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**higher education
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Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

**T670(E)(M25)T
APRIL EXAMINATION**

NATIONAL CERTIFICATE

FITTING AND MACHINING THEORY N2

(11022032)

**25 March 2013 (X-Paper)
09:00–12:00**

Candidates will require drawing instruments

Calculators may be used.

This question paper consists of 8 pages and a 1-page formula sheet.

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA
NATIONAL CERTIFICATE
FITTING AND MACHINING THEORY N2
TIME: 3 HOURS
MARKS: 100

NOTE: If you answer more than the required number of questions, only the required number of questions will be marked. All work you do not want to be marked, must be clearly crossed out.

INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions in SECTION A.
 2. Answer only TWO questions in SECTION B.
 3. Read ALL the questions carefully.
 4. Number the answers correctly according to the numbering system used in this question paper.
 5. Write neatly and legibly.
-

SECTION A**QUESTION 1: OCCUPATIONAL SAFETY**

NOTE: This question paper covers both the manufacturing and the mining industry in South Africa.

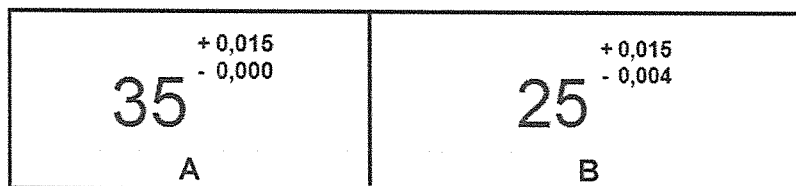
List FIVE responsibilities of the user which can be associated with the use of grinding wheels.

[5]**QUESTION 2: COUPLINGS**

Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'true' or 'false' next to the question number (2.1–2.5) in the ANSWER BOOK.

- 2.1 A coupling is a device which can be engaged and disengaged at will by the operator of the machine.
- 2.2 Couplings transmit rotary movement from the short shaft of the electric motor to the shaft of the machine.
- 2.3 A flexible coupling makes allowance for an alignment error.
- 2.4 A chain coupling is a flexible type of coupling.
- 2.5 A fluid coupling makes use of the centrifugal force of the fluid flowing to the rotor.

(5 × 1)

[5]**QUESTION 3: LIMITS AND FITS****FIGURE 1**

- 3.1 With reference to FIGURE 1, give the name of the type of tolerance in:
 - 3.1.1 A (1)
 - 3.1.2 B (1)
- 3.2 State the THREE main classes of fit associated with the ISO schedule of limits and fits. (3)

3.3 State the class of fit associated with the following:

3.3.1 Shrink fit (1)

3.3.2 Push fit (1)

[7]

QUESTION 4: BEARINGS

4.1 Lubrication of plain (journal) bearings takes place through an oil-hole or a groove in the bearing material.

Describe FIVE factors you should consider before inserting an oil-hole or oil-groove in a plain bearing. (5)

4.2 List THREE methods for the effective mounting (replacement) of a journal bearing. (3)

[8]

QUESTION 5: LUBRICATION AND VALVES

5.1 List THREE lubricating devices associated with the force-feed principle. (3)

5.2 Define the term *cold point*. (1)

5.3 Identify the THREE different types of valves used in the sketches in FIGURE 2 below. Write only the answers next to the letter (A–C) in the ANSWER BOOK.

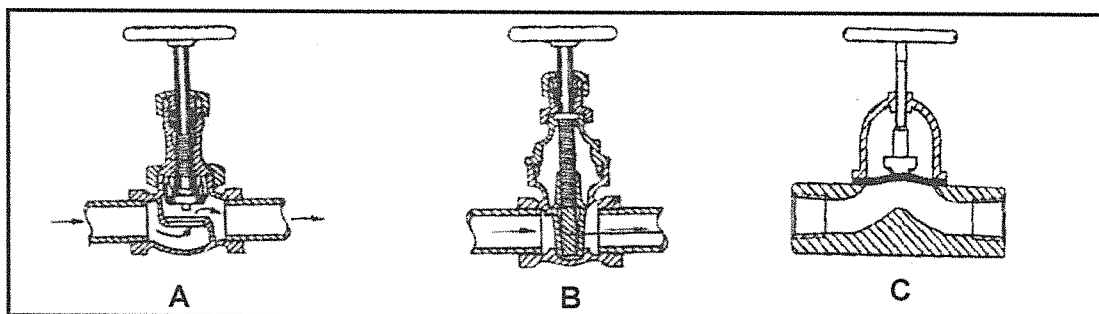


FIGURE 2

(3)

