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**NATIONAL
SENIOR CERTIFICATE**

GRADE 12

MECHANICAL TECHNOLOGY: FITTING AND MACHINING

NOVEMBER 2023

MARKING GUIDELINES

MARKS: 200

These marking guidelines consist of 27 pages.

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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. ✓

<div align="right">

(Any 2 x 1)   (2)
[10]

</div>

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:**

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

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

$$2l = \frac{78\text{-}55}{\tan 4°} \quad ✓$$

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

$$l = \frac{328,9153283}{2} \quad ✓$$

$$l = 164,46 \text{ mm} ✓$$

(4)

5.2.2　　**Tailstock set-over:**

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

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

$$= 19,89 \text{ mm} ✓$$

(4)

5.3   **Key ways:**

        5.3.1   **Width:**

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

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

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

        5.3.2   **Thickness:**

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

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

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

        5.3.3   **Length:**
$$\text{Length} = 1,5 \times \text{diameter of shaft}$$
$$= 1,5 \times 83 \checkmark$$
$$= 124,50 \, \text{mm} \checkmark \qquad (2)$$

5.4   **Straddle milling:**
        A. Side and face cutter / Milling cutters. ✓
        B. Arbor / Spacers / Spindle / Axle ✓   (2)
        [18]

QUESTION 6: TERMINOLOGY (INDEXING) (SPECIFIC)

6.1   **Gear terminology:**

        6.1.1   **Pitch-circle diameter:**

$$PCD = m \times T \qquad\qquad CP = m \times \pi$$
$$= 2,5 \times 180 \checkmark \qquad\qquad = 2,5 \times \pi$$
$$= 450\,mm \checkmark \qquad\qquad = 7,85\,mm \checkmark$$

$$\textbf{OR} \quad PCD = \frac{CP \times T}{\pi}$$
$$= \frac{7,85 \times 180}{\pi}$$
$$= 450\,mm \checkmark \qquad\qquad (2)$$

        6.1.2   **Dedendum:**

$$Dedendum = 1,157 \times m \qquad\qquad Dedendum = 1,25 \times m$$
$$= 1,157 \times 2,5 \checkmark \quad \textbf{OR} \qquad = 1,25 \times 2,5 \checkmark$$
$$= 2,89\,mm \checkmark \qquad\qquad\qquad = 3,13\,mm \checkmark \qquad (2)$$

        6.1.3   **Outside diameter:**

$$OD = PCD + 2(m)$$
$$= 450 + 2(2,5) \checkmark$$
$$= 455\,mm \checkmark \qquad\qquad\qquad\qquad (2)$$

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:

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

OR

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

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

(6)

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

Calculate AC or x:

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

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

$$AC = \frac{BC}{\text{Tan}\,\alpha} \quad \checkmark$$

$$AC = \text{Tan}\,\theta \times BC \quad \checkmark$$

OR

$$= \frac{10}{\text{Tan}30^\circ} \quad \checkmark$$

$$= \text{Tan}60^\circ \times 10 \quad \checkmark$$

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

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

m = W − [(2(AC) + 2(R)] $\checkmark$

   = 193,74 − [2(17,32) + 2(10)] $\checkmark$

   = 193,74 − (34,64 + 20)

   = 139,10 mm $\checkmark$

       OR

m = W − 2(AC + R) $\checkmark$

   = 193,74 − 2(17,32 + 10) $\checkmark$

   = 193,74 − (34,64 + 20)

   = 139,10 mm $\checkmark$

       OR

m = W − 2(AC) − 2(R) $\checkmark$

   = 193,74 − 2(17,32) − 2(10) $\checkmark$

   = 193,74 − 34,64 − 20

   = 139,10 mm $\checkmark$

                                         (6)

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

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

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

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

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

$$= \text{Indexing} : 0 \text{ full turns and 24 holes on a } 54-\text{hole circle} \quad \checkmark \qquad (3)$$

6.3.2   **Change gears:**

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

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

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

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

OR

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

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

$$\frac{Dr}{Dn} = \frac{32}{72} \begin{matrix}\checkmark \\ \checkmark\end{matrix}$$

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

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

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

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

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

$$\frac{Dr}{Dn} = \frac{32}{72} \begin{matrix}\checkmark \\ \checkmark\end{matrix}$$

