GAUTENG DEPARTMENT OF EDUCATION

SENIOR CERTIFICATE EXAMINATION

FITTING AND TURNING SG

FEB / MAR 2006

TIME: 3 hours

MARKS: 200

REQUIREMENTS:

- Pocket calculator and drawing instruments

INSTRUCTIONS:

- Answer ALL the questions.
- Unless otherwise indicated, all dimensions are in millimetres.
- For ALL applicable questions, the dividing head ratio is 40:1 and the milling machine lead screw pitch is 6 mm.
- An information sheet appears on pages 8 to 10 of this question paper.
- Use ONLY the formulae indicated on the information sheet. Derivatives of these formulae may however also be used.
- Show all calculations to earn part of the marks for them.

QUESTION 1

Answer Questions 1.1 to 1.9 on the **answer sheet** on the **inside cover** of the **answer book**. For each question, indicate the correct answer(s) by making a cross (**X**) over the appropriate letter(s) on the answer sheet. The mark allocation on the right-hand side is an indication of the number of correct answers for each question. There may be more than one correct answer.

1.1 The purpose of maintenance is to _____.

A. prevent workers from working overtime
B. minimise replacement costs
C. improve the quality of equipment
D. keep workers on their toes (2)

1.2 The advantages of multiple start screw-threads over single start screw-threads are that_____.

A. larger diameter shafts may be used
B. smaller pitches can be cut
C. shallower threads, thus stronger thread cores, are obtained
D. faster axial movement is obtained (2)

1.3 Points of-action guards are used on _____.

A. guillotines
B. rotating shaft ends
C. gearboxes
D. circular saws (2)

1.4 Form milling has its advantages and disadvantages. Identify the disadvantages from the list below.

A. Large cutter diameters needed
B. Unsuitable for other work
C. Must cut at high speed
D. Expensive (2)

1.5 Single helical gears have advantages and disadvantages. Choose the disadvantages from the list below.

A. Power distribution over two teeth
B. Causes end thrust
C. Frictionless movement
D. Noisy (1)

1.6 Gear tooth verniers measure the _____ of a gear.

A. addendum
B. dedendum
C. work depth
D. chordal width (1)

1.7 The factors that will influence the magnitude of the helix angle of a screw-thread are the _____.

A. lead of the thread
B. primary clearance angle of the cutting tool
C. root diameter of the thread
D. outside diameter of the thread (2)

1.8 Rapid indexing means that _____.

A. there is no need for calculations
B. the lead screw must be disengaged
C. the lead screw must be coupled to the dividing head
D. indexing is simple and fast (2)

1.9 Rivets are used for the joints in a large pressure vessel. To which of the following types of stress will the rivets be subjected?

A. Tensile stress
B. Shear stress
C. Compressive stress
D. A combination of tensile and compressive stress (1)

Answer Questions 1.10 to 1.14 in **your answer book**. Your are required to write only TRUE or FALSE next to the appropriate question number.

1.10 Undercutting at the end of a screw-thread is done to accommodate the cutting tool. (2)

1.11 The purpose of the secondary clearance angle on a milling cutter is to provide space for the cuttings and to permit the coolant to flow away. (2)

1.12 The amount of frictional resistance between two sliding surfaces depends on the magnitude of the force which keeps the surfaces in contact with each other. (2)

1.13 Left-hand screw-threads are only used on wheels that rotate anticlockwise. (2)

1.14 For dynamic balancing, the centres of gravity of all the masses in a system must be in the same plane. (2)
[25]

QUESTION 2

2.1 Mention the FIVE components of good workshop administration. (5)

2.2 Name FOUR aspects of preventative maintenance. (4)

2.3 Mention FOUR advantages of a good workshop layout. (4)

2.4 Draw a neat, labelled sketch of the dividing-head gear arrangement for when differential indexing must be performed. (6)

2.5 A spur gear has 75 teeth and a module of 6 mm. Calculate the following particulars of the gear:

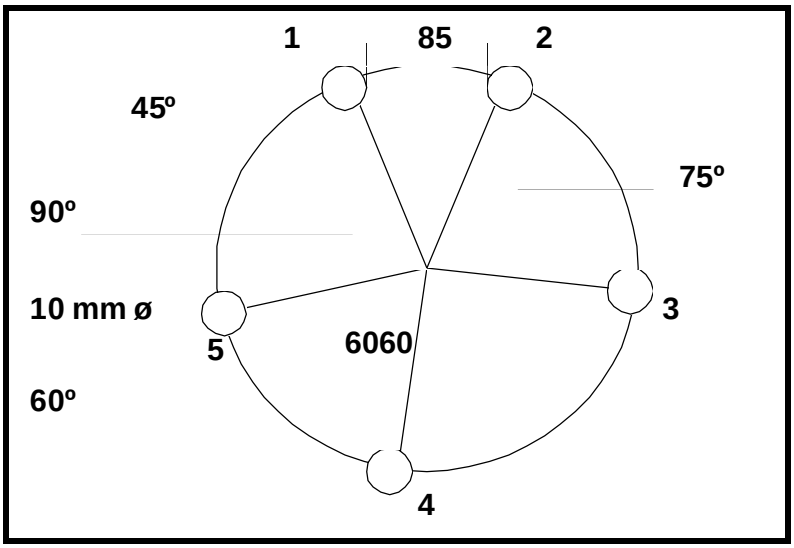
2.5.1 Pitch circle diameter
2.5.2 Outside diameter
2.5.3 Dedendum
2.5.4 Addendum
2.5.5 Work depth
2.5.6 Full depth (12)

