RDC — *ENGINEERING PROGRAM*

Pre-Engineering review questions:

Some suggestions for studying efficiently

Are you as efficient in your studying as you can be? Or are you spending a large amount of time with books and notes, but learning little because of poor study methods? The suggestions listed below are specifically meant to help you use this package efficiently, but they can be applied to any study session. We hope that by following these suggestions you will learn not only some mathematics, but the very method of how to learn it!

1. ***Attempt*** each question to the best of your ability and ***keep*** all your work in an organized binder or notebook, so that you will be able to review it later or show it to others. Remember that ***interaction*** with colleagues and/or teachers is essential for effective learning.

2. Use a ***pencil*** for your work, so that editing may be easier and clearer. However, ***do not erase errors*** that may teach you something in the long run.

3. If, for a given question, you arrive at a solution that you consider ***correct and complete***:
   - Place a ***check mark*** on the underlined space at the beginning of the question.
   - Identify which key ***methods*** you used and ***why*** they were the correct ones.
   - At the earliest opportunity you have, ***check*** with other students if they arrived at the same conclusions and ***discuss*** with them your agreement or disagreement.

4. If, for a given question, you arrive at a solution about which you are ***not fully confident***:
   - Place a ***question mark*** on the underlined space at the beginning of the question.
   - At the earliest opportunity you have, consult with other students and/or with your instructor to ***verify*** whether your conclusion is correct and complete and to ***clarify*** the reasons for your uncertainty.

5. If you ***cannot*** arrive at a correct and/or complete solution:
   - Place a ***star*** or other visible mark on the underlined space at the beginning of the question.
   - ***Identify*** the step at which you stopped.
   - Identify the ***reason*** why you had to stop.
   - If you stopped because you did not know the meaning of a word or the steps of a method, see if you can ***look it up*** in a book you have. Otherwise, at the earliest opportunity you have, ***consult*** other students and/or your instructor to learn the missing piece.

6. At the end of each section, answer the following ***self-reflective*** questions about your work:
   A) What are the ***most important*** concepts, methods and ideas of this section?
   B) Which of them are ***clear*** to me and what did I do to make them clear?
   C) Which of them are still ***confusing*** for me and why? Which one presents the biggest ***challenge*** to me? (Be as specific and practical as possible)
   D) How will I go about ***clarifying*** whatever is still confusing to me? (Be as specific and practical as possible)
   E) How do the concepts, methods and ideas of this section ***relate*** to other things I have learned, both in math and other courses?
   F) What would the ***test questions*** for this section look like? What does the instructor expect me to ***know*** and to be able to ***demonstrate***?

You may prefer to keep this list of questions in the back of your mind as you go through each section, rather than addressing them all at the end. Either way, these are very important questions, even though you may never have considered them before: there is much evidence that successful students engage in this kind of reflection on a regular basis.

But you are not done yet! What about those questions that gave you troubles? If you leave them alone, they will NOT go away! In fact they will come back when you least want them to appear, namely during a test! So, follow up on them too, as follows:

7. Periodically ***review*** the list of question you have already attempted and, for each of those that do not have a check mark:
   - If you have ***cleared*** all its problems and know how to arrive at the correct and complete conclusion, change your mark to a check mark and pat yourself on the back, or give yourself a suitable ***reward***.
   - If you are still ***unclear*** about some aspects of it, construct a realistic ***plan*** for how to resolve the lingering issues. Do so with ***confidence*** and ***determination***: you *can* learn this stuff and you will, even though it may require efforts and patience.

8. As a last step, look at how you ***wrote down*** your solution: would someone else be able to read what you wrote and understand it? Will *you* be able to understand it in a week? Keep in mind that instructors mark you on the basis of what they understand of your work. If you are messy, confused, incomplete, grammatically incorrect or otherwise difficult to read, you are not encouraging your instructor to give you a good grade. So, it is in your interest to improve your ***writing skills***, from format to grammar, from spelling to organization on the page. If you need help, there is plenty of assistance available at RDC.

Notice that there are no published *"answers"* to the questions that follow, so, how will you ***know*** whether your solution is correct and complete? This omission is done on purpose for these reasons:

- The ***goal*** of these questions is not to arrive at the answer, but to ***understand*** the nature of the question, to become ***familiar*** with the methods required to answer it and to ***develop*** a good sense for whether the conclusion makes sense.
- It is not unusual for students to arrive at the correct *"answer"* by using a whole series of ***incorrect*** steps. Therefore the focus should be on the solution process and on your efforts to develop it.

