higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

FITTING AND MACHINING THEORY N2

30 July 2021

This marking guideline consists of 9 pages.

SECTION A

QUESTION 1: OCCUPATIONAL SAFETY

1.1
1.1.1 True
1.1.2 False
1.1.3 True
1.1.4 True
1.1.5 True

(5 × 1) **[5]**

OR

1.2
1.2.1 True
1.2.2 True
1.2.3 True
1.2.4 False
1.2.5 True

(5 × 1) **[5]**

QUESTION 2: COUPLINGS

2.1 A coupling is a permanent connection between a drive and a driven shaft ✓ whereas a clutch is a coupling where the drive shaft and the driven shaft can be engaged and disengaged by the operator. ✓ (2)

2.2
- Spider coupling
- Bibby/resilient coupling
- Metal-disc coupling
- Pin and rubber bush coupling
- Rubber belt coupling
- Nylon sleeve coupling
- Tyre coupling
- Raffard coupling
- Fluid drive coupling

(Any 2 × 1) (2)

2.3
- Axial misalignment
- Radial misalignment
- Angular misalignment

(Any 2 × 1) (2)
[6]

QUESTION 3: LIMITS AND FIT

3.1	3.1.1	C		
	3.1.2	A		
	3.1.3	B		
			(3 × 1)	(3)
3.2	3.2.1	Unilateral tolerance		
	3.2.2	Unilateral tolerance		
	3.2.3	0,03 mm		
	3.2.4	0,04 mm		
			(4 × 1)	(4)
				[7]

QUESTION 4: BEARINGS

4.1 A – Inner / outer raceway / shaft / housing ring
B – Ball/rolling elements
C – Cage (3)

4.2
- Faulty maintenance and assembly
- Insufficient lubricant
- Incorrect lubricant
- Dirt or grit in the lubricant
- High operating temperature
- Wear/fatigue of bearing material
- Faulty design
- Corrosion of the bearing material
- Water contamination (Any 2 × 1) (2)

[5]

QUESTION 5: LUBRICATION AND VALVES

5.1
- Solids
- Liquids
- Semi-solids (grease) (Any 3 × 1) (3)

5.2 A ball valve consists of a ball with a hole through it.✓ When the opening in the ball coincides with that of the pipeline, the fluid will flow.✓ If the handle is turned through 90° to the pipeline no flow will take place.✓ (3)

[6]

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

6.1
- Prevent leaks in the different types of machinery.
- Acts as seal or joining when connecting pipelines to allow continuous flow of fluid.
- Prevent dust and foreign matter from entering machines and equipment.
- Maintains pressure within the system. (Any 1 × 1) (1)

6.2
- Clean all surfaces.
- Check that the seal housing is free from damage.
- Ensure the correct seal is used.
- Ensure no damage while installing seal.
- Lubricate the seal before installing.
- Use a protective sheath over a threaded section to protect the seal.
- Ensure that the seals are not subjected to any misalignment.
- Always tighten up lightly in the beginning for squaring up the seal.

(Any 5 × 1) (5)

6.3 6.3.1 Plug

6.3.2 Union

6.3.3 Nipple

(3 × 1) (3)
[9]

QUESTION 7: PUMPS

7.1
- Casing or housing
- Impeller
- Stuffing box assembly
- Bearings
- Shaft assembly (Any 2 × 1) (2)

7.2 When the piston moves out, liquid is drawn into the cylinder. ✓ When the piston moves inwards, the liquid is forced out of the cylinder. ✓ (2)

7.3 In a positive displacement pump a fixed amount of fluid is displaced with every stroke of the pump,✓ whereas in a non-positive displacement pump the amount of fluid displaced varies with every rotation of the pump.✓ (2)
[6]

QUESTION 8: COMPRESSORS

8.1
- Vane compressors
- Lobe compressors
- Rotary-screw compressors
- Centrifugal compressors (Any 3 × 1) (3)

8.2
- Pascal (Pa) / Kilopascal (KPa) / Megapascal (MPa) (Any 1 × 1) (1)

[4]

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

9.1
- Solid sprocket
- Solid sprocket with spokes
- Split sprocket with spokes (3)

9.2 9.2.1
- Velocity ratio is the relationship between the speeds of the drive gear to the speed of the driven gear.
- The number of teeth of the driven gear to the number of teeth of the drive gear. (Any 1 × 1) (1)

9.2.2 Mechanical advantage is the resultant effect between two meshing gears and can be obtained by varying the velocity ratio between them. (1)

9.3
- Slip will take place in the event of overloading
- No lubrication is required
- Operation is more silent
- They require very little attention
- In the case of multiple drives, when one belt breaks, the drive will continue to run, using the remaining belts. (Any 4 × 1) (4)

9.4
- Single-reduction gearbox
- Double-reduction gearbox
- Worm and worm-wheel gearbox (3)

[12]

TOTAL SECTION A: 60

SECTION B

Only TWO questions to be answered in SECTION B.

