



UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
(ONLINE)
SEMESTER I
SESSION 2020/2021**

COURSE NAME : METROLOGY AND MEASUREMENT
COURSE CODE : BDX 10402
PROGRAMME : BDX
EXAMINATION DATE : JANUARY/FEBRUARY 2021
DURATION : 2 HOURS
INSTRUCTION : **SECTION A: ANSWER ALL
QUESTIONS IN THIS SECTION.**
**SECTION B: ANSWER
TWO (2) QUESTIONS ONLY FROM
THREE (3) QUESTIONS PROVIDED IN
THIS SECTION.**

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THIS PAPER CONSISTS OF NINE(9) PAGES

SECTION A

Instruction: Please answer all questions in this section.

- Q1**
- (a) Metrology can be categorized into **THREE (3)** types. Identify all those types and explain at least **ONE (1)** of them. (6 marks)
- (b) Differentiate the characteristic of precise measurement tools and accurate measurement tools (6 marks)
- (c) A shaft for aircraft is fabricated to have interference fit with a bearing. In between-process inspection, a machinist measure the diameter of the shaft using a digital micrometer. Suggest **at least ONE (1)** practice during measurement that could cause random error and systematic error. (6 marks)
- (d) Height gauges and surface plate are used in measuring parts that are considerably large. Considering about temperature effect, workpiece weight and size, select the best material of the surface plate that suitable in measuring engine parts after metal cutting process. Give reason for your selection by arguing the advantages and disadvantages of the surface plate selected. (7 marks)
- Q2**
- (a) With examples, compare the difference between graduated and non-graduated measuring tools. (4 marks)
- (b) A hole with depth of 50mm and diameter of 10 mm is to be inspected during machining process. The measurement need to be controlled in ± 0.05 mm for the depth and ± 0.005 mm for the diameter. You are given a vernier caliper, depth micrometer, tubular-type micrometer and caliper type micrometer. From these instruments, select the best instrument to measure the depth and diameter of the hole. Give reason for your selection. (6 marks)
- (c) Screw thread can be measured using direct and indirect measurement method. Select the measuring instrument that can be used to measure screw diameter for each methods and discuss the influence of applying the methods from the point of measurement accuracy. (8 marks)
- (d) A metal block need to be machined to get a flat surface with roughness need to be controlled according to part drawing. From the part drawing in **Figure Q2**, demonstrate the surface roughness measurement method including the measuring direction, sampling length and judgement value. (7 marks)

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SECTION B

Instruction: Please answer TWO (2) questions from THREE (3) questions provided in this section.

- Q3** (a) Read the measurement from **Figure Q3** in metric and imperial. Show your calculation for imperial reading. (6 marks)
- (b) Bolt and screw diameter can be measured using profile projector. Examine the major factor contribute to reading error from the point of the measurement tool characteristics and workpiece handling. (6 marks)
- (c) A precision machine structure was inspected using autocollimator. The Z axis structure and X Y table must be perpendicular with maximum error of 0.2 degree. The rectile image in the autocollimator was 2 mm shifted downwards from center position. Calculate the Z axis shaft angle against X-Y plane. The Autocollimator focal length is 200 mm. Illustrate the condition of the Z axis structure. (8 marks)
- (d) A circular aluminum plate is polished to mirror surface in hard disc drive manufacturing. The surface need to be perfectly flat and no scratches are allowed. Select a method of inspection when the time and accuracy is crucially important. Support your selection from the point of equipment accuracy, source or error and error compensation method. (5 marks)
- Q4** (a) Turning process need to be done on a shaft of aircraft landing gear. The shaft need to be clamped into a three-jaw chuck of a lathe machine. Suggest the instrument and their accessories and how to use it during workpiece setup. (5 marks)
- (b) The surface after lathe process was measured using a portable roughness tester machine. The measurement cut-off length was 0.8mm and the data for the first 0.8mm from the total evaluation length are as shown in Table Q4.
- i. Find the R_{max} from the first sampling length (4 marks)
- ii. Find R_z if the measurement R_z of the other four (4) sampling area were, 1, 1, 1.5, 2 and $3\mu\text{m}$. (4 marks)
- (c) If the product specification states that the R_z must be atmost $2\mu\text{m}$, what is the justification for the shaft measured in Q4 (b)?