Therefore, to check your work, engage in ***discussions*** with other students and/or your instructor. Both kinds of interactions are much more fruitful than checking posted answers when it comes to real learning.

One final point: This package of questions is meant for your preparation work during the summer. Although it will also be used as the backdrop for the *Math Preparation Workshop* that will be offered during the week before classes start, you should use it regardless of your choice of attending or not that workshop:

- If you already plan to attend it, working on these questions will make the activities of that workshop much more effective.
- If you are not sure whether to attend that workshop, attempting these questions will give you a good gauge of your need for it.
- And if you plan not to attend it, you should definitely work on these questions to ensure that you will start the program with suitably strong technical skills.

Have fun with these questions and call us if you need help.

SECTION 1: LINEAR FUNCTIONS (STRAIGHT LINES)

1. ___ Determine the following features of the line that contains the points (-1, 1) and (2, 5):
a) Its slope
b) Its point-slope equation
c) Its slope-intercept equation
d) Its general equation

2. ___ Determine the slope-intercept equation, the graph and both intercepts of the line satisfying the given information:
a) It contains the points (0, 1) and (-2, 4).
b) It contains the point (-1, 2) and has a slope of -2.
c) It has slope 5 and *y*-intercept of -3.
d) It is the perpendicular bisector of the segment joining (-1, 1) and (2, 5).

3. ___ What is the equation of the line perpendicular to $y = 3x + 2$ and containing the point $(1, -2)$?

4. ___ Which common, but improper use of jargon did I use in question 3?

5. ___ Given a line of equation $y = mx + b$, find the equations of the lines parallel and perpendicular to it and containing, respectively, the point:
a) $(1, 2)$
b) (x_0, y_0)
c) $(a, 0)$

6. ___ Describe the general method that is needed to answer question 5.

7. ___ Which lines can be written in general form, but not in slope-intercept form? Why?

8. ___ Describe what a linear function is and present an example of a function that is not linear.

9. ___ Describe two common applications of linear functions.

10. ___ What are two reasons why linear functions constitute a particularly important type of functions?

SECTION 2: FUNCTIONS

11. ___ Evaluate each of the following functions at $x = 1, \pi, \sqrt{5}, \frac{1}{a}$ and express your answer in simple form.

a) $f(x) = -4.9x^2 + 3x + 20$　　b) $g(x) = 2x\sqrt{1+x^2}$

c) $h(x) = \cos x - \sec^2 x$　　d) $x(v) = \dfrac{1}{0.4v^3}$

12. ___ Given the functions $f(x) = \sqrt{3+4x}$, $g(x) = \dfrac{1}{x^2-4}$, $h(x) = \sin^2 x - \dfrac{3}{4}$, determine:

a) $f(g(x))$　　b) $g(f(x))$　　c) $h(f(x))$

d) $f \circ h(x)$　　e) The domain of $f(x)$　　i) The domain of $g(x)$

13. ___ For each of the following functions determine $\dfrac{f(x+h)-f(x)}{h}$ and express your answer in simple form.

a) $f(x) = \sqrt{3+4x}$　　b) $f(x) = \dfrac{1}{x-4}$　　c) $f(x) = x^2 - 3x$

14. ___ Describe what a function is and why functions are important in any scientific context.

15. ___ What is the connection between the equation and the graph of a line?

16. ___ In questions 11 and 13 you were asked to express the answer in simple form. How did you interpret this requirement and why? How were you asked to interpret the word "*simplify*" in the past? What problems or confusion, if any, has this word created to you in the past?

SECTION 3: BASIC WORD PROBLEMS

17. ___ A fuse has a length of 10 meters and burns at a rate of two centimetres per second when lit. What length of fuse (in cm) remains after t seconds and when will it totally burned out?

18. ___ Each time the handle of a tire jack undergoes a complete revolution, the threaded screw advances 3 millimetres. (This distance is called the *pitch*). If the jack has an initial height of 20 centimetres, what is its height after n turns?

19. ___ A bicyclist travels at a constant velocity v along a straight line, starting at the initial point s_i and finishing at the final point s_f. Write expressions to describe his location at time t and the time it takes for him to complete the journey.

