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SET B

UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION

JANUARY 2010 SESSION

SUBJECT CODE	:	FGD 12102
SUBJECT TITLE	:	METROLOGY
LEVEL	:	DIPLOMA
TIME / DURATION	:	12.30pm – 2.30pm (2 HOURS)
DATE	:	05 MAY 2010

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. Please write your answer on the answer booklet provided.
4. Answer should be written in blue or black ink except for sketching, graphic and illustration.
5. This question paper consists of TWO sections. Section A and B. Answer ALL questions in section A. For section B answer THREE (3) questions only.
6. Answer all questions in English.

THERE ARE 9 PAGES OF QUESTIONS AND 2 PAGES OF TOLERANCE TABLE, EXCLUDING THIS PAGE.

SECTION A (Total: 25 marks)

INSTRUCTION: Answer ALL questions.

Please use the objective answer sheet as provided.

1. What was the main problem with early methods (i.e. in ancient Egypt etc) related to the measurement systems?
   A. Same method of measuring the same thing
   B. Measures were not standardized
   C. Complex standards being used
   D. The use of official system of measurement units

2. The ability of two or more operators to obtain consistent results repeatedly when measuring the same set of parts and the same measuring instruments is called,
   A. Accuracy
   B. Precision
   C. Reliability
   D. Validity

3. According to Ancient Greek, metrology is defined as,
   A. Science of Measurement
   B. Measurement of Science
   C. Study of Measure
   D. Measure of Study

4. The correct physical quantity for temperature (i.e. thermodynamic) in Metric System (SI Unit) is,
   A. Celcius
   B. Kelvin
   C. Fahrenheit
   D. Watts

5. Accuracy maybe defined is several ways. Which of the following is correct?
   A. Accuracy is the measure of precision
   B. Accuracy is the measure of conformity
   C. Accuracy is the measure of reliability
   D. Accuracy is the measure of validity

6. Which of the following terms relates most closely to precision?
   A. Closeness of tolerance
   B. The number of measurements within a specified standard
   C. Ratio of correct to incorrect readings
   D. Refinement of measurement readings

7. Type of GD&T control for form includes:
   A. Profile of a Line, Circular Runout, Total Runout
   B. Straightness, Flatness, Roundness
   C. Angularity, Perpendicularity, Parallelism
   D. Position, Concentricity, Symmetry

8. Steel rulers are not recommended for control of high production. Which of the following is the best explanation for this?
   A. They do not have sufficient accuracy for most production
   B. They are more subject to instrumental error than most instruments
   C. They are insufficient reliable and less precision
   D. They are more low cost and easy to be used

9. Which of the following describes the parallax error?
   A. It is another name for the instrumental error
   B. It is the apparent shifting of an object when the position of the observer is changed.
   C. It is an error caused by the distance between the scale and the feature being measured.
   D. It is the difference in measurement that occurs when the object is viewed from the left instead of the right or vice versa

10. Which of the following methods is the best way to eliminate parallax error?
   A. Close one eye when taking the measurement
   B. Align the instrument so that the scale being read is along the line of measurement.
   C. Take the measurement in various angles
   D. Take the measurements first from one side, then from the other side, and then average them.

11. Some calipers have clamp screw so that they maybe locked to a fixed opening. Which of the following best describes the proper use of this feature?
    A. It keeps them from opening up when not in use
    B. It provides a memory of the last measurement
    C. It enables them to be used as snap gauges
    D. It prevents the measurement from being lost if the caliper is dropped

12. Which of the following is the greatest limitation of vernier height gauge?
    A. Accuracy of the column scale
    B. Low amplification of vernier instruments
    C. Wear of base
    D. Lack of stability

13. What is the major advantage of the micrometer over the vernier caliper?
    A. Easier to carry
    B. Greater precision
    C. Easier to read
    D. More accuracy

14. One limitation of micrometer is,
    A. Suitable for end measurement only
    B. Require oiling during use
    C. Need temperature control of frame
    D. Short measuring range

15. The primary purpose of wringing the gauge blocks is to:
    A. Remove air from between them
    B. Clean them
    C. Calibrate them
    D. Detect cracks in them

16. Which of the following people is generally credited with having the greatest influence on gauge blocks?
    A. Hjalmar Ellstrom
    B. Henry Ford
    C. Eli Whitney
    D. Carl Edvard Johansson

17. Which of the following is the best criterion for the selection of a set of gauge blocks?
    A. Lowest overall price
    B. Lowest price per block
    C. Sufficient range to provide one group of blocks for every dimension likely to be used.
    D. Best cost-effectiveness based on the number of people who maybe making up similar measurements at the same time.

