2001 Paper 3 Question 10

Numerical Analysis I

For IEEE Single Precision $\beta = 2$, $p = 24$, $e_{\max} = +127$, $e_{\min} = -126$. Explain these parameters. How many bits are required to store the *exponent* and the *significand*, respectively? How is the exponent stored? [6 marks]

By means of a table, or otherwise, describe how the following quantities are represented: *zero*, *denormal numbers*, *normalised numbers*, *infinities* and *Not a Number* (*NaN*). [5 marks]

Let ω represent any of the operations $+ - * $ or $/$. Let x be any normalised or denormal number or $\pm$ 0. Writing n for any *NaN* value, what do the following evaluate to?

(a) $x \ \omega \ n$

(b) $\pm \infty \ \omega \ n$

(c) $x \ \omega \ \pm \ \infty$

(d) $\sqrt{\pm \infty}$

[6 marks]

Let z be the smallest representable positive normalised number. What are the values of the following?

(e) z

(f) the largest representable number smaller than z

(g) the smallest representable positive number

[3 marks]