Level 3 Diploma/Extended Diploma in Advanced Manufacturing Engineering (4515)

May 2025 Version 1.0

Unit 322 Principles of Machining Processes

Mark Scheme - Version A - Sample

Introduction

This document **must** be held securely by centres and **not** made available to candidates.

Test conditions

All tests must be sat in **closed book conditions**, so notes or textbooks **cannot** be used. Tests should be taken under supervised conditions; this means that all activities will be completed with an invigilator present. Candidates may take the questions in their normal learning environment and the tutor may act as the invigilator. It is the centre's responsibility to ensure that each candidate's responses are their own and their own only.

How to use and mark tests

The tests should be printed along with their cover sheets and handed out to candidates immediately before they take the test.

The tests are intended to be completed by the candidate in writing; however, at the assessor's discretion the questions may be completed through oral questioning where this method of assessment is more suitable for the candidate. If an electronic recording device is used during oral questioning:

- the assessor and candidate must identify themselves at the start of the recording
- the questions asked and candidate's responses must be clearly recorded
- the data files must be saved and filed in a manner that assures their security and ease of retrieval for quality assurance purposes.

The tests are graded **pass** or **fail** only.

Where candidates do not achieve the necessary pass mark, they can be given a chance to re-sit at a later date.

Security and storage of assessment materials

Candidates should on no account be allowed to take question papers or answers away with them, and copies of question papers and answer packs should be kept securely by the centre at all times.

Candidate's completed answer sheets **must** be retained securely by centres for quality assurance purposes following certification. Currently this is for a period of **three** years from the date of certification, this may be in electronic format. After this time the papers may be securely destroyed. They **must** not be given to the candidate.

Knowledge Test – Version A

Unit 322 Principles of Machining Processes

For Tutor/Assessor use only

Below is the marking guide for the knowledge test. Please note that the guide is not exhaustive and that tutors/assessors must exercise their professional judgement when marking candidates' work as to the acceptability of answers.

To achieve a pass, candidates must achieve **40%** (60 marks)

Question/ Ref	Marking guide	Total marks
1 (AC1.1)	1 mark for **each** characteristic and 1 mark for **each** description to a maximum of 4 marks. • Uses a rotating cutter (1) to remove material from the side of the workpiece (1). • Spindle is parallel to worktable (1) for making deep cuts/removing large amounts of material (1). • Can produce accurate parts (1) with tight tolerances (1). • Typically accommodate larger workpieces (1) than vertical milling machines (1) Accept any other suitable response.	4
2 (AC1.2A)	1 mark for **each** relevant point to a maximum of 4 marks. For example: • This type of machine requires a deep box section to achieve great rigidity (1) and oppose any distortion (1) so as to produce work of high precision and quality in terms of dimensional accuracy and surface texture (1). • Strength (1) to support the tool mount (1) • Stability (1) • Control of movement (1) Accept any other suitable response.	4
3 (AC1.3)	1 mark for **each** correct stage of mounting to a maximum of 4 marks. • The position of the holes must be marked out on the floor (1). • Holes are drilled/chiselled, large enough for the barb section to enter (1). • Rag bolts located and clamped, for position and height. (1) • Holes filled with concrete (1). • Leave for a period so that the concrete has hardened before bolting the machine tool to the floor (1). Accept any other suitable response.	4
4 (AC1.4)	1 mark for **each** relevant point to a maximum of 2 marks.	2

	• Machine equipment keeps its tolerances (1) therefore always meeting the customer specifications (1) • Tool wear is detected (1) allowing tools to be changed to avoid poor machined surfaces (1) • Cutting tool assembly checked (1) to avoid errors when machining (1) Accept any other suitable response.	
5a (AC1.5)	1 mark for **each** relevant factor and 1 mark for **each** explanation to a maximum of 4 marks. • Concentricity (1) when the centre lines of the spindle and chuck are parallel, but not coaxial / not sharing the centreline (1) this causes a constant error value as you travel away from the chuck to the tailstock (1) • End float (1) movement of the spindle caused by worn bearings (1) this creates misalignment of the spindle (1) creating heat (1) and vibration (1) • Coaxial alignment (1) the spindle and chuck must be parallel and on the same centreline (1) to prevent heat build-up (1) vibration (1) and loading (1). Accept any other suitable response.	4
5b (AC1.5)	1 mark for **each** relevant point to a maximum of 2 marks. • Stick-slip is the spontaneous jerking motion (1) that can occur while two objects are sliding over each other (1). Accept any other suitable response.	2
6 (AC1.6)	1 mark for **each** stage to a maximum of 4 marks. • Place DTI in chuck so that the plunger is at right angles to the spindle (1) • Position engineers square on table with the blade upwards (1) • Set the DTI at the top of the blade and note the reading (1). • Feed the DTI downwards for a set length and note the reading (1) • Move the engineers square 90º to the first position and repeat the test (1) Accept any other suitable response and accept alternative appropriate standard tests.	4
7 (AC2.1)	1 mark for **each** relevant point to a maximum of 2 marks. • Greater power transmission (1) • Avoidance of slippage (1) • Greater accuracy of fine movement (1) • Lower chance of issues due to accidental/inadvertent lubrication (1) Accept any other suitable response.	2
8 (AC2.2)	1 mark for **each** relevant point to a maximum of 4 marks.	4

