higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T630(E)(J22)T

AUGUST EXAMINATION

NATIONAL CERTIFICATE

FITTING AND MACHINING THEORY N2

(11022032)

22 July 2014 (Y-Paper)
13:00–16:00

Calculators may be used.

This question paper consists of 9 pages and 1 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.   Answer either QUESTION 1.1 OR 1.2 of QUESTION 1

4.   Read ALL the questions carefully.

5.   Number the answers according to the numbering system used in this question paper.

6.   Write neatly and legibly.

Please turn over

SECTION A
ANSWER ALL THE QUESTIONS IN SECTION A.

QUESTION 1: OCCUPATIONAL SAFETY

Answer QUESTION 1.1 or QUESTION 1.2

1.1   Indicate whether the following statements are TRUE or FALSE with regard to safety in the workplace. Choose the answer and write only 'true' or 'false' next to the question number (1.1.1–1.1.5) in the ANSWER BOOK.

1.1.1   Overhead transmission belts must be provided with guards

1.1.2   When using a ladder, <u>never</u> secure the top part by means of a rope.

1.1.3   Fixed guards only move with each operation of the machine.

1.1.4   The manufacturer's information on a pressure vessel includes the date of export.

1.1.5   A machine must be stopped immediately, if it becomes a danger to those working in the area.

(5 x 1)   (5)

OR

1.2   Indicate whether the following statements are TRUE or FALSE with regard to safety in the workplace. Choose the answer and write only 'true' or 'false' next to the question number (1.2.1–1.2.5) in the ANSWER BOOK.

1.2.1   After a heating task is performed in a mine, a competent person must inspect the area to ensure there is no possibility of a fire breaking out.

1.2.2   Naked lights are allowed BUT may not be left close to flammable material that may cause a fire or an explosion.

1.2.3   Smoking is ONLY allowed in the lifting cage.

1.2.4   No welding, flame-cutting or flame heating is to take place in a mine, unless fire extinguishers have been provided.

1.2.5   Calcium carbide is not to be taken underground unless it is in a water tight container approved by the manager.

(5 x 1)   (5)
          [5]

QUESTION 2: COUPLINGS

2.1   Name FIVE different types of RIGID couplings.   (5)

2.2   Give TWO reasons why it is necessary to ensure the correct alignment of a
       fixed coupling.   (2)
                                                                                                 [7]

QUESTION 3: LIMITS AND FITS

A shaft is to be fitted into a bush. The sizes given for the bush and shaft are:

       <u>BUSH</u>   <u>SHAFT</u>

       $45^{+0,08}_{+0,03}$ mm $45^{+0,02}_{-0,00}$ mm

3.1   Determine the following:

       3.1.1   The minimum allowance of the fitted parts

       3.1.2   The maximum allowance of the fitted parts

       3.1.3   The tolerance on the shaft

       3.1.4   The tolerance of the hole   (4 x 1)   (4)

3.2   What is the classification of this type of fit?   (1)
                                                                                                 [5]

QUESTION 4: BEARINGS

4.1   State one property of each of the following bearing materials:

       4.1.1   White metal

       4.1.2   Cast iron

       4.1.3   Bronze

       4.1.4   Nylon

       4.1.5   Teflon

                                                                    (5 x 1)   (5)

