

SAMPLE EXAMINATION QUESTIONS – Chapter 1

The mid-term (final exam) will have up to 8 (25) questions for 1 (3) hours. Adjacent students will have different exams.

Special instructions: Closed book. No calculators. A non-electronic dictionary is permitted.

A) Attempt every question:

- In Part 1: Select the best answer among the choices listed in the right column.
- In Part 2: Write the answer (e.g. a, b, ...), and its reason or justification **unless** the answer is either "None of the above" or a choice of output values.

B) One point for each correct answer provided that the stated reason, where required, is sensible and specifically related to the situation. **Only Part 2 will be assessed for marks.**

Note: These sample exam questions should help you focus on issues for study and review. Avoid memorization since it only overloads/confuses you. Best to write a short program code to test, prove or disprove an idea--This will surely help you progress, write exams or do your homework.

Part 1 Note: Line numbers are added for reference purpose only.

The situation	In relation to the described situation:
<p>1. The following assignment expressions have a common syntax error:</p> <pre>f(x) = (a+b)*Area*x; g(x, y, z) = a*sin(x*y)*exp(b*z); A B = C; A*B = C; A+B*C = D;</pre>	<p><i>The syntax error may be due to:</i></p> <ul style="list-style-type: none"> a) A variable name is too long b) A right-hand-side variable name has illegal character(s) c) The left-hand-side is not a (valid) name d) The right-hand-side expression has illegal or missing operator(s) e) Unbalanced parentheses _____ f) None of the above
<p>2. The following expression is supposed to compute $V = x\sqrt{a^2 + b^2} \sin y$:</p> <pre>V = x*sqrt(a*a+b*b)*Sin y;</pre> <p>It has an error.</p>	<p><i>The error may be due to:</i></p> <ul style="list-style-type: none"> a) A variable name is too long b) The part $\sqrt{a^2 + b^2}$ is badly implemented c) The variable name in the left-hand-side has illegal character(s) d) The part $\sin y$ is badly implemented e) Unbalanced parentheses _____ f) None of the above

<p>3. The following expression is supposed to compute $V = x\sqrt{a^2 + b^2} \sin y$:</p> <pre>V = x * hypot(a,b) * sin y;</pre> <p>It has an error.</p>	<p><i>The syntax error may be due to:</i></p> <ul style="list-style-type: none"> a) The hypot function is not applicable b) Bad use of the sin-function c) Square root function is missing d) No space between arguments in hypot() e) Missing operator between sin and y <p>_____</p> <ul style="list-style-type: none"> f) None of the above
<p>4. Consider the following program:</p> <pre>main() { a = 3; b = 4; x = a^3; y = 0.2; V = x * hypot(a,b) * Sin(y); print(a, b, x, y, V); }</pre> <p>It does NOT execute as expected.</p>	<p><i>The error may be due to:</i></p> <ul style="list-style-type: none"> a) Missing or invalid operator(s) b) Undefined variable or function name c) Improper function argument(s) d) An illegal or missing operator e) Unbalanced parentheses <p>_____</p> <ul style="list-style-type: none"> f) None of the above
<p>5. Consider the following program:</p> <pre>main() { Dept = 3.5; Width = 0.12; Length = 2.1 Volume = Length * Dept * Width; print(Length, Dept, Width, Volume); }</pre> <p>It does NOT execute as expected.</p>	<p><i>The error may be due to:</i></p> <ul style="list-style-type: none"> a) Too many expressions on one line b) An undefined variable c) An expression is not terminated by semicolon d) Bad use of a function e) Unbalanced parentheses f) Improper function argument(s) <p>_____</p> <ul style="list-style-type: none"> g) None of the above
<p>6. Consider the following program:</p> <pre>main() { Dept = 3.5; Width = 0.12; Length = 2.1; Volume = Length * Depth * Width; print(Length, Dept, Width, Volume); }</pre> <p>It does NOT execute as expected.</p>	<p><i>The error may be due to:</i></p> <ul style="list-style-type: none"> a) An undefined variable b) Missing or invalid operator(s) c) Expression not terminated by semicolon d) Bad use of a function e) Unbalanced parentheses f) Improper function argument(s)

	<p>_____</p> <p>g) None of the above</p>
<p>7. Consider the following program:</p> <pre>main() { Dept=3.5;Width=0.12,Length=2.1; Volume = Length * Dept * Width; print(Length, Dept, Width, Volume); }</pre> <p>It does NOT execute as expected.</p>	<p><i>The error may be due to:</i></p> <p>a) Missing or invalid operator(s) b) An undefined variable c) Expression not terminated by semicolon d) Bad use of a function e) Unbalanced parentheses f) Improper function argument(s)</p> <p>_____</p> <p>g) None of the above</p>
<p>8.</p>	<p><i>The following expressions make use of built-in functions. One of them may have invalid argument(s). Which one?</i></p> <p>a) A = hypot(2, 4); b) A = cos(-2.1); c) print(pi#, 4/5, A = hypot(B = 3, C=4)); d) A = ln(-4.5); e) A = getnum(); f) A = round(2, B = 2/3);</p> <p>_____</p> <p>g) None of the above</p>
<p>9. Consider the following code segment:</p> <pre>{ F = (A=2)*3 + (B = (C=A^2)/2) * (D = 2*C^2/B + (E = (D = hypot(A=3,4)^2)/5)); print(A, B, C, D, E); }</pre>	<p><i>Its execution gives the following output:</i></p> <p>a) 3 2 4 21 5 b) 2 2 4 21 5 c) 3 2 4 16 5 d) 3 2 4 16 2 e) 3 18 36 149 5 f) 3 2 2 9 5</p> <p>_____</p> <p>g) None of the above</p>
<p>10. In relation to the use of functions in C-programming.</p>	<p><i>One of the following statements is false. Which one?</i></p> <p>a) Functions [other than main()] must be invoked by name for its execution b) Input data to function can be supplied as function arguments c) Functions are useful for their actions and/or</p>

	<p>returned values</p> <p>d) A function name must be followed by a closing pair of parentheses</p> <p>e) Built-in functions are functions supplied by the programming environment</p> <hr/> <p>f) None of the above</p>
<p>11. The followings are supposed to be unrelated examples of CMAP-expressions shown in no particular order. They may have faults in them.</p> <pre> 1 L = hypot(A); 2 A*B-C; 3 getnum(" Input A", A); 4 getnum(" Input A", 2*3); 5 sin(x = A/B); 6 A = sin(0.14) * getnum(); 7 print(A,B,C); 8 B = getnum(" Input B", getnum("Set prompt for B", sin(0.2)*cos(0.1))); 9 print(getnum(" Input A"));</pre>	<p><i>ONE of the following statements may be FALSE. Which one?</i></p> <p>a) Line 1: hypot() should have two scalar arguments.</p> <p>b) Line 3 gets user input for 'A'.</p> <p>c) Line 4: Input window shows 6 as a prompt value.</p> <p>d) Lines 2, 3, 4, 5: Expressions are valid but they serve no real purpose.</p> <p>e) Line 5: value of x is sent as argument to function sin().</p> <p>f) Line 6: Expression is valid and it serves to define the content of 'A'.</p> <p>g) Line 7: The actions done by print() is of great interest while its returned value is often ignored.</p> <p>h) Line 8: Expression is valid and useful, but not practical.</p> <p>i) Line 9 gets user-input value and prints it.</p> <p>j) In an expression, a constant or variable name can be replaced by a sub-expression.</p> <hr/> <p>k) None of the above</p>
<p>12. In relation to expressions in C-programming.</p>	<p><i>One of the following statements is false. Which one?</i></p> <p>a) The left-hand-side of the assignment operator must be a valid name</p> <p>b) Every variable in the right-hand-side of the assignment expression must have its value defined previously</p>

	<p>c) An invoked function must have valid arguments</p> <p>d) Every expression must have an assignment operator</p> <p>e) A variable name or constant in the right-hand-side of the assignment expression can be replaced by a sub-expression</p> <p>f) An upper case character is considered different from its lower case.</p> <p>_____</p> <p>g) None of the above</p>
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Part 2: For each question, write the answer number and its justification in its reserved space.

Question	Answer (a,b,...)	Reason or justification for the answer
1	(c)	A legal variable name must not have illegal special characters.
2	(d)	This part <code>sin y</code> should be implemented as <code>sin(y)</code>
3	(b)	Argument <code>y</code> of function <code>sin</code> must be in parentheses (<code>sin</code> is the name of a built-in function, not a variable name)
4	(b)	Built-in function <code>sin</code> must be in lower case
5	(c)	Semicolon missing after the expression <code>Length = 2.1</code> which becomes incomprehensible when merged with the next line.
6	(a)	Variable 'Depth' is undefined (even though Dept was defined). This kind of error is often typo error.
7	(c)	Terminate the expression " <code>Width = 0.12</code> " with a semicolon, not a comma
8	(d)	The argument of <code>ln()</code> cannot be negative
9	(a)	A and D are redefined later in the same expression
10	(f)	All preceding statements are true.
11	(b)	This expression displays value of A as a prompt only. For 'A' to be defined by user-input, the returned value of <code>getnum()</code> must be assigned to 'A' like this: <code>A = getnum();</code> See documentation on <code>getnum()</code> for its optional arguments.
12	(d)	Assignment operator is needed only when a value is to be saved or stored in a variable name.

