Do not turn this page until you have received the signal to start.
(Please fill out the identification section above, and read the instructions below.) Good Luck!

This midterm consists of 5 questions on 6 pages (including this one). When you receive the signal to start, please make sure that your copy is complete. If you do any rough work, indicate clearly what you want marked.

# 1: _____/ 3
# 2: _____/ 3
# 3: _____/ 4
# 4: _____/ 4
# 5: _____/ 5
TOTAL: _____/19
Assume all code is in a file starting with:

```racket
#lang racket
(require 2htdp/image)
```

Rough incomplete work can earn part marks, and prevent loss of marks if we can see you made a simple arithmetic error changing the final answer (if it doesn’t simplify the question).

**Question 1.  [3 MARKS]**

```racket
; What are the first and last additions performed/executed to evaluate (a 16).
; What is the value of (a 16).  
(define (a n)
  (if (= n 1)
      2
      (+ n (a (/ n 2)))))
(a 16)
```

**Question 2.  [3 MARKS]**

```racket
; What is displayed when evaluating (b 13).
; What is the value of (b 13).  
(define (b n)
  (displayln n)
  (if (even? n)
      (+ 1 (b (/ n 2)))
      (if (= n 1)
          0
          (b (+ (* 3 n) 1)))))
(b 13)
```
Question 3. [4 MARKS]

What is the value of (c 3).
What are the first 5 values displayed.

(define (c n)
  (displayln n)
  (if (positive? n)
      (* (c (- n 2)) (c (- n 1)))
      (+ n 2)))

(c 3)

Question 4. [4 MARKS]

What image is the value of (d 4).

(define (d n)
  (if (zero? n)
      empty-image ; an image with zero width and height
      ; recall that 'above' and 'beside' align the image centres
      (above (beside (d (- n 1))
                (d (- n 1)))
             (square 3 'solid 'black))))

(d 4)
Question 5.  [5 marks]

#| What is the value of (e 3 0).
   What is displayed?
   Just make sure you draw taller pictures taller than shorter ones. |#
(define (e d n)
  (display (text (number->string n) ; a picture of the number 'n'
    (* 10 (+ d 1)) ; the height of the picture
    'black))
  (if (zero? d)
      (+ n 1)
      (e (- d 1)
        (e (- d 1)
          (+ n 1))))))
(e 3 0)

Total Marks = 19