(4 marks)

- (d) According to ISO 9000 standard, measurement processes is to be considered as a support to obtain excellent quality level. Criticise the advantages of measurement from the point of product quality and manufacturing cost and customer satisfaction. (8 marks)

Q5 (a) Interpret the drawing in **Figure Q5 (a)** and **(b)**. (4 marks)

- (b) For the part in **Figure Q5 (a)** and **(b)**,
- i. Select the appropriate measuring instrument. (2 marks)
 - ii. Using schematic diagram, demonstrate how it can be measured. (4 marks)

(c) Two engineering parts come with technical drawing as shown in **Figure Q5 (c)**. Using MMC level 4, examine the virtual dimension and virtual condition. (8 marks)

(d) Coordinate measuring machine (CMM) is widely used in reverse engineering activity. Criticize the features that make CMM is preferred in reverse engineering works. (7 marks)



END OF QUESTIONS

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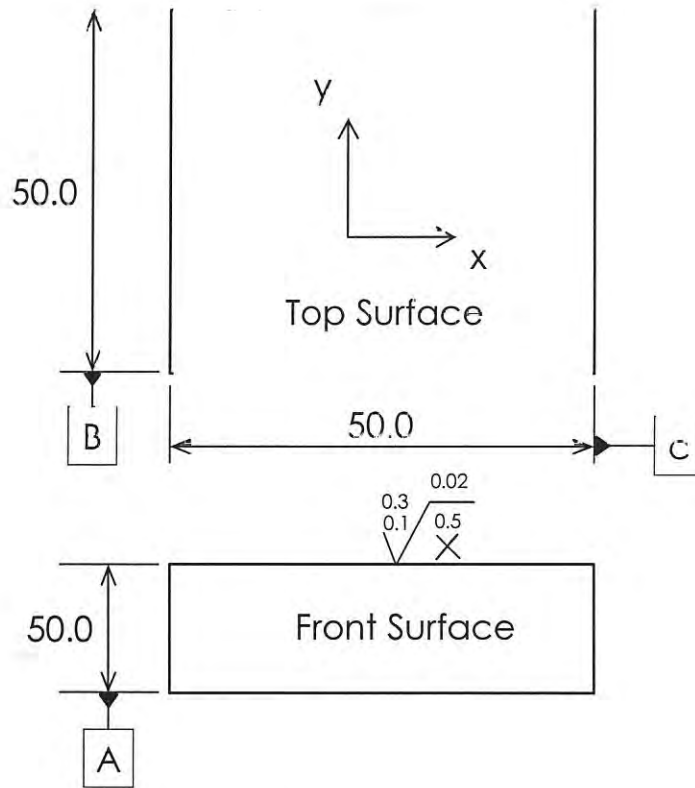


Figure Q2

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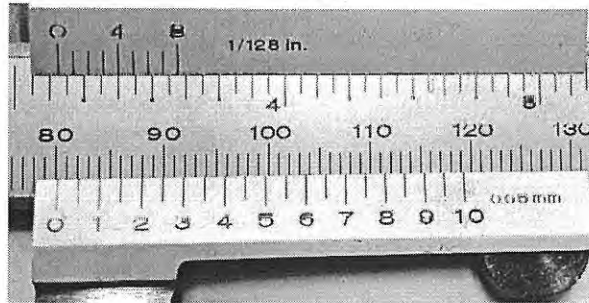


Figure Q3

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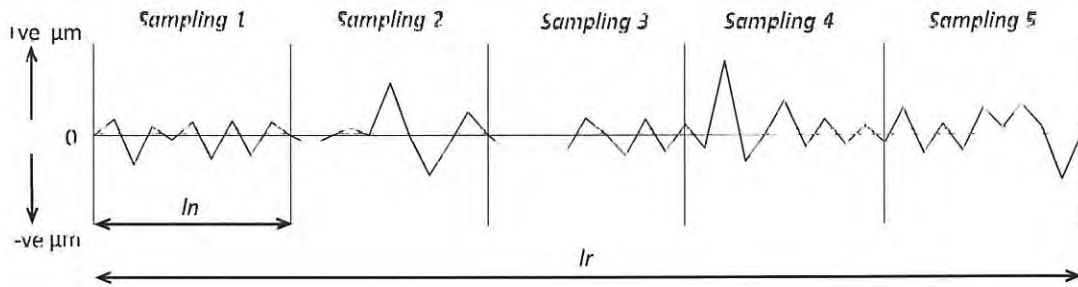


