NATURAL SCIENCE
MARKING GUIDELINES

April 2011
FITTING AND MACHINING THEORY N2
11022032

April 2011
PAS- EN MASJINEERTEORIE N2
**SECTION A - ALL QUESTIONS ARE TO BE MARKED IN THIS SECTION**

**QUESTION 1**

**OCCUPATIONAL SAFETY**

**NOTE** Candidates need ONLY QUESTION 1.1 or QUESTION 1.2

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1.1</strong></td>
<td>LOCK the switch in the &quot;OFF&quot; position – use key or padlock while performing maintenance on machines. (1)</td>
</tr>
<tr>
<td></td>
<td>Or REMOVE fuses (1)</td>
</tr>
<tr>
<td></td>
<td>Warning signs are to be posted while working (1)</td>
</tr>
<tr>
<td></td>
<td>Mark power supplies &quot;AC&quot; or &quot;DC&quot; (1)</td>
</tr>
<tr>
<td></td>
<td>Place &quot;DANGER!&quot; or &quot;DO NOT SWITCH ON&quot; sign boards at the place of disconnection of power supply. (1)</td>
</tr>
<tr>
<td></td>
<td>Label all circuit breakers to indicate which machines they serve. (1)</td>
</tr>
<tr>
<td></td>
<td>Label the MAIN SWITCH so that it is clear and stands out from the rest of the switches on the Distribution Board. (1)</td>
</tr>
<tr>
<td></td>
<td>Faulty portable electrical must not be used. (1)</td>
</tr>
<tr>
<td></td>
<td>Record regular checks of faulty equipment as well as the record of repairs and services (1)</td>
</tr>
</tbody>
</table>

**OR**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1.2</strong></td>
<td>Underground work - Every person in charge of more than 300 workmen must be in possession of a first aid certificate (1)</td>
</tr>
<tr>
<td></td>
<td>Underground work - All workers under the age of 50 years old must have a first aid certificate (1)</td>
</tr>
<tr>
<td></td>
<td>Workers on the surface – All workers near machinery on the surface must be in possession of a first aid certificate. (1)</td>
</tr>
<tr>
<td></td>
<td>Underground and Surface Mining – Every person has a period of ONE years within which to obtain a first aid certificate (1)</td>
</tr>
<tr>
<td></td>
<td>First Aid certificates are renewable every THREE years (1)</td>
</tr>
</tbody>
</table>

**QUESTION 2**

**COUPLINGS**

**FIGURE 1 (DIAGRAM SHEET) shows a sketch of a type of coupling. Give brief answers to the following questions on this type of coupling.**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2.1</strong></td>
<td>Marine coupling (1)</td>
</tr>
<tr>
<td><strong>2.2</strong></td>
<td>Consists of TWO solid flanges (1)</td>
</tr>
<tr>
<td></td>
<td>Holes for fixing the flanges are line up directly opp. each other, and they (1)</td>
</tr>
</tbody>
</table>

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QUESTION 3  LIMITS AND FITS

3.1.1 Tolerance – difference between the high, limit and the lower limit of the same nominal size and tolerance are able to fit each other and visa versa.

3.1.3 Allowance – the difference in fit/ limit between two mating components (example: high limit of a hole minus the low limit of a shaft = maximum allowance)

3.2.1 Transition

3.2.2 Clearance

3.2.3 Clearance

3.2.4 Interference

3.2.5 Clearance

QUESTION 4  BEARINGS

4.1 SUPPORTS SHAFT
ELIMINATES WEAR
ELIMINATES FRICTION PROVIDES A REPLACEABLE WEAR SURFACE

4.2 Load Capacity
Corrosion resistance
Thermal conductivity
Fatigue strength
Embedded ability
Compatibility
Conformability
Cost

4.3 Insufficient lubrication
overlubrication
drying-up of grease
foaming oil
oil-pollution
rotating journal sleeve
insufficient bearing clearance
bearing slip on shafts
flat on rolling element/s
incorrect assembly
shaft out of roundness
excessive bearing
clearance

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### QUESTION 5 LUBRICATION AND VALVES

<table>
<thead>
<tr>
<th>5.1.1</th>
<th>SEMI-SOLID</th>
<th>(1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1.2</td>
<td>LIQUID</td>
<td>(1)</td>
</tr>
<tr>
<td>5.1.3</td>
<td>LIQUID</td>
<td>(1)</td>
</tr>
<tr>
<td>5.1.4</td>
<td>SEMI-SOLID</td>
<td>(1) (4)</td>
</tr>
<tr>
<td>5.2</td>
<td>GLOBE</td>
<td>(1)</td>
</tr>
<tr>
<td></td>
<td>GATE</td>
<td>(1)</td>
</tr>
<tr>
<td></td>
<td>BALL</td>
<td>(1)</td>
</tr>
<tr>
<td></td>
<td>DIAPHRAGM</td>
<td>(1) (3)</td>
</tr>
</tbody>
</table>