SAMPLE EXAMINATION QUESTIONS – Chapter 2

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Part 1

The situation	In relation to the described situation:
<p>1. The following code segment has a syntax error:</p> <pre> if(Volume) notice(" Volume is not zero:", Volume); A = A/Volume; } </pre>	<p><i>The syntax error is caused by:</i></p> <ul style="list-style-type: none"> a) else-clause is missing b) 'if' is in lower case c) 'Volume' is undefined d) variable 'A' appears in both left and right hand side of the assignment expression e) unbalanced parentheses or braces
<p>2. Consider the following code segment:</p> <pre> if(Pressure) { notice(" Volume is not zero:", Volume); A = B/Pressure; } </pre>	<p><i>The main purpose of the if-statement is:</i></p> <ul style="list-style-type: none"> a) to test if 'Pressure' is positive b) to test if 'Pressure' is zero c) to test if 'Pressure' is negative d) to test if 'Pressure' is non-zero e) to test if 'Pressure' is greater than zero
<p>3. Consider the following program:</p> <pre> main() { A = 1; B = 10; C = 100; if(B >= (C = 20)) { </pre>	<p><i>The program produces the following output:</i></p> <ul style="list-style-type: none"> a) 1 10 100 b) 3 10 20 c) 10 10 100 d) 3 10 30

<pre> A = C/B; } else { A = 3; C = 30; } print(^, A, B, C); } </pre>	<p>_____</p> <p>e) None of the above</p>
<p>4. Consider the following code segment:</p> <pre> E1 = ((a=2+4) < a a > 0); E2 = ((b=5) == b && b <= 0); </pre>	<p>This code segment will give the following values for a, b, E1 and E2:</p> <p>a) a = 6, b = 5, E1 = 1, E2 = 0 b) a = 6, b = 5, E1 = 1, E2 = 1 c) a = 6, b = 5, E1 = 0, E2 = 0 d) a = 0, b = 1, E1 = 0, E2 = 1</p> <p>_____</p> <p>e) None of the above</p>
<p>5. Given the following program:</p> <pre> main() { Sum = 1; I = 3; do { Sum = Sum + I; print(^, I, Sum); I=I-1; } while(I); print(^" Final sum = ", Sum); } </pre>	<p><i>ONE of the following statements about the program may be FALSE. Which one?</i></p> <p>a) The program has no syntax error b) The final value of Sum is 6 c) The final value of I is 0 d) while-loop can also be used here e) The program prints 4 lines</p> <p>_____</p> <p>f) None of the above.</p>
<p>6. The following program is supposed to compute</p> $Sum = \sum_{I=1}^{N=10} I :$ <pre> main() { Sum = 0; I = 1; N = 10; do { Sum = Sum + I; print(^, I, Sum); I=I+1; } while(I); print(^" Final sum = ", Sum); } </pre>	<p><i>The program does NOT work as expected, and the error is due to:</i></p> <p>a) syntax error(s) b) 'N' is defined but not used c) bad initialization of 'I' d) bad loop-exit condition e) do-while loop is not applicable f) improper function argument(s)</p> <p>_____</p> <p>g) None of the above.</p>
<p>7. The following program is supposed to compute</p> $Sum = \sum_{I=1}^{N=10} I :$	<p><i>The program does NOT work as expected, and the error is due to:</i></p>

<pre> main() { Sum = 0; I = 1; N = 10; do { Sum = Sum + I; print(^, I, Sum); I=I+1; } while(I < N); print(^" Final sum = ", Sum); } </pre>	<p>a) syntax error(s) b) 'N' is defined but not used c) bad initialization of 'I' d) bad loop-exit condition e) do-while loop is not applicable f) improper function argument(s) _____</p> <p>g) None of the above.</p>
<p>8. The following program is supposed to find the square root of 'A' using the following iterative formula based on a previously estimated root r_1:</p> $r_2 = \frac{1}{2} \left(r_1 + \frac{A}{r_1} \right)$ <p>where r_2 is supposed to be a better estimate.</p> <pre> main() { A = getnum("Input A > 0 "); r1= A/2; do { r2 = (r1+A/r1)/2; Error = abs((r2-r1)/r1); } while(Error > 0.01); print(^,"A = ",A," Root = ",r2); } </pre>	<p><i>The program does NOT work because of:</i></p> <p>a) syntax error(s) b) no iterative improvement of root c) bad initialization of 'r1' d) bad loop-exit condition e) undefined variable(s) f) improper function argument(s) _____</p> <p>g) None of the above.</p>
<p>9. The following program is supposed to find the square root of 'A' using the following iterative formula based on a previously estimated root r_1:</p> $r_2 = \frac{1}{2} \left(r_1 + \frac{A}{r_1} \right)$ <p>where r_2 is supposed to be a better estimate.</p> <pre> main() { getnum("Input A > 0 "); r1= A/2; do </pre>	<p><i>The program does NOT work because of:</i></p> <p>a) syntax error(s) b) no iterative improvement of root c) bad initialization of 'r1' d) bad loop-exit condition e) undefined variable(s) f) improper function argument(s) _____</p> <p>g) None of the above.</p>

<pre> { r2 = (r1+A/r1)/2; Error = abs((r2-r1)/r1); r1 = r2; } while(Error > 0.01); print(^,"A = ", A, " Root = ", r2); } </pre>	
<p>10. The following program is supposed to find the square root of 'Z' using the following iterative formula based on a previously estimated root X_1:</p> $X_2 = \frac{1}{2} \left(X_1 + \frac{Z}{X_1} \right)$ <p>where X_2 is supposed to be a better estimate.</p> <pre> main() { Z = getnum("Input Z > 0 "); X1 = Z/2; do { X2 = (X1+Z/X1)/2; X1 = X2; Error = abs((X2-X1)/X1); } while(Error > 0.01); print(^,"Z = ", Z, " Root = ", X2); } </pre>	<p><i>The program does NOT work because of:</i></p> <ul style="list-style-type: none"> a) syntax error(s) b) no iterative improvement of root c) bad initialization of 'X1' d) bad loop-exit condition e) undefined variable(s) f) improper function argument(s) <hr/> <p>g) None of the above.</p>
<p>11.</p> <p>Consider the use of the keywords 'continue', 'break', 'case', and 'switch'.</p>	<p><i>ONE of the following statements may be FALSE. Which one?</i></p> <ul style="list-style-type: none"> a) The keywords 'continue' and 'break' can be used within a loop. b) Execution of 'break' inside a loop will terminate the loop. c) Without 'case', the switch-control structure loses its power. d) Execution of 'break' inside a switch-control structure will transfer control to the next 'case'. e) A program may have loops and switch-control structures nested within themselves in any number of levels. <hr/> <p>f) None of the above.</p>

12. Consider the following program which computes the same quantity using two mathematically equivalent forms $E_1 = E_2$:

$$E_1 = \sqrt{A+\varepsilon} - \sqrt{A}$$

$$E_2 = \frac{\varepsilon}{\sqrt{A+\varepsilon} + \sqrt{A}}$$

```
main()
{
  A = 100;
  Eps = 1;
  while(Eps>=1E-15){
    E1=sqrt(A+Eps)-sqrt(A);
    E2=Eps/(sqrt(A+Eps)+sqrt(A));
    print(^,Eps,E1,E2);
    Eps = Eps * 0.5;
  }
}
```

ONE of the following statements may be FALSE. Which one?

- a) The program computes E_1, E_2 for constant 'A' and decreasing value of ε .
 - b) The program has no error(s).
 - c) Output will have 3 columns of values.
 - d) Results for E_1 and E_2 should be nearly the same for relatively large value of ε .
 - e) As ε approaches zero, the computed E_2 should be more accurate than E_1 .
-
- f) None of the above.

13. Consider the following program:

```
main() {
  A = 2; B = 4; C = 0; SUM = 1;
  switch(A)
  {
    case 2:
      if(C){ C=1; SUM=SUM-C;}
      else { C=-1;SUM=SUM+C;}
    case 5:
      SUM = SUM + A + B + C;
      break;
    default:
      A=1; B=3; C=-1; SUM=1;
      break;
  }
  print (^, A, B, C, SUM);
}
```

Its execution will give the following output:

- a) 1 3 -1 1
 - b) 2 4 -1 5
 - c) 2 4 0 1
 - d) 2 4 1 7
 - e) 2 4 -1 0
-
- f) None of the above.

14. Consider the following program:

```
main()
{ F = (A=2^2*2) + (C=(B=2)*2+1) *
  (D=A/B+(E=hypot(3,4)^2/5)==5);
  X = 2*(C<3) + 3*(B==2)+2*(D > 3);
  print(^, A, B, C, D, E, X);
}
```

Its execution will give the following output:

- a) 8 2 5 9 5 5
 - b) 8 2 5 0 5 3
 - c) 8 2 5 5 1 5
 - d) 16 2 5 9 1 5
 - e) 16 2 5 0 5 3
-
- f) None of the above.

15. Concerning the working of loop-control structures, one of the following statements may be FALSE. Which one?

- a) do-while loop: the loop body is executed at least once.
 - b) while loop: the condition is tested before executing the loop body.
 - c) The first expression in the for-loop construct is executed just before each time the loop body is executed.
 - d) The body of the for-loop is executed only if the value of the second expression in the for-loop construct is non-zero.
 - e) The third expression in the for-loop construct is executed only after the loop body has been executed.
 - f) The keywords `break` and `continue` may change or disrupt the normal sequential execution of the loop body.
-
- g) None of the above

Part 2: For each question, write the answer number and its justification

Question	Answer	Reason or justification for the answer
1	(e)	Begin of if-block requires the brace {.
2	(d)	If Pressure is non-zero then the division by Pressure can be done.
3	(d)	The if-test failed and thus, the else-block is executed. Note that $(C = 20)$ is an assignment expression, NOT an equality test
4	(a)	E1 is true because $a > 0$ is true; E2 is false because $b > 0$.
5	(b)	The final value of Sum is 7.
6	(d)	Infinite loop: 'I' is always non-zero in while(I).
7	(d)	When I equals 10, the do-while loop terminates and exits without adding 10 into 'Sum'.
8	(b)	After computing 'r2', its value should be placed into 'r1' for the next iteration.

