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Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

MECHANICAL TECHNOLOGY: FITTING AND MACHINING

NOVEMBER 2022

MARKING GUIDELINES

MARKS: 200

These marking guidelines consist of 23 pages.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS (GENERIC)

- | | | |
|-----|-----|------------|
| 1.1 | B ✓ | (1) |
| 1.2 | B ✓ | (1) |
| 1.3 | C ✓ | (1) |
| 1.4 | C ✓ | (1) |
| 1.5 | A ✓ | (1) |
| 1.6 | B ✓ | (1) |
| | | [6] |

QUESTION 2: SAFETY (GENERIC)**2.1 Vital functions:**

- Breathing ✓
- Heart rate / pulse ✓
- State of consciousness ✓

(Any 2 x 1) (2)**2.2 Safety glasses during grinding:**

- To prevent any injuries to the operator's eyes. ✓
- To protect eyes from sparks and debris. ✓
- To prevent blindness due to injury. ✓

(Any 1 x 1) (1)**2.3 Type of guards:**

- Fixed guard ✓
- Automatic sweep-away ✓
- Self-adjusting / automatic guard ✓
- Electronic presence sensing device ✓
- Two-hand control device. ✓

(Any 2 x 1) (2)**2.4 Precautions *before* gas welding operations can be undertaken:**

- An operator has been instructed on how to use the equipment safely. ✓
- A workplace is effectively partitioned off. ✓
- An operator uses protective equipment (PPE). ✓
- Ensure that fire equipment is at hand. ✓
- Ensure that the equipment is in a safe working condition. ✓
- Ensure the gas equipment is set-up correctly. ✓
- Ensure the area is well ventilated. ✓
- Ensure that the working area is safe. ✓

(Any 3 x 1) (3)**2.5 TWO disadvantages of the product layout:**

- Lack of flexibility. ✓
- Optimum use of equipment is not possible. ✓

**(2)
[10]**

QUESTION 3: MATERIALS (GENERIC)**3.1 THREE properties:**

- Toughness ✓
- Hardness / Wear resistance ✓
- Softness ✓
- Case hardness ✓
- Ductility ✓
- Malleability ✓
- Elasticity ✓
- Brittleness ✓
- Strength ✓

(Any 3 x 1) (3)**3.2 Heat treatment processes:****3.2.1 Tempering:**

- It consists of heating the hardened steel ✓ to a temperature below its critical temperature (colour chart). ✓
- Soaking it at this temperature for a period of time, ✓
- Quenching/cooling it rapidly in water, brine or oil. ✓

(4)**3.2.2 Hardening:**

- The steel is heated slightly higher than the upper critical temperature. ✓
- The steel is soaked at that temperature for the required time. ✓
- The steel is then rapidly cooled by quenching in water, brine or oil. ✓

(3)**3.3 Examples of case-hardening:**

- Bearing cases ✓
- Bearing ball ✓
- Bearing needles ✓
- Crankshafts ✓
- Gears ✓
- Camshafts ✓
- Cylinder sleeves ✓
- Hammer head ✓
- Jack Hammer drill bits ✓

(Any 2 x 1) (2)**3.4 Why steels are cooled down in still air away from draughts:**

This prevents sudden cooling of localised spots, ✓ which might cause distortion/cracks. ✓

(2)**[14]**

QUESTION 4: MULTIPLE-CHOICE QUESTIONS (SPECIFIC)

4.1	C ✓	(1)
4.2	A ✓	(1)
4.3	B ✓	(1)
4.4	D ✓	(1)
4.5	C ✓	(1)
4.6	A ✓	(1)
4.7	B ✓	(1)
4.8	B ✓	(1)
4.9	C ✓	(1)
4.10	A ✓	(1)
4.11	B ✓	(1)
4.12	A ✓	(1)
4.13	D ✓	(1)
4.14	D ✓	(1)
		[14]

QUESTION 5: TERMINOLOGY (LATHE AND MILLING MACHINE) (SPECIFIC)**5.1 TWO advantages of cutting using the tailstock set-over method:**