4.2   Name the THREE types of rolling elements used in the manufacture of anti-
       friction design.   (3)
   **[8]**

Please turn over

QUESTION 5: LUBRICATION AND VALVES

FIGURE 1 represents a method of lubrication.
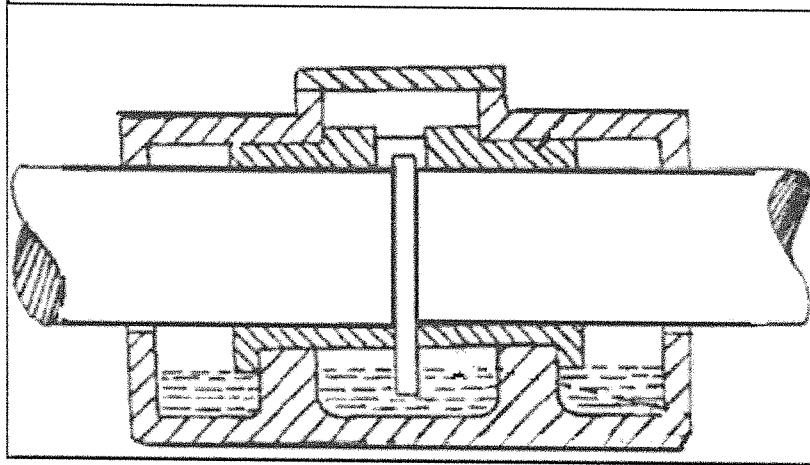
FIGURE 1

5.1 Name this type of lubrication. (1)

5.2 Briefly describe this lubrication method. (4)

5.3 State TWO functions of valves in fluid power systems. (2)

5.4 Differentiate between a normally open and a normally closed valve. (2)

[9]

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

6.1 FIGURE 2 shows FOUR types of joints that allow for expansion and contraction in pipelines. Name these FOUR types of joints. Write only the answer next to the question number (6.1.1 – 6.1.4) in the ANSWER BOOK.

(4)
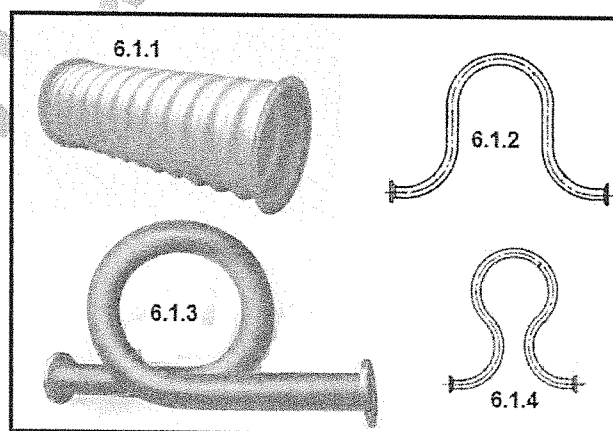
FIGURE 2

6.2 List FOUR important guidelines to ensure the proper fitting of o-rings and seals in hydraulic systems. (4)

[8]

QUESTION 7: PUMPS

7.1   State TWO methods of neutralising water hammer in plunger pumps.   (2)

7.2   Refer to FIGURE 3 and describe the operation of a double-acting plunger pump by inserting the correct letters for the various valves. Write only the answer next to the question number (7.2.1 – 7.2.4) in the ANSWER BOOK.

Stroke 1:
As the plunger moves upwards, water enters the chamber through the inlet valve (7.2.1), and delivers water past the outlet valve (7.2.2).

Stroke 2
As the plunger moves downwards, the water enters the chamber through the inlet valve (7.2.3), and delivers it past the outlet valve (7.2.4).
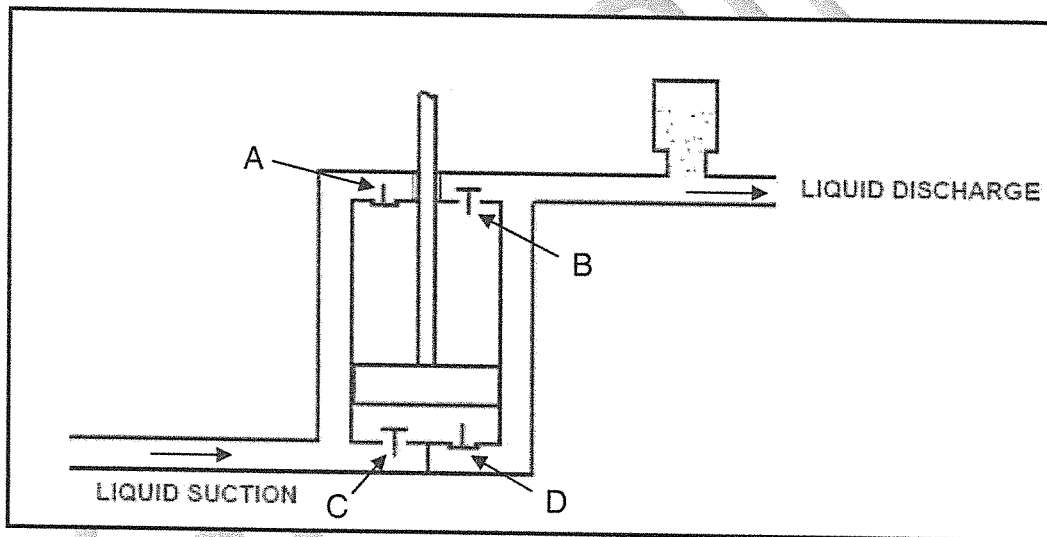
                                                    (4 x 1)   (4)
                                                               [6]