9	(e)	Variable 'A' is undefined.
10	(b)	The computed 'Error' is 0, hence the loop terminates after one iteration.
11	(d)	'break' transfers control to the statement following the switch block.
12	(f)	All preceding statements are true.
13	(b)	case 2 is executed, and then proceed through case 5 until break
14	(b)	
15	(c)	The first expression is executed only once, at the very beginning.

SAMPLE EXAMINATION QUESTIONS – Chapter 3

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Part 1. Note: Program line numbers are added for reference only

The situation	In relation to the situation at left
1. User-defined functions	<p><i>ONE of the following statements is FALSE. Which one?</i></p> <p>a) Any function other than <code>main()</code> must be invoked by name for it to be executed.</p> <p>b) All user-defined functions in a program will eventually be executed.</p> <p>c) Function name must be followed by parentheses which enclose optional function arguments or parameters.</p> <p>d) Function arguments must match the type of parameters declared inside the function heading.</p> <p>e) Execution of 'return' inside the function body will transfer control back to the calling expression.</p> <p>_____</p> <p>f) None of the above</p>

<p>2. Consider the following program:</p> <pre> 1. main() 2. { 3. A = HYPOT(3, 4); 4. print(A); 5. } 6. HYPOT(float a, float b) 7. { 8. float L; 9. L = sqrt(a*a+b*b); 10. return L; 11. }</pre>	<p>When the program executes, ONE of the following statements in relation to the results or program is FALSE. Which one?</p> <p>a) At line 4, 'A' is 5. b) At line 8, 'a' is 3 and 'b' is 4. c) At line 8, 'L' is 0 or possibly undefined d) At line 10, 'L' is 5 e) At line 4, 'a' is 3 and 'b' is 4 _____</p> <p>f) None of the above</p>
<p>3. Consider the following program:</p> <pre> 1. main() { 2. float a = 1; 3. b = 2; 4. f(a); 5. print(^, a, b, c); 6. } 7. f(float a) 8. { float c; 9. a = 100; b = 200; 10. print(^, a, b, c = a+b); 11. }</pre>	<p>When the program executes, ONE of the following statements in relation to the results or program is FALSE. Which one?</p> <p>a) At line 2, 'a' is declared to be local in main() b) Once line 4 executed, 'a' is 1 and 'b' is 2 c) At line 5, 'a' is 1 and 'b' is 2 d) At line 10, 'c' is 300 e) At line 5, 'c' is undefined _____</p> <p>f) None of the above</p>
<p>4. Consider the following program:</p> <pre> 1. main() { 2. float a = 1, b = 2; 4. f(a, b); 5. print(^, a, b, c = a+b); 6. } 7. f(float a, float b) 8. { float c; 9. a = 100; b = 200; 10. print(^, a, b, c = a+b); 11. }</pre>	<p>When the program runs, ONE of the following statements in relation to the results or program is FALSE. Which one?</p> <p>a) At line 2, 'a' and 'b' are declared to be local in main() b) Once line 4 executed, 'a' is 1 and 'b' is 2 c) At line 5, 'a' is 100, 'b' is 200 and 'c' is 300 d) At line 7, 'a' is 1 and 'b' is 2 e) At line 10, 'a' is 100, 'b' is 200 and 'c' is 300 _____</p> <p>f) None of the above</p>

5. Given the following program:

```
1. main()
2. { useoption("RADIANS");
3.   for(x = 1; x <= 90; x = x+1)
4.   {
5.       a = x*pi#/180;
6.       print(^, x, s1 = SIN(a),
              s2 = sin(a),
              (s1-s2)*100/s2);
7.   }
8. }

9. SIN(float x)
10. { // Compute sin of x by summing
     // its Taylor series
11. float Sum = T=x, n=3, Sign = -1;
12. do {
13.     T = T*(x*x)/(n*(n-1));
14.     Sum = Sum + Sign*T;
15.     n = n+2;
16.     Sign = -Sign;
17. } while (abs(T) > 0.0001);
18. return Sum;
19. }
```

ONE of the following statements in relation to the program is FALSE. Which one?

- a) The expression in Line 2 is good even though it might be redundant at times.
- b) 'x' in main() and 'x' in SIN() have separate storage or content
- c) At line 11, 'Sum' should be initialized to 0
- d) The argument 'x' in SIN() must be in radians
- e) Line 11 declares local variables for temporary data used in SIN()

f) None of the above

6. Consider the following program:

```
1. main()
2. {
3.     plot(x, -2, 3, T(x));
4.     xo = minz1(x, -2, 3, T(x));
5.     print(^, xo, T(xo));
6. }

7. T(float x)
8. {
9.     return 10-3*x+0.9*x*x;
10. }
```

ONE of the following statements in relation to the program is FALSE. Which one?

- a) xo in line 5 and x in function T() have separate storage
- b) Illegal duplicate of 'x' in lines 3 and 7
- c) In line 4, xo is the point at which T(x) is minimum
- d) Function arguments in minz1() are proper
- e) Function arguments in plot() are proper

f) None of the above

<p>7.</p>	<p>The following expressions make use of built-in functions. Only one of them may have invalid argument(s). Which one?</p> <p>a) plot(x, 0, pi#, f(x) = sin(x)*cos(x));</p> <p>b) plot(z, a=1, b=2, sin(z)*exp(-0.15*z));</p> <p>c) x = maxz1(z, a=1, b=2, sin(z)*exp(-0.15*z));</p> <p>d) root1(x, 0, 1, sin(x)-cos(x));</p> <p>e) clearplot();</p> <p>_____</p> <p>f) None of the above</p>
<p>8. Consider the following expression:</p> <pre>u = maxz1(z, a, b, sin(x*z)*exp(-y*z));</pre>	<p>ONE of the following statements in relation to the expression is FALSE. Which one?</p> <p>a) The purpose of the expression is to get the value z that makes $\sin(x*z)*\exp(-y*z)$ maximum within the interval $a \leq z \leq b$</p> <p>b) The expression will provide good result only if such result exists</p> <p>c) 'z' is a dummy variable name</p> <p>d) The fourth parameter in maxz1() must be an expression of z</p> <p>e) The expression has a syntax error</p> <p>f) The expression will execute only if the values of 'a', 'b', 'x' and 'y' are previously defined</p> <p>_____</p> <p>g) None of the above</p>
<p>9. Consider the following program:</p> <pre>1. main() 2. { 3. a = 1; b = 2; 4. print(A = F(0)); 5. }</pre>	<p>When the program executes, ONE of the following statements in relation to the results or program is FALSE. Which one?</p> <p>a) Variables 'a' and 'b' are global by default</p> <p>b) At line 8, 'L' is 1</p>

<pre> 6. F(float x) 7. { 8. float L = (a+b*x*sin(x)); 9. }</pre>	<p>c) At line 4, 'A' is 1 d) At line 8, 'x' is 0 e) At line 4, 'x' does not exist</p> <hr/> <p>f) None of the above</p>
<p>10. Consider the following program:</p> <pre> 1. main() 2. { 3. print(E(0.23)); 4. } 5. E(float y) 6. { // Return exp(y) by summing 7. // Taylor series 8. float S = T = K = 1; 9. do { 10. T = T * y/K; 11. S = S + T; 12. K = K + 1; 13. } while (abs(T) > 0.0001); 14. return S; 15. }</pre>	<p><i>When the program executes, ONE of the following statements in relation to the results or program may be FALSE. Which one?</i></p> <p>a) There is no syntax error b) At line 10, 'y' is 0.23 c) At line 8, 'K' is 1 d) At line 12, 'K' is incremented by 1 e) At line 14, 'S' is supposed to be the sum of the first K terms of the Taylor series</p> <hr/> <p>f) None of the above</p>
<p>11. The following program tests the function SIN(float x) which computes and returns sin(x) by summing the terms in the Taylor series until a term is smaller than 0.0001:</p> $\sin x = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \dots$ <pre> 1 main() 2 { 3 for(x=0, x<= 90, x=x+1) 4 { 5 K = 0; 6 y=x*pi#/180; 6 print(^,x, SIN(y),K); 7 } 8 } 9 SIN(float x) { 10 float Sum=Term=x, n=3, Sign = -1; 11 do { 12 K = K+1; 13 Term = Term*(x*x)/ (n*(n-1)); 14 Sum = Sum + Sign*Term; 15 n = n+2; 16 Sign = -Sign; 17 } while(abs(Term)<0.0001), 18 return Sum; 19 }</pre>	<p><i>ONE of the following statements may be FALSE. Which one?</i></p> <p>a) Line 3 has syntax error(s) b) Line 13 has a logical error b) Line 17 has logical error(s) c) Line 17 has syntax error(s) d) Once the preceding errors, if any, have been corrected, the program should work fine. e) K counts the number of terms being summed for each x.</p> <hr/> <p>f) None of the above</p>