- Long tapers can be cut. ✓
- The automatic feed can be used. ✓
- Good finish is obtained ✓

(Any 2 x 1) (2)**5.2 Big diameter of taper:**

$$\tan \frac{\theta}{2} = \frac{D - d}{2 \times l}$$

$$D = \tan \frac{\theta}{2} (2 \times l) + d \quad \checkmark$$

$$= \tan \frac{8^\circ}{2} (2 \times 290) + 42 \quad \checkmark$$

$$= \tan 4^\circ (580) + 42 \quad \checkmark$$

$$D = 82,56 \text{ mm} \quad \checkmark$$

(4)**5.3 Calculation of parallel key:**

$$5.3.1 \quad \text{Width} = \frac{D}{4}$$

$$= \frac{65}{4} \quad \checkmark$$

$$= 16,25 \text{ mm} \quad \checkmark$$

(2)

$$5.3.2 \quad \text{Thickness} = \frac{D}{6}$$

$$= \frac{65}{6} \quad \checkmark$$

$$= 10,83 \text{ mm} \quad \checkmark$$

(2)

$$5.3.3 \quad \text{Length} = 1,5 \times \text{diameter of shaft}$$

$$= 1,5 \times 65 \quad \checkmark$$

$$= 97,5 \text{ mm} \quad \checkmark$$

(2)

5.4 Disadvantages of straddle milling:

- The cutters used place more stress on the machine's spindle. ✓
- The milling machine works harder due to more than one cutter being used. ✓
- There can be more vibration. ✓
- Poor finishing. ✓

(Any 1 x 1) (1)**5.5 TWO milling processes:****The milling of:**

- Bevels ✓
- Keyways ✓
- Slides ✓
- Chamfers ✓
- Other angles ✓
- Grooves ✓
- Jigs recesses ✓
- Tees ✓
- Dovetail slots ✓
- Surface milling ✓
- Drilling ✓
- Reaming ✓
- Tapping ✓
- Up-cut milling ✓
- Down-cut milling ✓

(Any 2 x 1) (2)**5.6 Calculate X:**

$$x = \frac{\text{Diameter of workpiece} - \text{Thickness of cutter}}{2} \quad \checkmark$$

$$= \frac{60 - 12}{2} \quad \checkmark$$

$$= \frac{48}{2}$$

$$= 24 \text{ mm} \quad \checkmark$$

**(3)
[18]**

QUESTION 6: TERMINOLOGY (INDEXING) (SPECIFIC)**6.1 Gear calculations:****6.1.1 Module:**

$$\begin{aligned}\text{Module} &= \frac{\text{PCD}}{T} \\ &= \frac{165}{110} \quad \checkmark \\ &= 1,5 \quad \checkmark\end{aligned}$$

(2)

6.1.2 Outside diameter:

$$\begin{aligned}\text{OD} &= \text{PCD} + 2(m) \\ &= 165 + 2(1,5) \quad \checkmark \\ &= 168 \text{ mm} \quad \checkmark\end{aligned}$$

$$\begin{aligned}\text{OR} \quad \text{OD} &= m(T + 2) \\ &= 1,5(110 + 2) \quad \checkmark \\ &= 168 \text{ mm} \quad \checkmark\end{aligned}$$

(2)

6.2 Dovetail calculations:

$$W = 120 + 2(\text{DE})$$

$$m = W - [2(\text{AC}) + 2(\text{R})] \quad \text{OR} \quad m = W - 2(\text{AC} + \text{R}) \quad \text{OR} \quad m = W - 2(\text{AC}) - 2(\text{R})$$