FIGURE 3

QUESTION 8: COMPRESSORS

Explain the function of each of the following compressor components:

8.1   Filter

8.2   Drain Valve

8.3   Intercooler

8.4   After cooler

8.5   Pressure regulator switch

                                                    (5 x 1)   [5]

QUESTION 9: V-BELT, CHAIN, GEAR DRIVES AND REDUCTION GEARBOXES

9.1 State TWO advantages of chain drives when compared to gear drives. (2)

9.2 State TWO reasons for the need to eliminate excessive sag on chain drives. (2)

9.3 Name THREE different types of sprockets associated with chain drives. (3)

[7]

TOTAL SECTION A: **60**

SECTION B

ANSWER ONLY TWO OF THE QUESTIONS IN SECTION B

QUESTION 10: PNEUMATICS AND HYDRAULICS

10.1 Explain the function of a pressure relief valve in a hydraulic system. (1)

10.2 State FIVE factors which influence the choice of pneumatics over hydraulics for transmitting power to machines. (5)

10.3 Identify the FIVE hydraulic components shown in FIGURE 4. Write only the answer next to the question number (10.3.1 – 10.3.5) in the ANSWER BOOK. (5)
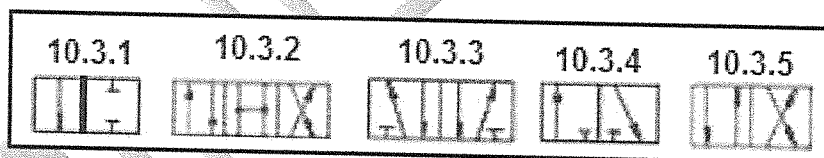

FIGURE 4

10.4 State FIVE basic aspects of inspection in the routine maintenance of a hydraulic circuit. (5)

10.5 Name the FOUR components which make up a pneumatic service unit. (4)

[20]

QUESTION 11: CENTRE LATHE

11.1 State FOUR advantages of the use of mandrels for the machinist. (4)

11.2 Name the TWO methods for setting over the tailstock in preparation for taper-turning on the centre lathe. (2)

11.3 A taper of included angle 6° (SIX DEGREES) has to be turned on a work-piece 280 mm long. Calculate the amount of tailstock set-over required. (3)

11.4 A round shaft with a pitch diameter of 100mm must be provided with a two-start square thread with a 5 mm pitch. The clearance angle is 3°.

Calculate:

11.4.1   the helix angle of the thread   (3)

11.4.2   the leading angle of the cutting tool   (1)

11.4.3   the following angle of the cutting tool   (1)

11.5   Explain the following terms applicable to CNC machining

11.5.1   Incremental programming   (1)

11.5.2   Absolute programming   (1)

11.6   List FOUR items of information required by the parts programmer when writing a CNC machining programme.   (4)
[20]

