

1. (10 points):  $\frac{4-i}{3-i} = \left(\frac{4-i}{3-i}\right) \left(\frac{3+i}{3+i}\right) = \frac{(4-i)(3+i)}{3^2-i^2} = \frac{13+i}{10} = \frac{13}{10} + \frac{1}{10}i.$

2. (15 points): The rational roots of  $p(x) = x^3 - 7x^2 + 17x - 15$  are among  $\pm 1, \pm 3, \pm 5, \pm 15$ . Since  $p(3) = 0$  it follows that 3 is a root of  $p(x)$  and thus  $x-3$  is a divisor of  $p(x)$ . Dividing  $p(x)$  by  $x-3$  gives a quotient of  $x^2 - 4x + 5$ . By the quadratic formula the roots of  $x^2 - 4x + 5$  are  $2+i$  and  $2-i$ . Thus a)  $3, 2+i, 2-i$  (**10 points**) and b)  $(x-3)(x^2 - 4x + 5)$  (**5 points**).

3. (15 points): Since  $4+i$  is a root of  $p(x)$ , and  $p(x)$  has real coefficients,  $\overline{4+i} = 4-i$  must be a root also (**3 points**). Since  $-3$  is a root of  $p(x)$ , and  $p(x)$  has degree 3,  $p(x) = a(x - (-3))(x - (4+i))(x - (4-i)) = a(x+3)(x^2 - 8x + 17)$  for some real number  $a$  (**5 points**). Since  $13 = p(2) = a(2+3)(2^2 - 8 \cdot 2 + 17) = a(5)(5)$  we conclude that  $a = \frac{13}{25}$  (**3 points**). Therefore  $p(x) = \frac{13}{25}(x+3)(x^2 - 8x + 17)$  (**4 points**).

4. (20 points): a)  $\ln(x-7) + \ln x = \ln 44$  implies  $\ln((x-7)x) = \ln 44$  which implies  $(x-7)x = 44$  (**4 points**). The latter holds since  $\ln$  is one-one. Now  $(x-7)x = 44$  if and only if  $0 = x^2 - 7x - 44 = (x-11)(x+4)$ . Thus  $x = 11$  is a solution (**6 points**) since it checks. (Note that  $x = -4$  is NOT a solution since  $-4$  is not in the domain of  $\ln$ .)

b)  $3e^{2x+5} = 11$  is the same as  $e^{2x+5} = \frac{11}{3}$ . Applying  $\ln$  to both sides we obtain  $2x + 5 = \ln\left(\frac{11}{3}\right)$

(**5 points**) and thus  $x = \frac{\ln\left(\frac{11}{3}\right) - 5}{2} \approx -1.850$  (**5 points**).

5. (20 points): a)  $3200 \left(1 + \frac{.096}{4}\right)^{4 \cdot 7} \approx 6216.540$  (**10 points**). b)  $3 \cdot 3200 = 3200e^{.096x}$  or  $3 = e^{.096x}$  (**5 points**). Applying  $\ln$  to both sides we have  $\ln 3 = .096x$  so  $x = \frac{\ln 3}{.096} \approx 11.444$  (**5 points**).

6. (20 points): a) All real numbers except for  $x = 6/11$  (**3 points**). b)  $y = 4/11$  (**3 points**). c)  $x = 6/11$  (**3 points**). d) At  $x = -3/4$  (**3 points**). e) At  $y = -1/2$  (**3 points**). e) Labeling (**3 points**) and shape of graph (**2 points**).