COMP105 Class Test

Worth 25% of total marks for the module
TIME ALLOWED : 50 minutes
Electronic devices are not permitted

Answer all questions. Answers should be filled in on the computer-readable answer sheet.

Section A – Recursion

1. The function `t` is defined as follows.

```
t 0 = 0
t 1 = 1
t 2 = 2
t n = t (n-3)
```

What is the result of the following query?

```
ghci> t 7
```

A. `2`

B. `3`

C. `0`

D. `1`

E. The query results in an infinite loop.

2. The function `f` is defined as follows.

```
f []     = []
f (x:xs) = x : (f xs) ++ [x]
```

What is the result of the following query?

```
ghci> f [1,2,3]
```

A. `[1,2,3,1,2,3]`

B. `[1,2,3,3,2,1]`

C. `[3,2,1,3,2,1]`

D. `[3,2,1,1,2,3]`

E. The query results in an error.

3. The function `g` is defined as follows.

```
g []       = []
g [x]      = [x]
g (x:y:xs) = y : g xs
```

What is the result of the following query?

```
ghci> g "abcd"
```

A. `"bd"`

B. `"bc"`

C. `"ac"`

D. `"ad"`

E. The query results in an error.

4. Using the same definition of `g` as given in Question 3, what is the result of the following query?

```
ghci> g [1,2,3,4,5]
```

A. `[2,4]`

B. `[1,3]`

C. `[2,4,5]`

D. `[1,3,5]`

E. The query results in an error.

5. The function `h` is defined as follows.

```
h []     acc = acc
h (x:xs) acc = h xs (acc + 2 * x)
```

What is the result of the following query?

```
ghci> h [1,1,1,1] 0
```

A. `15`

B. `4`

C. `8`

D. `30`

E. The query results in an error.

6. The function `h` given in Question 5 is an example of:

A. Mutual recursion.

B. List recursion.

C. Tail recursion.

D. Lazy evaluation.

E. Multiple recursion.

7. The function `p` is defined as follows.

```
p []     = 0
p (x:xs) = x + p xs + p xs
```

What is the result of the following query?

```
ghci> p [3,2,1]
```

A. `9`

B. `17`

C. `11`

D. `6`

E. The query results in an error.

Section B – Higher order functions

8. What is the result of the following query?

```
ghci> map (\ (x,y) -> y ) [(1,2), (3,4), (5,6)]
```

A. `[(2,1), (4,3), (6,5)]`

B. `[3,7,11]`

C. `[1,3,5]`

D. `[2,4,6]`

E. The query results in an error.

9. What is the result of the following query?

```
ghci> filter (\ x -> length x <= 2 ) ["a", "ab", "abc", "abcd"]
```

A. `["a", "ab"]`

B. `["a"]`

C. `["a", "ab", "abc"]`

D. `["a", "ab", "abc", "abcd"]`

E. The query results in an error.

10. What is the result of the following query?

```
ghci> foldr (\ x acc -> x ) 0 [1,2,3,4]
```

A. `1`
B. `0`
C. `4`
D. `10`
E. The query results in an error.

11. What is the result of the following query?

```
ghci> scanl1 (\ acc x -> acc ) [1,2,3,4]
```

A. `[4,3,2,1]`
B. `[1,1,1,1]`
C. `[1,2,3,4]`
D. `[4,4,4,4]`
E. The query results in an error.

12. The functions `d` and `d_list` are defined as follows.

```
d (x, y) = (x `div` 2, y / 2)

d_list xs ys = map d (zip xs ys)
```

What is the result of the following query?

```
ghci> d_list [10, 20] [4, 8]
```

A. `[(5,2),(10.0,4.0)]`
B. `[(5,10),(2.0,4.0)]`
C. `[(5,2.0),(10,4.0)]`
D. `[(5.0,10.0),(2,4)]`
E. The query results in an error.

13. What is the *most general* type annotation for the function `d` from Question 12?

A. `(Fractional a, Integral b) => (a, b) -> (a, b)`
B. `(Integral a, Fractional b) => (a, b) -> (a, b)`
C. `(Int, Float) -> (Int, Float)`
D. `(Integer, Double) -> (Integer, Double)`
E. `(a, b) -> (a, b)`

14. What is the result of the following query?

```
ghci> map (+1) . filter (<2) $ [1,2,3,4]
```

A. `[1,2]`
B. `[1]`
C. `[2,3]`
D. `[2]`
E. `[]`

15. The function `curry` is defined in the following way.

```
curry f = (\ x y -> f (x, y) )
```

What is the type of `curry`?

