1.4 DATA TYPES & STRUCTURES · 1.4.1 A-LEVEL

Floating point numbers

Original practice questions · 30 marks · about 45 minutes · spec 1.4.1(g)(h)

Convention for this paper. Floating point numbers use an **8-bit mantissa** and a **4-bit exponent**, both in two's complement, with the binary point immediately after the mantissa's sign bit.

Instructions. Answer all questions. Marks are shown in brackets [ ]. Show your working — method marks are available.

1

Total: 4 marks

(a) State the formula that gives the value of a floating point number from its mantissa and exponent. **[1]**

(b) State which part of a floating point number determines its **precision**. **[1]**

(c) State which part determines its **range**. **[1]**

(d) State how the position of the binary point in the mantissa is interpreted. **[1]**

2

Total: 6 marks

Convert each floating point number to denary. Show your working.

(a) Mantissa `0.1100000`, exponent `0010`. **[2]**

(b) Mantissa `0.1011000`, exponent `0011`. **[2]**

(c) Mantissa `1.0110000`, exponent `0010`. **[2]**

3

Total: 6 marks

Convert each denary number to a normalised floating point number. Show your working.

(a) `6.5` **[3]**

(b) `-6.5` **[3]**

4

Total: 5 marks

(a) Explain the purpose of normalising a floating point number. **[2]**

(b) The number mantissa `0.0011010`, exponent `0100` is **not** normalised. Write it in normalised form. Show your working. **[2]**

(c) State the effect on the stored number of increasing the number of **mantissa** bits. **[1]**

5

Total: 6 marks

Two floating point numbers are: A = mantissa `0.1010000` exp `0010`, and B = mantissa `0.1100000` exp `0001`.

(a) Calculate A + B, giving your answer as a normalised floating point number. Show your working (align exponents, add mantissas, renormalise). **[5]**

(b) State why the result had to be renormalised. **[1]**

6 Total: 3 marks

(a) Give the most negative number that can be stored with this 8-bit mantissa and 4-bit exponent, as a denary value. Show your working. **[2]**

(b) State what is meant by *underflow*. ______________________ **[1]**

END OF QUESTIONS