18. When compared to other methods of measurement, which of the following is the main advantage of gauge blocks?
    A. Gauge blocks are self-calibrating
    B. Gauge blocks methods are relatively slow
    C. Gauge blocks provide better precision and reliability
    D. Gauge blocks methods have a longer range

19. What other terms are used for pneumatic gauging?
    A. Hole gauging
    B. Air gauging
    C. Coordinate gauging
    D. Feeler gauging

20. Which of the following is the primary purpose of calibration?
    A. To detect wear and adjustment malfunctions of the instruments
    B. To determine whether or not an instrument that is inadequate for the requirement is being used.
    C. To detect errors due to parallax and other careless procedures
    D. To determine the adherence of an instrument or process to standards

21. What is the basic principle of calibration?
    A. Comparison with a higher standard
    B. Examination of repetitive measurements
    C. Measurement under constant temperature conditions
    D. Use of high precision equipments

22. What is a Universal Bevel Protractor?
    A. Any instrument that measures all bevels
    B. A protractor with a vernier scale and adjustable blades
    C. A combined protractor and linear measuring instruments
    D. An instrument that can be used either gauge blocks or vernier scale to measure angles.

23. What is the limitation of a Universal Bevel Protractor?
    A. Measure acute angles only
    B. Measures obtuse angle only
    C. Discrimination of 5 minutes
    D. Discrimination of between 30 seconds to 10 minutes

24. Which of the following is the best description of sine bar?
    A. It is a steel bar that holds cylinders at an accurate spacing
    B. It is a hypotenuse in physical form of steel bar that can be set up with various sine lengths to form angles.
    C. It is the combination of a sine instrument, gauge blocks and surface granite table.
    D. It is a bar that always holds cylinders at 100mm centers

25. Which of the following designation/occupational title in the manufacturing industry most likely dealt with metrology in their daily job?
    A. Forklift Driver
    B. Material Handler
    C. Store Keeper
    D. QC Inspector

SECTION B (Total: 75 marks)

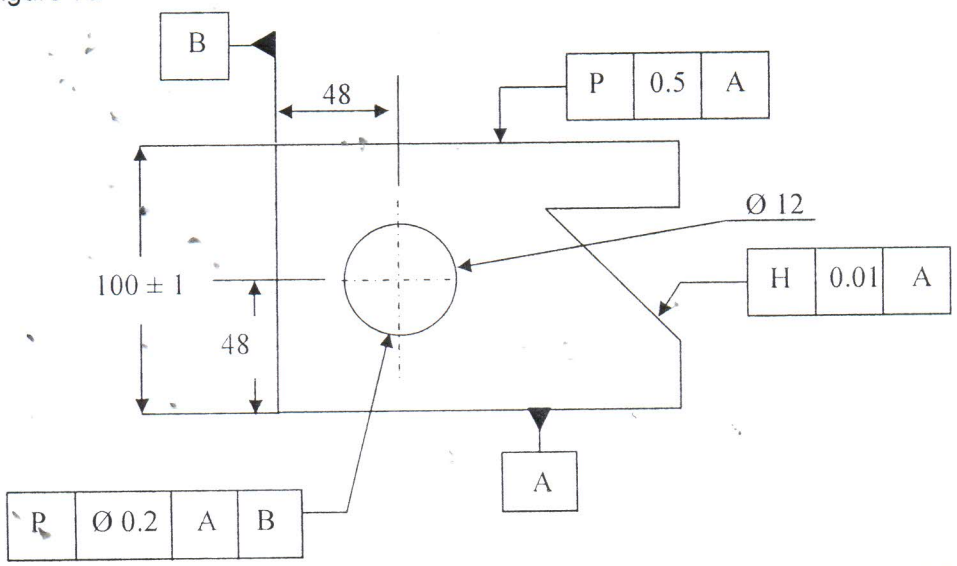
INSTRUCTION: Answer only THREE questions.