QUESTION 12: MILLING MACHINES AND SURFACE GRINDERS

12.1   Name the FOUR types of milling cutters shown in FIGURE 5. Write only the answer next to the question number (12.1.1 – 12.1.4) in the ANSWER BOOK.
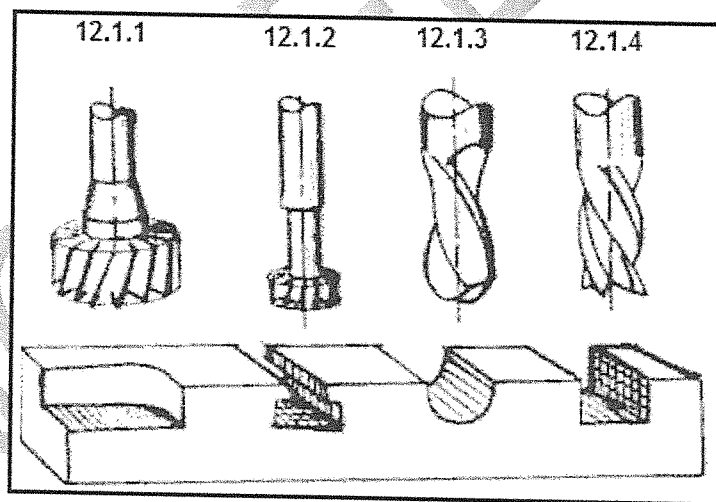

FIGURE 5
(4)

12.2   A work-piece must have 13 gear-teeth machined on its circumference.

12.2.1   What type of indexing would you perform on this gear blank?   (1)

12.2.2   Calculate the required indexing, using a Cincinnati dividing head as shown below

The Cincinnati Dividing Head										
Side 1	24	25	28	30	34	37	38	39	41	42	43
Side 2	46	47	49	51	53	54	57	58	59	62	66

(4)

12.3　State TWO advantages of the down cut milling process (2)

12.4　State TWO disadvantages of the down cut milling process (2)

12.5　State FOUR factors related to the workpiece, which will help you to select the correct grinding wheel. (4)

12.6　Name THREE types of bonding materials which holds the abrasive particles in grinding wheels together. (3)

[20]

TOTAL SECTION B:　40
GRAND TOTAL:　100

FITTING AND MACHINING THEORY N2

FORMULA SHEET

$$f = ft \times T \times N$$

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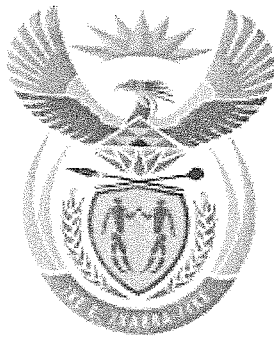
$$S = \pi DN$$

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

$$\frac{N}{9°}$$

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

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

Leading angle = 90° - (Helix angle + clearance angle)

Following angle =90° + (Helix angle - clearance angle)

Lead = No of starts × pitch

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MARKING GUIDELINE

NATIONAL CERTIFICATE

AUGUST EXAMINATION

FITTING AND MACHINING THEORY N2

22 JULY 2014

This marking guideline consists of 8 pages.

√ = ½ mark
✓ = 1 mark

QUESTION 1: OCCUPATIONAL SAFETY

1.1 1.1.1 True

    1.1.2 False

    1.1.3 False

    1.1.4 False

    1.1.5 True

                     (5 x 1) (5)

<div align="center">OR</div>

1.2 1.2.1 True

    1.2.2 False

    1.2.3 False

    1.2.4 True

    1.2.5 True

                     (5 x 1) (5)
                                [5]

QUESTION 2: COUPLINGS

2.1
- Flange
- Gear
- Marine
- Chain
- Fluid

                           (5)

2.2
- Efficient operation of machinery
- Cost savings of the maintenance materials
- Lengthens the life-span of components
- Minimize downtime and the need for overtime

                    (Any 2 x 1) (2)
                                [7]

QUESTION 3: LIMITS AND FITS

3.1.1   0,01 mm

3.1.2   0,08 mm

3.1.3   0,02 mm

3.1.4   0,05 mm   (4 x 1)   (4)

3.2   Clearance fit
                                                                                   (1)
                                                                                   [5]

QUESTION 4: BEARINGS

4.1   4.1.1   Embeddability
                 Compatibility   (Any 1)

       4.1.2   High load carrying ability

       4.1.3   Embedability
                 Resistance to seizure
                 Corrosion resistant   (Any 1)

       4.1.4   Low coefficient of friction
                 Heat resistant
                 No lubrication required   (Any 1)

       4.1.5   Low coefficient of friction
                 Self-lubricating
                 Corrosion resistant
                 High operating temperatures   (Any 1)
                                                                        (5 x 1)   (5)