<p>12. Consider the following program:</p> <pre> 1. main() { 2. float a = 1, b = 2; 3. c = f(a) 4. +f(b); 5. print(^, a, b, c); 6. } 7. f(float a) 8. { 9. float c = a+1; 10. return c+1; 11. }</pre>	<p><i>ONE of the following statements may be FALSE. Which one?</i></p> <p>a) At line 2, 'a' and 'b' are local b) At line 3, 'c' is a local variable of main() c) 'a' in Line 3 and 'a' in line 7 have different storage d) 'c' in Line 9 is a local variable of f() e) The values printed are 1, 2, 7 f) Removing the return-keyword in Line 10, the values printed are 1, 2, 0</p> <hr/> <p>g) None of the above</p>
<p>13. Consider the following program:</p> <pre> 1 float G = 1; H = 1; 2 main() 3 { 4 float H = 3, K = 4; 5 print(f(G, h), G, H, K); 6 } 7 f(float G, H) { 8 G = G + 1; 9 H = H + 1; 10 K = 1; 11 print(^,G, H, K); 12 }</pre>	<p><i>ONE of the following statements may be FALSE. Which one?</i></p> <p>a) Line 1 has syntax error(s). b) Line 4 declares local variables. c) Line 5 has a typo error. d) Line 7 has syntax error(s). e) If syntax and typo errors are properly corrected, the output would be: 2 4 1 0 1 3 4</p> <hr/> <p>f) None of the above.</p>
<p>14. Consider the following program:</p> <pre> main() { float a = 1; b = 2; f(a, b); print(a, b); }</pre>	<p><i>Its execution will give the following output:</i></p> <p>a) 2 1 1 2 1 b) 1 2 1 2 1 c) 2 1 2 1 2 d) 1 2 1 1 2</p>

<pre>f(float a, float b) { float T = 0; if(a < b){ T=a; a=b; b = T; } print(a, b, T); }</pre>	<pre>e) 2 1 1 1 2 f) 1 2 2 1 1</pre> <hr/> <p>g) None of the above.</p>
<p>15. Consider the following program:</p> <pre>1 main() 2 { 3 print(f(1,9,2)); 4 } 5 f(float M; float N; float K) 6 { 7 float I, Sum = 0; 8 for(I = M, I <= N, I = I+K); 9 { 10 Sum = Sum + I; 11 if(I>=N-3){Print(I,Sum);} 12 } 13 }</pre>	<p><i>ONE of the following statements may be FALSE. Which one?</i></p> <p>a) Line 5 has syntax error(s). b) Line 8 has syntax error(s). c) Line 11 has a typo error. d) After correcting all the errors, execution of f() will give I = 11 when the loop terminates. e) After correcting all the errors, execution of the program will give this output:</p> <pre>7 16 9 25 0</pre> <hr/> <p>f) None of the above.</p>

Part 2: For each question, write the answer number and its justification

Question	Answer	Reason or justification for the answer
1	(b)	Only those invoked will be executed.
2	(e)	Variables 'a' and 'b' exist only within HYPOT() while HYPOT() is being executed.

3	(c)	Local variable 'a' remains at 1 while global variable 'b' has been changed by function f()
4	(c)	Being local variables in main(), 'a' and 'b' cannot be changed by f()
5	(c)	The loop starts with the second term of the series (i.e. x^3), and thus, Sum is initialized with the first term (x) in the series.
6	(b)	Any name will do.
7	(a)	The illegal variable name f(x) in the RHS invalidates the expression to be plotted.
8	(e)	The syntax is proper
9	(c)	F() does not have the return statement, and hence CMAP returns 0 by default. i.e. 'A' is 0.
10	(e)	'S' is supposed to be the sum of the first K-1 terms of the Taylor series
11	(b)	The expression is fine as is.
12	(b)	'c' is global by default [i.e. Not declared as local in main()]
13	(f)	
14	(e)	
15	(f)	

SAMPLE EXAMINATION QUESTIONS – Chapter 4

The mid-term (final exam) will have up to 8 (25) questions for 1 (3) hours. Adjacent students will have different exams.

Special instructions: Closed book. No calculators. A non-electronic dictionary is permitted.

A) Attempt every question:

- In Part 1: Select the best answer among the choices listed in the right column.
- In Part 2: Write the answer (e.g. a, b, ...), and its reason or justification **unless** the answer is either "None of the above" or a choice of output values.

B) One point for each correct answer provided that the stated reason, where required, is sensible and specifically related to the situation. **Only Part 2 will be assessed for marks.**

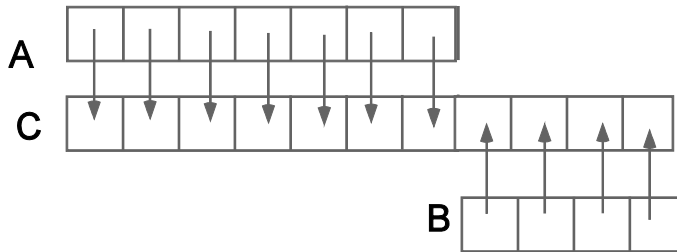
Note: These sample exam questions should help you focus on issues for study and review. Avoid memorization since it only overloads/confuses you. Best to write a short program code to test, prove or disprove an idea--This will surely help you progress, write exams or do your homework. Functions `cat()` and `view()` placed at strategic places will make debugging easier.

Part 1

Note: Line numbers are added for reference only.

The situation:	In relation to the described situation:
<p>1. The following program is supposed to sum all elements of the matrix M.</p> <pre> main() { defmat (M[N = 3], 2, 3, 7); float I, Sum = 0; for(I=1; I<= N; I=I+1) { Sum = M[I]; } print(" Sum = ", Sum); } </pre>	<p><i>ONE of the following statements is FALSE. Which one?</i></p> <p>a) Matrix M has three elements</p> <p>b) As is, the program prints Sum = 7</p> <p>c) 'M' is a local array of main()</p> <p>d) 'I' and 'Sum' are local variables of main()</p> <p>e) Element M[2] contains 3</p> <p>f) When the loop terminates, the value of I is 4</p> <p>g) The program has logical error(s)</p> <p>_____</p> <p>h) None of the above</p>

2. The following program is supposed to copy elements of arrays A and B into C as shown.



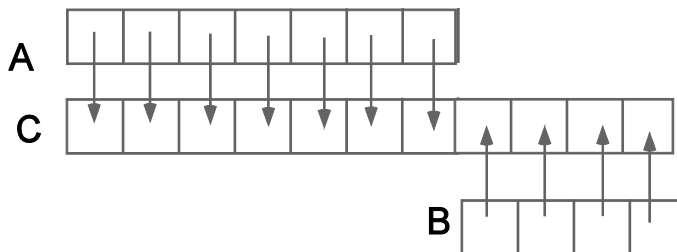
```
main()
{
    defmat (A[M=7],3,1,2,4,0,6,9);
    defmat (B[N=3],-1,-8,-2);
    zero(C[K=M+N]);
    float I, J = 0;
    for(I=1; I<= K; I=I+1)
    {
        if(I <= M) { C[I] = A[I]; }
        else { C[I] = B[J = J+1];}
    }
    print(A, B, C);
}
```

ONE of the following statements is FALSE. Which one?

- a) As is, the program gives C[5] the value 0
- b) As is, the program gives C[9] the value -8
- c) As is, the size of array C is 1 by 10
- d) All arrays are global
- e) Variables I and J are local while M, N, K global
- f) When the loop terminates, the value of I is 11
- g) The program has logical error(s)

h) None of the above

3. The following program is supposed to copy elements of arrays A and B into C as shown.



```
main()
{
    float I, J, M = 7, N = 3, K = M+N;
    mat A[M], B[N], C[K];
    defmat(A,3,1,2,4,0,6,9);
    defmat(B,-1,-8,-2);
    zero(C[K]);
    for(I=1; I<= M; I=I+1)
    {
        C[I] = A[I];
    }
    for(J = 1; J <= N; J=J+1)
    {
        C[I] = B[J];
        I = I+1;
    }
}
```

ONE of the following statements is FALSE. Which one?

- a) All variables are local
- b) When the second loop starts, value of I is 8
- c) When the second loop terminates, value of J is 4
- d) When the second loop terminates, value of I is 11
- e) In the second loop, when 'J' is 2 then C[9] is set
- f) The program works as intended

g) None of the above

<pre>print(A, B, C); }</pre>	
<p>4. Consider the following program.</p> <pre>main() { defmat(A[3],3,1,2); defmat(B[4],0,-1,-8,-2); C = f(A[1], B[3]); // Line 5 print(C, A[2], f(A[3], B[4])); } f(float A, float B) { return A+B; }</pre>	<p><i>ONE of the following statements is FALSE. Which one?</i></p> <p>a) The program has no syntax error b) 'A' and 'B' in main() are global arrays c) 'A' and 'B' in f() are local float variables d) The arguments of f() in Line 5 are 3 and -8 e) Function f() must not use 'A', 'B' as names of parameters in order to avoid conflict with global array names. f) On program execution, the output will be -5, 1, 0</p> <hr/> <p>g) None of the above</p>
<p>5. Consider the following program.</p> <pre>main() { zero(M[3], N[2]); S = Set(M,3,1) // Line 4 + Set(N[1], 2); // Line 5 print(S); } Set(mat A,float I,float Val) { // Assign Val to A[I] A[I] = Val; return 2*Val; }</pre>	<p><i>ONE of the following statements is FALSE. Which one?</i></p> <p>a) When Set() is invoked in Line 4, value 3 is copied into local var 'I', and 1 to Val b) When Set() is invoked in Line 4, array A is created as a copy of M c) The intention of Line 5 is clear but it has at least 2 errors d) Once the errors are fixed, M[3] should be 1 and 'S' should be 6 e) If the return-command in Set() is deleted, 'S' will be zero, but arrays [M] and [N] are not affected</p> <hr/> <p>f) None of the above</p>
<p>6. Consider the following function which adds two vectors $A_{1 \times N}$ and $B_{1 \times N}$ giving C.</p> <pre>1. AddArrays(mat A, mat B, 2. mat C, N) 3. { // Add vectors C = A+B 4. mat C[N]; 5. float I;</pre>	<p><i>ONE of the following statements in relation to the given function is FALSE. Which one?</i></p> <p>a) At line 2, 'N' should be declared as float. b) The declaration on Line 4 is invalid. c) The function should initialize C with zero. d) At line 6, semicolon must be used after N instead of comma.</p>

