1996 Paper 11 Question 2

Modula-3

Explain the purposes of the Modula-3 reserved words `NIL`, `NULL`, `REFANY` and `TYPECASE` and describe how they are used in the following program.

```
MODULE Sub EXPORTS Main;

IMPORT IO, Fmt;

TYPE
  RefLink = REF Link;
  Link = RECORD val : CARDINAL; next : RefLink := NIL END;

PROCEDURE ToText (r : REFANY) : TEXT =
  BEGIN
    TYPECASE r OF
      NULL        => RETURN "NIL"
    | RefLink (r1) => RETURN Fmt.Int (r1^.val) & "::" &
                                              ToText(r1^.next)
      ELSE
        RETURN "** Unknown Type **"
      END
    END ToText;

VAR
  jack : RefLink;
  jill := NEW (RefLink, val := 4);

BEGIN
  jill^.next := NEW (RefLink, val := 7,
                               next := NEW (RefLink, val := 11));
  IO.Put (ToText(jack) & "\n");
  IO.Put (ToText(jill) & "\n")
END Sub.
```

[6 marks]

What is output by the program? Explain how this comes about.   [4 marks]

Explain the use of the Modula-3 functions `ISTYPE` and `NARROW`.   [4 marks]

Suppose `TYPECASE` were missing from Modula-3. Rewrite the procedure `ToText` using `ISTYPE` instead. Explain the operation of the revised procedure.   [6 marks]