20. ___ According to Hooke's Law, to extend a spring by a total distance x beyond its equilibrium position, a force $F = kx$ must be applied, where k is the spring's constant. Assume that a certain spring has an equilibrium length of 6 inches and that a weight of 2 pounds increases its length to 7 inches. Find the spring constant and express the length of the spring as a linear function of the applied force F.

21. ___ The freezing and the boiling points of water are defined as 0^oC and 100^oC in Celsius, and as 32^oF and 212^oF in Fahrenheit. Find linear equations to convert from one scale to another.

22. ___ A cowboy chases after a feisty cow along a straight path. His horse runs at a speed of 30 m/s and the cow runs at 20 m/s. If the cow begins with a 30-meter head start, express the distance between the cow and the cowboy as a function of the time t. Plot the location of the cowboy, the location of the cow, and the distance between them on the same graph. At what time does the cowboy catch up with the elusive bovine?

23. ___ Spike (who is 6 feet tall) stands at a distance of x feet from a 24 foot high street light. Express the length L of his shadow as a function of x.

24. ___ A cylindrical rain gauge consists of a graduated cylinder and an enlarged opening to collect the rain. Assume that the radius of the opening is twice the radius of the cylinder. Express the height of the water collected as a function of the amount of rain that has fallen. What is the advantage of having an enlarged opening?

25. ___ What is your preferred strategy for solving a word problem?

26. ___ Which strategies have been suggested to you in the past but have not worked for you? Why?

27. ___ Which steps in the solution of a word problem cause you most difficulties and what do you plan to do to overcome such difficulties?

28. ___ In what ways does a word problem differ from an exercise that is presented by using many words? Be as specific as possible.

SECTION 4: LINEAR SYSTEMS OF EQUATIONS

29. ___Solve each of the following systems of linear equations by using either the addition method or the substitution method:

a) $\begin{cases} 2x+3y=2 \\ 3x+2y=1 \end{cases}$ b) $\begin{cases} 2x+3y=2 \\ 4x+6y=1 \end{cases}$ c) $\begin{cases} x+y=3 \\ 2x+2y=6 \end{cases}$

30. ___What constitutes the *"solution"* of a linear system?

31. ___Solve the system of equations $\begin{cases} 2x+y=4 \\ x-y=5 \end{cases}$ by using the graphing method.

32. ___What is the geometrical interpretation of the solution set of a linear system in two variables?

33. ___The length of a rectangle is one inch more than three times its width. If the perimeter of the rectangle is 50 inches, what are its length and width?

34. ___Two angles are complementary and one of them is 6^{o} less than twice the other one. Find the measure of each angle.

35. ___Two angles are supplementary and the larger angle is 20^{o} less than three times the smaller angle. Find the measure of each angle.

36. ___Milling Machine A costs \$90,000 to purchase and \$3,000 per month to operate. Milling Machine B costs \$130,000 to purchase, but it is more efficient and costs only \$2,500 per month to operate. After how many months will the total costs of each of the two machines be the same?

37. ___Suppose that you have two solutions of the same acid from the chemistry lab. The first solution is 20% acid and the second solution is 45% acid. Both percentages are by volume. How many milliliters of each solution should you mix together to obtain 100 ml of a 30% acid solution?

38. ___Use the method of back substitution to solve the system $\begin{cases} x-2y+3z=9 \\ y+3z=5 \\ z=2 \end{cases}$

39. ___Solve each of the following systems of equations by using the substitution and elimination method. Use at each step the appropriate addition, multiplication or substitution:

a) $\begin{cases} 3x-2y+z=1 \\ x+y+z=0 \\ 2x-y+z=-1 \end{cases}$ b) $\begin{cases} x-3y+z=1 \\ 2x-y-2z=2 \\ x+2y-3z=-1 \end{cases}$ c) $\begin{cases} y-z=0 \\ x \quad -3z=-1 \\ -x+3y \quad =1 \end{cases}$

40. ___In the last two questions none of the equations involved is the equation of a line. So, why do we still call these *linear systems*? What is their connection to lines?

SECTION 5: FACTORING, EQUATIONS AND INEQUALITIES

41. ___Factor the following expression completely:

a) $3x^4 - 12x^2$ b) $4x^{7/4} + 8x^{3/4} + 4x^{-1/4}$ c) $x^2 - 5y^2$

d) $3x^3 + 24$ e) $2x^3 - 6x^2 + 2x - 6$ f) $\dfrac{x^3 + 5}{x^2 - 4}$

42. ___Explain in plain, but technically correct words, what *"factoring"* and *"factoring completely"* mean and identify what the opposite of *"factoring"* is.