2.6 Calculate the chordal addendum of a helical gear with 56 teeth and a normal module of 4,8 mm. The helix angle of the gear is 20°. (4)
[35]

QUESTION 3

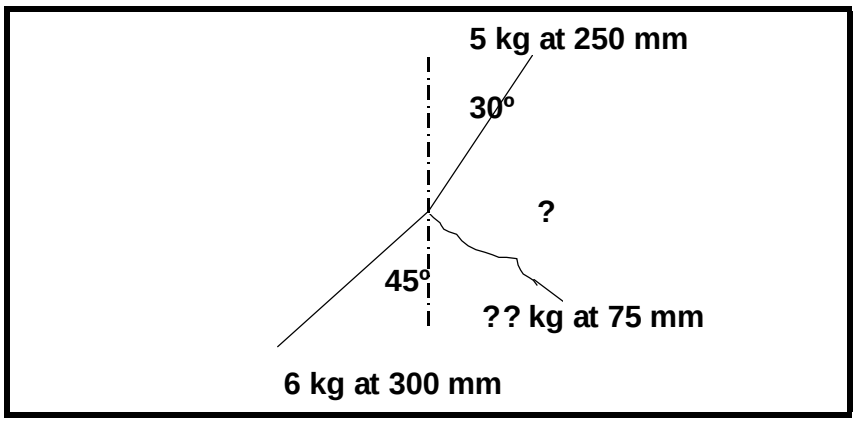
3.1 Five holes must be drilled on a pitch circle as indicated on the sketch. Toolmakers' buttons with a diameter of 10 mm are used for the set up. The distance between buttons **1** and **2** is 85 mm. Calculate the

3.1.1 chordal distance of holes **1** and **2**.
3.1.2 pitch circle diameter of the holes.
3.1.3 distance between buttons **1** and **4**. (12)



3.2 The diagram below represents two unbalanced arms of a machine part. Determine graphically the angle ? and the magnitude of the balance mass (in kg) placed at a distance of 75 mm from the centre of the hub to balance the part. Draw up a mass/distance table to indicate the units you are going to use for your vector diagram. Use a scale of 1 mm = 20 kg.mm.

(11)



3.3 By means of a neat line sketch, indicate how a workpiece mounted on a face plate must be statically balanced using two equal mass pieces. (4)

3.4 Name FOUR advantages of using a numerically controlled machine. (4)

3.5 Mention FOUR examples in practice where friction is considered a disadvantage. (4)
[35]

QUESTION 4

4.1 A three-start internal V-thread with a root diameter of 35 mm and a pitch of 4 mm must be cut on a pipe with an outside diameter of 50 mm and a wall thickness of 10 mm. Calculate the

4.1.1 effective diameter of the thread.
4.1.2 lead of the thread.
4.1.3 helix angle of the thread.
4.1.4 leading angle of the cutting tool.
4.1.5 following angle of the cutting tool. (13)

4.2 Describe, in detail, how to cut the screw-thread described in Question 4.1 on a lathe using the **compound slide** method. (10)

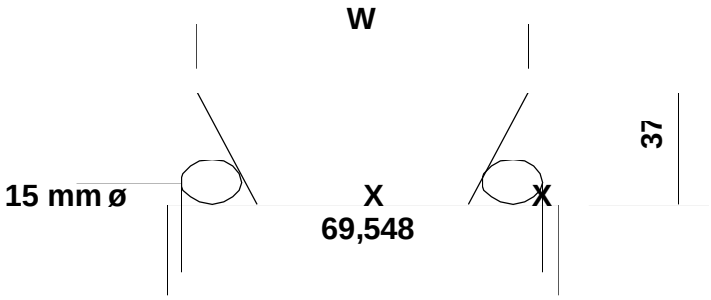
4.3 Mention FIVE advantages of coarse-tooth milling cutters over fine-tooth milling cutters. (5)

4.4 Define the term **slab milling**. (2)

4.5 Name FIVE reasons why helical milling cutters are sometimes nicked. (5)
[35]

QUESTION 5

5.1 The internal dovetail in the sketch below must be tested for accuracy. The dimensions of the dovetail are as indicated on the sketch. Calculate the dimensions **X** and **W**. (16)



5.2 A pressure of 35 MPa is required in the cylinder of a hydraulic jack to lift a load of 12 250 N. Calculate the diameter of the jack piston. (7)

