basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

MECHANICAL TECHNOLOGY: FITTING AND MACHINING

NOVEMBER 2023

MARKING GUIDELINES

MARKS: 200

These marking guidelines consist of 27 pages.

QUESTION 1: MULTIPLE-CHOICE (GENERIC)

1.1 B ✓ (1)

1.2 A ✓ (1)

1.3 C ✓ (1)

1.4 C ✓ (1)

1.5 A ✓ (1)

1.6 B ✓ (1)
[6]

QUESTION 2: SAFETY (GENERIC)

2.1 **Examination checks:**

- Severe bleeding ✓
- Internal bleeding ✓
- Head injuries ✓
- Neck injuries ✓
- Fractures ✓
- Vital signs ✓
- Physical abnormalities ✓

(Any 2 x 1) (2)

2.2 **Safety devices on the power-driven guillotine:**

- Finger protectors / Fixed guards / Blade guard ✓
- Rear view mirrors ✓
- Rear light curtains ✓
- Automatic sweep-away ✓
- Revolving warning lights ✓
- Two-hand / dual control device ✓
- Additional emergency buttons ✓
- Self-adjusting guards ✓
- Covered footswitch ✓

(Any 2 x 1) (2)

2.3 **Grinding wheel:**

- The wheel should be rated above the speed of the motor. ✓
- Check for cracks on the grinding wheel. ✓
- Check for chips on the grinding wheel. ✓
- Check that the arbor hole is the correct size. ✓
- Must not be contaminated by oil/fluids or grease. ✓
- Correct size of the wheel. ✓
- Correct type of wheel for the material. ✓

(Any 2 x 1) (2)

2.4 **Gas welding equipment – safety devices:**

- Valve guard ✓
- Flash back arrestor ✓
- Pressure regulator ✓
- C-clamps on hoses/Parallel hose clips ✓
- Acetylene spindle key must always be in place. ✓
- Cylinder valves. ✓

(Any 2 x 1) (2)

2.5 **Advantages of process layout of machines are:**

- High machine utilisation. ✓
- Better supervision. ✓
- Less interruption in the flow of work. ✓
- Lower equipment costs. ✓
- Better control of total manufacturing costs. ✓
- Greater flexibility. ✓

(Any 2 x 1) (2)

[10]

QUESTION 3: MATERIALS (GENERIC)

3.1 **Colour code of metal:**

- To identify the type of metal. ✓
- To identify carbon content especially after the metal was stored. ✓
- To identify the profile/size of the metal. ✓

(Any 1 x 1) (1)

3.2 **Tests to determine properties of steel:**

3.2.1 **Sound test:**

- Hardness ✓
- Softness ✓

(Any 1 x 1) (1)

3.2.2 **Bending test:**

- Ductility ✓
- Bend strength ✓
- Fracture strength ✓
- Resistance to fracture
- Brittleness ✓
- Elasticity ✓
- Plasticity ✓
- Flexibility ✓

(Any 1 x 1) (1)

3.2.3 **Machining test:**

- Hardness ✓
- Strength ✓

(Any 1 x 1) (1)

3.3 **Reasons metal soaked during heat treatment:**

- To ensure uniform heat distribution ✓ throughout the metal. ✓
- To achieve a uniform grain structure ✓ after cooling the metal. ✓

(Any 1 x 2) (2)

3.4 **Case hardening:**

- Carburising ✓
- Nitriding ✓
- Cyaniding ✓

(Any 2 x 1) (2)

3.5 **Annealing process:**

Heating the steel slightly above AC_3, (upper critical temperature) ✓ soaking it for a required time/period ✓ and then slow cooling ✓ back to room temperature. (3)

3.6 **Rapid quenching mediums:**

- Brine/Salt water ✓
- Water ✓
- Nitrogen ✓
- Oil ✓

(Any 2 x 1) (2)

3.7 **Heat treatment process:**

Tempering ✓ (1)

[14]

QUESTION 4: MULTIPLE-CHOICE (SPECIFIC)

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

[14]

QUESTION 5: TERMINOLOGY (LATHE AND MILLING MACHINE) (SPECIFIC)

5.1 **Disadvantages of compound slide method**

- Only short tapers can be cut. ✓
- It causes fatigue to the operator. ✓
- The automatic feed of the machine cannot be used. ✓

(Any 2 x 1) (2)