6.2.1 Maximum width distance of dove tail. (W)**Calculate DE:**

$$\tan \alpha = \frac{\text{DE}}{\text{AD}}$$

$$\tan \theta = \frac{\text{AD}}{\text{DE}}$$

$$\text{DE} = \tan \alpha \times \text{AD} \quad \checkmark$$

$$\text{DE} = \frac{\text{AD}}{\tan 60^\circ} \quad \checkmark$$

OR

$$= \tan 30^\circ \times 30 \quad \checkmark$$

$$= \frac{30}{\tan 60^\circ} \quad \checkmark$$

$$= 17,32 \text{ mm} \quad \checkmark$$

$$= 17,32 \text{ mm} \quad \checkmark$$

$$\begin{aligned}W &= 120 + 2(\text{DE}) \quad \checkmark \\ &= 120 + 2(17,32) \quad \checkmark \\ &= 120 + 34,64 \\ &= 154,64 \text{ mm} \quad \checkmark\end{aligned}$$

(6)

6.2.2 Distance between the rollers. (m)**Calculate AC:**

$$\tan \alpha = \frac{BC}{AC}$$

$$AC = \frac{BC}{\tan \alpha} \checkmark$$

$$= \frac{11}{\tan 30^\circ} \checkmark$$

$$= 19,05 \text{ mm} \checkmark$$

$$\tan \theta = \frac{AC}{BC}$$

$$AC = \tan \theta \times BC \checkmark$$

$$= \tan 60^\circ \times 11 \checkmark$$

$$= 19,05 \text{ mm} \checkmark$$

OR

$$\begin{aligned} m &= W - [(2(AC) + 2(R))] \checkmark \\ &= 154,64 - [2(19,05) + 2(11)] \checkmark \\ &= 154,64 - (38,10 + 22) \\ &= 94,54 \text{ mm} \checkmark \end{aligned}$$

OR

$$\begin{aligned} m &= W - 2(AC + R) \checkmark \\ &= 154,64 - 2(19,05 + 11) \checkmark \\ &= 154,64 - (38,10 + 22) \\ &= 94,54 \text{ mm} \checkmark \end{aligned}$$

OR

$$\begin{aligned} m &= W - 2(AC) - 2(R) \checkmark \\ &= 154,64 - 2(19,05) - 2(11) \checkmark \\ &= 154,64 - 38,10 - 22 \\ &= 94,54 \text{ mm} \checkmark \end{aligned}$$

(6)

6.3 Milling of spur gear:**6.3.1 Indexing:**

$$\begin{aligned}\text{Indexing} &= \frac{40}{n} = \frac{40}{163} \\ &= \frac{40}{A} = \frac{40}{160} \checkmark \\ &= \frac{1}{4} \times \frac{6}{6} \\ &= \frac{6}{24} \checkmark\end{aligned}$$

Approximate indexing: 6 holes on a 24-hole circle. ✓

OR

7 holes on a 28-hole circle. ✓

(3)

6.3.2 Change gears:

$$\begin{aligned}\frac{D_r}{D_n} &= (A - n) \times \frac{40}{A} \\ &= (160 - 163) \times \frac{40}{160} \checkmark \\ &= -3 \times \frac{40}{160} \checkmark \\ &= \frac{-120}{160} \\ &= \frac{12}{16} \times \frac{2}{2} \checkmark \quad \text{OR} \quad \frac{12}{16} \times \frac{4}{4} \checkmark \\ &= \frac{24}{32} \checkmark \quad \text{OR} \quad \frac{48}{64} \checkmark\end{aligned}$$

(5)

6.4 **TWO types of balancing methods:**

- Static balance (stationary balancing) ✓
- Dynamic balance (running balancing) ✓

(2)

6.5 **TWO advantages of correct balancing:**

- Prevents vibrations. ✓
- Prevents poor finish / ensure good finish. ✓
- Prevents wear on bearings / components. ✓
- Prevents accidents. ✓
- Improve production. ✓
- Promotes accuracy. ✓
- Prevent damage to workpiece. ✓
- Prevent components from loosening. ✓

(Any 2 x 1)