Please use the answer booklet as provided.

Question 1

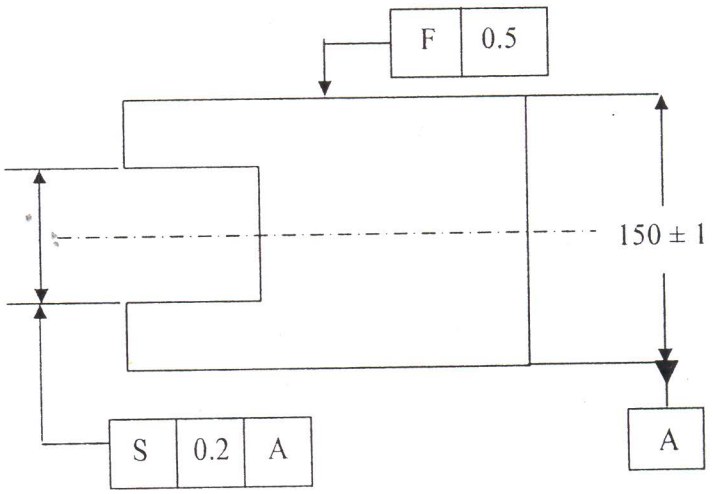
Explain the types of inspection that could be done in the figure below.

(a) Figure 7a



(15 marks)

(b) Figure 7b



(10 marks)

Question 2

Use Table 2.1 and 2.2 to answer the following questions:

Table 2.1: Types of Equipments

Equip. No	Equipment	Measuring Range	Measuring Accuracy
1	Vernier Caliper	0 – 200 mm	0.02 mm
2	Vernier Caliper	0 – 250 mm	0.02 mm
3	External Micrometer	0 – 25 mm	0.01 mm
4	External Micrometer	25 – 50 mm	0.01 mm
5	Digital Height Gauge	0 – 300 mm	0.01 mm
6	Gauge Blocks Set	0 – 100 mm	0.001 mm

Table 2.2: Types of Work pieces

Work piece	Feature	Max Dimension	Std Tolerance
A	Cylinder (i.e. Piston)	Φ40 mm	± 0.01 mm
B	Shaft (i.e. Cam Shaft)	Φ15 mm	± 0.05 mm
C	Round (i.e. Ball Bearing)	Φ100 mm	± 0.02 mm
D	Rectangular (i.e. Engine Block)	Length = 240 mm	± 0.04 mm
E	Hole (Blind)	Depth = 50 mm	± 0.02 mm
F	Rectangular Part	Height = 150 mm	± 0.04 mm
G	Hole	Φ10 mm	± 0.04 mm
H	Rectangular Block	Height = 50 mm	± 0.03 mm

(a) Select the appropriate equipment (s) in Table 2.1 that can be used to measure the dimension for each work piece A ~ H in Table 2.2.

(16 marks)

(b) Indicate rating or ranking of the accuracy and precision for the equipments in Table 2.1 with "Best", "Moderate" or "Poor".

(9 marks)

Question 3

Describe and give an example for each of the following principal terms used by the LIMITS and FITS:

(a) Maximum limit size

(5 marks)

(b) Nominal size

(5 marks)

(c) Tolerance

(5 marks)

(d) Maximum Material Condition (MMC)

(5 marks)

(e) Least Material Condition (LMC)

(5 marks)

Question 4

Determine the 'Close running' tolerances for a shaft and hole that have a basic diameter of **85** mm. The specification is **85 H9 / 85 f6.** Find:

i. Maximum clearance (4 marks)

ii. Define the specification (5 marks)

iii. Minimum clearance (4 marks)

	Hole	Shaft
Tolerance Grade		
Upper deviation		
Lower deviation		
Max Diameter		
Min Diameter		
Ave Diameter		

(12 marks)