5.2 **Taper calculations:**

5.2.1 **Length of taper:**

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

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

$$2l = \frac{78 - 55}{\tan 4°} \checkmark$$

$$2l = \frac{23}{0{,}069926811}$$

$$l = \frac{328{,}9153283}{2} \checkmark$$

$$l = 164{,}46 \text{ mm} \checkmark$$

(4)

5.2.2 **Tailstock set-over:**

$$\text{Set - over} = \frac{\text{L}(\text{D - d})}{2\,l}$$

$$= \frac{284{,}46(78 - 55)}{2 \times 164{,}46} \quad (\checkmark \checkmark \checkmark)$$

$$= 19{,}89 \text{ mm} \checkmark$$

(4)

5.3 **Key ways:**

5.3.1 **Width:**

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

$$\text{Width} = \frac{83}{4} \checkmark$$

$$= 20,75\,\text{mm} \checkmark \quad (2)$$

5.3.2 **Thickness:**

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

$$\text{Thickness} = \frac{83}{6} \checkmark$$

$$= 13,83\,\text{mm} \checkmark \quad (2)$$

5.3.3 **Length:**

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

$$= 1,5 \times 83 \checkmark$$

$$= 124,50\,\text{mm} \checkmark \quad (2)$$

5.4 **Straddle milling:**

A. Side and face cutter / Milling cutters. ✓
B. Arbor / Spacers / Spindle / Axle ✓ (2)

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QUESTION 6: TERMINOLOGY (INDEXING) (SPECIFIC)

6.1 **Gear terminology:**

6.1.1 **Pitch-circle diameter:**

$$\begin{aligned} PCD &= m \times T \\ &= 2,5 \times 180 \ \checkmark \\ &= 450\,mm \ \checkmark \end{aligned}$$

$$\begin{aligned} CP &= m \times \pi \\ &= 2,5 \times \pi \\ &= 7,85\,mm \ \checkmark \end{aligned}$$

OR

$$\begin{aligned} PCD &= \frac{CP \times T}{\pi} \\ &= \frac{7,85 \times 180}{\pi} \\ &= 450\,mm \ \checkmark \end{aligned}$$

(2)

6.1.2 **Dedendum:**

$$\begin{aligned} Dedendum &= 1,157 \times m \\ &= 1,157 \times 2,5 \ \checkmark \\ &= 2,89\,mm \ \checkmark \end{aligned}$$

OR

$$\begin{aligned} Dedendum &= 1,25 \times m \\ &= 1,25 \times 2,5 \checkmark \\ &= 3,13\,mm \checkmark \end{aligned}$$

(2)

6.1.3 **Outside diameter:**

$$\begin{aligned} OD &= PCD + 2(m) \\ &= 450 + 2(2,5) \ \checkmark \\ &= 455\,mm \ \checkmark \end{aligned}$$

(2)

6.2 **Dovetails:**

W = 136 + 2(DE)
m = W – [2(AC) + 2(R)] **OR** m = W – 2(AC + R) **OR** m = W – 2(AC) – 2(R)

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

Calculate DE or y:

$$\tan\theta = \frac{DE}{AD}$$
$$DE = \tan\theta \times AD \checkmark$$
$$= \tan 30° \times 50 \checkmark$$
$$= 28,87\,mm \checkmark$$

OR

$$\tan\theta = \frac{AD}{DE}$$
$$\tan 60° = \frac{50}{DE} \checkmark$$
$$DE = \frac{50}{\tan 60°} \checkmark$$
$$= 28,87\,mm \checkmark$$

$$W = 136 + 2(DE) \checkmark$$
$$= 136 + 2(28,87) \checkmark$$
$$= 136 + 57,74$$
$$= 193,74\,mm \checkmark$$

(6)

6.2.2 **Distance between the rollers: (m)**

Calculate AC or x:

$\text{Tan}\alpha = \frac{BC}{AC}$

$AC = \frac{BC}{\text{Tan}\alpha}$ ✓

$= \frac{10}{\text{Tan}30^{o}}$ ✓

$= 17,32 mm$ ✓

OR

$\text{Tan}\theta = \frac{AC}{BC}$

$AC = \text{Tan}\theta \times BC$ ✓

$= \text{Tan}60^{o} \times 10$ ✓

$= 17,32 mm$ ✓

m = W – [(2(AC) + 2(R)] ✓
= 193,74 – [2(17,32) + 2(10)] ✓
= 193,74 – (34,64 + 20)
= 139,10 mm ✓

