

# higher education & training

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

## **MARKING GUIDELINE**

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

**25 MARCH 2014**

This marking guideline consists of 10 pages.

**SECTION A****QUESTION 1**

NOTE Candidates need ONLY QUESTION 1.1 or QUESTION 1.2

- 1.1
- Do not attempt to lift a load that is awkward or too heavy ✓
  - Use the correct lifting technique ✓
  - Correct body position when lifting ✓
  - Wear appropriate clothing and safety shoes with strong caps at all times. ✓
  - Depending on the nature of the load, it may be necessary to use gloves, hand leathers or goggles. ✓
  - Aprons must be worn when lifting chemicals. ✓
  - The area through which the load is to be moved must be clear and provide adequate space. ✓
  - All handling operations should be supervised. ✓
  - Determine how many persons are required to move a load safely. ✓
  - The supervisor must give clear instruction and signals. ✓ (Any 5 × 1) (5)
- OR
- 1.2
- 1.2.1
- No person is allowed to drive any vehicles unless authorised in writing by the manager of the mine. ✓
  - No person is allowed on or in a self-propelled vehicle attached to haulage equipment. ✓ (2 × 1) (2)
- 1.2.2
- No person must work or travel in an un-illuminated mine unless they carry a light ✓
  - Machinery with moving parts must be lighted in such a way that the moving parts are clearly visible ✓
  - No light or lamp are allowed in a mine unless approved by the director of the mines ✓ (3 × 1) (3)
- [5]**

**QUESTION 2**

- 2.1
- 2.1.1 Angular misalignment ✓ (1)
- 2.1.2 Radial misalignment ✓ (1)
- 2.2 Fixed or permanent or rigid couplings (1)
- 2.3 Fluid-drive coupling (1)
- 2.4
- Flange coupling ✓
  - Marine coupling ✓
  - Chain coupling ✓
  - Gear coupling ✓
  - Oldham coupling ✓
- (Any 2 × 1) (2)
- [6]**

**QUESTION 3**

- |     |       |  |            |
|-----|-------|--|------------|
| 3.1 | 3.1.1 | Washer <b>OR</b> any example of a Slide-, Push-, Running-, Clearance-fit types                   | (1)        |
|     | 3.1.2 | Bush, bearing fitting within a casing <b>OR</b> any example of a Force-, Drive-, Press-fit types | (1)        |
| 3.2 | 3.2.1 | False  |            |
|     | 3.2.2 | False  |            |
|     | 3.2.3 | False  |            |
|     | 3.2.4 | False  |            |
|     | 3.2.5 | True   |            |
|     |       | (5 × 1)  | (5)<br>[7] |

**QUESTION 4**

- |     |       |  |            |
|-----|-------|--|------------|
| 4.1 | 4.1.1 | Radial bearing/plain journal bearing/bush ✓  |            |
|     | 4.1.2 | Part bearing ✓   |            |
|     | 4.1.3 | Footstep ✓   |            |
|     | 4.1.4 | Guide bearing or machine slide ✓   |            |
|     |       | (4 × 1)  | (4)        |
| 4.2 |       | <ul style="list-style-type: none"> <li>• Oil should be distributed over as <u>wide an area</u> as possible ✓</li> <li>• Lubrication should provide for <u>adequate cooling</u> ✓</li> <li>• Oil groove must <u>not be cut over the overall length</u> of the bearing (to avoid oil leakage) ✓</li> <li>• <u>Sharp and raised edges</u> should be <u>cleaned up</u> ✓</li> <li>• <u>Entry</u> of lubricant to be <u>at the lowest pressure</u> for free flow of oil ✓</li> <li>• <u>Vertical bearings</u> to have a spiral groove against shaft rotation – forcing oil upwards ✓</li> <li>• Guide bearings should have <u>patterned grooves</u> on sliding edges ✓</li> </ul> | (3)<br>[7] |
|     |       | (Any 3 × 1)  |            |

