\limits_{h\to 0} \dfrac{\sqrt{2(x+h)+5} - \sqrt{2x+5}}{h}$

$= \lim\limits_{h\to 0} \left(\dfrac{\sqrt{2x+5+2h} - \sqrt{2x+5}}{h} \cdot \dfrac{\sqrt{2x+5+2h} + \sqrt{2x+5}}{\sqrt{2x+5+2h} + \sqrt{2x+5}} \right)$ 1M

$= \lim\limits_{h\to 0} \dfrac{2x+5+2h-(2x+5)}{h\left(\sqrt{2x+5+2h} + \sqrt{2x+5}\right)}$

$= \lim\limits_{h\to 0} \dfrac{2}{\sqrt{2x+5+2h} + \sqrt{2x+5}}$

$= \dfrac{1}{\sqrt{2x+5}}$ 1A

(b) $\dfrac{d}{dx} e^{\sqrt{2x+5}}$

$= \lim\limits_{h\to 0} \dfrac{e^{\sqrt{2(x+h)+5}} - e^{\sqrt{2x+5}}}{h}$

$= \lim\limits_{h\to 0} \left(\dfrac{e^{\sqrt{2(x+h)+5}} - e^{\sqrt{2x+5}}}{\sqrt{2(x+h)+5} - \sqrt{2x+5}} \cdot \dfrac{\sqrt{2(x+h)+5} - \sqrt{2x+5}}{h} \right)$ 1M

$= \lim\limits_{h\to 0} \dfrac{e^{\sqrt{2(x+h)+5}} - e^{\sqrt{2x+5}}}{\sqrt{2(x+h)+5} - \sqrt{2x+5}} \cdot \lim\limits_{h\to 0} \dfrac{\sqrt{2(x+h)+5} - \sqrt{2x+5}}{h}$

$= \left(\dfrac{1}{\sqrt{2x+5}}\right) \lim\limits_{h\to 0} \dfrac{e^{\sqrt{2x+5}}\left(e^{\sqrt{2(x+h)+5}-\sqrt{2x+5}} - 1\right)}{\sqrt{2(x+h)+5} - \sqrt{2x+5}}$ 1M

$= \left(\dfrac{e^{\sqrt{2x+5}}}{\sqrt{2x+5}}\right) \lim\limits_{h\to 0} \dfrac{\left(e^{\sqrt{2(x+h)+5}-\sqrt{2x+5}} - 1\right)}{\sqrt{2(x+h)+5} - \sqrt{2x+5}}$

$= \dfrac{e^{\sqrt{2x+5}}}{\sqrt{2x+5}}$ 1A

Guidelines

Consider $\lim\limits_{k\to 0} \dfrac{e^k - 1}{k} = 1$.

3. **(a)** $\displaystyle\int \frac{x+3}{x}\,dx = \int \left(1 + \frac{3}{x}\right) dx$ 1M

$= x + 3\ln|x| + C,$ 1A

where C is a constant.

(b) $\displaystyle\int \frac{6x^5}{2x^3-3}\,dx = \frac{1}{2}\int \frac{2x^3\,(6x^2)}{2x^3-3}\,dx$

$\displaystyle = \frac{1}{2}\int \frac{2x^3-3+3}{(2x^3-3)}\,d(2x^3-3)$

1M + 1A

$= \dfrac{1}{2}(2x^3 - 3 + 3\ln|2x^3-3|) + C,$ 1A

where C is a constant.