OR

m = W – 2(AC + R) ✓
= 193,74 – 2(17,32 + 10) ✓
= 193,74 – (34,64 + 20)
= 139,10 mm ✓

OR

m = W – 2(AC) – 2(R) ✓
= 193,74 – 2(17,32) – 2(10) ✓
= 193,74 – 34,64 – 20
= 139,10 mm ✓

(6)

6.3 **Milling of spur gear:**

6.3.1 **Indexing:**

$$\text{Indexing} = \frac{40}{N} = \frac{40}{89}$$

$$= \frac{40}{A} = \frac{40}{90} \checkmark$$

$$= \frac{4}{9} \times \frac{6}{6}$$

$$= \frac{24}{54} \checkmark$$

$$= \text{Indexing: 0 full turns and 24 holes on a 54 – hole circle} \checkmark$$

(3)

6.3.2 **Change gears:**

$$\frac{Dr}{Dn} = (A - n) \times \frac{40}{A}$$

$$\frac{Dr}{Dn} = (90 - 89) \times \frac{40}{90} \checkmark$$

$$= 1 \times \frac{40}{90}$$

$$= \frac{40}{90} \checkmark$$

$$= \frac{4}{9}$$

$$= \frac{4}{9} \times \frac{8}{8} \checkmark$$

$$\frac{Dr}{Dn} = \frac{32}{72} \checkmark \checkmark$$

OR

$$\frac{\text{Driver}}{\text{Driven}} = \frac{A - N}{A} \times \frac{40}{1}$$

$$= \frac{90 - 89}{90} \times \frac{40}{1} \checkmark$$

$$= \frac{1}{90} \times \frac{40}{1}$$

$$= \frac{40}{90} \checkmark$$

$$= \frac{4}{9} \times \frac{8}{8} \checkmark$$

$$\frac{Dr}{Dn} = \frac{32}{72} \checkmark \checkmark$$

(5)

6.4 **Balancing constraints/disadvantages:**

- Requires specialised machinery. ✓
- Difficult to ascertain the exact point of unbalance. ✓
- Requires accurate removal or adding of material (weight) to the object. ✓
- Can lead to interference with parts of the machine when weights are added to parts. ✓

(Any 2 x 1) (2)

[28]

QUESTION 7: TOOLS AND EQUIPMENT (SPECIFIC)

7.1 **Instrument to measure indentation:**
Microscope ✓ (1)

7.2 **Brinell hardness number:**
- Calculations ✓
- The use of a Brinell hardness table ✓ (2)

7.3 **Function of moment tester:**
To determine the reactions on either side of a simply loaded beam. ✓ (1)

7.4 **Principal of tensile tester:**
The tensile tester is a destructive ✓ tester that subjects a piece of material to an increasing axial load ✓ while measuring the corresponding elongation of the material.✓ (3)

7.5 **Depth and screw-thread micrometer:**
The scale on the depth micrometer's barrel reads in the opposite direction compared to the screw thread micrometer. ✓ (1)

7.6 **Hardness assessment:**
- Resistance to penetration / Hardness tests ✓
- Sound test ✓
- Elastic hardness / Bending test / Tensile test ✓
- Resistance to abrasion / File test / Spark test / Machining test ✓

(Any 3 x 1) (3)

7.7 **Micrometer measurement:**

5,94 + 50 = 55,94 mm ✓ ✓ (2)

[13]

QUESTION 8: FORCES (SPECIFIC)

8.1 **Forces:**

8.1.1 **Horizontal component:**

$$\sum HC = 45\cos 0° + 75\cos 30° - 15\cos 75° - 120\cos 270°$$

$$\sum HC = 45 + 64,95 - 3,88 - 0 \quad (\checkmark \ \checkmark \ \checkmark)$$

$$\sum HC = 106,07 \text{ N} \checkmark$$

(4)

8.1.2 **Vertical component:**

$$\sum VC = 45\sin 0° + 75\sin 30° + 15\sin 75° - 120\sin 270°$$

$$\sum VC = 0 + 37,5 + 14,49 - 120 \quad (\checkmark \ \checkmark \ \checkmark)$$

$$\sum VC = -68,01 \text{ N} \checkmark$$

(4)