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

6.1
- clean all surfaces (1)
- lubricate the seal before install ensure the correct seal use a protective sheath over a threaded section to protect the seal. (1)
- ensure no damage while installing seal (1)
- Always tighten up lightly in the beginning for squaring up the seal (1) (5)

<table>
<thead>
<tr>
<th>6.2</th>
<th>PVC PIPE</th>
<th>(1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>sewage draining</td>
<td>(1)</td>
</tr>
<tr>
<td></td>
<td>storm water drainage</td>
<td>(1)</td>
</tr>
<tr>
<td></td>
<td>electrical conduit</td>
<td>(1)</td>
</tr>
<tr>
<td></td>
<td>underground ducting</td>
<td>(1)</td>
</tr>
<tr>
<td></td>
<td>POLYTHENE PIPE</td>
<td>(1)</td>
</tr>
<tr>
<td></td>
<td>electrical sheathing</td>
<td>(1)</td>
</tr>
<tr>
<td></td>
<td>industrial tubing (air, oil etc.)</td>
<td>(1) (4)</td>
</tr>
</tbody>
</table>

### QUESTION 7 PUMPS

<table>
<thead>
<tr>
<th>7.1</th>
<th>USED TO DISPLACE FLUID FROM INLET TO OUTLET</th>
<th>(1) (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.2</td>
<td>A OUTLET</td>
<td>(1)</td>
</tr>
<tr>
<td></td>
<td>B INLET</td>
<td>(1)</td>
</tr>
<tr>
<td></td>
<td>C ROTOR</td>
<td>(1)</td>
</tr>
<tr>
<td></td>
<td>D BLADES / VANES</td>
<td>(1) (4)</td>
</tr>
</tbody>
</table>

### QUESTION 8 COMPRESSORS

<table>
<thead>
<tr>
<th>8.1.1</th>
<th>Safety valve – PREVENTS EXCESSIVE PRESSURE BUILD-UP IN AIR RECEIVER</th>
<th>(1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.1.2</td>
<td>Belt transmission guard – SAFETY OF WORKERS &amp; MACHINE</td>
<td>(1)</td>
</tr>
<tr>
<td>8.1.3</td>
<td>Drain valve – DRAINAGE POINT FOR WATER, CONDENSATE, DIRT, OIL</td>
<td>(1)</td>
</tr>
<tr>
<td>8.1.4</td>
<td>Receiver – STORAGE OF AIR – PRESSURE ENERGY</td>
<td>(1)</td>
</tr>
<tr>
<td>8.1.5</td>
<td>Pressure regulator switch – ENSURES CUT OUT OF MACHINE AT DESIRED AIR PRESSURE</td>
<td>(1) (9)</td>
</tr>
</tbody>
</table>

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QUESTION 9  V-BELT, GEAR AND CHAIN DRIVES

9.1 Velocity ratio is the relationship between the speeds of the drive gear to the speed of the driven gear or the number of teeth of the driven gear to the number of teeth on the drive gear.

Mechanical advantage is the resultant effect between two meshing gears and can be obtained by varying the velocity ratio between them.

An increase in velocity ratio results in the ability of two meshing gears to handle higher torque and low speed situations.

Decrease of the velocity ratio means a lower torque and higher speed can be achieved.

Velocity ratio therefore affects the mechanical advantage directly.

9.2 SLIP TAKES PLACE
NO LUBRICATION REQUIRED
TRANSITS MOTION OVER A LONGER DISTANCE
CHEAPER

END OF SECTION A – TOTAL 60 MARKS

SECTION B
CANDIDATES NEED ONLY ANSWER TWO QUESTIONS IN THIS SECTION - SECTION B

QUESTION 10  HYDRAULICS AND PNEUMATICS

10.1 10.1.1 CHECK VALVE
10.1.2 4/3 WAY N/C VALVE
10.1.3 PUMP – SINGLE DIRECTION
10.1.4 PRESSURE RELIEF VALVE
10.1.5 DOUBLE ACTING CYLINDER

10.2 Hydraulics = BACK TO TANK – OIL IS RECYCLED
pneumatics = AIR IS NOT RECYCLED BUT IS EXHAUSTED INTO THE ATMOSPHERE

10.3 manually
electrically
by fluid pressure (pilot pressure)

10.4.1 VACUUM PUMP – PRODUCES NEGATIVE PRESSURE FOR EG. SUCTION FUNCTION (SUCTION CUP FOR PICKING UP COMPONENTS).
10.4.2 PRESSURE REGULATOR – ENSURES THAT THE WORKING PRESSURE IS MAINTAINED AFTER PRE-SETTING
10.4.3 DOUBLE ACTING CYLINDER – ACTUATOR FOR PRODUCING MECHANICAL MOVEMENT IN A LINEAR DIRECTION