<pre> 6. for(I=1; I<= N, I=I+1) 7. { 8. C[I] = A[I]+B[I]; 9. } 10. return 1; 11. } </pre>	<p>e) Line 10 should be <code>return C;</code></p> <p>f) In order to use this function, the argument for C must have the size 1 by N.</p> <hr/> <p>g) None of the above.</p>
<p>7. Consider the following function which performs the dot product of vectors $A_{1 \times N}$ and $B_{1 \times N}$.</p> <pre> 1. Dot Product(mat A, mat B, 2. float N); 3. { // Dot product of A & B 4. float I, C; 5. zero(C); 6. for(I=1; I<= N; I=I+1) 7. { 8. C[I] = A[I]+B[I]; 9. } 10. return C; 11. } </pre>	<p><i>ONE of the following statements in relation to the given function is FALSE. Which one?</i></p> <p>a) The function name is illegal.</p> <p>b) At line 2, the semicolon should be removed.</p> <p>c) At line 5, the argument in zero() is invalid.</p> <p>d) At line 8, the multiplication operator should be used instead of the addition operator.</p> <p>e) At line 8, the scalar C is mistakenly used as a vector.</p> <p>f) There is no additional error other than those mentioned above.</p> <hr/> <p>g) None of the above.</p>
<p>8. Consider the following program.</p> <pre> 1. main() 2. { // Test sample 3. defmat(X[K=4], 2,5,1); 4. print(Average(X,K)); 5. } 6. Average(mat A, float N) 7. { 8. float I, Sum; 9. for(I=1; I<= N; I=I+1) 10. { 11. Sum = Sum + A[I]; 12. } 13. } </pre> <p>Where function Average(mat A, float N) computes and returns the average value of the elements of vector $A_{1 \times N}$.</p>	<p><i>ONE of the following statements in relation to the given program is FALSE. Which one?</i></p> <p>a) Variables X and K in main() are global.</p> <p>b) Average() requires the return statement.</p> <p>c) At line 4, value of K is passed and stored as N in function Average().</p> <p>d) Arrays A and X share the same storage.</p> <p>e) At line 3, K does not match the data list.</p> <p>f) At line 4, since X and K are global, they must not be passed as function arguments.</p> <hr/> <p>g) None of the above.</p>
<p>9. Consider the following expressions that operate on the physical vectors A and B:</p> <pre> 1. !D = A &* B; 2. E = !A * (B-A); 3. Q = !A^2*B^2; 4. if(A==B){print("A equals B");} 5. F = !A^B; </pre>	<p><i>ONE of the following statements is false. Which one?</i></p> <p>a) Line 1 computes $D_i = A_i B_i \quad i = 1, 2, \dots, N$</p> <p>b) Line 2 computes $E = \sum_{i=1}^N A_i (B_i - A_i)$</p>

<pre> 6. !G = A*B; 7. !H = A[3] + B[1]; </pre>	<p>c) Line 3 computes $Q = \begin{pmatrix} \sum_{i=1,2,3\dots}^N A_i^2 \end{pmatrix} \begin{pmatrix} \sum_{i=1,2,3\dots}^N B_i^2 \end{pmatrix}$</p> <p>d) Line 4 gives error.</p> <p>e) Line 5 gives error.</p> <p>f) At line 6, the resulting G is a 1 by 1 matrix.</p> <p>g) Line 7 gives error.</p>
<p>10. In relation to the following expression that operates on the position vectors A and B:</p> <pre> !D = (C=B-A)/hypot(!C); </pre>	<p><i>ONE of the following statements is false. Which one?</i></p> <p>a) The expression computes the unit vector along the line AB.</p> <p>b) The computed vector D contains the direction cosines of the line AB.</p> <p>c) The computed vector C is the vector from point A to point B.</p> <p>d) The exclamation in hypot(!C) is necessary because the argument C is an array--hypot() normally accepts scalar arguments.</p> <p>e) hypot(!C) returns the length of vector C.</p> <p>f) This expression works ONLY for vectors A, B of size 1 by 3.</p> <hr/> <p>g) None of the above.</p>
<p>11. Refer to the following program.</p> <pre> 1. main() 2. { 3. defmat(U[M = 3, N = 4], 4. -2, 0, 2, 1, -1, 3, 4, 0, 5. 3, 1, -1, 3); 6. zero(R[N], C[M]); 7. F1(U, 3, 3, R); 8. F2(U, 1, 2, C); 9. print(R,C); 10. } 11. 12. F1(mat A, float M, 13. float N, mat B) 14. { 15. !B = A(M) + A(N); 16. } 17. 18. 19. F2(mat A, float M, </pre>	<p><i>ONE of the following statements in relation to the given program is FALSE. Which one?</i></p> <p>a) It has no syntax error.</p> <p>b) Matrices U, R, C are global.</p> <p>c) Value of $U_{2,3}$ is 4.</p> <p>d) Line 6 creates and initializes the vectors R and C for later use.</p> <p>e) After execution of line 7, element R_4 is 4.</p> <p>f) After execution of line 8, element C_3 is 4.</p> <hr/> <p>g) None of the above.</p>

<pre> 20. float N, mat B) 21. { 22. !B = A{M} + A{N}; 23. }</pre>	
<p>12. Refer to the following program.</p> <pre> 1. main() 2. { 3. defmat(U[M = 3, N = 4], 4. -2, 0, 2, 1, -1, 3, 4, 0, 5. 3, 1, -1, 3); 6. print(F(U, M, N)); 7. } 8. 9. F(mat A, float R, float C) 10. { 11. float I, J, Val = A[1,1]; 12. for(I=1; I<=R; I=I+1) 13. { 14. for(J=1; J<=C; J=J+1) 15. { 16. if(Val > A[I, J]) 17. { Val = A[I, J];} 18. } 19. } 20. } 21. return Val; 22. }</pre>	<p><i>ONE of the following statements in relation to the given program is FALSE. Which one?</i></p> <p>a) It has no syntax error.</p> <p>b) Line 6 prints "4".</p> <p>c) At line 9, the value of $A_{2,3}$ is 4.</p> <p>d) At line 21, values of I and J are, respectively, 4 and 5.</p> <p>e) Once F() returns, the variables I, J and Val no longer exist.</p> <p>f) Within F(), the values of R and C are, respectively, 3 and 4.</p> <p>g) Line 21 is necessary for the program to work as expected.</p>
<p>13. Consider the following expressions:</p> <pre> 1. L = hypot(A, B); 2. L = hypot(!C); 3. view(A, B, C, L); 4. G = defmat(A[3], 2, 1, 4); 5. H = defmat(A[2],2,0)* defmat(B[2], 3,4); 6. K = ! defmat(A[2],1,2)* defmat(B[2], 3,4);</pre>	<p><i>ONE of the following statements is false. Which one?</i></p> <p>a) Variables A and B in line 1 must be float-type.</p> <p>b) Variable C in line 2 must be mat-type.</p> <p>c) Function view() in line 3 can display both float- and mat-type variables.</p> <p>d) Line 4 assigns 0 to G.</p> <p>e) Line 5 assigns 0 to H.</p> <p>f) Line 6 assigns 10 to K.</p> <hr/> <p>g) None of the above.</p>

Part 2: For each question, write the answer number and its justification

Question	Answer	Reason or justification for the answer
1	(c)	M is not declared as local in main(), hence it's global by default.
2	(g)	The program works as intended.
3	(g)	
4	(e)	Local variables may have any valid names
5	(b)	When Set() is invoked in Line 4, 'A' becomes the local name of the storage of array 'M', and thus, if Set() changes 'A', it changes 'M' simultaneously.
6	(e)	If desired, matrix C can be returned with <code>return !C;</code>
7	(f)	The products are not summed properly. Line 8 should be <code>C = C+A[I]*B[I]; // with C initialized to 0 previously</code>
8	(f)	With arguments, Average() is more versatile and convenient to use.
9	(c)	Power operator is not defined for matrices (except for matrix inverse).
10	(f)	It works for vectors of any size.
11	(e)	R_3 is 6.
12	(b)	It prints number -2 (the smallest element of matrix U).
13	(f)	Line 6 assigns $(1*3+2*4) = 11$ to K.

Sample Multiple Choice Questions – Chapter 5

In Part 1: Consider carefully each question, and select the best answer
 In Part 2: Write the answer number and its reason or justification.