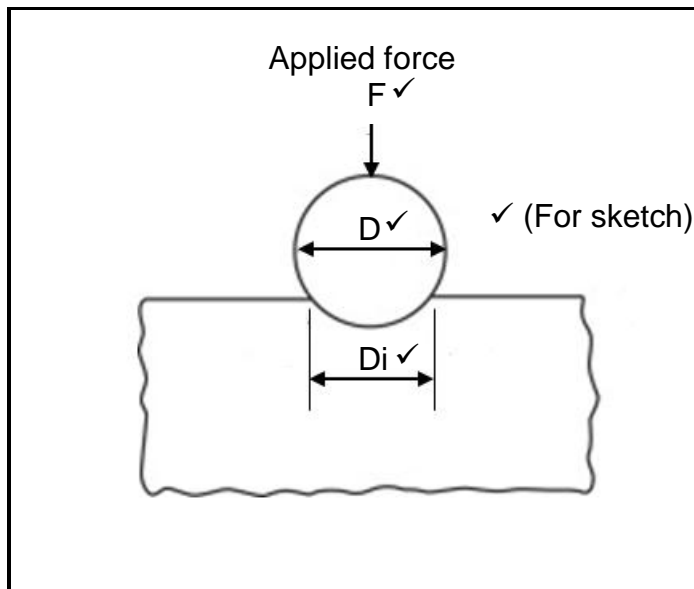
(2)

[28]

QUESTION 7: TOOLS AND EQUIPMENT (SPECIFIC)**7.1 Function of a screw-thread micrometer:**

The screw-thread micrometer is specifically designed to measure ✓ the pitch diameter ✓ of a screw thread.

(2)

7.2 Brinell labelled drawing:

Di - Indentation

D - Indenter diameter

(4)

7.3 Types of forces:

- Tensile force ✓
- Compressive force ✓
- Shear force ✓
- Torsional force ✓
- Gravitational force ✓
- Normal Force ✓
- Frictional Force ✓
- Reaction Force ✓

(Any 2 x 1)

(2)

7.4 ISO-Metric screw-thread:

7.4.1 A – Root/Root land ✓

B – Pitch diameter / Effective diameter / Mean diameter ✓

C – Crest diameter / Major diameter / Outside diameter / Basic diameter ✓

(3)

7.4.2 Pitch diameter:

$$D_p = D_n - (0,866 \times P)$$

$$D_p = 12 - (0,866 \times 1,75) \checkmark$$

$$D_p = 12 - 1,52$$

$$D_p = 10,48 \text{ mm} \checkmark$$

(2)

[13]

QUESTION 8: FORCES (SPECIFIC)**8.1 Forces:****8.1.1 Horizontal component:**

$$\Sigma HC = 25\cos 90^\circ + 40\cos 0^\circ + 55\cos 70^\circ - 120\cos 30^\circ$$

$$\Sigma HC = 0 + 40 + 18,81 - 103,92$$

$$\Sigma HC = -45,11\text{N} \quad (4)$$

8.1.2 Vertical component:

$$\Sigma VC = 25\sin 90^\circ - 40\sin 0^\circ - 55\sin 70^\circ - 120\sin 30^\circ$$

$$\Sigma VC = 25 - 0 - 51,68 - 60$$

$$\Sigma VC = -86,68\text{N} \quad (4)$$

OR

Force	θ	8.1.1 $\Sigma HC/x = F\cos\theta$	8.1.2 $\Sigma VC/y = F\sin\theta$
25N	90°	$HC = 25\cos 90^\circ$	$VC = 25\sin 90^\circ$
40N	0°	$HC = 40\cos 0^\circ$	$VC = 40\sin 0^\circ$
55N	290°	$HC = 55\cos 290^\circ$	$VC = 55\sin 290^\circ$
120N	210°	$HC = 120\cos 210^\circ$	$VC = 120\sin 210^\circ$
		Total	

$$\begin{array}{l} 0\text{N} \\ 40\text{N} \checkmark \\ 18,81\text{N} \checkmark \\ -103,92\text{N} \checkmark \\ \mathbf{-45,11\text{N} \checkmark} \end{array} \quad \begin{array}{l} 25\text{N} \checkmark \\ 0\text{N} \\ -51,68\text{N} \checkmark \\ -60\text{N} \checkmark \\ \mathbf{-86,68\text{N} \checkmark} \end{array} \quad (8)$$

