

Appendix

CE Mathematics (93-97)

Suspected Carelessness and Too Carefree

- Took amount instead of interest as answer (1(a), 93)
- Give answers of x and y out of the specified range (2(b), (c), 93)
- Give x in terms of y as the answer (2(b), 93)
- Just took $1/7+1/10$ as answer without analyzing (9(c), 94)
- Forget to include $y > 0$ as constraint, and equality as constrain (11(b)(i), 94)
- Did not exhaust all vertices in the testing (11(b)(ii), 94)
- Forget that the x -coordinate of R is negative (12(b), 94)
- Forget to use brackets (2(a), 95)
- Should be more careful about unit and accuracy (I, 93, 94, 95, 97)
- Forget to make r as subject (1, 96)
- Use 4th term as n th term (3(a), 96)
- Use $f(-1)$ without defining $f(x)$ (4(a), 96)
- Did not test all points before drawing conclusion (9(c), 96)
- Wrong answer in tedious calculations (12(a)(i), 12(b), 96)
- Forget to add the money in previous months (12(c), 96)
- Take $2x^2-15x+26$ as required equation (8(b), 97)
- Mix up units (10(a)(i), (ii), 93)
- Miss out units (12(a)(i), 97)
- Take approximate value instead of surd (1(c), 94)

Mixing Up Information, Making Wrong Assumptions

- Took the wrong denominator when calculating % gain/loss (4(b), 95)
- Take $b=2a$ instead of $b=-2a$ (8(b), 95)
- Gave the coordinates of the vertices as the answer (12(b), 95)
- Problem in understanding more complicated questions (I, 95, 96, 97)
- Mixing up major sector with minor sector (II, 95)
- Mistook some triangles are right-angled (15(c), 96)
- Took open box as closed one (16(a)(i), 96)
- Took the wrong water level (16(b)(iii), 96)
- Took curved surface area as total surface area (II, 96)
- Mistook OPQ as right angled (14(a), 94)
- Mistook $AD=CD$ (5(c), 97)
- Mistook $\text{arc}AB:\text{arc}BC = AB:BC$ (9(c), 97)
- Mistook lengths of arc proportional to lengths of cords (II, 93)
- Simply took $(1+2\%)*2$ as population growth rate in two years (10(a), 97)
- Mistook surface area of green house as includes the base (12(a)(ii), (b)(iii), 97)
- Mistook remaining belts and handbags were sold at half of their previous price (13(a)(iii), 97)

Missing Information, Understanding of the Question

- Can't use answer in first part to solve second part (4, 93)
- Did not give answers in positive indices only (7(a), 94)
- Can't see two external tangents symmetric (12(e), 94)
- Can't analyze the situation properly (11(b)(ii)(I), 95; 14(b)(i), 97)
- Can't see relationship between height and base radius (13(c)(ii), 95)

Can't see OD is in fact the height of the triangle (15(c), 95)
Can't see OD is independent of the angle of elevation (15(d)(ii), 95)
Did not see the answer is the mid-point (11(c)(i), 96)
Did not see the answer is the point of division (11(c)(ii), 96)
Can't see probability should be calculated without replacement (14(a)(iv), 97)
Attempts to calculate the $A(1)+A(2)+A(3)+A(4)$ instead of just $A(4)$ (15(a)(ii), 97)

Knowledge

Did not understand percentage gain (6(a), 94)
Inter-quartile range (7(b)(i), 93)
Not familiar with the theorems for isosceles triangles (14(a)(ii), 95)
Weak in basic concepts/skills (I, 93, 94, 95, 96, 97; 16(b), 97)
Basic statistical knowledge (I, 93)
Basic knowledge in A.P., G.P. (I, 93, 94; II, 94)
Basic knowledge in probability (I, 94)
Basic knowledge in linear programming (I, 94)
Can't recall cosine formula (II, 95)
Not familiar with basic properties of logarithm (3(b), 97)
Could not write down the range of x which satisfy both inequalities (4(ii), 97)
Can't use ratio of surface areas of similar solids = square of ratio of height (9(b), 93; 7(b), 97)
Weak in relation between similar plan figures and similar solids (II, 94)
Not familiar with standard score (11(c)(i), 97)