4.2   • Ball
       • Roller
       • Spherical roller
       • Needle roller

                                                                     (Any 3 x 1)   (3)
                                                                                   [8]

QUESTION 5: LUBRICATION AND VALVES

5.1   Oil ring lubrication or splash feed lubrication
                                                                                   (1)

5.2   The ring is in rolling contact with the shaft ✓ and the lower part is dipped in
       the oil.✓ As the shaft rotates the oil is brought up by the ring and is
       distributed along the shaft.✓ Gradually, the oil drips back into the sump due
       to gravity.✓
                                                                                   (4)

5.3   • A valve is used to control the direction of flow.
       • A valve is used to control pressure.   (2)

5.4   Normally open valves are designed to be opened when in use whereas a
       normally closed valve is closed during normal use.   (2)
                                                                                   [9]

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

6.1   6.1.1   Corrugated expansion
       6.1.2   Expansion U-Joint / Expansion bend
       6.1.3   Full Loop
       6.1.4   Horseshoe   (4)

6.2   • Clean all surfaces thoroughly
       • Ensure no damage to the oil ring or the surfaces
       • Use the correct seal
       • Lubricate the seal before fitting
       • Protective sheath to be used when fitting a ring seal or o-ring over a sharp
         ridge or threaded section
       • Tighten up lightly ensuring that the ring seal fits squarely
                                                       (Any 4 x 1)   (4)
                                                                                   [8]

QUESTION 7: PUMPS

7.1   • open and close valves gradually
       • use an air chamber in the delivery line   (2)

7.2   7.2.1   C
       7.2.2   B
       7.2.3   A
       7.2.4   D   (4)
                                                                                   [6]

QUESTION 8: COMPRESSORS

8.1   Ensure the intake of clean air, free of dirt and other foreign matter.

8.2   Used for draining water or moisture, which accumulates inside the air
       receiver.

8.3   Cools air between the low pressure and high pressure stages before entering
       the high-pressure cylinder.

8.4   Cools air after the high-pressure stage of compression before being stored in
       the air receiver.

8.5   Allows the compressor to be switched off electrically, after the prescribed
       pressure has been reached.
                                                       (5 x 1)   [5]

QUESTION 9: V-BELT, CHAIN, GEAR DRIVES AND REDUCTION GEARBOXES

9.1
- Transmits motion over <u>long distances</u>
- Transmits motion to <u>more than one drive</u> at a time
- Easier to <u>maintain</u>
- Relative <u>cheap</u>

(Any 2 x 1)   (2)

9.2
- <u>Destructive</u> to the chain <u>(shorter life span)</u>
- <u>Detrimental</u> to smooth running <u>(low efficiency)</u>
- <u>Causes whipping</u> and vibration <u>(chain could come off the sprocket)</u>
- <u>Could ruin</u> the sprockets <u>(cause unnecessary wear)</u>

(2)

(Any 2 x 1)

9.3
- Solid sprocket
- Solid sprocket with spokes
- Split sprocket with spokes

(3)

[7]

TOTAL SECTION A: **60**

SECTION B

QUESTION 10: PNEUMATICS AND HYDRAULICS

10.1   Ensures that the normal working pressure is not exceeded by relieving excess fluid pressure in the tank.

(1)

10.2
- Noise factor
- Cost factor
- Power to weight ratio required
- Cleanliness factor
- Speed factor
- Rigidity factor

(Any 5 x 1)   (5)

10.3   10.3.1 – 2/2 Way Directional Control Valve
10.3.2 - 4/3 Way Directional Control Valve
10.3.3 - 5/2 Way Directional Control Valve
10.3.4 - 3/2 Way Directional Control Valve
10.3.5 - 4/2 Way Directional Control Valve

(5)

10.4
- <u>Hose fittings and pipes</u> are not loose
- Hoses and fittings must seat correctly
- <u>Oil and air filters</u> are clean
- <u>Hoses and pipings are clean</u> prior to installation
- <u>Release system pressure</u> to tool before disconnecting
- <u>All guards</u> to be fitted
- <u>Before start check</u> that persons are clear of danger