**QUESTION 5**

- 5.1 Consists of an inverted glass bottle filled with oil, closed off with a plug. The needle passes through the plug and touches the shaft. When the shaft rotates, the needle vibrates. This vibration causes the oil to flow down the needle onto the shaft . (4)
- 5.2
- Graphite ✓
  - Zinc oxide ✓
  - Soapstone ✓
  - Talc ✓
  - Wax ✓
  - Mica ✓
  - French chalk ✓
- (Any 2 × 1) (2)
- 5.3 Rising stem-type, in which the stem and hand wheel rise with the gate. (1)
- 5.4 Non-rising stem type, in which the stem and hand wheel do not rise as the gate is opened. (1)
- [8]

**QUESTION 6**

- 6.1
- Always clean all surfaces - remove all burrs.
  - Check for correct seal.
  - Gently stretch the seal and push it into its groove
  - Make sure that the seal is not torn or twisted.
  - Lubricate the seal.
  - Fit protective sheath or sleeve - protect the seal over thread.
  - Tighten up lightly, ensure fits squarely.
  - Tighten up fully only after final assembly of all components. (Any 4 × 1) (4)
- 6.2
- Unaffected by many fluid mediums
  - Cheaper than steel
  - Fitting is easy
  - Light and portable
  - High insulating qualities
  - Corrosion resistant
  - No machining required
- (Any 4 × 1) (4)
- [8]

**QUESTION 7**

- 7.1
- Houses the packing or sealing material
  - Guides the linear movement of the shaft or piston rod
  - Prevents the escape of fluid past the piston rod
- (Any 1 × 1) (1)
- 7.2
- 7.2.1 Inlet port
- 7.2.2 Outlet port
- 7.2.3 Vane
- 7.2.4 Rotor
- (4 × 1) (4)  
[5]

**QUESTION 8**






- 8.1
- 8.1.1
- Cools pressurized air between the high pressure cylinder (Second stage) and the receiver. ✓
  - Acts as a dryer (dries the air) by removing moisture from the air before entering the receiver. ✓
- 8.1.2
- prevents water entering tools and machinery ✓
  - allows water to be tapped in a container (being heavier than air) and air to continue on its normal pathway ✓
  - Centrifugal force allows air (which is lighter) to continue on its flow-path. Water (which is heavier) is allowed to drop into a trap/ container/vessel – from where it can be tapped off. ✓
- 8.1.3 ON/OFF Switch - the switch is used to electrically isolate the compressor. This is commonly used to switch the compressor OFF at night or over weekends.
- (Any 3 × 1) (3)
- 8.2 A compressor is used to compress air and store it in a container ✓ so that the energy in the compressed air may be used for driving different tools and pneumatically operated machines ✓
- (2)  
[5]

**QUESTION 9**

- 9.1
- Milling machines
  - Lathes
  - Compressors
  - Ventilators
  - Heat exchanges
  - Motor vehicles/cars
  - Drilling machines
  - Pumps
- (Any 3 × 1) (3)
- 9.2
- Slip occurs
  - No lubrication required
  - Quiet operation
  - Little maintenance (attention) required
  - On multiple V-belt drives the machine may still continue to operate if one belt breaks
- (Any 3 × 1) (3)
- 9.3
- Always fit guards
  - During maintenance switch off at mains and lockout
  - Never adjust tension while machine is running
  - Keep belt free of grease and oil
  - Use correct size belt
  - Do not join a broken belt
  - Ensure correct installation procedure – a belt jumping off can seriously harm others
  - Make sure pulleys are tightly fitted on their shafts
  - Use tensioning pulleys to adjust the slackness of the belt
- (Any 3 × 1) (3)
- TOTAL SECTION A: 60**

**SECTION B****QUESTION 10**

- 10.1
- Hydraulic cranes – rotation of driver compartment
  - Stamping machines
  - Parts orientation
  - Welder robots
- (Any 2 × 1) (2)
- 10.2
- 10.2.1 Hydraulic pump
- 10.2.2 Reservoir
- 10.2.3 Electric Motor
- 10.2.4 Pressure Gauge
- (4 × 1) (4)