Technique

Non-routine calculations like finding AP/PB from roots of equation (8(c), 93)
Don't realize the relationship between area of ABC and $\alpha-\beta$ (8(c), 94)
Reading of cumulative frequency polygon (7(b)(ii), 93)
Can't find class frequency from cumulative frequency (9(c), 95)
Can't find number of students with yearly average scores lying within the required range (9(e), 95)
Did not exhaustively tested all points in testing (12(c), 95)
Round off (II, 95; II, 96)
Unfamiliar with completing square (13(c), 96)
Can't give correct x in the cumulative frequency table (14(c)(I), 96)
Convert units (II, 97)

Choice of Technique

Distinguish between theorems and converse (13(c)(i), 94; I, 94, 95)
Use the wrong formula (15(d), 96)
Attempt to solve θ by method of bisection (which is wrong) (12(b)(iv), 97)

Presentation and Reasoning

Did not show root lies between .6 and 1 (10(c)(ii), 94)
Did not show which triangles they are using (13(b), 95)
Difficulty in presenting logical steps (11(c), 93; 14(b), 95)
Difficulty in giving brief and concise explanation (14(c)(i), 95)
Should show detailed working (I, 95, 96)
Should use proper mathematical and ordinary language (I, 93, 95, 96, 97)
Write down correct but irrelevant statements (6, 96)

Lack of clearly-explained answer (13(b)(ii), 96; 14(b), 96; 14(d), 96; 16(c), 96; 15(b)(ii), 97; 16(a)(iii), 97)

Use mathematical supports to give explanations (I, 96, 97)

Weak in geometric proofs, avoid irrelevant statements (I, 96, 97)

Jump to conclusion with too few cases (10(b), 97)

Can't give brief and concise explanation (11(b), 97)

Can't give logical and well-sequenced proof (16(a)(ii), 97)

Others

Consequential error (12(b), 93; 14(b), (c) (d)(i), 94; 13(c)(i) 95)

Can't draw 2-dimensional diagrams to illustrate 3-dimensional situation (I, 94)

Weak in 3-dimensional visualization (II, 95; I, 96)

Weak in answering open-ended questions (I, 96, 97)

Weak in probability (II, 96)

Weak in plane geometry (II, 96)

Can't use standard score to compare distributions (conceptual) (11(c)(ii)(II), 97)

Initial Observations

Most concerns attitude (carelessness), approach to problems (mixing up information) etc rather than knowledge and technique. Much difficulty was found in the handling of units. Major problem is not knowing what were given and what is asked, and then making tacit assumptions

Problems in geometric proofs, giving explanations, open ended question more serious as these questions become popular these years.

Weak in basic knowledge in junior forms and knowledge with specific topics like statistics, A.P., G.P., and ratio of surface areas of similar solids are weak.

Others include spatial concept and choice of problem solving techniques but not frequent as CE exam seldom involve these (showing that CE questions too stereotyped and seldom involve choice of techniques? Once non-routine questions are set, e.g. open boxes, greenhouse without a base, students get the information mixed up).

CE Additional Mathematics (93-97)

Suspected Carelessness and Too Carefree

Making mistake in comparing the real part and imaginary part of two sides of equations (93 I 2(b))

Finding cube of a complex number instead of cube roots. (93 I 4)

Missing proper symbol for vector quantity. (93 I 6(a),8(a),94 I 3, 95 I 7 8(a), 97 I 7)

Missing dot sign in dot product expression. (93 I 6(b),8(d)(ii),95 I 7, 97 I 7 9(a)(b))

Careless in computing derivative (93 I 9(b),93 II 9(b),95 I 9(b),97 I 2)

Forget to simplify the answer (93 I 10(b), II 3(a), II 10(a), 95 II 4)

Memorize the formula wrongly (93 II 4, 94 II 1, 94 II 6(a) 11(c), 95 I 2, 95 II 2(b),95 II 4)

