

12. [10 points] Consider the rational function below where  $n$  is a **positive whole** number.

$$Q(x) = \frac{(3x - 1)(x + 1)^2(x - 2)}{(x + 1)^n(x - 3)}.$$

For each blank below, choose the best possible answer from the bottom of the page. There is only one best answer for each blank.

- a. [2 points]  $Q(x)$  has a hole at  $x = -1$  \_\_\_\_\_.
  
- b. [2 points]  $Q(x)$  has a vertical asymptote at  $x = -1$  \_\_\_\_\_.
  
- c. [2 points]  $Q(x)$  has no horizontal asymptotes \_\_\_\_\_.
  
- d. [2 points]  $Q(x)$  has a horizontal asymptote at  $y = 0$  \_\_\_\_\_.
  
- e. [2 points]  $Q(x)$  has a vertical asymptote at  $x = \frac{1}{3}$  \_\_\_\_\_.

**Possible answers:**

- for any possible value of  $n$                       for no possible values of  $n$
  
- for  $n \geq 2$                       for  $n \geq 3$                       for  $n \geq 4$                       for  $n = 1, 2$                       for  $n = 1, 2, 3$
  
- for  $n = 1, 2, 3, 4$                       for  $n = 2, 3$                       for  $n = 2, 3, 4$                       for  $n = 3, 4$
  
- for  $n = 1$  only                      for  $n = 2$  only                      for  $n = 3$  only                      for  $n = 4$  only