5.3 A strut of a steel frame is subjected to a tensile load. The stress induced in the strut is measured at 7,3 MPa just before the strut fractures. The strut is a 25 mm x 50 mm hollow rectangular tube with a 3 mm wall thickness. Calculate the magnitude of the tensile load. (9)

5.4 Name THREE detrimental consequences/effects of friction on the moving parts of a machine. (3)

[35]

QUESTION 6

6.1 The ram of a hydraulic press can lift a load of 15 kN when a force of 300 N is exerted on the plunger. The diameter of the ram is 565,7 mm. Calculate the

6.1.1 pressure in the press.
6.1.2 diameter of the plunger. (12)

6.2 A 150 mm diameter disc-grinding wheel must be used to sharpen the teeth of a 120 mm diameter side and face cutter. The primary clearance angle is 4°.

6.2.1 Calculate the off-set of the tooth rest.
6.2.2 Draw a sketch to show the position of the tooth rest in relation to the grinding wheel. (9)

6.3 Calculate the indexing in each of the following cases:

6.3.1 An angle of 13° 20'

6.3.2 Differential indexing for 119 teeth (Choose 120 teeth). Determine the

(a) necessary indexing.
(b) change gears needed.
(c) rotational direction of the index plate. (14)

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TOTAL: 200

INFORMATION SHEET

1. Gears for milling machine

Standard and special gear wheels

24 (two of); 28; 32; 40; 44; 46; 47; 48; 52; 56; 58; 64; 68; 70; 72; 76; 84; 86 and 100 teeth.

2. Index plate for milling machine

24; 25; 28; 30; 34; 37; 38; 39; 41; 42; 43; 46; 47; 49; 51; 53; 54; 57; 58; 59; 62 and 66 holes.

3. Formulae

3.1 Stress = $\frac{F}{A}$

3.2 Cross-sectional area of solid cylinder = $\frac{\pi}{4} D^2$

3.3 Cross-sectional area of hollow cylinder = $\frac{\pi(D^2 - d^2)}{4}$

3.4 Fluid pressure in a hydraulic press: $\frac{F1}{A1} = \frac{F2}{A2}$

Volume of fluid displaced by plunger = volume displaced by piston
volume = area x L

3.5 Spur gears:

3.5.1 PCD	=	Tm
3.5.2 add	=	m
3.5.3 ded	=	$1{,}157_m$
3.5.4 Clearance	=	$0{,}157_m$
3.5.5 OD	=	PCD + 2 add
3.5.6 T	=	$\frac{PCD}{m}$

3.5.7 Chordal addendum = $m + \left[\frac{mT}{2} (1 - \cos \frac{90^0}{T}) \right]$

3.5.8 Chordal width = $mT \sin \frac{90^0}{T}$

3.5.9 Circular pitch = πm

3.6 Helical gears

3.6.1 PCD = TMw

3.6.2 add = m_n

3.6.3 ded = 1,157 m_n

3.6.4 clearance = 0,157 m_n

3.6.5 OD = PCD + 2 add

3.6.6 T = $\frac{PCD}{m_c}$

3.6.7 m_n = $m_c \cos\theta$

3.6.8 Number of teeth marked on the milling cutter:

Number = $\frac{T}{(\cos\theta)^3}$

3.6.9 Chordal addendum = $m_n + \left[\frac{m_n T}{2} (1 - \cos \frac{90^0}{T}) \right]$

3.6.10 Chordal thickness = $m_n T \sin \frac{90^0}{T}$

3.6.11 Lead of helix : l = π x PCD x cot θ

or

l $\frac{\pi x PCD}{\tan\theta}$

3.6.12 Helix angle : $\tan\theta = \frac{\pi x PCD}{l}$

3.6.13 Circular pitch = πm_n

3.6.14 Lead of milling machine = Dividing head ratio x pitch of leadscrew

3.6.15 Change gears required $\frac{Dr}{G} = \frac{L}{l}$

3.7 Indexing:

3.7.1 Simple indexing = $\frac{40}{N}$

3.7.2 Angular indexing = $\frac{?}{9^0}$

3.7.3 Differental indexing = $\frac{Dr}{G} = \frac{(A-N)}{A} \times \frac{40}{1}$

3.7.4 Rack:

$$\text{Indexing} = \frac{\text{Dividing head ratio}}{\text{Pitch of lead screw}} \times \frac{\text{Pitch of rack}}{\text{Gear ratio}}$$

3.8 Grinding of milling cutter teeth:

3.8.1 Disc grinding wheel: Offset = $R \sin \theta$.

3.8.2 Cup wheel: Offset = $r \sin \theta$.

3.9 Graphical solution of static balancing:

Out-of-balance effect = Mass X distance of mass from centre of face plate.

3.10 Tool angles for cutting square threads:

3.10.1 Helix angle: $\tan \eta = \frac{\text{Lead}}{pD_m}$

3.10.2 Leading tool angle = 90^0 – (Helix angle + Clearance angle)

3.10.3 Following tool angle = 90^0 + (Helix angle – Clearance angle)

END