Part 1

The situation	In relation to the described situation:
<p>1. Consider the following program (Line numbers are added for reference only):</p> <pre style="margin-left: 20px;"> 1. main() 2. { 3. mat AB[3], u[3], F[3]; 4. // Position vectors A & B 5. defmat(A[3],1,-1,2);//Point A 6. defmat(B[3],0,1,-1);//Point A 7. ! AB = B-A; 8. ! u = AB/hypot(!AB); 9. ! F = 2500*u; 10. acos(!T = u); 11. print(AB, u, F, T); 12. }</pre>	<p><i>ONE of the following statements may be FALSE. Which one?</i></p> <p>a) The program has NO syntax error(s). b) Arrays 'A', 'B' and 'T' are global. c) Arrays 'AB', 'u' and 'F' are local. d) At the end, 'u' is the unit vector along the line AB. e) At the end, vectors 'T' and 'u' are equal. f) At the end, 'F' is a vector along the line AB, and its magnitude is 2500 units.</p> <p>-----</p> <p>g) None of the above.</p>
<p>2. Consider the following program (Line numbers are added for reference only):</p> <pre style="margin-left: 20px;"> 1. main() 2. { 3. defmat(A[3],1,-1,2);//Point A 4. defmat(B[3],0,1,-1);//Point B 5. defmat(C[3],2,-1,0);//Point C 6. !u = (T=B-A)/hypot(!T); 7. !F1 = 1000*u; 8. !F2 = 2000*(T=C-A)/hypot(!T); 9. !R = F1+F2; 10. acos(!T = R/hypot(!R)); 11. print(F1, F2, R, T); 12. }</pre>	<p><i>ONE of the following statements may be FALSE. Which one?</i></p> <p>a) The program has NO syntax error(s). b) All variables are global. c) All variables are vectors of 3 elements. d) At line 6, 'T' is the vector from A to B, but at line 8 it becomes the vector from A to C. e) At the end, 'T' contains the angles between 'R' and the axes. f) The magnitude of vector F2 is twice the magnitude of vector F1.</p> <p>-----</p> <p>g) None of the above.</p>

<p>3. Consider the following program (Line numbers are added for reference only):</p> <pre> 1. main() 2. { mat uAB[1], uAC[1], T[1]; 3. defmat(A[3],1,-1,2);//Point A 4. defmat(B[3],0,1,-1);//Point B 5. defmat(C[3],2,-1,0);//Point C 6. !uAB = (T=B-A)/hypot(!T); 7. !uAC = (T=C-A)/hypot(!T); 8. acos(!T = uAB*uAC); 9. print(T); 10. }</pre>	<p><i>ONE of the following statements may be FALSE. Which one?</i></p> <p>a) The program has NO syntax error(s).</p> <p>b) Arrays 'uAB', 'uAC', 'T' are local.</p> <p>c) At the end, arrays 'uAB', 'uAC', 'T' are vectors of 3 elements.</p> <p>d) At line 6, 'T' is the vector from A to B, but at line 7 it becomes the vector from A to C.</p> <p>e) At the end, 'T' contains the angle between the lines AB and AC.</p> <p>f) 'uAB' and 'uAC' are unit vectors.</p> <p>-----</p> <p>g) None of the above</p>
<p>4. The following program is supposed to compute the resultant force 'R' of 'N' input forces stored in 'F' (Line numbers are added for reference only):</p> <pre> 1. float N; // Number of forces 2. main() 3. { 4. mat F[N = getnum(), 3], R[3]; 5. view(F); 6. Resultant(F, R); 7. print(R); 8. } 9. 10. 11. Resultant(mat F, float R) 12. { 13. for(i=1; i<= N; i = i+1) 14. { 15. ! R = F(i); 16. } 17. }</pre>	<p><i>ONE of the following statements may be FALSE. Which one?</i></p> <p>a) Column 2 of arrays 'F' and 'R' should be for the y-components of the forces.</p> <p>b) Line 5: Size of 'F' is needed here.</p> <p>c) Line 11: type of 'R' is incorrect.</p> <p>d) In Resultant(): It is a good practice to declare 'i' local.</p> <p>e) In Resultant(): 'R' should be initialized to zero.</p> <p>f) Logical error on line 15.</p> <p>-----</p> <p>g) None of the above.</p>
<p>5. A particle (at the axis origin) is supported by 3 cables which are attached to points [A]. The particle is subject to a known resultant force {R}. The following program is supposed to compute the tensions in the 3 cables (Line numbers are added for reference only):</p>	<p><i>ONE of the following statements may be FALSE. Which one?</i></p> <p>a) User should input the coordinates of the cables' anchored points into array 'A', one point per row.</p>

<pre> 1. main() 2. { 3. mat A[3, 3], R[3]; 4. view(A,R); //Components x,y,z 5. CableTensions(A, R); 6. print(R); 7. } 8. CableTensions(mat C, mat R) 9. { // Set up equilibrium equations 10. // and solve for cable tensions 11. float i; 12. zero(D[3,3]); 13. for(i = 1; i <= 3; i=i+1) 14. { 15. !V=(Ci=C(i))/hypot(!Ci); 16. !D{i}=V; 17. } 18. solve(S,D, !R = -R); 19. }</pre>	<p>b) At line 8: 'C' is the new name for the array 'A' of main().</p> <p>c) Line 8: Parameter types, number and sequence are consistent with the function arguments in line 5.</p> <p>d) In CableTensions(), 'D' and 'V' should be declared local.</p> <p>e) Line 15: 'V' is the unit vector along cable i.</p> <p>f) Line 13: Once the for-loop terminates, 'D' contains the direction cosines of the cable lines.</p> <p>g) Line 18: At the end, 'R' contains the cable tensions.</p> <p>-----</p> <p>h) None of the above.</p>
---	---

Part 2: For each question, write the answer number and its justification

Question	Answer	Reason or justification for the answer
1	(e)	Line 10: acos() converts 'T' into the angles between 'u' and the axes.
2	(g)	All the preceding statements are TRUE.
3	(c)	Size of vector T becomes 1 by 1 in line 8.
4	(b)	'F' is an existing matrix. Its size need not be specified again in view().
5	(h)	All the preceding statements are TRUE.

Sample Multiple Choice Questions – Chapter 7

In Part 1: Consider carefully each question, and select the best answer
 In Part 2: Write the answer number and its reason or justification.

Part 1

The situation	In relation to the described situation:																
<p>1. Consider the following equations:</p> $\left. \begin{aligned} A_{11}X_1 + A_{12}X_2 + A_{13}X_3 &= B_1 \\ A_{21}X_1 + A_{22}X_2 + A_{23}X_3 &= B_2 \\ A_{31}X_1 + A_{32}X_2 + A_{33}X_3 &= B_3 \end{aligned} \right\}$ $C_1X_1 + C_2X_2 + C_3X_3 = D$ <p>where the units of X_i, B_i and D are as follows:</p> <table style="margin-left: 20px; border-collapse: collapse;"> <thead> <tr> <th style="text-decoration: underline;">Variables</th> <th style="text-decoration: underline;">Units</th> </tr> </thead> <tbody> <tr><td>X_1</td><td>kN</td></tr> <tr><td>X_2</td><td>m</td></tr> <tr><td>X_3</td><td>kN.m</td></tr> <tr><td>B_1</td><td>kN.m</td></tr> <tr><td>B_2</td><td>m</td></tr> <tr><td>B_3</td><td>Radians</td></tr> <tr><td>D</td><td>\$</td></tr> </tbody> </table>	Variables	Units	X_1	kN	X_2	m	X_3	kN.m	B_1	kN.m	B_2	m	B_3	Radians	D	\$	<p><i>ONE of the following statements may be FALSE. Which one?</i></p> <ul style="list-style-type: none"> a) The unit of C_1 is \$ b) The unit of A_{12} is kN c) The unit of A_{33} is $\text{kN}^{-1} \text{m}^{-1}$ d) The unit of A_{21} is m/kN e) The unit of A_{32} is 1/m. f) The unit of A_{21} is m/kN g) The unit of C_3 is $\text{\\$/}(\text{kN.m})$
Variables	Units																
X_1	kN																
X_2	m																
X_3	kN.m																
B_1	kN.m																
B_2	m																
B_3	Radians																
D	\$																
<p>2. Consider the following equations:</p> $\left. \begin{aligned} A_{11}X_1 + A_{12}X_2 + A_{13}X_3 &= B_1 \\ A_{21}X_1 + A_{22}X_2 + A_{23}X_3 &= B_2 \\ A_{31}X_1 + A_{32}X_2 + A_{33}X_3 &= B_3 \end{aligned} \right\}$ <p>where the units of X_i, and B_i are as follows:</p> <table style="margin-left: 20px; border-collapse: collapse;"> <thead> <tr> <th style="text-decoration: underline;">Variables</th> <th style="text-decoration: underline;">Units</th> </tr> </thead> <tbody> <tr><td>X_1</td><td>kN</td></tr> <tr><td>X_2</td><td>m</td></tr> <tr><td>X_3</td><td>kN.m</td></tr> <tr><td>B_1</td><td>kN.m</td></tr> <tr><td>B_2</td><td>m</td></tr> <tr><td>B_3</td><td>Radians</td></tr> </tbody> </table> <p>Let C be the inverse of the coefficient matrix A.</p>	Variables	Units	X_1	kN	X_2	m	X_3	kN.m	B_1	kN.m	B_2	m	B_3	Radians	<p><i>ONE of the following statements may be FALSE. Which one?</i></p> <ul style="list-style-type: none"> a) The unit of C_{11} is 1/m b) The unit of C_{21} is 1/kN c) C_{31} is dimensionless d) The unit of C_{12} is kN/m e) The unit of C_{32} is kN f) The unit of C_{23} is m g) The unit of C_{22} is m 		
Variables	Units																
X_1	kN																
X_2	m																
X_3	kN.m																
B_1	kN.m																
B_2	m																
B_3	Radians																