(95 II 12(a),97 I 3, 97 II 11(b) 12(a))

(Cosine Formula, angle between two straight lines, Trigonometric identities)

Forget the lower and upper limits in the "equations" of integration (93 II 9(b), 95 II 8(b)) (97 II 11(c))

Don't label the turning point and end points in the graph (93 I 11(d), 94 I 9(d)(i), 97 I 10(c))

Don't test the turning points. (94 I 9(c), 95 I 9(c), 97 I 10(b))
 Mistake any vector is unit vector. (94 I 10(d)(ii))
 Missing integration constant. (94 II 1, 97 II 2 11(a))
 "Combining" degree and radian measure in the answer (94 II 2, 97 II 4)
 Do not check the validity of answer. (95 II 11(b)(ii))
 Omitting unit or wrong unit.(97 I 4)
 Computational error in distance formula (97 II 13(c)(i))

Mixing Up Information, Making Wrong Assumptions

Don't see that the circles do not touch each other. (93 II 11(a))
 Assume that vectors, \mathbf{p} , \mathbf{q} are perpendicular. (95 I 8(b)(ii))
 Consider $f(3) = 0$ instead of $f'(3) = 0$ (97 I 10(a))
 Mistake $SA = 2SB$. (97 I 13(b)(i))
 Take BD is angle bisector of $\angle ABC$. (97 II 12(b)(ii))
 Mistake $k = 0$ is a condition for minimum value of $\sqrt{5(k^2 - k + 2)}$ (97 II 13(b))

Missing Information, Understanding of the Question

Don't know what is the meaning of the variable V . (93 II 12(b))
 Can't see that BE is the required distance. (94 I 10(d)(ii))
 Don't know $\vec{AC} = \vec{AB} + \vec{BC}$ (93 I 6(b))
 Can't see that the required rate is $\frac{d\mathbf{q}}{dt}$. (94 I 12(a))
 Don't link to previous parts. (94 I 12(c), 94 II 9(a)(c) 13(b), 97 II 11(d))
 Fail to find the surface area of water. (94 II 13(a))
 Instead of writing down a pair of similar triangle, they try to prove the similarities. (95 I 12(a))
 Mistook intersection of curves as x , y -intercepts of the curve. (97 I 10(b))
 Don't know the orientation of the points in the formula of area of triangle. (97 II 3(b))

Knowledge

Cannot express complex number in polar form and don't know what is polar form (93 I 4) (95 I 11(a))
 Cannot determine the solution of quadratic inequality (93 I 5, 95 I 1, 95 I 10(c)(i))
 Cannot distinguish vector and scalar (93 I 8(a) 97 I 9(a)(b))
 Cannot find all roots of trigonometric equations in a given range, some even use degree instead of radian in their answer. (93 I 11(a)(c))
 Don't know how to label the axes of Argand diagram. (93 I 12(a))
 Error in finding general solution of trigonometric equation. (93 II 2, 95 II 9, 97 II 4)
 Don't know the compound angle formula. (93 II 8(b))
 Improper treatment of inequality. (94 I 1, 95 I 4, 97 I 5)
 Don't know how to solve absolute inequality. (94 I 8, 95 I 10(c)(i), 97 I 8(b))
 Misconception in parallel vectors. (94 I 10(c))
 Weak in handling fraction arithmetic. (94 II 5)
 Using Point-slope form to find equations of Curves. (94 II 8)
 Wrong Integration process. $\int f(x)g(x) dx = \int f(x)dx \cdot \int g(x)dx$ (94 II 10(d))
 Don't know the geometric interpretation of dot product. (95 I 7)
 Difficulty in handling the arithmetic of modulus of complex number. (95 I 11(b))

Don't know how to determine when the function is increasing/decreasing. (95 I 12(b)(i))

Improper treatment of irrational equation. (95 II 10(b))

Cannot find Max/min when the first derivative is not equal to 0 for all x . (97 I 12(c))

Difficulty in representing a given area by a definite integral. (97 II 10(b))