OR

Force	***θ***	8.1.1 **∑HC/x = Fcosθ**		8.1.2 **∑VC/y = Fsinθ**	
45N	0º	HC = 45cos0°	45N ✓	VC = 45sin0°	0N
75N	30º	HC = 75cos30°	64,95N ✓	VC = 75sin30°	37,5N ✓
15N	105º	HC = 15cos105°	-3,88N ✓	VC = 15sin105°	14,49N ✓
120N	270º	HC = 120cos270°	0N	VC = 120sin270°	-120N ✓
		Total	**106,07N** ✓		**-68,01N** ✓

(8)

8.1.3 **Resultant:**

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

$$R = \sqrt{(-68,01)^2 + (106,07)^2} \ \checkmark$$

$$R = \sqrt{15876,21}$$

$$R = 126,00 \text{ N} \checkmark$$

(2)

8.1.4 **Angle and direction of resultant:**

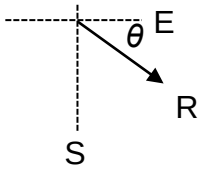
Angle:

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

$$\theta = \tan^{-1}\left(\frac{-68,01}{106,07}\right) \checkmark \checkmark$$

$$\theta = \tan^{-1}(0,64)$$

$$\theta = 32,67° \checkmark$$



Direction:

$R = 126,00N\ 32,67° / 32°40'$ South of East ✓

OR

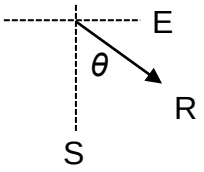
Angle:

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

$$\theta = \tan^{-1}\left(\frac{106,07}{-68,01}\right) \checkmark \checkmark$$

$$\theta = \tan^{-1}(1,559623585)$$

$$\theta = 57,20° \checkmark$$



Direction:

$R = 126,00N\ 57,33° / 57°20'$ East of South ✓ (4)

8.2 **Reaction in supports A and B:**

Reaction in support A:
Take moments about B:

$$\sum \text{LHM} = \sum \text{RHM}$$

$$\overset{\checkmark}{(55 \times 7)} = \overset{\checkmark}{(A \times 7)} + \overset{\checkmark}{(160 \times 1{,}5)}$$

$$385 = 7A + 240$$

$$A = \frac{145}{7} \quad \checkmark$$

$$A = 20{,}71 \text{ N} \quad \checkmark$$

Reaction in support B:
Take moments about A:

$$\sum \text{LHM} = \sum \text{RHM}$$

$$\overset{\checkmark}{(B \times 7)} = (55 \times 0) + \overset{\checkmark}{(160 \times 8{,}5)}$$

$$7B = 0 + 1360$$

$$B = \frac{1360}{7} \quad \checkmark$$

$$B = 194{,}29 \text{ N} \quad \checkmark$$

(9)

8.3 **Stress and strain:**

8.3.1 **Maximum load:**

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

$$= \frac{\pi 0{,}02^2}{4} \checkmark$$

$$= 3{,}14159265 \times 10^{-4} m^2 \checkmark \textbf{ OR } \quad 3{,}14 \times 10^{-4} m^2 \checkmark$$

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

$$F = A \times \sigma \checkmark$$

$$F = 3{,}14159265 \times 10^{-4} \times 640 \times 10^{6} \quad (\checkmark \text{ and } \checkmark)$$

$$F = 201061{,}93\,N$$

$$F = 201{,}06\,kN \checkmark \textbf{ OR } \quad 200{,}96\,kN \checkmark$$

(6)

8.3.2 **Safe working stress:**

$$SF = \frac{MS}{SS}$$

$$SS = \frac{MS}{SF} \checkmark$$

$$SS = \frac{640 \times 10^6 \checkmark}{3 \checkmark}$$

$$SS = 213333333{,}3\ Pa$$

$$SS = 213{,}33\ MPa \checkmark$$

(4)
[33]

QUESTION 9: MAINTENANCE (SPECIFIC)

9.1 **Preventative maintenance:**
Subgroups of preventative maintenance:
- Planned or scheduled maintenance ✓
- Conditional-based maintenance ✓ (2)

9.2 **Advantages of belt drives over gear drives:**
- Produce less noise than gear drives. ✓
- Produce less vibration than gear drives. ✓
- More cost effective.✓
- Belt drives will slip under a sudden load /over load to protect the drive. ✓
- Do not need lubrication like gear drives.✓
- Belt drives do not require parallel shafts. ✓
- Belts can be used over long distances. ✓