[7]

QUESTION 6: PACKING, STUFFING BOXES, JOINTS AND WATER PIPE SYSTEMS

- 6.1 List FOUR factors to consider when choosing the correct type of sealing material for pipeline- installations. (4)
- 6.2 Give THREE reasons for the lagging of steam-pipelines. (3)
- 6.3 Will you make adjustments to a stuffing box while the pump is running? Give ONE reason for your answer. (2)
- [9]**

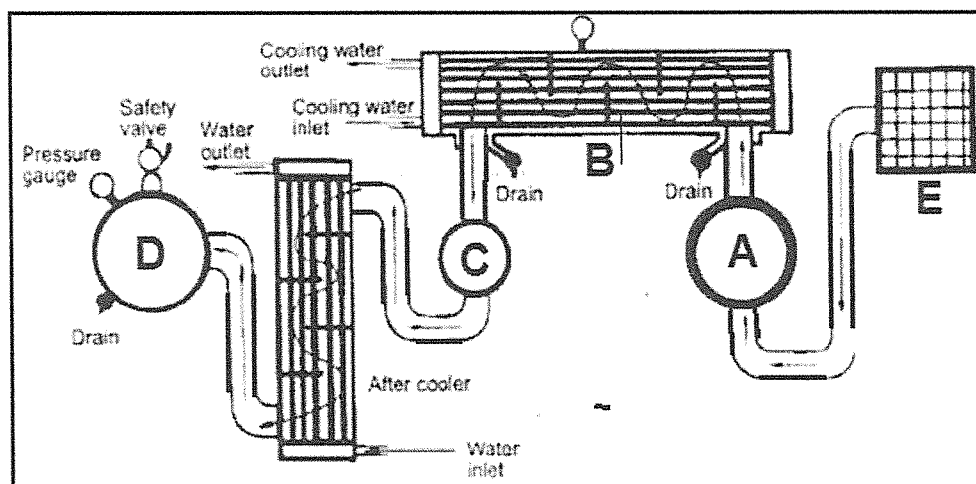
QUESTION 7: PUMPS

Complete the following sentences by filling in the missing word(s). Write only the word(s) next to the question number (7.1–7.4) in the ANSWER BOOK.

- 7.1 Single-acting pumps have one ... and one ... (2)
- 7.2 A plunger is ... than its stroke length and a piston is ... than its stroke length. (2)
- 7.3 Reciprocating pumps are ... displacement pumps. (1)
- 7.4 The rotating element of a centrifugal pump is called an impeller. The rotating element of a rotary pump is called a ... (1)
- [6]**

QUESTION 8: COMPRESSORS

List the FIVE compressor components numbered A–E below in FIGURE 3 below. Write only the answer next to the letter (A–E) in the ANSWER BOOK.

**FIGURE 3****[5]**

QUESTION 9: V-BELT, GEAR AND CHAIN DRIVES

- 9.1 Explain in your own words, the following chain-drive terms:
- 9.1.1 Chain pitch (1)
 - 9.1.2 Drive sprocket (1)
- 9.2 Give TWO reasons for the use of a guard on chain drives. (2)
- 9.3 List TWO lubrication methods when dealing with chain drives. (2)
- 9.4 Name TWO types of chain drives. (2)

[8]**TOTAL SECTION A: 60****SECTION B**

Answer any TWO questions in this section.