43. ___Solve the following equations:

a) $3x^4 - 12x^2 = 0$ b) $4x^{7/4} + 8x^{3/4} + 4x^{-1/4} = 0$ c) $x^2 - 5y^2 = 0$

d) $3x^3 + 24 = 0$ e) $2x^3 - 6x^2 + 2x - 6 = 0$ f) $\dfrac{x^3 + 5}{x^2 - 4} = 0$

g) $16^{x^2 + x + 4} = 32^{x^2 + 2x}$

44. ___How did you use your solutions to question 41 to answer question 43?

45. ___Explain the role of factoring in the strategy for solving equations.

46. ___Solve the following equations by using the quadratic formula.

a) $2x^2 - x - 3 = 0$ b) $2y^2 - 4y + 2 = 0$ c) $x^4 + \sqrt{3}x^2 - 6 = 0$

d) $2^{2x+1} - 2^x - 3 = 0$ e) $pz^2 - qz + 3r = 0$ f) $\dfrac{3}{x^2} + \dfrac{5}{x} - 12 = 0$

47. ___Solve each of the following inequalities:

a) $3x^4 - 12x^2 \geq 0$ b) $4x^{7/4} + 8x^{3/4} + 4x^{-1/4} > 0$ c) $x^2 - 5y^2 < 0$

d) $3x^3 + 24 \leq 0$ e) $2x^3 - 6x^2 + 2x - 6 < 0$ f) $\dfrac{x^3 + 5}{x^2 - 4} < 0$

g) $2x^2 - x - 3 \leq 0$ h) $2y^2 - 4y + 2 > 0$ i) $x^4 + \sqrt{3}x^2 - 6 < 0$

j) $2^{2x+1} - 2^x - 3 \leq 0$ k) $2^{2x+1} - 2^x - 3 \geq 0$ l) $\dfrac{3}{x^2} + \dfrac{5}{x} - 12 > 0$

48. ___How did you use your solution to questions 43 and 46 to answer question 47? How does this tie in with the correct method for solving inequalities?

49. ___Show how to use the method of *"completing the square"* to obtain the quadratic formula.

50. ___In question 46 e), how did you decide which letter represented the unknown variable and which ones represented constants? Are other choices possible?

51. ___Solve the equation $y^{2x} + y^x - 2 = 0$ and describe what the solutions represent

52. ___If $x + y = 3$ and $x^2 + y^2 = 6$, how much is $x^3 + y^3$?

SECTION 6: BASIC TRIGONOMETRY

53. ___ Sketch the graph of each of the following functions by using their basic properties (such as special values, period, amplitude, asymptotes etc.) You may check the accuracy of your graph by using your graphing calculator.

a) $y = \sin\left(x + \frac{\pi}{2}\right)$ b) $y = 1 + \cos x$ c) $y = \cot x$

54. ___ Prove that $\tan\alpha + \cot\alpha = \sec\alpha\csc\alpha$.

55. ___ Prove that $(\sin\beta - \cos\beta)(\csc\beta + \sec\beta) = \tan\beta - \cot\beta$

56. ___ If an angle θ is in the first quadrant and its tangent is 4/3, what is the exact value of its cosine?

57. ___ If $\tan\gamma = 0.5$ and $\sin\gamma < 0$, find $\cos\gamma$.

58. ___ Two trains leave a railroad station at noon. The first train travels along a straight track at 140 km/hr. The second train travels at 120 km/hr along another straight track that makes an angle of 130^o with the first track. At what time will the trains be at a straight distance of 600 km?

59. ___ A small fire is sighted from ranger stations A and B. The bearing of the fire from A is N35^{o}E, and the bearing of the fire from B is N49^{o}W. Station A is 1.3 miles due west of station B.

a) How far is the fire from each ranger station?

b) At fire station C, which is 1.5 miles from A, there is a helicopter that can be used to drop water on the fire. If the bearing of C from A is S42^{o}E, find the distance from C to the fire, and find the bearing of the fire from C.