- 10.3
- Controls energy flow
  - Opens or closes flow path
  - Directs the flow
  - Regulates the flow rate
  - Regulates the pressure
- (Any 3 × 1) (3)
- 10.4
- Electric motor
  - Pump
  - Pressure relief valve
  - Reservoir
  - Filter
  - Pressure gauge
  - Check valve
- (Any 2 × 1) (2)
- 10.5
- 10.5.1 Weir/Separator/Dividing Plate
- 10.5.2 Air filler/Breather
- 10.5.3 Pump/Electric motor
- 10.5.4 Min and Max Sight Glass Indicator levels
- (4 × 1) (4)
- 10.6
- 10.6.1
- 
- HYDRAULIC MOTOR
- 10.6.2
- 
- SHUT OFF VALVE
- 10.6.3
- 
- ACCUMULATOR
- 10.6.4
- 
- PRESSURE GAUGE
- 10.6.5
- 
- MECHANICAL PUMP
- (5 × 1) (5)  
[20]

## QUESTION 11

11.1 11.1.1 Lathe bed

11.1.2 Saddle

(2 × 1) (2)

$$\begin{aligned}
 11.2 \quad 11.2.1 \quad \text{Set - over} &= \frac{D-d}{2} \times \frac{\text{length of workpiece}}{\text{length of taper}} \checkmark \\
 &= \frac{60-50}{2} \times \frac{220}{140} \checkmark \\
 &= 7.86 \text{ mm} \checkmark
 \end{aligned}$$

(3)

$$11.2.2 \quad \tan \frac{\theta}{2} = \frac{5}{140} = 2,045 \checkmark$$

$$\theta = 4,09^\circ = 4^\circ 5' \checkmark$$

(2)

$$11.3 \quad L = f_t \times N \times t$$

$$t = \frac{L}{f_t \times N} \checkmark$$

$$= \frac{250}{0.5 \times 199} \checkmark$$

$$= 2 \text{ minutes } 31 \text{ seconds} \checkmark$$

(3)

$$11.4 \quad \text{Lead} = \text{No of starts} \times \text{pitch}$$

$$= 3 \times 6$$

$$= 18 \checkmark^{1/2}$$

$$D_{\text{mean}} = OD - \frac{1}{2} \times \text{pitch}$$

$$= 40 - \frac{1}{2} \times 6$$

$$= 37 \checkmark^{1/2}$$

$$\tan \theta = \frac{\text{lead}}{\pi \times D_m}$$

$$= \frac{18}{\pi \times 37} \checkmark$$

$$\theta = \tan^{-1} 0,0516 \checkmark^{1/2}$$

(3)



## FITTING AND MACHINING THEORY N2

$$= 8,8^\circ = 8^\circ 48' \checkmark^{1/2}$$

- 11.5 11.5.1 INCREMENTAL – each tool movement makes reference to the previous tool position
- 11.5.2 ABSOLUTE – each tool movement makes reference to a fixed point or origin.
- 11.5.3 G-codes: indicates tool movement
- 11.5.4 M-codes: indicates machine function or movement. (4 × 1) (4)
- 11.6
- Time saving – no setting up required
  - Concentricity is guaranteed
  - Batch production is possible
  - Mandrels can be modified to suit later work
  - Setting up can be delegated to unskilled operators
  - Workpieces are easily mounted and dismounted
- (Any 3 × 1) (3)  
[20]

## QUESTION 12

- 1.2.1 12.1.1 End-milling cutter
- 12.1.2 Slotting cutter
- 12.1.3 Gang-milling (3 × 1) (3)
- 12.2
- Simple
  - Rapid
  - Differential
  - Angular (4)
- 12.3
- Too slow a speed
  - Metal clogging the space between abrasive particles
  - Wrong wheel
  - Insufficient coolant
  - Dirty coolant
  - Grinding wheel is too soft
  - Incorrect wheel dressing (Any 3 × 1) (3)
- 12.4 D = 0,035 meter (35 mm)  
S = ? m/min  
N = 360 rpm
- S =  $\pi D N$  ✓  
=  $\pi \times 0,035 \times 360$  ✓ (3)

= 39,58 m/min ✓

- 12.5
- Less power consumption
  - More easily sharpened when worn
  - Cheaper to manufacture – fewer teeth
  - Less vibration/chattering is reduced
  - Coarse feed is possible
  - Less friction
- 12.6
- Cheaper
  - Chattering is reduced
  - Higher speeds can be used
  - They save on power consumption
  - Less chance of the key being sheared off

(Any 4 × 1) (4)

(Any 3 × 1) (3)  
[20]

**TOTAL SECTION B: 40**  
**GRAND TOTAL: 100**