Figure Q4

Table Q4

Measurement data from Sampling 1

Point no.	Value (μm)
1	2
2	-3
3	1
4	-1
5	1.5
6	-2.5
7	5
8	-1
9	2
10	0



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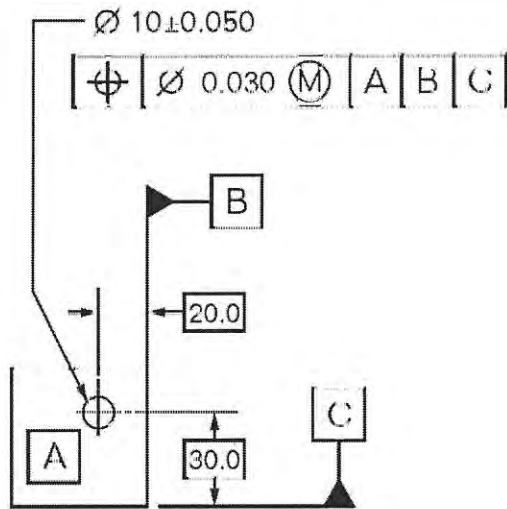


Figure Q5 (a)

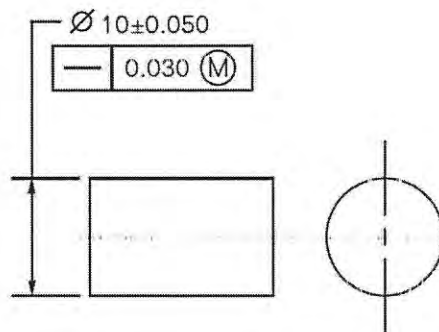


Figure Q5 (b)

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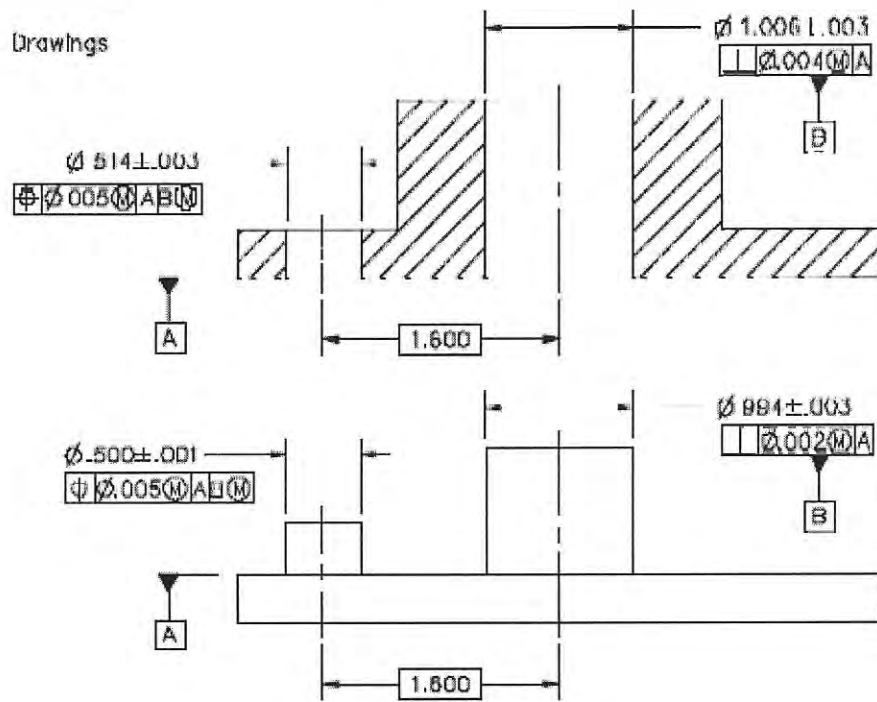


Figure Q5 (c)

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