60. ___ An airplane crashes in a lake and is spotted by observers at lighthouses A and B along the coast. Lighthouse B is 1.5 miles due East of lighthouse A. The bearing of the airplane from lighthouse A is S20°E, and from lighthouse B is S42°W.

a) Find the distance from each lighthouse to the crash sight.

b) A rescue boat is already in the lake, three fourths of a mile away and at a bearing of S35°E from lighthouse B. Find the distance from the rescue boat to the airplane, in miles and feet. Also, find the bearing of the plane from the rescue boat.

61. ___ What angles α will satisfy the equation $5\sin^2\alpha + 25\sin\alpha - 2.4375 = 0$?

62. ___ Sides AB and AC of an isosceles triangle ABC have an equal length of l, and the angle at A is θ. Determine the length of the side BC and the perpendicular distance from A to BC in terms of the length l and the angle θ.

63. ___ Trigonometry has the reputation for being a difficult part of mathematics. Why do you think that is so and what can your new instructors do to help you learn and understand this important area better?

64. ___ Angles are commonly measured in either degrees or radians. What are the advantages and disadvantages of each type of measurement?

65. ___ When and why are degrees better to measure angles? When and why are radians better?

66. ___ Provide a proof of the law of sines for a triangle.

SECTION 7: DIFFERENTIAL CALCULUS

67. ___Find the first derivative of each of the following functions:

a) $f(x) = x^{10} + 50x + 1$ b) $f(t) = \sqrt{t} - \frac{1}{\sqrt{t}} + 4$ c) $G(y) = \frac{y^2 + 1}{2y - 7}$

d) $S(t) = (t-1)\sqrt{t}$ e) $h(x) = \frac{x+2}{x-1}$ f) $y = \frac{ax+b}{cx+d}$

g) $y = \frac{\sin x}{1 + \cos x}$ h) $f(\alpha) = \alpha \tan \alpha$ i) $g(t) = e^t \sin t$

j) $h(t) = e^t \ln t$ k) $y = \tan 10x$ l) $h(t) = \ln(3t + 2)$

m) $s(t) = e^{3t}$ n) $v(t) = 6\left(1 - e^{t^2}\right)$ o) $v(t) = \sqrt{t}e^{-0.2t}$

p) $y(x) = (2x+5)^2 \cos(3x+2)$

68. ___Find the first and second derivatives of the function $s(t) = 2\sin\frac{\pi t}{5} + 4$.

69. ___Two variables x and α are functions of time t and are related by the equation $64 = 9 + x^2 - 6x\cos\alpha$. Find the first derivative of x with respect to t.

70. ___The position of two machine tools moving in the *x*-*y* plane is given by the following functions of time:

a) $(x, y) = \left(30t, 9t^2\right)$ b) $(x, y) = (\cos 3t, \sin 3t)$

In each case, sketch the tool's trajectory and find the components of both velocity and acceleration.

71. ___Each of the following equations describes the flight paths of a rocket, and both coordinates *x* and *y* are functions of time *t*. Write the expressions for the first two derivatives of y with respect to *t* and describe their physical interpretation.

a) $y = x - \frac{x^2}{400}$ b) $(y - 40)^2 = 160x$

72. ___Water is leaking out of an inverted right conical tank at a rate of 10,000 cm^3/min. At the same time water is being pumped into the tank at a constant rate. The tank height is 6 m and the diameter at the top is 4 m. If the water level is rising at a rate of 20 cm/min when the height of the water is 2 m, find the rate at which water is being pumped into the tank.

73. ___Assume that you want to cut a rectangular beam out of a circular log which has a radius of 30 cm.

a) If the *"strength"* of a rectangular beam is defined as the product of its width and the square of its height, which dimensions will provide the strongest beam?
b) If the *"stiffness"* of a rectangular beam is defined as the product of the width and the cube of the height, which dimensions will provide the stiffest beam?

74. ___In your first year of engineering you will spend a substantial amount of time reviewing and deepening your understanding of differential calculus. At this point:

a) Explain what the key goal of calculus is.
b) Identify what you want to learn better in the coming months.
c) Describe what aspect of calculus appeals to you most and why.

SECTION 8: INTEGRAL CALCULUS

75. ___Evaluate the following integrals:

a) $\int \pi \, dx$ b) $\int x^{-2} \, dx$ c) $\int (\cos\theta - \sec^2\theta) d\theta$

d) $\int \frac{du}{(u-0.4)^{-3}}$ e) $\int e^x dx$ f) $\int_{-1}^{8} 6 \, dx$

g) $\int_0^1 (y^9 - 2y^5 + 3y) dy$ h) $\int_0^3 (-4.9t^2 + 3t + 20) \, dt$ i) $\int_1^2 \frac{x^3 - 3x^2 + 4}{x^2} dx$

j) $\int_a^b 35x^{-2} \, dx$ k) $\int_0^{\pi/2} (\cos A + 2\sin A) \, dA$ l) $\int_1^V \frac{dv}{-0.4v^3}$

76. ___What is the difference between the integrals in a) – e) of question 75 and those in f) – l) ?

