PRIFYSGOL ABERYSTWYTH - ABERYSTWYTH UNIVERSITY

DEGREE EXAMINATIONS 2011-2012 SEMESTER 1

FACULTY OF SCIENCE

Computer Science, CS10410: The Mathematics Driving License for Computer Science

Time allowed: 2 hours

Calculators are not allowed in this examination.

Answer all questions.

X	1	2	3	4	5	6	7	8	9	10	11	12
1	1	2	3	4	5	6	7	8	9	10	11	12
2	2	4	6	8	10	12	14	16	18	20	22	24
3	3	6	9	12	15	18	21	24	27	30	33	36
4	4	8	12	16	20	24	28	32	36	40	44	48
5	5	10	15	20	25	30	35	40	45	50	55	60
6	6	12	18	24	30	36	42	48	54	60	66	72
7	7	14	21	28	35	42	49	56	63	70	77	84
8	8	16	24	32	40	48	56	64	72	80	88	96
9	9	18	27	36	45	54	63	72	81	90	99	108
10	10	20	30	40	50	60	70	80	90	100	110	120
11	11	22	33	44	55	66	77	88	99	110	121	132
12	12	24	36	48	60	72	84	96	108	120	132	144

Figure 1: a simple "Times Table" for the numbers 1 to 12

Turn over

1. This question concerns sets.

   a) Let A = {4,6,8,9,12,45,99}. What is $| A |$?

      [2 marks]

   b) Let A = {black,blue,yellow,orange,pink} and let B = {green,black,yellow}.
      (i)   What is A ∪ B?

            [2]

      (ii) What is A ∩ B?

            [2]

      (iii) What is A \ B?

            [2]

   c) Let A = {red,green,orange}, and let B = {pear,pepper}.
      What is A × B?

      [2]

   d) Suppose A = {4,7,10}. What is $\mathcal{P}$ A?

      [2]

   e) What is $\mathcal{P}\emptyset$? What is $| \mathcal{P}\emptyset |$?

      [2]

   f) Suppose A = {x | 5 < x < 13 } and B = {x | 9 < x < 21}.
      (i) Complete the definition: A ∪ B = {x | ... } by adding a suitable
           membership condition for A ∪ B.

           [2]

      (ii) Complete the definition: A ∩ B = {x | ... } by adding a suitable
           membership condition for A ∩ B.

           [2]

   g) Let A = {ball,bat,mallet} and let B = {shuttle,bowl,bat}.
      Using {a,b} as a tag set, evaluate the disjoint union A+B

      [2]

2. This question concerns numbers, logarithms and exponents.

a) Does 0.3×11.1 evaluate to a rational number? Explain your answer.

[2]

b) Write 9.642 to two significant figures.

[2]

c) Write 0.06512 to three decimal places.

[2]

d) Simplify $2^9 \div 2^5$. Express your answer as a power of 2.

[2]

e) What is the greatest common divisor of 36 and 48?

[2]

f) Rewrite $10^4 = 10000$ in logarithmic form.

[2]

g) Rewrite $\log_2 64 = 6$ in exponential form.

[2]

h) If $2^4 = 16$, what is $16^{\frac{3}{4}}$?

[2]

i) What is the decimal value of the binary number 110.11?

[2]

j) Express the binary number 1001 1011 as an octal number and as a hex number.

[2]

3. This question concerns formula manipulation.

a) Simplify $7a + 4a^2 + a - 5 - 3a - a^2 + 6$

[2]

b) Simplify $7x - (4x - 5y + 2)$

[2]

c) Simplify $\frac{a}{5} \times \frac{a^5}{b}$

[2]

d) Simplify $\frac{(3a-3)(a+3)}{(a-5)} \div \frac{(a-1)}{(a-5)}$

[2]

e) Expand $(3x - 3)(2x + 3)$

[2]

f) What are the factors of $x^2 - 5x + 6$

[2]

g) What values of y satisfy $2y^2 + 2y - 4 = 0$?

[2]

h) Rearrange $y = \frac{7-x}{4}$ to make x the subject of the equation.

[2]

i) What values of a and b simultaneously satisfy $a + 3b = 10$ and $2a - b = -1$?

[2]

j) If $y = 2$, and $y = \frac{4y-6}{(x-1)}$, what is the value of x?

[2]

4. This question concerns probability and statistics

   a) A bag contains a pink ball, a blue ball, a yellow ball, an orange ball and a grey ball. List all the possible outcomes of drawing a single ball at random from the bag.

   [2]

   b) Six Computer Science students and three Physics students put their names into a hat.

   (i) A name is drawn at random from the hat. What is the probability that it is a Computer Science student's name?

   [2]

   (ii) If two names are drawn from the hat, what is the probability that they are both Computer Science students' names?

   [2]

   c) Two dice are thrown and their scores are added together. What is the probability that the sum of the scores is 4?

   [2]

   d) A web application was tested by nine users. The following response times (in seconds) were recorded:

   $$2, 3, 3, 4, 4, 3, 1, 3, 13$$

   (i) What is the mode of the set of response times?

   [2]

   (ii) What is the median response time?

   [2]

   (iii) What is the mean response time?

   [2]

   (iv) What is the range of the set of response times?

   [2]

   (v) What is the variance of the set of response times?

   [2]

   (vi) Give two plausible explanations for the unusually slow response time (13 seconds) recorded by one user.

   [2]

5. This question concerns truth tables, logic and reasoning.

a) Write a truth table for $A \wedge B$ where $\wedge$ stands for for logical **and** (conjunction).

[2]

b) (i) Write a truth table for the Boolean formula $A \wedge (B \vee C)$, where $\wedge$ stands for logical **and** and $\vee$ stands for logical **or**.

[2]

   (ii) Write a truth table for the Boolean formula $A \vee (B \wedge C)$, where $\wedge$ stands for logical **and** and $\vee$ stands for logical **or**.

[2]

c) (i) Write a truth table for $A \Leftrightarrow B$, where $\Leftrightarrow$ stands for logical equivalence (iff).

[2]

   (ii) Which assignments of truth values to A and B satisfy $A \Leftrightarrow B$?

[2]

d) Rewrite each of the following statements as a quantified logical expression.

   (i) Every mouse is a rodent

[2]

   (ii) Some mice are brown

[2]

e) An argument is logically valid if, given the truth of its premises, then the truth of its conclusion is guaranteed. An invalid argument contains a structural flaw that breaks this relationship between the truth of the premises and of the conclusion.

   A valid argument can be sound or unsound. A valid argument is sound if it is based on true premises, and unsound if it is based on false premises.

   For each of the following arguments, state whether or not it is valid and whether or not it is sound.

   (i) All students like curry
       Jeremy is a student
       Therefore Jeremy likes curry

[2]

   (ii) All Mazda cars are red
        I see a red car
        The car that I see is a Mazda.

[2]

   (iii) Every bicycle has two wheels
         A `Raleigh Chopper` was a bicycle
         Therefore a `Raleigh Chopper` had two wheels.

[2]