# Instructions

Teacher's Notes

## Lesson Plan

| Length | 60 mins | Specification Link | 214/pq | |
|---|---|---|---|---|
| Learning objective | | Candidates should be able to:<br>(p) explain how instructions are coded as bit patterns<br>(q) explain how the computer distinguishes between instructions and data | | |

| Time (min) | Activity | Further Notes |
|---|---|---|
| 10 | As a revision of previous work and to prepare for this lesson, ask the students to describe the fetch–decode–execute cycle covered in episodes 7 and 8.<br><br>Inform the students that in this lesson they will be looking at the nature of these instructions.<br>Using a projector, display the **Interactive Starter Activity**. | The cycle in the CPU in which instructions are fetched from memory. The control unit then decodes the **instruction** to ascertain what action to perform and then carries out the command. |
| 10 | Watch the video, pausing to discuss the content. | |
| 5 | Discuss the video to assess learning. Ask questions such as:<br>• What are opcodes and operands?<br><br>• In what form is the information in the opcode and operand encoded? | Answers:<br><br>They are the components of each of the instructions.<br>The opcode specifies the operation that is to be performed, e.g. add numbers or store data in a register.<br>The operand stores the data that is to be used or the register in which it can be found or has to be stored.<br>As binary bit patterns. |
| 15 | **Worksheet 1**<br>Students to complete Worksheet 1 either on paper or on computer. They may need access to the Internet to research some of the questions.<br>Ask individual students for their answers and discuss with the class so that all students will have the correct answers. | Answers provided.<br><br>Ask students with the correct responses to explain to the class how they arrived at their answers. |
| 10 | The students use **Interactive Activity 1**. | |
| | **Extension Challenge/Homework**<br>Students to complete and submit **Worksheet 2** for homework. | |

| Time (min) | Activity | Further Notes |
|---|---|---|
| 10 | **Plenary – Test a friend interactive activity**<br>The students should work in pairs to test each other's knowledge using this interactive activity. | |

## WORKSHEET 1 ANSWERS

**1** **(a) Explain what is meant by 'machine code' or 'machine language'.**

Machine code or machine language is a system of instructions and data executed directly by the central processing unit of a computer.

**(b) State the format in which the instructions are coded.**

The instructions are encoded in binary.

**(c) What is the name given to the range of instructions that can be executed?**

The instruction set.

**(d) State whether there is a common set of instructions or if each set is unique for each processor or family of processors.**

The instructions are unique for each processor type.

**2** **Each machine code instruction consists of two fields.**

**State the names of each of these fields and the information that they contain.**

The two fields are the opcode and the operand.

The opcode specifies the operation that is to be performed, e.g. add numbers or store data in a register.

The operand stores the data that is to be used or the register in which it can be found or has to be stored.

**3** **Explain what mnemonics are and why they are used by programmers.**

A mnemonic is a word that is used to represent an opcode, as it is difficult for programmers to remember all of the opcodes in binary format and use them accurately when coding algorithms.

**4** The following table shows part of the instruction set of a particular microprocessor that uses 4 bits for opcode and 8 bits for the operand.

| Opcode | Mnemonic | Explanation |
|---|---|---|
| 0000 | STO | Store data at memory location indicated by the operand. |
| 0001 | LOAD | Load the number located in the operand |
| 0010 | LOAD | Load the number found at the memory location indicated by the operand. |
| 0100 | ADD | Add the number located in the operand. |
| 1000 | ADD | Add the number found at the memory location indicated by the operand. |

(e) Give the opcodes and operands for the following:

(i) Load the number 13.

| Opcode | Operand |
|---|---|
| 0001 | 0001101 |

(ii) Load the number found at memory location 6.

| Opcode | Operand |
|---|---|
| 0010 | 00000110 |

(iii) Add the number 113.

| Opcode | Operand |
|---|---|
| 0100 | 01110001 |

(iv) Load the number 10, add the number 21 and store the result at memory location 30.

| Opcode | Operand |
|---|---|
| 0001 | 00001010 |
| 0100 | 00010101 |
| 0000 | 00011110 |

(f) State the data that would be found at memory location 30.

000011111

## WORKSHEET 2 ANSWERS

In both parts to this question there are two marks for each advantage and therefore two points must be made for each – a statement and an explanation of why it is an advantage.

**1** **(a) Explain what is meant by the following:**

**(i) an opcode** **(2)**

An opcode is the portion of a machine language instruction (1) that specifies the operation to be performed by a microprocessor. (1)

**(ii) an operand.** **(2)**

The operand contains either the data that has to used in an operation (1) or a memory address where data can be found or stored. (1)

**(b) How is the information contained in opcodes and operands coded?** **(1)**

In binary format.

**(c) State the name for the words that programmers use to represent opcodes.** **(1)**

Mnemonics.