<p>3. Consider the following linear equation system:</p> $\mathbf{A}_{n \times m} \mathbf{X}_{m \times 1} = \mathbf{B}_{n \times 1}$	<p><i>ONE of the following statements may be FALSE. Which one?</i></p> <p>a) The solution \mathbf{X} is unique when \mathbf{A} is non-singular.</p> <p>b) The solution \mathbf{X} is exact when the residual vector is a null vector</p> <p>c) If $n > m$, the system has more equations than the number of unknowns, and the system is called "overdetermined".</p> <p>d) An overdetermined system can never have exact solution.</p> <p>e) If $n < m$, the system has more unknowns than the number of equations, and the system is called "underdetermined".</p> <p>f) An underdetermined system usually has infinite solutions.</p>
<p>4. Consider the following lines of expressions, each of which is supposed to solve the linear equation system $\mathbf{A}_{n \times m} \mathbf{X}_{m \times 1} = \mathbf{B}_{n \times 1}$ (Line numbers are added for reference only):</p> <ol style="list-style-type: none"> 1. <code>! X = A^(-1) * B;</code> 2. <code>solve(S, A, B);</code> 3. <code>solve(S, A, !X = B);</code> 4. <code>svd(A, W, V); svsolve(A,W,V,B,X);</code> 	<p><i>ONE of the following statements may be FALSE. Which one?</i></p> <p>a) All expressions require matrix \mathbf{A} to be a square matrix, and if $m \neq n$, it is necessary to pad matrix \mathbf{A} with column(s) or row(s) of zero.</p> <p>b) Expression 1 works only if matrix \mathbf{A} is well-conditioned.</p> <p>c) Expression 2 works for any system.</p> <p>d) Expression 2 stores the solution in \mathbf{B}.</p> <p>e) Expression 3 stores the solution in \mathbf{X}.</p> <p>f) The expressions in line 4 always yield solution of some kind.</p>
<p>5. The following program attempts to fit the parabola $y = C_1 + C_2x + C_3x^2$ to the three</p>	<p><i>ONE of the following statements may be FALSE. Which one?</i></p>

given points:

x	-1	0	1
y	20	10	60

(Line numbers are added for reference only)

```

1. main()
2. { // Set up and solve [A]{C}={B}
3.   defmat(B[3], 20, 10, 60);
4.   defmat(A[3,3], 1, -1, 1, 1, 0, 0, 1,
           1, 1);
5.   solve(S, A, B);
6. }
```

- a) The program has no syntax error(s).
- b) Data for {B} is correct.
- c) Data for [A] is correct.
- d) Solution for {C} is found in {B}.
- e) At the end, the original matrix [A] remains intact.
- f) solve() is good enough for this curve fitting problem.
-
- g) None of the above.

6. The following program attempts to fit the parabola $y = C_1 + C_2x + C_3x^2$ to the four given points:

x	-1	0	0.5	1
y	20	10	30	60

(Line numbers are added for reference only)

```

1. main()
2. { // Set up and solve [A]{C}={B}
3.   defmat(B[4], 20, 10, 30, 60);
4.   defmat(A[4,4], 1, -1, 1, 0,
           1, 0, 0, 0, 1, 0.5, 0.25, 0,
           1, 1, 1, 0);
5.   svd(! U = A,W,V);
6.   svsolve(U,W,V,B,C);
7. }
8. }
```

- ONE of the following statements may be FALSE. Which one?*
- a) The program has no syntax error(s).
 - b) Data for {B} is correct.
 - c) Data for [A] is correct.
 - d) Solution for {C} is found in {B}.
 - e) At the end, the original matrix [A] remains intact.
 - f) Line 7 decomposes $[A] = [U] [W][V]^T$
 -
 - g) None of the above.

7. The following program attempts to fit the parabola $y = C_1 + C_2x + C_3x^2$ to the two given points (Line numbers are added for reference only):

x	-1	0
y	20	10

```

1. main()
2. { // Set up and solve [A]{C}={B}
3.   defmat(B[3], 20, 10, 0);
4.   defmat(A[3,3], 1, -1, 1,
           1, 0, 0, 0, 0, 0);
5.   svd(!U = A,W,V);
6.   svsolve(U,W,V,B,C);
7. }
8. }
```

- ONE of the following statements may be FALSE. Which one?*
- a) The program has no syntax error(s).
 - b) Data for {B} is correct.
 - c) Data for [A] is correct.
 - d) There is an infinite set of solutions for this problem.
 - e) The length of the residual vector should be nearly zero.
 - f) Line 6 decomposes $[A] = [U] [W][V]^T$
 -
 - g) None of the above.

Part 2: For each question, write the answer number and its justification

Question	Answer	Reason or justification for the answer
1	(a)	The unit of C_1 is \$/kN.
2	(g)	C_{22} is dimensionless.
3	(d)	Exact solution exists when (i) B is null, or when (ii) the system is consistent.
4	(c)	Not good for singular matrix.
5	(e)	[A] has been destroyed by solve().
6	(d)	Line 8: Solution for C is found in C.
7	(g)	All the preceding statements are true.

Sample Multiple Choice Questions – Chapters 9, 10, 11

In Part 1: Consider carefully each question, and select the best answer
 In Part 2: Write the answer number and its reason or justification.

Part 1

The situation	In relation to the described situation:
<p>1. Consider the following program that computes, in various ways, the first derivative of the function $f(x, a, b)$:</p> <pre style="font-family: monospace; font-size: 0.9em;"> main() { xo = 0.5; Dx = 0.001; a = 1.2; b = -0.15; Df1 = (f(xo+Dx,a,b)- f(xo,a,b))/Dx; Df2 = (f(xo+Dx/2,a,b) - f(xo-Dx/2,a,b))/Dx; Df3 = deriv(x,xo,f(x,a,b)); Df4 = deriv(x,a,f(xo,x,b)); print(^,Df1, Df2, Df3, Df4); } f(float x, float a, float b) { return a*cos(x)*exp(b*x); } </pre>	<p><i>ONE of the following statements may be FALSE. Which one?</i></p> <p>a) The program has no syntax error(s)</p> <p>b) Df1 gives $\left. \frac{df}{dx} \right _{x=x_o}$ while a, b are constant</p> <p>c) Df1 and Df2 are the same derivative but Df2 should be more accurate than Df1</p> <p>d) If Dx is too small or too large, accuracy of the computed derivatives may suffer</p> <p>e) Df2 and Df3 are the same derivative</p> <p>f) Df4 is the derivative of $f(x,a,b)$ with respect to 'a'</p> <p>-----</p> <p>g) None of the above.</p>
<p>2. Consider the following program that plots the function $f(x, a, b)$ and its first derivative (12 Line numbers are added for reference only):</p> <pre style="font-family: monospace; font-size: 0.9em;"> 1 main() 2 { 3 a = 1.2; b = -0.15; 4 clearplot(); 5 plot(t,0,2*pi#,f(t,a,b)); 6 setop(C, 4); 7 plot(t,0,2*pi#, deriv(x,t,f(x,a,b))); 8 } 9 f(float x, float a, float b) 10 { 11 return a*cos(x)*exp(b*x); 12 } </pre>	<p><i>ONE of the following statements may be FALSE. Which one?</i></p> <p>a) Line 4 clears the plot window</p> <p>b) Line 5 plots $f(x,a,b)$ for varying x, and hence 'x' must be used in place of 't'</p> <p>c) Line 6 sets the color for subsequent plot</p> <p>d) Line 7 plots the derivative $\frac{df(x,a,b)}{dx}$ for varying x</p> <p>e) The plot range is from 0 to 2π</p> <p>f) The program has no syntax error(s)</p>

3. Consider the following program that plots the function $f(t, x, y)$ and its various partial derivatives:

```

1  main()
2  {
3      a = 1.2; b = -0.15;
4      clearplot();
5      plot(t,0,2*pi#,f(t,a,b));
6      setop(C, 4);
7a     plot(x,0,2*pi#,
           deriv(t,x,f(t,a,b)));
7b     plot(x,0,2*pi#,
           deriv(t,x,f(0.5,t,b)));
7c     plot(x,0,2*pi#,
           deriv(t,x,f(0.5,a,t)));

8  }

9  f(float t, float x, float y)
10 {
11     return t^2*cos(x)*exp(x*y);
12 }

```

ONE of the following statements may be FALSE. Which one?

- a) Line 7a plots the derivative $\frac{\partial f(t,a,b)}{\partial t}$ versus t
- b) $f(t,a,b)$ in line 7a can be replaced by $t^2*\cos(a)*\exp(a*b)$ to get the same plot.
- c) Line 7b plots the derivative $\frac{\partial f(0.5,x,b)}{\partial x}$ versus x
- d) Line 7c plots the derivative $\frac{\partial f(0.5,a,y)}{\partial y}$ versus y

(e) None of the above.

4. Consider the following program that computes the various partial derivatives of $f(x,y)$ at the point x_0, y_0 . (14 Line numbers are added for reference only):

```

1  main()
2  {
3      x0 = 2; y0 = 0.3;
4      D1 = deriv(u,x0,f(u,y0));
5      D2 = deriv(v,y0,f(x0,v));
6      D3 = deriv(x,x0,
           deriv(u,x,f(u,y0)));
7      D4 = deriv(y,y0,
           deriv(v,y,f(x0,v)));
8      D5 = deriv(x,x0,
           deriv(y,y0,f(x,y)));
9      cat();
10 }

11 f(float x, float y)
12 {
13     return x*y^2+exp(x);
14 }

```

ONE of the following statements may be FALSE. Which one?

- a) D1 gives $\frac{\partial f}{\partial x}$
- b) D2 gives $\frac{\partial f}{\partial y}$
- c) D3 gives $\frac{\partial}{\partial x} \left(\frac{\partial f}{\partial x} \right)$
- d) D4 gives $\frac{\partial}{\partial y} \left(\frac{\partial f}{\partial y} \right)$
- e) D5 gives $\frac{\partial}{\partial x} \left(\frac{\partial f}{\partial y} \right)$
- f) The significance of the first argument in `deriv()` depends on its position in the list of function parameters, not on its name.

(g) None of the above.