Difficulty in representing volume of a body by a definite integral. (97 II 10(c))

Technique

Do not retain sufficient significant figure in intermediate step. (93 II 7(b) 94 II 11(c))

Cannot apply the substitution repeatedly. (93 II 9(c), 94 II 10(c))

Do not aware that Compound angle formula should be used. (94 II 2)

Unable to pick out the require term. (94 II 3)

Cannot resolve a fraction to Partial Fraction. (94 II 10(d))

Fail to apply chain rule. (97 I 12(b))

Misconception in trigonometric function. (97 I 12(c))

Choice of Technique

Only equate $\frac{dS}{dq} = 0$ for finding stationary point without knowing the change of sign does the same. (95 I 12(b)(ii))

Overlook the "hint", use other method to compute which end in clumsy, lengthy calculation.

(97 II 9(c)(i))

Presentation and Reasoning

Cannot give logical argument, some even use ratio of two vector quantities, 0/0. (93 I 8(c))

Don't know how to find the fixed points of family of curves logically. (93 I 10(c))

Poor presentation. (94 II 6,8(c))

Cannot distinguish proposition from function of n in Mathematical Induction. (95 II 6, 97 II 7)

Others

Weak in geometric interpretation of complex numbers. (95 I 5, 97 I 6)

Weak in recognizing geometrical property of a function. (95 II 3(b), 97 II 9(c)(ii), 97 II 10(d))

Could not make use of the "hint" in the question. (95 II 8(d)(ii))

Weak in locus concept. (95 II 10(c)(i))

Do not check the requirement given in the question. (95 II 4, 7, 10(c)(ii), 95 II 12(a), 97 II 2) (97 II 6(b) 12(b))

Fail to point out $\cos q \neq 0$. (97 I 11(c))

Cannot distinguish function and equation. (97 II 5)

Not familiar with properties of parallelogram. (97 II 12(b)(ii))

Weak in 3D visualization. (97 II 12(c))

Weak in 2D Geometry properties.

Mathematics and Statistics (94-97)

Suspected Carelessness and Too Carefree

The leaf digits in any row of a stem-leaf diagram are to be arranged in ascending order and evenly spaced. (95 1)

Forget the integration constant. (94 4, 95 4, 96 2, 97 4)

Forget to add a “-” sign when the rate is decreasing. (96 5(b))

Forgot to include binomial coefficient when applying binomial distribution. (96 (c)(i))

Not careful to deal with “more than two” (96 13)

Only concentrate on the first few terms of infinite series while other terms are “forgotten”(97 1)

Compute the derivative wrongly. (97 8(d)(i))

Forget to show that the critical point gives a maximum. (97 8(d)(ii) 9(b))

Mixing Up Information, Making Wrong Assumptions

Missing Information, Understanding of the Question

“100 units lots” is not needed in calculation. (96 6)

Misinterpret “at least 3 of these 4 batches are good” as “3 or 4 defective chips are found in a batch (96 12(c)(i))

Misinterpret the probability required as “at least 3 of the first 4 batches are *good* and at least 5 of the last 6 batches are *good*.” (96 12(c)(ii))

Don't know “more than 5” is equivalent to “6 or more”. (97 6)

Knowledge

Insufficient knowledge in cumulative frequency table/polygon. (94 4)

Cannot relate the integral with the area under the standard normal curve. (94 6(b))

Deficiency in graph plotting. (94 8(d))

Fail in applying integration (94 9(a) 10(b)(ii))

Do not have good practice in finding mean and variance of normal distribution. (94 12(b))

Cannot distinguish binomial model and geometric model (94 11(a)(ii))

Don't have geometric property about the normal distribution curve. (94 12(b) 13(e))

Fail to apply logarithm differentiation. (95 2(b))

Don't know the difference between definite integral and indefinite integral (95 4, 97 4)

Fail to evaluate integral of the type: $\int a^x dx$ and $\int e^{ax} dx$. (95 6(b))

Not familiar with the product rule and quotient rule. (95 7(a)(ii))