(Any 3 x 1) (3)

9.3 **Belt drives:**
- V-pulley ✓
- Wedge pulley ✓
- Flat pulley ✓
- Round belt ✓
- Timing/Toothed belt ✓
- Multi-groove belt ✓

(Any 3 x 1) (3)

9.4 **Non-stick material:**
Teflon ✓ (1)

9.5 **Uses:**
Polyvinyl chloride (PVC):

9.5.1
- Trays for food and toiletries ✓
- Clear bottles ✓
- Blister packaging ✓
- Drain and sewerage pipes ✓
- Electrical pipes ✓
- Drip bags ✓
- Cooking bottles ✓
- Vinegar bottles ✓
- Credit cards ✓
- Shoe soles ✓
- Floor tiles ✓
- Wallpaper ✓
- Outdoor furniture ✓
- Disposable cutlery ✓

(Any 2 x 1) (2)

9.5.2 **Bakelite:**

- Electrical insulators ✓
- Kitchenware ✓
- Jewellery ✓
- Toys ✓
- Distributor rotors ✓
- Disc brake cylinders ✓
- Sauce pan handles ✓
- Electrical switches ✓
- Electrical parts ✓
- Aircraft components ✓
- Bearings ✓
- Clutch linings ✓
- Brake linings ✓
- Laminated materials ✓
- Computer motherboards ✓

(Any 2 x 1) (2)

9.5.3 **Fibre Glass**

- Surface covering ✓
- Woven cloth ✓
- Pillow stuffing ✓
- Reinforced plastics ✓
- Boats ✓
- Motor vehicle bodies ✓
- Roof sheeting ✓
- Petrol tanks ✓
- Swimming pools ✓
- Furniture ✓
- Fruit and salad bowls ✓
- Ornaments ✓
- Sporting equipment ✓
- Jigs forms ✓

(Any 2 x 1) (2)

9.6 **Thermo-hardened or thermoplastic:**

9.6.1 **Carbon fibre:**
Thermo-hardened / Thermosetting ✓ (1)

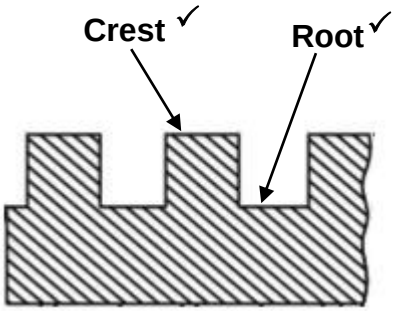
9.6.2 **Nylon:**
Thermoplastic ✓ (1)

9.6.3 **Bakelite:**
Thermo-hardened / Thermosetting ✓ (1)

[18]

QUESTION 10: JOINING METHODS (SPECIFIC)

10. 1 **Square screw thread:**



✓ **(For the sketch)**

(3)

10.2 **Square Thread:**

10.2.1 **Pitch diameter:**

$$\text{Pitch} = \frac{\text{Lead}}{\text{Number of starts}}$$
$$= \frac{25}{2} \checkmark$$
$$= 12{,}50 \text{ mm} \checkmark$$

$$\text{PD} = \text{OD} - \frac{\text{P}}{2}$$
$$= 70 - \frac{12{,}50}{2} \checkmark$$
$$\text{PD} = 63{,}75 \text{ mm} \checkmark$$

(4)

10.2.2 **Helix angle of the thread:**

$$\text{Tan}\theta = \frac{\text{Lead}}{\pi \times D_p}$$
$$\text{Tan}\theta = \frac{25 \checkmark}{\pi \times 63{,}75} \checkmark$$
$$\theta = \tan^{-1}(0{,}124827406) \checkmark$$
$$= 7{,}12° \text{ OR } 7°7' \checkmark$$

(4)

10.2.3 **Leading angle:**

Leading angle = 90°– (Helix angle + Clearance angle)
= 90°– (7,12° + 3°) ✓
= 79,88° **OR** 79°53' ✓

(2)

10.2.4 **Following angle:**

Following angle = 90° + (Helix angle – Clearance angle)
= 90° + (7,12°– 3°) ✓
= 94,12° **OR** 94°7' ✓ (2)

10.3 **ISO V-screw thread:**

A. Helix angle ✓
B. Pitch / Lead ✓
C. Root ✓ (3)

[18]

QUESTION 11: SYSTEMS AND CONTROL (DRIVE SYSTEMS) (SPECIFIC)

