

**ORGANISED BY ECFDPB
GOOD LUCK FOR 2024.10 TMUA!**

NOTES FOR TMUA CALCULUS

- when finding out the area between the curve and x-axis through integral, pay attention to whether the area is above or below the x-axis.
- when finding out the highest terms of a polynomial, make sure that the power of highest term and its corresponding coefficient both exist.
- finding out the derivative step by step. $[e^x]' = u' \cdot e^u$. distinguish between $f'(u) = f'(u)$ and $[f(u)]' = f'(u) \cdot u'$.

SKETCHING

- trace the curve by focusing on the transformation of some easy points: from $f(x)$ to $f(kx)$, you stretch the curve with scale $1/k$ horizontally; from $f(x)$ to $f(x+k)$, you transform the curve by $-k$ units horizontally towards the positive direction of x-axis.
- | | |
|---------------------|------------------------|
| (m,n) as center | $f(m+x) + f(m-x) = 2n$ |
| period of k units | $f(x) = f(x+k)$ |
- when finding out the number of real roots, remember to do the derivative, find out the stationary points and then sketch the graph(horizontal test)! not accurate coordinates are required! if relating with trigonometric, think about period.
- repeated roots = tangent in the graph.
- equally spaced $r^2 \neq$ equally spaced circles in the graph.
- do check the domain once you finish your sketching: $\log x$, $x > 0$? positive or negative? whole numbers?
- judge which graph is correct: symmetry with x/y-axis? trend? special points?

POLYNOMIAL

- sketch when equations that are obviously difficult to solve, and sketch when problems are relating to obvious transformations.
- solve the equation by substitution, especially when x is on the power.
- sometimes we solve the equation by using matrix, but consider the situation when $\det M = 0$.
- once facing an extremely strange equation, do try special values($x=0$ etc.)
- when there are many $\sin x$ and $\cos x$, and the equation is the sum of equal-power products, try to divide some $\cos x$ on the both sides to convert all the trigonometric functions into $\tan x$.
- check once you solving the equation! do you divide/multiply both sides with 0? are there some additional/missing roots when you squaring the both sides/finding out the square roots of both sides? will the roots you found make $\log x$, $x < 0$? will the roots you found make the denominator be 0? will the roots you found satisfy the conditions mentioned in the questions?
- when solving inequality, if you decide to divide/multiply both sides with some functions, pay attention to whether these functions are positive or negative: this may change the greater-than/smaller-than symbols of the inequality!
- if question says it wants distinct/positive/negative roots, then check your answer again to ensure that they are distinct/positive/negative roots!
- if question says tangent or normal, assume a line by considering gradient.
- if question says a polynomial, judge whether or not we have roots by focusing on the highest term.
- if question says the constant term of a polynomial, try $x = 0$.
- if question says the highest term of a polynomial, consider whether the coefficient is 0.
- when finding out the number of real roots, remember to do the derivative, find out the stationary points and then sketch the graph(horizontal test)! not accurate coordinates are required! if relating with trigonometric, think about period.
- substitution backwards once you make a substitution initially! remember what you want!

ORGANISED BY ECFDPB
GOOD LUCK FOR 2024.10 TMUA!

- $f(g(x))$ is just to convert all the x in $f(x)$ into $g(x)$.
- after each item of the arithmetic/geometric sequence changes, its common ratio/difference will also change.
- when finding out the sum of infinite terms of an geometric sequence, make sure that $|r|$ is smaller than 1.
- when finding out the maximum/minimum of a curve, consider the corresponding values of the boundaries of the range.
- complex roots occur in pairs.
- sum of coefficient occurs when $x = 1$, constant coefficient occurs when $x = 0$.
- Remainder Theorem.
- Vieta Theorem.
- change in roots(AS Further Math).

LOGIC

- consider special values(0,1etc.).
- change in add/minus signs(minus a fracture and there is a minus sign in the numerator etc.)/ change in greater-than/smaller-than sign(divide/multiple both sides by a negative function, log x with a base smaller than 1 etc.)/ check square/square roots(additional/missing roots).
- $a|b^2 \neq a|b$, multiple of prime may be prime.
- complex probability? try Venn Graph!
- given the number of elements/mean/median/mode/range of a set and ask you to find out the maximum/minimum value: if finding out the maximum, then only leave one maximum number and leave as many minimum numbers as possible, eventually solve the question by using function etc.
- which is initial set and which is subset? if initial set is true, then its corresponding subset is also true.
- necessary or sufficient?
- counterpositive statements are the same!

WISH THE BEST LUCK BE WITH YOU!



UNIVERSITY OF
CAMBRIDGE



UNIVERSITY OF
OXFORD

I M P E R I A L

**ORGANISED BY ECFDPB
GOOD LUCK FOR 2024.10 TMUA!
FINAL TIPS FOR TMUA**

(1)

READ THE QUESTIONS FIRST!

Integer?

Can Be or Cannot Be?

What in Form of What?

Non-negative or Positive?

If or Only If? Sufficient or Necessary

(2)

CHECK EACH OPTIONS!

**Especially Check Through Whether There Exists An
Equal Symbol For An Inequality**

(3)

Process of Solving Equations:

① SOLVING

Divide/Multiple by Negative Function Thus

Changes Greater-Than/Smaller-Than Symbols?

Find Out Square/Square Root of Both Sides Thus

Add/Miss roots?

② CHECKING

Substitution Back?

$\log x, x > 0?$

$1/(1-r), |r| < 1?$

$\text{sqrt}(m), m \geq 0?$

③ SPECIAL VALUE

Coefficient of Highest Term?

Boundaries?

Sketching?

(4)

DO YOUR BEST!