5. Consider the following program that computes the gradient and total differential at a point. (14 Line numbers are added for reference only):

```

1  main()
2  {
3      defmat(X[4], 1, 1.5, 1.2, 3);
4      zero(G[4]); // The gradient
5      grad(X, G, F(X)); // G at X
6      print(X, G);
7      defmat(Dx[4],0.01,0.2,0.15,
            0.2); // Changes in X
8      print(^^, F(X), DF = !G*Dx);
9  }

10 F(mat X)
11 {
12     float a = X[1], b = X[2],
           x = X[3], y = X[4];
13     return a*y*sin(b*x);
14 }

```

ONE of the following statements may be FALSE. Which one?

- a) {X} is the point at which the gradient is computed.
- b) grad() is a built-in function for computing the gradient. Its third argument specifies the expression in terms of the variable name in the first argument.
- c) Line 5: F(X) can be replaced by X[1]*X[2]*sin(X[3]*X[4]) without changing the computed values.
- d) Line 9: DF is the total change in F due to changes in X.
- e) Line 13: Returned value depends on {X}.
- f) The program has no syntax error.

6. Consider the following program that finds the minimum of F(m,t,w) with respect to t: (14 Line numbers are added for reference only)

```

1  main()
2  {
3      m = 0.15; W = 1000;
4      a = 0; b = 0.3;
5      to = root1(x, a, b,
           deriv(t, x, F(m, t, W)));
6      t1 = minz1(x,a,b,F(m,x,W));
7      print(^^,to,t1,F(m, to, W));
8      clearplot();
9      plot(x,a,b, F(m,x,W));
10 }

11 F(float m, float t, float W)
12 {
13     return m*W/(m*sin(t)+cos(t));
14 }

```

ONE of the following statements may be FALSE. Which one?

- a) The program determines the minimum of function F() by direct minimization.
- b) The program determines the minimum of function F() by locating the zero(s) of its first derivative.
- c) F() is minimized with respect to its second parameter while the others are fixed.
- d) Line 11: parameters 'm' and 'W' can be omitted as they are global constants.
- e) Line 5: Improper use of function argument(s).
- f) The range of t in F(.., t, ..) is from 0 to 0.3.

(g) None of the above.

<p>7. Consider the following non-related expressions, each solving a math problem. Function F(float x, float y, float z)--not show-is an existing user-defined function that returns the value of the function for any given x, y, z.</p> <pre> 1. r1 = root1(z,0,1,F(0,z,2)-0.2); 2. r2 = root1(z,0,1,deriv(t,z, F(t,1,2))+ 2*z); 3. r3 = root1(z, 0, 1, integ(t,0,z,F(1,2,t))-0.1); 4. I1 = integ(x,0,2, integ(y,x^2,2*x,F(x,y,1)-x*y)); 5. r4 = root1(z,0,1, ((F(1,z+(Dz=1e-4)/2,2)) -(F(1,z-Dz/2,2)))/Dz); </pre>	<p>ONE of the following statements may be FALSE. Which one?</p> <p>a) Line 1 solves $F(0,x,2) = 0.2$ for x</p> <p>b) Line 2 solves $\frac{\partial}{\partial x} F(x,1,2) = -2x$ for x</p> <p>c) Line 3 solves $\int_0^x F(1,2,u)du = 0.1$ for x.</p> <p>d) Line 4 computes:</p> $\int_0^2 \int_{x^2}^{2x} [F(x,y,1) - xy] dydx$ <p>e) Line 5 solves $\frac{\partial}{\partial x} F(1,x,2) = 0$ for x</p> <hr/> <p>f) None of the above.</p>
<p>8. The arc length of the curve $y = f(x)$ within the interval $a \leq x \leq b$ is given by the integral</p> $L = \int_a^b \sqrt{1 + \left(\frac{df(x)}{dx}\right)^2} dx$ <p>The following program is supposed to compute the arc length of the curve $f(x) = \int_0^x \ln(\cos t) dt$ within the interval $0 \leq x \leq \pi/3$. (11 Line numbers are added for reference only)</p> <pre> 1 main() 2 { 3 clearplot(); 4 a = 0; b = pi#/3; 5 plot(x, a, b, f(x)); 6 L = integ(x, a, b, sqrt(1+deriv(t,x,f(t))^2)); 7 } 8 f(float z) 9 { 10 return integ(z,0, t,ln(cos(z))); 11 } </pre>	<p>ONE of the following statements may be FALSE. Which one?</p> <p>a) The program has no syntax error(s)</p> <p>b) Line 6 has error(s)</p> <p>c) Line 10 has error(s)</p> <p>d) The value of $\int_0^x \ln(\cos t) dt$ is independent of t.</p> <p>e) The value of $L = \int_a^b \sqrt{1 + \left(\frac{df(x)}{dx}\right)^2} dx$ is independent of x.</p> <p>f) 'x' in Line 5 or 6 can be replaced by another name such as u, v, y, z, etc...</p> <hr/> <p>g) None of the above</p>
<p>9. The solution x of the equation $f(x) = 0$ may be found by the iterative formula:</p>	<p>ONE of the following statements may be FALSE. Which one?</p> <p>a) Function Root(float x1) is supposed to</p>

$$x_2 = x_1 - \frac{f(x_1)}{\left. \frac{df(x)}{dx} \right|_{x=x_1}}$$

where x_1 is the initial estimate of the solution.

The following program is supposed to make use of the above formula to solve for the root of the equation $xe^{3x} - x^2 - 1 = 0$. (27 Line numbers are added for reference only)

```

1  float K;
2  main()
3  {
4      float x;
5      for(x=-10; x<=10; x=x+1)
6          {
7              K = 0; N = 0;
8              Z = f(R = Root(x));
9              print(^, x, R, Z, K, N);
10         }
11     }

12 Root(float x1)
13 { // Newton-Raphson iteration
14     float Err, x2;
15     do
16     {
17         x2 = x1 - f(x1)/
18             deriv(x, x1, f(x));
19         Err = abs((x2-x1)/x2);
20         x2 = x1;
21         N = N+1;
22     } while (Err > 0.001);
23     return x2;
24 }

24 f(float x)
25 { K = K+1;
26     return x*exp(3*x)-x^2-1;
27 }
```

accept the initial estimate 'x1' and returns the final estimate of the root.

b) Function `Root(float x1)` is supposed to keep iterating until the estimated relative error of the solution is sufficiently small.

c) Function `Root(float x1)` should work fine.

d) $\left. \frac{df(x)}{dx} \right|_{x=x_1}$ is the derivative of $f(x)$ evaluated at x_1 .

e) The program tries 21 different initial estimates of the root.

f) Line 18: $x_2 - x_1$ is the difference between the two last estimated solutions—hence it may be used as an error estimate.

g) Line 8: 'x' is the initial estimate of the root, 'R' is the computed root, and 'Z' is the residual.

h) For each initial estimate, 'K' counts the number of evaluation of $f()$ while 'N' counts the number of iterations.

k) None of the above

10. The following program is supposed to compute the definite integral $\int_a^b 2xe^{-0.12x^2} \sin x \, dx$ by summing the areas of N rectangular strips under the curve.

(23 Line numbers are added for reference only)

```

1  main()
2  {
```

ONE of the following statements may be FALSE. Which one?

a) The value of $\int_a^b 2xe^{-0.12x^2} \sin x \, dx$ is independent of x

b) Function `Integral(. . .)` accepts input for integral limits, number of strips, and

<pre> 3 float a=0, b=4, N, A; 4 for(N=5; N<=40 ; N=N+5) 5 { 6 A = Integral(a,b,N); 7 print(^^, N, A); 8 } 9 } 10 f(float x) 11 { 12 return 2*x*e^(-0.12*x^2) 13 * sin x; 14 } 14 Integral(float a,float b,float N) 15 { 16 float S=0,i,dx=(b-a)/N, 17 x = a + dx/2; 18 for(i=1, i<=N, i=i+1) 19 { 20 x = x + dx; 21 S = f(x)* dx; 22 } 23 return S; 24 }</pre>	<p>returns the approximate value of the integral.</p> <p>c) Line 16 sets the width of the strip and the center of the first strip.</p> <p>d) Line 17 has syntax error(s).</p> <p>e) Lines 19 and 20 have logical errors.</p> <p>f) Higher value of 'N' generally gives better accuracy for the computed integral.</p> <p>g) Function f() has error.</p> <p>h) The program tries 8 different strip sizes.</p> <hr/> <p>i) None of the above</p>
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Part 2: For each question, write the answer number and its justification

Question	Answer	Reason or justification for the answer
1	(g)	All the preceding statements are true.
2	(b)	't' is ok. When f(t,a,b) is invoked, value of 't' is sent to 'x' in function f(x, a, b)
3	(e)	
4	(g)	All the preceding statements are true.
5	(c)	Replace F(X) by X[1]*X[4]*sin(X[2]*X[3])
6	(e)	All function arguments are ok.
7	(d)	Should be $\int_0^2 \int_{x^2}^{2x} [F(x, y, 1) - xy] \, dydx$

8	(b)	<p>Line 6 is ok.</p> <p>Notes:</p> <ul style="list-style-type: none"> - Line 10 should be: <code>return integ(t,0, z, ln(cos(t)));</code>
9	(c)	<p>Logical error. Line 19 should be <code>x1 = x2;</code> This makes 'x2' the new initial estimate 'x1' for input into the iterative formula.</p>
10	(i)	<p>All the preceding statements are true.</p> <p>Notes:</p> <ul style="list-style-type: none"> - Line 12 should be: <code>return 2*x*exp(-0.12*x^2) * sin(x);</code> - Lines 19 and 20 should be 19 <code>S = S + f(x)*dx;</code> 20 <code>x = x + dx;</code>