QUESTION 10: HYDRAULICS AND PNEUMATICS

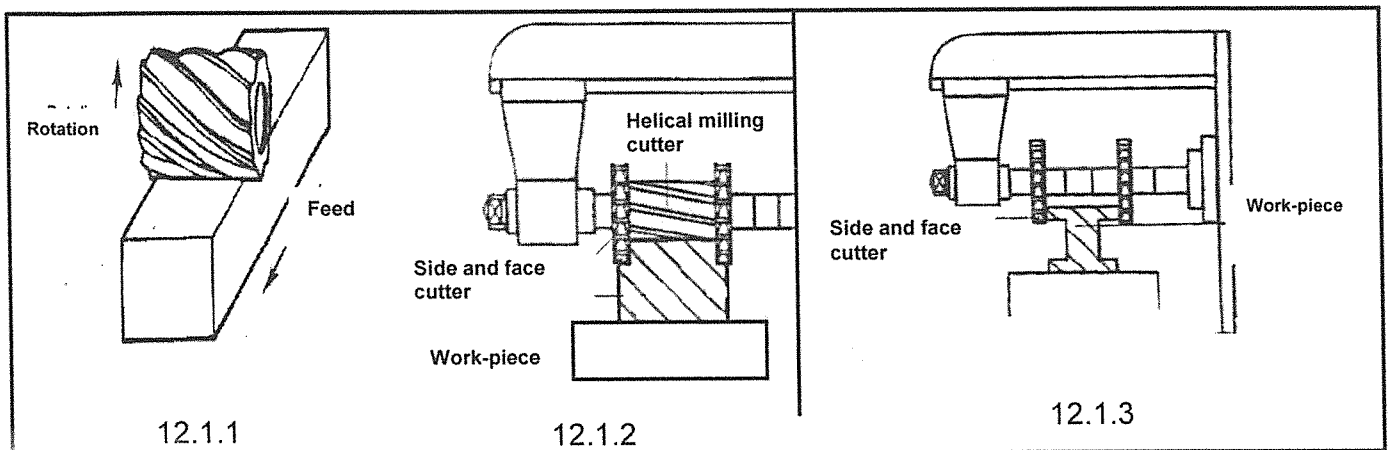
- 10.1 Explain the function of a pump in a hydraulic system. (1)
- 10.2 Make neat freehand sketches of **symbols** representing the following pneumatic and hydraulic components:
- 10.2.1 Vacuum pump
 - 10.2.2 Pressure gauge
 - 10.2.3 Pressure source
 - 10.2.4 Compressor
 - 10.2.5 Pneumatic motor
- (5 × 1) (5)
- 10.3 List FIVE basic components of a hydraulic system. (5)
- 10.4 State the SIX basic aspects of inspection in the routine maintenance of a hydraulic system. (6)
- 10.5 State the THREE main functions of hydraulic fluid. (3)

[20]**OR**

QUESTION 11: CENTRE LATHES

- 11.1 List FOUR types of mandrels used on the lathe. (4)
- 11.2 Explain TWO advantages of using mandrels on a lathe. (2)
- 11.3 Name the THREE basic instructional forms used on a CNC turning centre. (3)
- 11.4 Explain the difference between ABSOLUTE and INCREMENTAL programming used on CNC turning centres. (2)
- 11.5 A 5 mm pitch, 2-start square thread is to be cut on a lathe having a 5 mm pitch lead screw with the pitch diameter of the thread being 100 mm.
- Calculate the following:
- 11.5.1 The helix angle of the thread. (3)
- 11.5.2 The lead and following angles of the cutting tool used (Assume a clearance angle of 3°) (2)
- 11.6 Give the TWO reasons why steadies are used on a centre lathe. (2)
- 11.7 State ONE advantage and ONE disadvantage of using the graduated sleeve method for cutting a taper on a centre lathe. (2)
- [20]**

OR

QUESTION 12: MILLING MACHINES AND SURFACE GRINDERS**FIGURE 4**

- 12.1 Identify the milling methods in FIGURE 4. Write only the answer next to the question number (12.1.1–12.1.3) in the ANSWER BOOK. (3)
- 12.2 Name any FOUR components of a dividing head. (4)
- 12.3 State THREE possible factors which cause burning of a work-piece when working on a surface grinder. (3)
- 12.4 Grinding wheels have markings for identification purposes.
State FIVE factors by which you would identify a grinding wheel. (5)
- 12.5 State FOUR advantages of using helical milling cutters with nicked teeth. (4)
- 12.6 Name the milling cutter used for machining a keyway in a shaft. (1)
- [20]**