	• The cam is mounted on a shaft (1) and turned by a handle/motor (1). • As the cam rotates (1) the follower rises and falls (1) thus producing linear/reciprocating motion (1). • The profile of this motion is determined by the shape of the cam (1). Accept any other suitable response.	
9 (AC2.3)	1 mark for **each** relevant point to a maximum of 4 marks. • The output shaft has a pair of manually adjusted conical pulley halves, through which a wide drive belt from the motor pulley loops (1) • A hand wheel is used to reduce the width of gap between the two halves (1) • The gear ratio between the fixed pulley and the output shaft alters when the position of the pulley is adjusted on the cone (1), it reduces/increases the speed (1) • A tension pulley is used to ensure the belt is kept at a constant tension (1). Accept any other suitable response.	4
10a (AC2.4)	1 mark for **each** relevant point to a maximum of 3 marks. • The hydraulic pump, driven by a motor (1) is linked to a hydraulic cylinder which transmits pressurised hydraulic fluid. (1) The motor speed may be varied to increase/decrease hydraulic fluid flow (1). Accept any other suitable response.	3
10b (AC2.4)	1 mark for the relevant **method** and 1 mark for the **explanation** to a maximum of 2 marks. • Variable capacity pump (1) • Differential cylinders (1) • Bleed valves (1) • Pressure control valves (1) • Sequence valves (1) Explanation such as: • by controlling the volume/pressure of fluid within the system (1) Accept any other suitable response.	2
11a (AC2.5)	1 mark for **each** relevant point to a maximum of 3 marks. • The compressor alters the physical volume of the compression chamber (1) by adjusting the swash plate/port control/valves (1). • This changes the amount of air pumped into the system (1), changing the pressure (1). • As pressure increases the speed of movement increases (and vice versa) (1). Accept any other suitable response.	3

11b (AC2.5)	1 mark for the relevant **method** and 1 mark for the **explanation** to a maximum of 2 marks. • Directional control valves (1) Supply air throttling (1) • Exhaust air throttling (1) • Pressure reducing valves (1) • Pressure operated valves (1) Explanation such as: • by managing the release of air within/from the system to maintain/reduce the pressure (1) Accept any other suitable response.	2
12 (AC3.1)	1 mark for **each** relevant advantage and 1 mark for the explanation of **each**, up to a maximum of 6 marks. 1 mark for **one** relevant limitation. 1 mark for the explanation to a maximum of 2 marks. Advantages: • Precision of work produced (1). CNC machines execute a program, and it will do so exactly the same time and time again (1), the work produced is of higher quality than a conventional machine (1) • Rate of production (1). CNC machine tools do not require breaks/can work 24/7 (1) and programmers can apply the most efficient cutting conditions to attain the best cycle times (1) • Accuracy of work to be machined (1). CNC machine tools can generate complex motions (1), producing shapes that are in most cases extremely difficult to produce on conventional machine tools (1) Limitations: • Programming skills would be required to operate the machine tools (1) therefore adding the cost of additional training requirements (1). • CNC machines are more expensive than manually operated machines (1) which means that higher initial capital investment is required (1). Accept any other suitable response.	8
13a. (AC3.2)	1 mark for **each** relevant point to a maximum of 2 marks. • An open loop control system does not make use of feedback (1) which means that the output signal does not influence the input signal (1) **Or** • is set up to provide a predetermined output (1) which is not influenced by feedback (1).	2

	Accept any other suitable response.	
13b. (AC3.2)	1 mark for **any** relevant operating principle and 1 mark for explanation up to a maximum of 2 marks. • Use of microcontrollers (1) which allow programmable operation (1) • Use of sensors (1) to ensure accuracy/precision/reliable operation (1) Accept any other suitable response.	2
14a (AC3.3)	1 mark for **each** relevant point to a maximum of 2 marks. • Canned cycles are a set of codes used for a predetermined machining sequence (1) usually called into the part-program by one code command (G Code) (1) • They allow one compact block of code to command many moves (1) • They are permanently stored within the machine (1) and cannot be altered by the user (1). Accept any other suitable response.	2
14b (AC3.3)	1 mark for **each** relevant point to a maximum of 2 marks. • A sub-routine is a program within a program (1) which can be called at any point during the main program (1) to avoid repetition of code (1). Accept any other suitable response.	2