77. ___Compute the following integrals by using the method of substitution:

a) $\int (3x+2)^{-2} \, dx$ b) $\int 2x\sqrt{1+x^2} \, dx$ c) $\int (3x+2)^{-1} \, dx$

d) $\int_0^S \frac{ds}{0.2s+10}$ e) $\int \frac{3x^2 \, dx}{\sqrt{x^3+2}}$ f) $\int \frac{6 \, dx}{(2x+1)^2}$

g) $\int \sin A \cos A \, dA$ h) $\int \tan^2 A \sec^2 A \, dA$ i) $\int_2^3 \frac{(3x^2-1) \, dx}{(x^3-x)^2}$

j) $\int_{-4}^{0} \sqrt{1-2x} \, dx$ k) $\int_0^x \frac{dt}{\sqrt{6+2t}}$ l) $\int \frac{v \, dv}{0.001v^2 + 9.81}$

m) $\int xe^{x^2} dx$

78. ___What is the difference in the solution steps between parts a) – d) and parts e) – m) of question 77?

79. ___Which rule of differentiation is behind the method of substitution?

80. ___Find the areas of the plane regions bounded by the curves:

a) $y = x^2$ and $y = 2x - x^2$

b) $y = x^2$ and $y = x^3$

81. ___What are the connections between the letter S used in the symbol for an integral and the concept of definite integral? Be as specific and thorough as possible.

82. ___Which applications of integration, besides computing areas, have you seen or heard mentioned?

SECTION 9: MOTION PROBLEMS

83. ___In each of the following equations, $y=y(t)$ represents the position at time t of an object moving along the y-axis and $\dot{y}=\frac{dy}{dt}$ represents its velocity. Find an explicit representation of $y(t)$.

a) $\frac{dy}{dt}=\frac{3t^2+e^t}{4y^3}$ b) $t^2\dot{y}+y=0$

c) $\dot{y}=e^{t-y}; \quad y(0)=1$ d) $\frac{dy}{dt}=\frac{ty+3t}{t^2+1}; \quad y(2)=2$

84. ___If the acceleration of a particle is described by the function $a(v)=v^2+1$, where $v(t)$ is the velocity at time t, find the distance travelled by the particle as a function of velocity.

85. ___If the acceleration of a particle is given by the function $a(s)=4s$, where $s(t)$ is the position at time t, find the velocity function $v(s)$.

86. ___As a train starts travelling along a straight track at 2 m/s, it is subjected to an acceleration given by $a=60v^{-4}$, where v is in m/s. Determine the velocity and position of the train after 3 seconds.

87. ___A particle travels from the origin towards the right along the x axis, with a velocity given by $v=\frac{5}{4+s}$ m/s, where s is the distance in metres from the starting point. Determine its position when t=6 seconds.

88. ___A particle moves with an accelerated motion such that $a=ks$, where s is the distance from the starting point and k is a proportionality constant. When s=2 ft, the velocity is 4 ft/s, and when s=3.5 ft, the velocity is 8 ft/s. What is s when v=0?

SECTION 10: VECTORS

89. ___If $\vec{a}=\langle 1,2,-1\rangle$ and $\vec{b}=\langle 3,-1,0\rangle$ are two 3-dimensional vectors, determine:

a) the vector $\vec{a}+\vec{b}$ b) the magnitude $\|\vec{a}+\vec{b}\|$ c) the magnitude $\|2\vec{a}\|$

90. ___Given the vector $\langle 2,1,-2\rangle$ determine its magnitude and the unit vector along its direction.

91. ___Given the vectors $\vec{a}=\langle 1,-1,2\rangle$ and $\vec{b}=\langle 2,-1,-2\rangle$, find:

a) their scalar product $\vec{a}\bullet\vec{b}$;
b) the angle between $\vec{a}$ and $\vec{b}$;
c) a vector that is orthogonal to $\vec{a}$;
d) a vector that is parallel to $\vec{b}$.