Cannot relate polynomial expansion to the probability evaluation. (96 8(a)(ii))

Most of the students do not know $\frac{1-x^6}{1-x} = 1+x+x^2+x^3+x^4+x^5$ and

$$(1-x^6)(1-x)^{-4} = (1+x+x^2+x^3+x^4+x^5)^4. (96 8(b)(iii))$$

Not familiar with exponential equations. Mistook $at + be^{at} + de^{ft} = 0$ when $t = 0$ (96 10(b)(i)(ii))

Cannot realize that it is conditional probability and use point probability or joint probability instead. (96 11(c)(ii) 12(c)(ii) 13(c)(ii), 97 12(c)(ii))

Cannot remember the formula of geometric distribution. (96 13(b))

Do not understand the meaning of geometric distribution. (97 13(b))

Not familiar with Poisson distribution. (96 13(c)(i))

Cannot formulate the joint probability. (97 11(c)(iii))
Weak in using normal table. (97 12(b))

Technique

Students don't keep sufficient number of decimal places in intermediate steps (95 7(a), 96 9(a), 97 10(d)(i))
Application of chain rule is not satisfactory. (96 5(a))
Fail to draw probability tree diagram in a useful way. (96 6)
Not do well in differentiation. (97 8(a)(i)(d)(i))

Presentation and Reasoning

Use convexity to explain some irrelevant part. (95 7(b)(ii))

Others

Cannot translate the problem in mathematical terms. (94 7 9)
Don't use the hint given in the question, use their own method and result in complex calculation. (95 2, 96 8(b)(iii))
Overlook the condition given in the questions. (94 8(c) 10(a) 11(b)(iii) 12(d), 96 9(a) 13(c)(iii), 97 5 8(a)(i) 11(c)(i) 12(b))
Cannot use convexity or shape of curve to explain the trapezoidal rule provide underestimate. (95 7(a)(iii), 97 10(d)(iv))
Use truncated series but forget to check coefficients of the remaining terms are positive. (95 7(b)(ii))
Don't know how to use the condition, graph in the question. (96 9(b)(iii))
Weak in dealing newly introduced (box-and-whisker diagram) terminology. (97 2)
Don't know that the number of clams sold between two consecutive days was $M(n) - M(n-1)$.
Don't know how to make use of previous parts. (97 10(c))
Misinterpret "increasing sub-interval" as "increasing length of sub-interval". (97 10(d)(iii))
Don't know "not more than 3 trials" means "1 trial or 2 trials or 3 trials" (97 13 (c))
Weak in 3D problem. (94 3)

Initial Observation

Many of students overlook the condition/hint in the questions. They are rather weak in Calculus. Many of them fail to apply integration or product rule, chain rule. Some even cannot distinguish definite and indefinite integral. This may be due to the weak Mathematics background of non-science students. Interpretation of graph/area under the graph and the plotting of graph is also a problem. Misunderstanding of probability distribution/distribution curve, joint probability/conditional probability also cause a trouble to students. They cannot apply their "constructed" knowledge to solve some "non-typical" problem. Cannot interpret the probability event such as "more than 3 trials" etc.

AS Applied Mathematics I (94-97)

Suspected Carelessness and too Carefree

Mistook u for \dot{r} . (94 2(b))

Mix up percentage and the actual number of part time students. (95 2(a))

No proper symbol for vector quantity. (95 11)

Incorrect moment formula (vector version) (96 1)

Mistakes in solving differential equation (96 6(a))

Mistake in simplifying answer (96 6(a))

Error in computing derivative. (97 8(a)(i))

Mixing up Information, Making Wrong Assumption

Assuming the independence of events E and F so that $P(E \cap F) = P(E) \cdot P(F)$ (94 3)

Mistook $ABCD$ is a parallelogram. (97 11(a))

Missing Information, Understanding of the Question

Misinterpret $P(x \geq 30)$ as $P(x \geq 39.5)$ (97 4(b))

Misinterpret $\frac{dx}{dt} = 0.015x$ as $\frac{dx}{dt} = 0.0015$ (97 II 7(c))