A. `(a -> a -> a) -> ((a, a) -> a)`
B. `((a, b) -> c) -> (a -> b -> c)`
C. `(a -> b -> c) -> ((a, b) -> c)`
D. `((a, a) -> a) -> (a -> a -> a)`
E. The function will cause a compilation error.

Section C – Custom types

16. The following custom data type will be used in Questions 16 and 17.

```
data Shape = Circle | Square | Triangle deriving (Show, Eq, Ord, Read)
```

What is the result of the following query?

```
ghci> Circle < Square && Square < Triangle
```

A. `True`
B. `Circle`
C. `False`
D. `Triangle`
E. The query results in an error.

17. What is the result of the following query?

```
ghci> read "Triangle" :: Int
```

A. `2`

B. `3`

C. `Triangle`

D. `"Triangle"`

E. The query results in an error.

18. Consider the following custom type.

```
data Point a = Point a a deriving Show
```

Which of the following points would produce an error, if typed into ghci?

A. `Point (1, 1) (2, 2)`

B. `Point True False`

C. `Point 1 3`

D. `Point "hi" "there"`

E. `Point 'a' "b"`

19. The function `add_maybes` is defined in the following way.

```
add_maybes (Just x) (Just y) = Just (x + y)
add_maybes Nothing  Nothing  = Nothing
```

What is the result of the following query?

```
add_maybes (Just 3) Nothing
```

A. `3`

B. `Maybe 3`

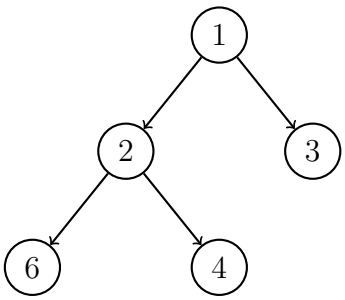
C. `Just 3`

D. `Nothing`

E. The query results in an error.

20. Consider the following custom data-tree type.

```
data DTree a = Leaf a | Branch a (DTree a) (DTree a) deriving Show
```



The tree above can be represented as a `DTree Int` in ghci like so

```
ghci> let tree = Branch 1 (Branch 2 (Leaf 6) (Leaf 4)) (Leaf 3)
```

Suppose that we have loaded the following function into ghci.

```
tree_f (Leaf x)       = x
tree_f (Branch x l r) = tree_f l + tree_f r
```

What is the result of the following query?

```
ghci> tree_f tree
```

A. `10`

B. `16`

C. `7`

D. `13`

E. `3`

Section D – General questions

21. Suppose that you are programming in an imperative language, and you are using a one-argument subroutine called `sub`. You call `sub` with the argument `"hello"` and it returns the integer `3`. You call `sub` with the argument `"hello"` a second time, and it returns the integer `9`. What can you conclude about `sub`?

A. `sub` has no side effects.

B. `sub` is a pure function.

C. `sub` is deterministic.

D. `sub` is not deterministic.

E. None of the above are true for `sub`

22. You now call the zero-argument subroutine `open`. You observe that `open` opens a connection to an external webserver, and always returns the integer `0`. Which of the following statements is true?

A. `open` is a pure function, because it is deterministic and has no side effects.

B. `open` is a pure function, because it is deterministic.

C. `open` is a pure function, because it has no side effects.

D. `open` is not a pure function, because it is not deterministic.

E. `open` is not a pure function, because it has side effects.

23. The IO action `act` is defined as follows.

```
act :: IO Int
act = do
    x <- return 1
    y <- return 2
    z <- return 3
    return y
```

What is *returned by* the following query?

```
ghci> act
```

A. `1`

B. `2`

C. `IO 1`

D. `IO 2`

E. The query produces an error.

24. Using the action `act` from Question 23, what is the result of the following query.

```
ghci> act + 2
```

A. `4`

B. `IO 4`

C. `IO 3`

D. `3`

E. The query produces an error.

25. Consider the following function:

```
mystery = 0 : 1 : zipWith (+) mystery (tail mystery)
```

What is the result of the following query?

```
ghci> take 6 mystery
```

A. `[0,1,1,2,3,5]`

B. `[0,1,0,2,0,4]`

C. `[0,1,2,3,5,8]`

D. The query produces an error.

E. The query enters an infinite loop.

Do not turn this over until the start of the test.

End