11.1 **Hydraulic systems :**

11.1.1 **Area of Ram:**

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

$$A = \frac{\pi (0{,}110)^2}{4} \checkmark$$

$$A = 0{,}0095\ m^2 \checkmark \quad \textbf{OR} \quad 9{,}50 \times 10^{-3}\ m^2 \checkmark \qquad (2)$$

11.1.2 **Applied force on plunger:**

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

$$\frac{f}{a} = \frac{F}{A} \checkmark$$

$$f = \frac{F \times a}{A}$$

$$f = \frac{350 \times 0{,}005}{0{,}0095} \checkmark$$

$$f = 184{,}21\ N \checkmark \qquad (3)$$

11.1.3 **Displacement h:**

$$V_{Plunger} = V_{Ram}$$

$$a \times h = A \times H$$

$$h = \frac{A \times H}{a} \quad \checkmark$$

$$h = \frac{0,0095 \times 0,025}{0,005} \quad \checkmark$$

$$h = 0,0475 \text{ m}$$

$$h = 47,5 \text{ mm} \quad \checkmark$$ (3)

11.2 **Pressure gauge:**

- To adjust pressure control valves. ✓
- Determining the pressure being exerted. ✓
- For safety. ✓
- Indicates if leakages are present in the system. ✓

(Any 2 x 1) (2)

11.3 **Advantages of pneumatics:**

- Pneumatic tools are very environmentally friendly. / Clean operation ✓
- Last longer. ✓
- More robust. ✓
- More compact. ✓
- Easily maintained. ✓
- Easily installed.✓
- Cost effective. ✓
- Safe to use. ✓
- High power-to-weight ratio. ✓
- Simple control. ✓
- Quick response. ✓
- Versatile. ✓

(Any 1 x 1) (1)

11.4 **Belt drive:**

11.4.1 **The rotational frequency in r/sec:**

$$N_{DR} \times D_{DR} = N_{DN} \times D_{DN}$$

$$N_{DN} = \frac{N_{DR} \times D_{DR}}{D_{DN}} \quad \checkmark$$

$$N_{DN} = \frac{25 \times 75}{350} \quad \checkmark \checkmark$$

$$N_{DN} = 5{,}36 \text{ r/sec} \quad \checkmark$$

(4)

11.4.2 **Belt speed:**

$$\text{Belt Speed}(V) = \pi D_{DR} \times N_{DR}$$
$$= \pi \times 0{,}075 \times 25 \quad \checkmark$$
$$= 5{,}89 \text{ m/s} \quad \checkmark$$

OR

$$\text{Belt Speed}(V) = \pi D_{DR} \times N_{DR}$$
$$= \pi \times 0{,}350 \times 5{,}36 \quad \checkmark$$
$$= 5{,}89 \text{ m/s} \quad \checkmark$$

(2)

11.5 **V-Belt:**
The slippage of the v-belt. ✓ (1)

11.6 **Gear drives:**

11.6.1 **The rotational frequency:**

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

$$\frac{N_A}{N_D} = \frac{T_B \times T_D}{T_A \times T_C}$$

$$\frac{95}{N_D} = \frac{55 \times 50}{30 \times 25} \quad \checkmark \checkmark$$

$$N_D = \frac{30 \times 25 \times 95}{55 \times 50} \quad \checkmark$$

$$N_D = \frac{71250}{2750}$$

$$N_D = 25{,}91 \text{ r/min} \quad \checkmark$$

(4)

11.6.2 **Power transmitted:**

$$\text{Power}(P) = \frac{2\pi\ N\ T}{60}$$

$$P = \frac{2 \times \pi \times 95 \times 120}{60}\ \checkmark$$

$$P = 1193{,}81\ \checkmark\ \text{Watt}(W)\ \checkmark$$

OR

$$P = 1{,}19\ \checkmark\ \text{Kilowatt}(kW)\ \checkmark$$

(3)

11.7 **Length of spanner:**

$$\text{Torque}(T) = \text{Force} \times \text{Radius}$$

$$\text{Radius} = \frac{T}{F}\ \checkmark$$

$$\text{Radius} = \frac{135}{300}\ \checkmark$$

$$\text{Radius} = 0{,}45\ \text{m}\ \checkmark$$

OR

$$\text{Radius} = 450\ \text{mm}\ \checkmark$$

(3)
[28]

TOTAL: 200