Knowledge

Cannot differentiate \vec{e}_r and \vec{e}_θ (94 2)

Do not know the geometric properties of function. (94 8(b)(ii), 95 8(b)(ii), 96 9(b)(iv))

Messy in handling transformation. (94 8(d))

Not clear concept in lines of action. (94 11(a))

Little understanding of the principle behind least square method. (95 1(b))

Don't aware that magnitude should be non-negative. (95 6)

In finding maximum magnitude of velocity, students always forgot to put the absolute sign to the function. (95 6)

Cannot write the error term correctly. (95 7(a)(i), 97 1(b))

Fail to distinguish absolute and relative extremum. (95 8(b)(i))

Don't aware the part involved conditional probability. (96 10(c) 11(c)(d))

Not able to write the correct position vector of P . (95 11)

Weak in handling of conditional probability. (96 3(b)(ii))

Mistook one of the polynomial $g(x), h(x), r(x)$ as $f(x)$ (96 8(c))

Do not apply continuity correction in using normal approximation. (96 10(b)(iii))

Weak concept of Type II error (96 12(b)(ii))

Fail to recognize the critical value depends on sample size. (96 12(b)(iii))

Improper handling of error term. (97 1(b))

Overlook the need of negative sign in decreasing rate. (97 2)

Insufficient knowledge of trigonometric function. (97 3(b))

Do not aware of asymptotes, point of inflexion in plotting a graph. (97 7(b))

Incorrect formula of Taylor's expansion. (97 9(a)(i))

Fail in distinguishing between continuous and discrete variables. (97 10(a))

Poor concept of moment. (97 11(b)(ii))

Fail to recognize the category of differential equations. (97 12(b)(i))

Mix up \dot{r} and $|\dot{r}|$. (97 12(b)(ii))

Technique

- Overlook the need to use logarithm (94 1)
- Cannot show all the iterates lie in the interval [1,2] (94 5(a))
- Do not know the shortcut method (complementary events) (94 9(c))
- Fail to equate the sum of forces and sum of moments of the forces. (94 11(d))
- Not familiar with the method of completing square. (95 1)
- Cannot write the correct equation for describing the system of forces. (95 12)
- Couple was omitted in description of system of forces. (95 12)
- Weak in handling motion involving polar coordinate. (96 2)
- Weak in applying chain rule of differentiation. (96 6)
- Cannot sketch the curve smoothly. (96 7)

Choice of Technique

- Instead of direct method, students tend to use more tedious method. (95 11)

Presentation and Reasoning

- Weak in interpreting mathematical result in practical situation.(95 4(b),96 7(b)(i))
- Imprecise and illogical argument. (95 4(b) 9(b),97 6(b) 8(b) 9(a)(ii))
- Prove $\frac{g(x) + g(-x)}{2} \geq g(0)$ for all x by mentioning $\frac{g(a) + g(-a)}{2} \geq g(0)$ only. (96

9(a)

- No justification for “self-made” formula: $|\vec{AB} \times \vec{BC} + \vec{AD} \times \vec{CD}| = |\vec{AB} \times \vec{BC}| + |\vec{AD} \times \vec{CD}|$
(97 11(a))

Others

- Overlook the condition/requirement/instruction in the question. (94 1 10(e) 12(a)(ii),95 1(b),97 8(a)(ii) 9(a)(ii) (c) 10(c))
- Overlook the necessity to demonstrate the extremum value found. (94 6 12(a)(ii))
- Do not make use of previous part. (94 7(d) 12(b)(i))
- Cannot setup equation according to the condition given. (96 4(b),97 2)
- Overlook the need to show the resultant force is zero. (97 11(a))

Initial Observation

Fairly weak in handling polar coordinate, vector, presenting logical argument, interpret the mathematical result to practical situation. Weaknesses in moment (vector version), line of action were also found. Fail to recognize the geometric property of function is also weak point of student, overlook the condition/ requirement/instruction is the usual problem of students.