TOTAL SECTION B: 40
GRAND TOTAL: 100

FITTING AND MACHINING THEORY N2**FORMULA SHEET**

$$f = f_t \times T \times N$$

$$S = \frac{\pi DN}{60}$$

$$S = \pi DN$$

$$\frac{40}{N}$$

$$\frac{N}{9^\circ}$$

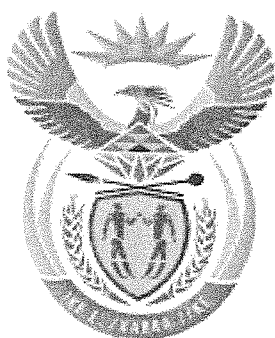
$$\frac{D-d}{2} \times \frac{\text{length of workpiece}}{\text{length of taper}}$$

$$\tan \frac{\theta}{2} = \frac{X}{L}$$

$$90^\circ - (\text{Helix angle} + \text{clearance angle})$$

$$90^\circ + (\text{Helix angle} - \text{clearance angle})$$

$$\text{Lead} = \text{No of starts} \times \text{pitch}$$



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MARKING GUIDELINE

**NATIONAL CERTIFICATE
APRIL EXAMINATION
FITTING AND MACHINING THEORY N2**

25 MARCH 2013

This marking guideline consists of 8 pages.

SECTION A: COMPULSORY**QUESTION 1: OCCUPATIONAL SAFETY**

- Resolutions per minute (rpm) must be clearly visible
- CANNOT fit a grinding wheel unless the rpm is marked clearly on wheel
- Speed of spindle must not exceed the manufacturers' rated wheel speed
- Damaged wheel or a wheel not dressed should not be used
- A grinding wheel must be mounted on spindle between two strong flanges - diameter of flange must be 1/3 size of wheel diameter
- Paper washers to be fitted to prevent metal-on-metal contact
- Adequate guards
- Tool rest must have a maximum gap of 3 mm from grinding wheel
- Goggles must be used

(Any 5 × 1) [5]

QUESTION 2: COUPLINGS

2.1 False

2.2 True

2.3 True

2.4 False

2.5 True

(5 × 1) [5]

QUESTION 3: LIMITS AND FITS

3.1 3.1.1 Unilateral tolerance (1)

3.1.2 Bilateral tolerance (1)

3.2 3.2.1 Interference

3.2.2 Transition

3.2.3 Clearance (3 × 1) (3)

3.3 3.3.1 Interference (1)

3.3.2 Clearance fit (1)

[7]

QUESTION 4: BEARINGS

- 4.1
- Distribution – must be over as wide an area as possible
 - Adequate cooling must be provided
 - Oil-groove should not be cut over the entire length
 - Clean up raised or sharp edges
 - Entry point for fluid should be at a low pressure area
 - Spiral grooves to be cut against the direction of rotation
 - Vertical bearings – spiral groove to force oil upward
 - Guide bearings should be accommodated with a cross pattern of grooves
- (Any 5 × 1) (5)
- 4.2
- Screw puller
 - Impact puller (Slide-hammer)
 - Hydraulic puller
 - Puller plates
 - Hydraulic press
- (Any 3 × 1) (3)
[8]

QUESTION 5: LUBRICATION AND VALVES

- 5.1
- Stauffer cup
 - Tell-tale lubricator
 - Grease applicator gun
 - Oil pump
- (Any 3 × 1) (3)
- 5.2 **COLD POINT**
The lowest temperature at which a lubricant ceases to flow (1)
- 5.3
- A Globe
 - B Gate
 - C Diaphragm
- (3 × 1) (3)
[7]

QUESTION 6: PACKING, STUFFING BOXES, JOINTS AND WATER PIPE SYSTEMS

- 6.1
- Nature of fluid medium
 - Pressure within
 - Environment
 - Operating temperature
 - Temperature
- (Any 4 × 1) (4)
- 6.2
- Retains heat
 - Prevents heat loss
 - Prevents condensation/water forming in pipes
 - Prevents water-hammer
- (Any 3 × 1) (3)

- 9.4
- Single and multi-strand roller
 - Double pitch roller chain
 - Silent
 - Leaf

(Any 2 × 1)

(2)
[8]**TOTAL SECTION A:****60****SECTION B**

Candidates need only to answer TWO questions in this section.

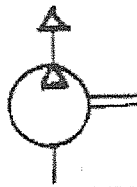
QUESTION 10: HYDRAULICS AND PNEUMATICS

- 10.1
- Converts mechanical energy into pressure energy
 - Transports fluid from the reservoir or tank to the hydraulic circuit

(Any 1 × 1)

(1)

10.2 10.2.1



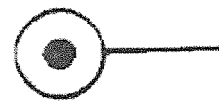
(1)

10.2.2



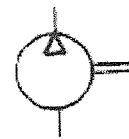
(1)

10.2.3



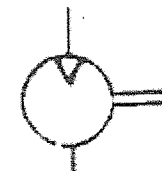
(1)

10.2.4



(1)