(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:**

$$\sum HC = 45\cos0° + 75\cos30° - 15\cos75° - 120\cos270°$$

$$\sum HC = 45 + 64,95 - 3,88 - 0$$

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

(4)

8.1.2   **Vertical component:**

$$\sum VC = 45\sin0° + 75\sin30° + 15\sin75° - 120\sin270°$$

$$\sum VC = 0 + 37,5 + 14,49 - 120$$

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

(4)

OR

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

(8)

8.1.3   **Resultant:**

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

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

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

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

(2)

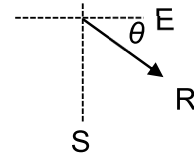8.1.4   **Angle and direction of resultant:**
Angle:

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

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

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

$$\theta = 32,67° ✓$$

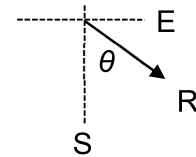**Direction:**
R = 126,00N 32,67° / 32°40' South of East ✓

OR

Angle:

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

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

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

$$\theta = 57,20° ✓$$

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:

$$\sum LHM = \sum RHM$$

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

$$385 = 7A + 240$$

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

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

Reaction in support B:
Take moments about A:

$$\sum LHM = \sum RHM$$

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

$$7B = 0 + 1360$$

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

$$B = 194{,}29 \text{ N} \checkmark$$ (9)

8.3   **Stress and strain:**

8.3.1   **Maximum load:**

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

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

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

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

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

$$F = 3,14159265 \times 10^{-4} \overset{\checkmark}{} \times 640 \times 10^6 \overset{\checkmark}{}$$

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

$$F = 201,06\,kN \checkmark \textbf{ OR } \quad 200,96\,kN \checkmark$$ (6)

8.3.2   **Safe working stress:**

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

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

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

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

$$SS = 213,33\,MPa \checkmark$$ (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)
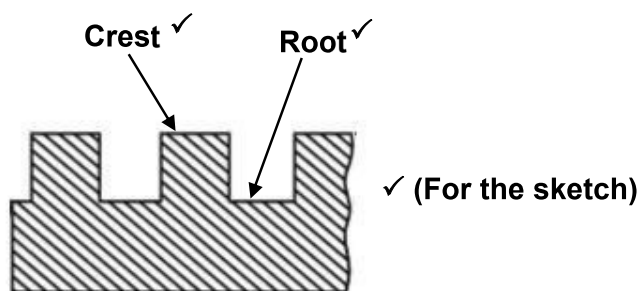
9.6.2   **Nylon:**
Thermoplastic ✓   (1)

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

[18]

QUESTION 10: JOINING METHODS (SPECIFIC)

10. 1   **Square screw thread:**

Crest ✓   **Root** ✓

✓ **(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:**

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

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

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

11.1.2   **Applied force on plunger:**

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

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

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

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

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

11.1.3   **Displacement h:**

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

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

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

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

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

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

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)

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11.4   **Belt drive:**

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

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

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

$$N_{DN} = \frac{25 \times 75}{350} \quad \begin{array}{l}\checkmark\\\checkmark\end{array}$$

$$N_{DN} = 5,36 \text{ r / sec} \quad \checkmark \tag{4}$$

11.4.2   **Belt speed:**

$$\begin{array}{ll}
\text{Belt Speed}(V) = \pi D_{DR} \times N_{DR} & \text{Belt Speed}(V) = \pi D_{DR} \times N_{DR}\\
\qquad = \pi \times 0,075 \times 25 \ \checkmark \quad \textbf{OR} & \qquad = \pi \times 0,350 \times 5,36 \ \checkmark\\
\qquad = 5,89 \text{ m / s} \ \checkmark & \qquad = 5,89 \text{ m / s} \quad \checkmark \qquad (2)
\end{array}$$

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

11.6   **Gear drives:**
11.6.1   **The rotational frequency:**

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

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

$$\frac{95}{N_D} = \frac{55 \times 50}{30 \times 25} \quad \begin{array}{l}\checkmark\\\checkmark\end{array}$$

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

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

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

(4)

11.6.2   **Power transmitted:**

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

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

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

OR

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

(3)

11.7   **Length of spanner:**

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

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

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

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

OR

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

(3)

[28]

TOTAL: 200