8.1.3 Resultant:

$$R^2 = VC^2 + HC^2$$

$$R = \sqrt{(-86,68)^2 + (-45,11)^2} \quad \checkmark$$

$$R = \sqrt{9549,24}$$

$$R = 97,72\text{N} \quad \checkmark \quad (2)$$

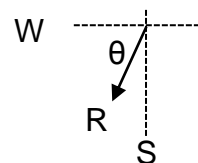
8.1.4 **Angle and direction of resultant:****Angle:**

$$\tan \theta = \frac{VC}{HC}$$

$$\theta = \tan^{-1} \left(\frac{-86,68}{-45,11} \right) \checkmark$$

$$\theta = \tan^{-1}(1,92)$$

$$\theta = 62,5^\circ \checkmark$$

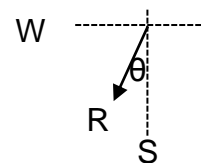
**OR**

$$\tan \theta = \frac{HC}{VC}$$

$$\theta = \tan^{-1} \left(\frac{-45,11}{-86,68} \right) \checkmark$$

$$\theta = \tan^{-1}(0,52)$$

$$\theta = 27,49^\circ \checkmark$$

**Direction:**

$$R = 97,72\text{N } 62,5^\circ \text{South of West } \checkmark$$

OR

$$R = 97,72\text{N } 27,5^\circ \text{West of South } \checkmark$$

(3)

8.2 **UDL Beam:**8.2.1 **Distributed load:**

Uniform distributed load:

$$7 \times 12 = 84 \text{ N } \checkmark$$

(1)

8.2.2 **Reaction in support A:****Take moments about B:**

$$\checkmark \quad \checkmark \quad \checkmark$$

$$(75 \times 12,5) + (84 \times 5,5) + (55 \times 0) = (A \times 14)$$

$$937,5 + 462 + 0 = 14A$$

$$A = \frac{1399,5}{14} \checkmark$$

$$A = 99,96\text{N } \checkmark$$

(5)

**8.2.3 Reaction in support B:
Take moments about A:**

$$(B \times 14) = (75 \times 1,5) + (84 \times 8,5) + (55 \times 14)$$

$$14B = 112,5 + 714 + 770$$

$$B = \frac{1596,5}{14}$$

$$B = 114,04 \text{ N}$$

(5)

8.3.1 Resistance area:

$$\sigma = \frac{F}{A}$$

$$A = \frac{F}{\sigma}$$

$$A = \frac{85 \times 10^3}{36 \times 10^6}$$

$$A = 2,36 \times 10^{-3} \text{ m}^2$$

(3)

8.3.2 Change in length:

$$E = \frac{\sigma}{\varepsilon}$$

$$\varepsilon = \frac{\sigma}{E}$$

$$\varepsilon = \frac{36 \times 10^6}{90 \times 10^9}$$

$$\varepsilon = 4 \times 10^{-4}$$

$$\varepsilon = \frac{\Delta L}{L}$$

$$\Delta L = \varepsilon \times L$$

$$\Delta L = 4 \times 10^{-4} \times 0,12$$

$$\Delta L = 4,8 \times 10^{-5} \text{ m}$$

$$\Delta L = (4,8 \times 10^{-5}) \times 1000$$

$$\Delta L = 0,048 \text{ mm}$$

(6)
[33]

QUESTION 9: MAINTENANCE (SPECIFIC)**9.1 Failure to conduct preventative maintenance:**

- Risk of injury or death. ✓
- Financial loss due to damage suffered as a result of part failure. ✓
- Loss of valuable production time. ✓
- Equipment failure. ✓
- Damage to material or project. ✓

(Any 3 x 1) (3)**9.2 Mechanical drives:**

- Belt drives ✓
- Gear drives ✓
- Chain drives ✓
- Hydrostatic drives ✓
- Hydraulic drives ✓
- Cable drives ✓
- Pneumatic drive ✓