10.2.5



(1)

- 10.3
- Electric motor
 - Pump
 - Reservoir
 - Actuator
 - Check valve
 - Directional control valve
 - Pressure relief valve
 - Throttle valve
 - Accumulator
 - Pressure gauge
 - Pipes
 - Pressure sensor
 - Filters
- (Any 5 × 1) (5)
- 10.4
- Check **oil-level in crankcase**
 - **Belt-tension** of motor to pulley drive
 - **Pressure regulator cut-out of pressure** on pressure gauge
 - **Drain air receiver**
 - Check **filter element**
 - Check **hoses and fittings**
 - **Check service unit**
 - Check for **air receiver leaks**
- (Any 6 × 1) (6)
- 10.5
- Transmits **hydraulic energy**
 - **Lubricates** components
 - Prevents **corrosion**
 - **Removes dirt**
 - Dissipates heat **or cools**
- (Any 3 × 1) (3)
[20]

QUESTION 11: CENTRE LATHES

- 11.1
- Expanding mandrel
 - Plain mandrel
 - Screw mandrel
 - Cone mandrel
- (4 × 1) (4)
- 11.2
- No setting-up of work-piece is needed.
 - Work-pieces are easily mounted and dismounted.
- (2)
- 11.3
- G – command is the code for the CNC lathe to prepare for a specific cycle
- M – command is the on and off functions of the CNC lathe
- X- and Y- shaft movement is the movement along the x- and y-axis
- (3)

- 11.4 Absolute dimensioning means the reference is taken from a common reference point.
Incremental dimensioning is the distance from one point to a second point on a work piece without referring to a common reference point (2)

- 11.5 OD = 100 mm 2 Start thread

Pitch = 5 mm

Lead = No of starts x pitch = 2 x 5 = 10 mm

Pitch diameter = (OD – $\frac{1}{2}$ pitch) = 100 – 2,5 = 97,5 mm

Pitch circumference = π x pitch diameter = π x 97,5 = 306,3 mm

- 11.5.1 To find helix angle ϕ

$$\begin{aligned}\tan \phi &= \frac{\text{Lead}}{\text{Pitch circumference}} = \frac{10}{306,3} \\ &= 0,0326\end{aligned}$$

$$\text{Therefore: } \phi = \tan^{-1} 0,0326 = 1,867^\circ = 1^\circ 52' \quad (3)$$

- 11.5.2 Lead angle: $90^\circ - (\text{Helix angle} + \text{Clearance angle})$
 $= 90^\circ - (3^\circ + 1^\circ 52')$
 $= 90^\circ - 4^\circ 52'$
 $= 85^\circ 48'$

$$\begin{aligned}\text{Following angle: } &= 90^\circ + (\text{Helix angle} - \text{Clearance angle}) \\ &= 90^\circ + (3^\circ - 1^\circ 52') \\ &= 90^\circ + 1^\circ 48' \\ &= 91^\circ 48' \quad (2)\end{aligned}$$

- 11.6 To prevent a long shaft from bending under its own weight when it is machined. (2)

- 11.7 Advantage
 – long tapers can be turned.
 – cross slide can be fed automatically

(any one)

Disadvantage

- only external tapers can be turned.
 – uneven wear takes place on the centres and centre holes.

(any one) (2)

[20]

QUESTION 12: MILLING MACHINES AND SURFACE GRINDERS

12.1	12.1.1	Slab milling		
	12.1.2	Gang milling		
	12.1.3	Straddle milling		(3)
12.2	-	Index plate		
	-	Crank pin		
	-	Single-start worm		
	-	Worm wheel	(4 × 1)	(4)
12.3	-	Too slow a speed		
	-	Metal clogging the space between abrasive particles/Wheel clogged		
	-	Wrong wheel		
	-	Wheel too hard		
	-	Insufficient coolant/Disruption in coolant supply	(Any 3 × 1)	(3)
12.4	-	Abrasive type		
	-	Grade		
	-	Bonding material		
	-	Grain size		
	-	Structure		(5)
12.5	-	Power consumption is reduced		
	-	Chattering is reduced		
	-	Shavings are broken up and evacuated easily		
	-	Much better cutting action		
	-	Surface finish is improved	(Any 4 × 1)	(4)
12.6		Slotting cutter/Slotting/Slot drill		(1)
				[20]
			TOTAL SECTION B:	40
			GRAND TOTAL:	100