END OF QUESTION

TOLERANCE GRADE TABLE (Appendix)						
BASIC SIZE	TOLERANCE GRADE					
	IT 6	IT 7	IT 8	IT 9	IT 10	IT 11
0-3	0.006	0.010	0.014	0.025	0.040	0.060
3-6	0.008	0.012	0.018	0.030	0.048	0.075
6-10	0.009	0.015	0.022	0.036	0.058	0.090
10-18	0.011	0.018	0.027	0.043	0.070	0.110
18-30	0.013	0.021	0.033	0.052	0.084	0.130
30-50	0.016	0.025	0.039	0.062	0.100	0.160
50-80	0.019	0.030	0.046	0.074	0.120	0.190
80-120	0.022	0.350	0.054	0.087	0.140	0.220
120-180	0.025	0.040	0.063	0.100	0.160	0.250
180-250	0.029	0.046	0.072	0.115	0.185	0.290
250-315	0.032	0.052	0.081	0.130	0.210	0.320
315-400	0.036	0.057	0.089	0.140	0.230	0.360

Source : Preferred Metric Limits and Fits , ANSI B4.2-1978. See also BSI 4500

FUNDAMENTAL DEVIATIONS FOR SHAFTS

BASIC SIZE	UPPER DEVIATION LETTER					LOWER DEVIATION LETTER				
	c	d	f	g	h	k	n	p	s	u
0-3	-0.060	-0.020	-0.006	-0.002	0	0.000	+0.004	+0.006	+0.014	+0.018
3-6	-0.070	-0.030	-0.010	-0.004	0	+ 0.001	+'0.008	+'0.012	+'0.019	+'0.023
6-10	-0.080	-0.040	-0.013	-0.005	0	+ 0.001	+0.010	+0.015	+0.023	+0.029
10-14	-0.095	-0.050	-0.016	-0.006	0	+ 0.001	+0.012	+0.018	+0.028	+0.033
14-18	-0.095	-0.050	-0.016	-0.006	0	+ 0.001	+0.012	+0.018	+0.028	+0.033
18-24	-0.110	-0.065	-0.020	-0.007	0	+ 0.002	+0.015	+0.022	+0.035	+0.041
24-30	-0.110	-0.065	-0.020	-0.007	0	+ 0.002	+0.015	+0.022	+0.035	+0.048
30-40	-0.120	-0.080	-0.025	-0.009	0	+ 0.002	+0.017	+0.026	+0.043	+0.060
40-50	-0.130	-0.080	-0.025	-0.009	0	+ 0.002	+0.017	+0.026	+0.043	+0.070
50-65	-0.140	-0.100	-0.030	-0.010	0	+ 0.002	+0.020	+0.032	+0.053	+0.087
65-80	-0.150	-0.100	-0.030	-0.010	0	+ 0.002	+0.020	+0.032	+0.059	+0.102
80-100	-0.170	-0.120	-0.036	-0.012	0	+0.003	+0.023	+0.037	+0.071	+0.124
100-120	-0.180	-0.120	-0.036	-0.012	0	+0.003	+0.023	+0.037	+0.079	+0.144
120-140	-0.200	-0.145	-0.043	-0.014	0	+0.003	+0.027	+0.043	+0.092	+0.170
140-160	-0.210	-0.145	-0.043	-0.014	0	+0.003	+0.027	+0.043	+0.100	+0.190
160-180	-0.230	-0.145	-0.043	-0.014	0	+0.003	+0.027	+0.043	+0.108	+0.210
180-200	-0.240	-0.170	-0.050	-0.015	0	+0.004	+0.031	+0.050	+0.122	+0.236
200-225	-0.260	-0.170	-0.050	-0.015	0	+0.004	+0.031	+0.050	+0.130	+0.258
225-250	-0.280	-0.170	-0.050	-0.015	0	+0.004	+0.031	+0.050	+0.140	+0.284
250-280	-0.300	-0.190	-0.056	-0.017	0	+0.004	+0.034	+0.056	+0.158	+0.315
280-315	-0.330	-0.190	-0.056	-0.017	0	+0.004	+0.034	+0.056	+0.170	+0.350
315-355	-0.360	-0.210	-0.062	-0.018	0	+0.004	+0.037	+0.062	+0.190	+0.390
355-400	-0.400	-0.210	-0.062	-0.018	0	+0.004	+0.037	+0.062	+0.208	+0.435

Source : Preferred Metric Limits and Fits , ANSI B4.2-1978. See also BSI 450