(Any 3 x 1) (3)**9.3 Enhance the strength of glass fibre:**

Polyester resin ✓

(1)**9.4 Properties:****9.4.1 Bakelite:**

- Stiff ✓
- Strong ✓
- Hard / wear resistant ✓
- Chemical resistance ✓
- Thermo hardened ✓
- Water resistant ✓
- Electrical isolation ✓
- Heat resistant ✓
- Machinable ✓
- Brittleness ✓

(Any 2 x 1) (2)**9.4.2 Carbon fibre:**

- Good fatigue resistance ✓
- Heat resistance ✓
- Tough ✓
- Strong ✓
- Semi rigid ✓
- Good chemical resistance ✓
- Light weight ✓
- Water resistant ✓
- Flexible ✓

(Any 2 x 1) (2)

9.5 **Manufacturing of PVC:**

- Oil ✓
- Salt ✓
- Coal ✓

(Any 1 x 1) (1)

9.6 **Ways to conduct preventive maintenance:**

- Inspection ✓
- Measuring ✓
- Cleaning ✓
- Lubricating ✓
- Adjusting of parts ✓
- Replacing of parts ✓
- Tests ✓

(Any 3 x 1) (3)

9.7 **Main types of plastic composites:**

- Thermoplastic ✓
- Thermosetting plastic / Thermo-hardened ✓

(2)

9.8 **Non-stick coatings for frying pans:**

Teflon ✓

(1)

[18]

QUESTION 10: JOINING METHODS (SPECIFIC)**10.1 Screw thread terminology:****10.1.1 Lead:**

It is the distance ✓ that the point (nut/bolt) on a screw thread will move / advance ✓ along the axis, ✓ when turned through one complete revolution / turn. ✓

(4)

10.1.2 Helix angle:

It is the angle that the thread makes with a line perpendicular / 90° ✓ to the axis of the screw thread. ✓

(2)

10.2 Square Thread:**10.2.1 Pitch:**

Lead = Pitch × Number of starts

$$\text{Pitch} = \frac{\text{Lead}}{\text{Number of starts}} \quad \checkmark$$

$$= \frac{42}{2} \quad \checkmark$$

$$= 21 \text{ mm} \quad \checkmark$$

(3)

10.2.2 Pitch diameter:

$$\text{PD} = \text{OD} - \frac{P}{2}$$

$$= 90 - \frac{21}{2} \quad \checkmark$$

$$= 79,50 \text{ mm} \quad \checkmark$$

(2)

10.2.3 Helix angle of the thread:

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

$$\tan \theta = \frac{42 \checkmark}{\pi \times 79,50 \checkmark}$$

$$\tan \theta = 0,168163713$$

$$\theta = \tan^{-1} 0,168163713$$

$$= 9,55^\circ \text{ or } 9^\circ 33' \checkmark$$

(3)

10.2.4 Leading tool angle:

$$\text{Leading tool angle} = 90^\circ - (\text{helix angle} + \text{clearance angle})$$

$$= 90^\circ - (9,55^\circ + 3^\circ) \checkmark$$

$$= 77,45^\circ \text{ or } 77^\circ 27' \checkmark$$

(2)

10.2.5 Following tool angle:

$$\text{Following tool angle} = 90^\circ + (\text{helix angle} - \text{clearance angle})$$

$$= 90^\circ + (9,55^\circ - 3^\circ) \checkmark$$

$$= 96,55^\circ \text{ or } 96^\circ 33' \checkmark$$

(2)

[18]

QUESTION 11: SYSTEMS AND CONTROL (DRIVE SYSTEMS) (SPECIFIC)**11.1 Hydraulic calculations :****11.1.1 The fluid pressure in the hydraulic system in MPa:**

$$A(\text{Ram}) = \frac{\pi d^2}{4}$$

$$A = \frac{\pi(0,25)^2}{4} \quad \checkmark$$

$$A = 0,049 \text{ m}^2 \quad \text{OR} \quad 4,91 \times 10^{-2} \text{ m}^2 \quad \checkmark$$

$$p = \frac{F}{A}$$

$$p = \frac{34000}{0,049} \quad \checkmark$$

$$p = 693877,55 \text{ Pa}$$

$$p = 0,69 \text{ MPa} \quad \checkmark$$

(4)