AL Pure Mathematics (95-97)

Suspected Carelessness and Too Carefree

Error in operations of matrices (95 I 1(b), 96 I 8(a))

Error in computing derivative. (93 II 8, 95 II 1)

Missing integration constant. (95 II 7)

Make mistake in signs on the relation between roots and coefficients. (96 I 7(b))

Do not clarified the “self-made” variables. (96 I 10(a)(iii))

Forget to simplify the answer. (96 I 10(b))

$\sqrt{\sin^2 q} = \sin q$ without considering the signs of $\sin q$. (96 II 11)

Mix up $|z^2|$ and z^2 (97 I 1(a))

Forget to check the whether divisor is zero or not. (97 I 6(a) 7(b) 8(a))

Mixing Up Information, Making Wrong Assumptions

Assume that a_i are non-negative (94 I 4(b))

Improper Induction assumption (95 I 6)

put $a_1 = u_1 s_1, a_2 = u_2 s_2, \dots$ without supporting argument. (95 I 8(a)(ii))

Assume that the sequence is unbounded. (95 I 12(b))

Assume that the sequence is decreasing and bounded below. (95 I 12(c))

Assume that \vec{m}, \vec{n} are orthonormal vector. (97 I 11(a))

Missing Information, Understanding of the Question

Mistake $P(2^{h+1})$ be : $\left(\frac{a_1 + \dots + a_{2^h} + a_{2^{h+1}}}{2^{h+1}} \right)^m \leq \frac{a_1^m + a_2^m + \dots + a_{2^h}^m + a_{2^{h+1}}^m}{2^{h+1}}$ (96 I 13(c)(i))

Misunderstanding the “identity” of the symbol in the question. (Mistake r as variable) (97 I 13)

Knowledge

Weak concept in Mathematical Induction (93 I 2)

Don't know geometric meaning of $\vec{a} \cdot \vec{b} = 0$ and $\vec{a} \times \vec{b} = \vec{0}$ (93 I 8(c))

Misconception in vector operation: $\vec{z} \cdot \vec{u} = \vec{r} \cdot \vec{u} \Rightarrow \vec{z} = \vec{r}$ (93 I 8)

Misconception in complex number (93 I 4(a) II 11(a), 94 I 6(b))

such as: $|z_1 + z_2|^2 = (z_1 + z_2)^2$, $\text{Arg} \frac{z_1}{z_2} = n\pi \pm \frac{P}{2}$

Weak in applying Triangular inequality. (93 II 11(a))

Weak in simplifying integral (93 II 10(c) 11(a))

Do not notice the separate treatment of special value (94 I 7(b) II 8(a) 9)

Don't know what is a surjective function. (94 I 11(a)(ii))

Don't know $x^4 - w^4 = (x - w)(x^3 + x^2w + xw^2 + w^3)$ (94 I 12(b))

Fail to use Sandwich rule properly (94 II 11)

Cannot find out the interval for which the function is increasing/decreasing (94 II 14)

Poor knowledge in periodic function property (94 II 13, 95 I 4(a))

Unable to apply appropriate Surface Area Formula. (93 II 4)

Don't know “consistent” of system of linear equations. (95 I 9(b))

Cannot write down the Euclidean algorithm correctly. (95 I 10(b))

Cannot figure out what the plane figure is when an equation of curve is given. (95 I 11(c), 97 II 8)

Fail to distinguish the difference between local max/min and absolute max/min. (95 II 4, 97 II 4) (97 II 7)

Could not handle Polar equation/curve. (94 II 4, 95 II 5)

Unable to find the upper and lower limits of integration. (95 II 5 11)

Improper handling of inequalities (93 II 8 12(b), 95 II 8)

Vague concept of limit. (93 I 5 9(b) II 1 6 13, 94 I 8(c) II 11, 95 II 10, 97 I 12(c))

Fail to recall the Fundamental Theorem of Calculus. (95 II 12)

Fail to write down Integration by parts. (95 II 12, 97 II 1)

Treating Matrix equation as algebraic equation: $(A - 2I)(A - I) = 0 \Rightarrow A = 2I$ or I (96 I 1)