(Any 5 x 1)   (5)

10.5   • Lubricator
        • Water trap
        • Drain valve
        • Filter
        • Pressure regulator   (4)
                                              (Any 4 x 1)   **[20]**

QUESTION 11: CENTRE LATHE

11.1   • Setting up <u>time is reduced</u>
        • <u>Concentricity</u> is guaranteed
        • <u>Batch production</u> of large amounts is possible
        • Mandrels <u>can be modified</u> to suit a large range of work
        • Setting up can be delegated to <u>unskilled operators</u>   (4)
                                              (Any 4 x 1)

11.2   • Graduated sleeve method
        • Dial test indicator method   (2)

11.3 $\tan \dfrac{\theta}{2} = \dfrac{X}{L}$

        $X = L \times \tan \dfrac{6}{2}$ ✓

        $\quad = 280 \times 0,0524$ ✓

        $\quad = 14,67\, mm$ ✓   (3)

11.4   11.4.1 $Lead = No.of\ starts \times Pitch$

                  $\quad = 2 \times 5$

                  $\quad = 10\, mm$ √

        $Pitch\, diameter = OD - \dfrac{1}{2} \times Pitch$

        $\qquad\qquad\quad = 100 - \dfrac{1}{2} \times 5$ √

        $\qquad\qquad\quad = 97,5\, mm$ √

        $\tan \theta = \dfrac{Lead}{Pitch\, circumference}$

        $\qquad = \dfrac{10}{\pi \times 97,5}$ √

        $\qquad = 0,033$ √

        $\therefore \theta = \tan^{-1} 0.033$

        $\qquad = 1,87°$ √   (3)

11.4.2   Leading angle = 90° − (Helix + clearance angle)
$$= 90° − (1,87 + 3) \quad \sqrt{}$$
$$= 85,13° \quad \sqrt{}$$
(1)

11.4.3   Following angle = 90° + (helix − clearance angle)
$$= 90° + (1,87° − 3°) \quad \sqrt{}$$
$$= 88,87° \quad \sqrt{}$$
(1)

11.5   11.5.1   Incremental − each tool movement refers to the previous/ last tool position
(1)

       11.5.2   Absolute − each tool movement refers to a fixed point or origin (zero point)
(1)

11.6
- Material type
- Stock length
- Information from a drawing
- Operating sequence
- Tooling required
- Dwell time
- Coolant application
- Sizes according to dimensioning position
- Cutting speed

(Any 4 x 1)   (4)
[20]

QUESTION 12: MILLING MACHINES AND SURFACE GRINDERS

12.1   12.1.1   Square milling
       12.1.2   T-Slot milling
       12.1.3   Ball milling cutter
       12.1.4   End milling cutter
(4)

12.2   12.2.1   Simple indexing
(1)

12.2.2
$$\frac{40}{N} = \frac{40}{13} = 3\frac{1}{13} \quad \checkmark$$
$$= 3 \, turns \, and \, \frac{1}{13} \, of \, a \, turn \quad \checkmark$$

$$\frac{1}{13} \times \frac{3}{3} = \frac{3}{39} \quad \checkmark$$

Required indexing = 3 turns of crank & 3 holes in a 39 hole circle. $\checkmark$

(4)

12.3
- Deeper cuts can be made as the force of the cutter is downwards.
- A finer finish is obtained

(2)

12.4
- Vibration in the arbor is unavoidable
- A finer feed is to be used
- Material with hard scales could cause damage to the cutter teeth

(Any 2 x 1)   (2)

12.5
- Amount of material to be ground
- Hardness of the material
- Wet or dry grinding
- Wheel speed
- Surface area

(Any 4 x 1)   (4)

12.6   **V:** Vitrified
B: Resinoin or synthetic
R: Rubber bonding
E: Shellac
S: Silicates

(Any 3 x 1)   (3)
[20]

TOTAL SECTION B: 40
GRAND TOTAL: 100