11.1.2 Diameter of the plunger:

$$p = \frac{F}{A}$$

$$A = \frac{F}{p}$$

$$A = \frac{215}{693877,55} \quad \checkmark$$

$$A = 0,309852 \times 10^{-3} \text{ m}^2 \quad \checkmark \quad \text{OR}$$

$$\frac{F_1}{A_1} = \frac{F_2}{A_2}$$

$$\frac{F_1}{\pi d^2} = \frac{F_2}{\pi D^2}$$

$$\frac{215}{d^2} \checkmark = \frac{34000}{250^2} \checkmark$$

$$A = \frac{\pi d^2}{4}$$

$$d = \sqrt{\frac{4 \times A}{\pi}} \quad \checkmark$$

$$d = \sqrt{\frac{4(0,309852 \times 10^{-3})}{\pi}} \quad \checkmark$$

$$d = 0,019862422 \text{ m}$$

$$d = 19,86 \text{ mm} \quad \checkmark$$

$$d^2 \times 34000 = 215 \times 250^2 \quad \checkmark$$

$$d = \sqrt{\frac{215 \times 250^2}{34000}} \quad \checkmark$$

$$d = 19,88 \text{ mm} \quad \checkmark$$

(5)

11.2 Hydraulic filters:

- Pressure line filter \checkmark
- Return line filter \checkmark

(2)

11.3 Hydraulic symbols:

11.3.1 Reservoir \checkmark

(1)

11.3.2 Directional control valve / Non-return valve / One way valve \checkmark

(1)

11.4 Belt drive:**11.4.1 The rotational frequency in r/sec:**

$$N_{Dr} \times D_{Dr} = N_{Dn} \times D_{Dn}$$

$$N_{Dn} = \frac{N_{Dr} \times D_{Dr}}{D_{Dn}} \quad \checkmark$$

$$N_{Dn} = \frac{1330 \times 0,15}{0,32} \quad \checkmark$$

$$N_{Dn} = \frac{623,44 \text{ r/min}}{60}$$

$$N_{Dn} = 10,39 \text{ r/sec} \quad \checkmark$$

(3)

11.4.2 Power transmitted in Watt:

$$P = \frac{(T_1 - T_2) \pi D N}{60}$$

$$P = (175 - 130) \pi \times 0,32 \times 10,39 \quad \checkmark \quad \checkmark \quad \checkmark$$

$$P = 470,03 \text{ Watt} \quad \checkmark$$

OR

$$P = \frac{(T_1 - T_2) \pi D N}{60}$$

$$P = \frac{(175 - 130) \pi \times 0,15 \times 1330}{60} \quad \checkmark \quad \checkmark \quad \checkmark$$

$$P = 470,06 \text{ Watt} \quad \checkmark$$

(4)

11.5 Gear drive:**11.5.1 Identify gear drive:**

Compound gear drives system ✓

(1)

11.5.2 Rotational frequency of the input shaft N_A :

$$\frac{N_{\text{input}}}{N_{\text{output}}} = \frac{\text{Product of teeth on driven gears}}{\text{Product of teeth on driver gears}}$$

$$\frac{N_A}{N_F} = \frac{T_B \times T_D \times T_F}{T_A \times T_C \times T_E} \quad \checkmark$$

$$\frac{N_A}{625} = \frac{40 \times 50 \times 80}{20 \times 35 \times 25} \quad \checkmark$$

$$N_A = \frac{40 \times 50 \times 80 \times 625}{20 \times 35 \times 25}$$

$$N_A = 5714,29 \text{ r / min} \quad \checkmark$$

(4)

11.6 Torque on the lathe spindle:

Torque(T) = Force × Radius

$$T = 250 \times 0,025 \quad \checkmark \quad \checkmark$$

$$T = 6,25 \text{ Nm.} \quad \checkmark$$

(3)

[28]**TOTAL: 200**