Don't know the roots of a polynomial are in conjugate pairs. (96 I 3(c))

Omitting the particular case ($n = 1$) in mathematical induction. (96 I 6(b))

Don't know what linear independent is. (93 I 8(a), 96 I 8(a))

Cannot write down the Leibniz' Formula correctly. (96 II 1)

Weak concept of continuity and differentiability. (96 II 4, 97 II 6 8)

Weak concept in point of inflexion and asymptote. (96 II 8)

Cannot state the Mean Value Theorem correctly. (93 II 11(a) 13(a), 96 II 9)

Improper lower bound: A sequence $\{r_n\}$ is bounded from below by $\frac{1}{n}$. Lower bound should be independent of n (96 II 10).

Fail to recall the formula of arc length. (96 II 11)

Improper version of "theorem": $\{r_n\}$ is decreasing and bounded below by $1 \Rightarrow \lim_{n \rightarrow \infty} r_n = 1$, without noticing that 1 may not be the greatest lower bound of $\{r_n\}$. (96 II 13)

Cannot apply AM>GM other than "standard type" expression: They know $\frac{a+b+c}{3} \geq (abc)^{\frac{1}{3}}$ but do not know $\frac{ab+bc+ca}{3} \geq (abc)^{\frac{2}{3}}$ (97 I 5(a))

Do not know determinant and matrix operation:

- $|PQ| = |P||Q|$ where P, Q are matrices. (97 I 5(b))
- $|xA| = x^n |A|$ (97 I 7)
- Wrong operation: $|A - xI| = |A| - |xI|$

Do not know the meaning of inverse trigonometric function. (97 I 10(b)(ii))

Fail to use half angle formula (97 II 1)

Weak in locus problem. (97 II 3)

Don't know the "standard" symbol of mathematics such as **Q, Z**. (97 II 10)

Cannot find the derivative of the inverse function. (94 II 7, 97 II 11)

Unable to handle 3D problem (93 II 2, 94 II 3)

Technique

Cannot resolve rational function to partial fraction (94 II 2(b))

Problems in handling chain rule (94 II 12)

Forget the t formula which is learnt in CE Additional Mathematics. (95 II 11)

Use the technique of "distance between point and line" to compute the "distance between point and plane" (96 I 10(a)(ii))

Improper handling of partial fractions. (95 II 8)

Cannot apply Mathematical Induction properly. (96 II 13, 97 I 1(b) 2)

Presentation and Reasoning

Illogical presentation (93 I 3(b) 12, 94 II 12)

Replace “no real roots” by “no roots” (95 I 3(c))

Cannot give clear argument. (95 II 4)

Claim $f(|x + y|) \leq f(|x|) + f(|y|)$ without any proper reasons. (96 I 4(b))

Replace $\sqrt{3}$ by $-\sqrt{3}$ and use the result in (a) but it was invalid in (a) (97 I 12(b))

Using their own system of symbols without defining clearly in their answer. (97 II 8)

Others

Don't pay attention to the condition/requirement given in the question. (93 I 3(a)

11(b), 94 I 2 9(a)(ii) 10(a)

(93 II 2, 95 I 3(b) 7(a) 13(a), II 7)

Don't refer to previous parts. (95 I 9(c), II 2(b), 96 I 13(b))

Weak in geometry (95 II 12)

Weak in using newly encountered theorems. (95 II 13)

Proving the “converse” of the question. (96 I 12)

Forget to check the conditions before they apply the results of previous parts. (94 II 14)

Weak in dealing “new” problem which need to relate knowledge of several aspects (94 I 10(c)) (97 II 12 13)

Initial Observation

The students are fairly weak in several aspects such as Limits, complex number, matrix operation, continuity, differentiability. They also show poor performance in handling of 3D problem, polar equation. Many of them only concentrate on the consequence of the theorem without checking the assumption of the theorem, some even use the “wrong” version of the theorem. They are weak in logical/valid presentation/reasoning in their work. Inter-relation of several topics are not understood by the students.