QUESTION 10: HYDRAULICS AND PNEUMATICS

10.1
- Pump
- Reservoir
- Actuator
- Valves or pressure relief valve or control valve
- Piping (Any 3 × 1) (3)

10.2
- Transmits energy
- Lubricates
- Prevents corrosion
- Removes dirt
- Acts as a coolant (Any 3 × 1) (3)

10.3
A – Reservoir
B – Hydraulic motor
C – Pressure relief valve
D – Check valve / One-way valve
E – Actuator / Cylinder (5)

10.4
- Compressed air supply is readily available.
- They are more reliable and durable than hydraulic systems.
- They are more easily adaptable than hydraulic systems.
- They are safer than hydraulic systems.
- Reciprocating motion is easily and cheaply achieved.
- Variable speeds can be obtained in pneumatic systems.
- They are more economical as they have lower set-up and maintenance costs. (Any 5 × 1) (5)

10.5 Ensures that the normal working pressure is not exceeded by relieving excess fluid pressure in the tank. (1)

10.6
- Check for leaks/cracks
- Check for kinks
- Check for perished rubber
- Check for blockages (Any 3 × 1) (3)

[20]

QUESTION 11 : CENTRE LATHES

11.1
- Supporting long, slender workpieces between centres
- Maintaining concentricity of long workpieces while machining
- Reducing vibration or chatter, ensuring a better finish of the workpiece
- Supporting workpieces against the pressure of heavy machining

(Any 3 × 1) (3)

11.2 11.2.1

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

$$= \frac{45-30}{2} \times \frac{250}{150} \checkmark$$

$$= 12{,}5\ mm \checkmark$$

(2)

11.2.2

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

$$= \frac{7{,}5}{150} \checkmark$$

$$= 0{,}05$$

$$\frac{\theta}{2} = 2{,}86° \checkmark$$

$$\theta = 5{,}72°$$

$$= 5°\,43' \checkmark$$

(3)

11.3

$$S = \pi DN$$

$$D = \frac{S}{\pi \times N} \checkmark$$

$$= \frac{56{,}55}{\pi \times 1800} \checkmark$$

$$= 10\ mm \checkmark$$

(3)

11.4

$$L = f \times N \times t$$

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

$$= \frac{250}{0{,}5 \times 199} \checkmark$$

$$= 2{,}513\ min$$

$$= 2\ min\ 30{,}8\ seconds \checkmark$$

(3)

11.5 11.5.1 $\text{Lead} = \text{Number of starts} \times \text{pitch of thread}$
$= 2 \times 12$
$= 24 \text{ mm}$✓

$$\text{Mean diameter (Dm)} = \text{Outside diameter} - \frac{\text{pitch}}{2}$$
$$= 66 - \frac{12}{2}$$
$$= 60 \text{ mm}$$✓

$$\tan\theta = \frac{\text{Lead}}{\pi \times \text{Dm}}$$

$$= \frac{24}{\pi \times 60}$$

$$= 0{,}127 \checkmark$$

$$\theta = 7{,}24° \checkmark$$ (4)

11.5.2 Leading angle = 90°- (helix angle + clearance angle)
= 90°- (7,256°+ 3°)
= 79,744 mm (1)

11.5.3 Following angle = 90°+ (helix angle - clearance angle)
= 90°+ (7,256-3°)
= 94,256 mm (1)
[20]

QUESTION 12: MILLING MACHINES AND SURFACE GRINDERS

12.1 12.1.1 A – Up-cut milling
B – Down-cut milling

12.1.2 A – The workpiece is fed against the direction of rotation of the milling cutter.
B – The work piece is fed with the direction of rotation of the milling cutter.

12.1.3
- There is a chance of the cutter lifting the work piece.
- The finish on the work piece is not of a high standard.

12.1.4
- Deeper cuts can be made.
- A good finish is obtained.

(4 × 2) (8)

12.2 Indexing = $\frac{40}{N}$

$= \frac{40}{9}$✓

$= 4\frac{4}{9}$✓

$= 4\left[\frac{4}{9} \times \frac{2}{2}\right]$✓

$= 4\ \frac{8}{18}$✓

Indexing = four full turns of the crank handle and 8 holes in an 18-hole plate.✓ (5)

12.3
- Costs less
- Less vibration on the arbour
- Higher arbour speed may be used
- Less power needed to drive the cutter
- Less chance of shearing the key

(5)

12.4 12.4.1 Aluminium oxide/A
12.4.2 Silicon carbide/C

(2 × 1) (2)
[20]

TOTAL SECTION B: 40
GRAND TOTAL: 100