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10.5 PRESSURE (Force/Area) and VOLUME (Area/Diameter of Piston) (2) (2)
10.6 Noise/silent;
    power consumption/low; (1)
    clean; (1)
    high speed manufacturing; (1)
    components are lightweight (1) [5]

QUESTION 11 CENTRE LATHES

11.1
    • Time saving (1)
    • Concentricity is guaranteed (1)
    • Batch production is possible (1)
    • Mandrels can be modified to suit later work (1)
    • Setting up can be delegated to unskilled operators (1) [4]

10.2 ADVANTAGES TAILSTOCK SET-OVER

<table>
<thead>
<tr>
<th>ADVANTAGES TAILSTOCK SET-OVER</th>
<th>DISADVANTAGES TAILSTOCK SET-OVER</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Automatic feed (1)</td>
<td>• Time-consuming to set up (1)</td>
</tr>
<tr>
<td>• Finish is improved (1)</td>
<td>• Damage is done to the centre / workpiece (1)</td>
</tr>
<tr>
<td></td>
<td>• Too many cuts cause wear on the centre-hole and lead to inaccuracy of the taper (1)</td>
</tr>
<tr>
<td></td>
<td>• Internal tapers cannot be machined (1)</td>
</tr>
<tr>
<td></td>
<td>• Large angle tapers cannot be machined (1)</td>
</tr>
<tr>
<td></td>
<td>• Light cuts must be taken (1) [4]</td>
</tr>
</tbody>
</table>

11.3.1

\[
\sin \frac{\theta}{2} = \frac{x}{\text{Lengte van werk}}
\]

\[
x = \sin \frac{\theta}{2} \times \text{lengte}
\]

\[
= \sin 3^\circ \times 240
\]

\[
= 0.0523 \times 240
\]

\[
x = 12.55 \text{ mm}
\]

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11.4 OPLossing
(a) Styging = steek x aantal beginnend
= 10 x 3
= 30 mm
Steek diameter = Buitendiameter - 1/2 steek
= 50 - 5
= 45 mm
Helikshock tan \( \theta \) = \( \frac{\text{styging}}{\text{steekomtrek}} \)
= \( \frac{30}{\pi \times 45} \)
= 0.212 2
\( \theta \) = 11° 58'
(b) Voorloopshock = 90° - (helikshock + vryloopp)
= 90° - (11° 58' + 3°)
= 75° 2'
(c) Naloopshock = 90° + helikshock - vryloopp
= 90° + 11° 58' - 3°
= 98° 58'

11.5 A - HELIX ANGLE
B - CLEARANCE ANGLE
C - LEADING ANGLE
D - FOLLOWING ANGLE

QUESTION 12 MILLING MACHINES AND SURFACE GRINDERS

12.1.1 T-Slot cutter
12.1.2 Dove-tail cutter
12.1.3 Helical cutter with nicked teeth

12.2 simple
rapid
differential
angular

12.3 Too slow a speed
Metal clogging the space between abrasive particles
Wrong wheel
Insufficient coolant

12.4 D = 0,035 meter (35 mm)
S = ? m/min
N = 360 rpm

\[ S = \pi D N = \pi \times 0.035 \times 360 = 38.58 \text{ m/min} \]

12.5 ADVANTAGES
The cut can start from underneath the hardened outer-skin of a casting,
flange or forging etc.
The cut is positive – ie. Table direction is opposite to direction of cutter
Less vibration
Coarse feed is possible

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DISADVANTAGES
The cutter may lift work from the holding device (1)
A good quality surface finish cannot be guaranteed (1)
cheaper (1)
chattering is reduced (1)
higher speeds can be used (1)
they save on power consumption (1)

12.6

TOTAL SECTION B: 40
GRAND TOTAL: 100
### Formula Sheet / Formuleblad

\[ f = \text{ft} \times T \times N \]

\[ S = \frac{\pi DN}{60} \]

\[ S = \frac{\pi DN}{60} \]

\[ \frac{40}{N} \]

\[ \frac{40}{N} \]

\[ \frac{N}{9^\circ} \]

\[ \frac{N}{9^\circ} \]

\[ D - d \times \text{length of workpiece} \]

\[ \frac{2}{\text{length of taper}} \]

\[ \text{length of taper} \]

\[ \text{length van werkstuk} \]

\[ \text{length van spitsstuk} \]

\[ \tan \theta = \frac{X}{2 \cdot L} \]

\[ \tan \theta = \frac{X}{2 \cdot L} \]

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

\[ 90^\circ - (\text{Helikshoek} + \text{vryloophoek}) \]

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

\[ 90^\circ + (\text{Helikshoek} - \text{vryloophoek}) \]

\[ \text{Lead} = \text{no. of starts} \times \text{pitch} \]

\[ \text{Styping} = \text{Aantal beginne} \times \text{Steek} \]