



# **basic education**

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Department:  
Basic Education  
**REPUBLIC OF SOUTH AFRICA**

## **SENIOR CERTIFICATE EXAMINATIONS/ NATIONAL SENIOR CERTIFICATE EXAMINATIONS**

**MECHANICAL TECHNOLOGY: FITTING AND MACHINING**

**MAY/JUNE 2025**

**MARKING GUIDELINES**

**MARKS: 200**

**These marking guidelines consist of 24 pages.**

## Instructions to marker: Mechanical Technology – Fitting and Machining

### 1. General marking instructions:

- 1.1 During the marking of multiple-choice questions, only ONE possible answer can be accepted. If the candidate indicated two or more responses, ONLY the first response will be recognised/acknowledged and marked according to the marking guidelines.
- 1.2 Where the number of responses of the candidate exceeds the required number stated in the question, ONLY the first number of responses will be accepted. For example, if the question states, 'Name THREE ...' and the candidate stated four different responses, ONLY the first three will be accepted and recognised.
- 1.3 If question numbering of sub questions is not correct according to the question paper sequence, the responses can be accepted if a sequence pattern can be identified.
- 1.4 Attention must be given to mark allocation in questions where two (2) marks were allocated for one response, e.g (**Any 1 x 2**).
- 1.5 There must be ONE tick allocated for each mark awarded.
- 1.6 An unanswered question must be indicated with a cross (X).
- 1.7 All blank pages in an ANSWER BOOK must be crossed out to indicate that the pages have been seen by the marker.
- 1.8 Attention must be given to questions where the candidate did not complete the question and continued answer(s) on subsequent pages in the ANSWER BOOK. Continue marking such questions and award marks, if applicable.
- 1.9 During calculation marking, pay attention to the position of the tick mark(s).
- 1.10 If a candidate skipped a step where a tick mark is allocated in the marking guidelines and the final answer is correct, the total amount of tick marks must be indicated by the marker to indicate full marks awarded for the question correctly answered, so that the examination assistant can verify marks awarded.

- 1.11 If the unit required for calculations is specified in the question, the final answer can be considered correct without explicitly stating the unit, provided that the numerical value matches the unit specified or used in the question.
- 1.12 If an incorrect unit is stated in the candidate's answer during calculations, the answer will be marked incorrect even if the value itself is correct.
- 1.13 Attention must be given to calculation type questions when different methods are used by candidates to obtain the correct answer.
- 1.14 Attention must be given to special marking instructions to the marker which are stated for specific questions in the marking guidelines.
- 1.15 A red line must be drawn by the marker to indicate the end of each question.
- 1.16 Marks of sub question totals must be indicated on the outside margins of the ANSWER BOOK pages and NOT on the inside margins.
- 1.17 Marks of sub question totals, when indicated on the outside margins, must be in line with the sub questions and must NOT be circled.
- 1.18 Total marks of a question must be indicated on the red line drawn by the marker and circled as to indicate marks for particular questions.
- 1.19 The marker must transfer the marks to the cover page and ensure the correctness of the transfer.

**QUESTION 1: MULTIPLE-CHOICE QUESTIONS (GENERIC)**

- |     |     |            |
|-----|-----|------------|
| 1.1 | A ✓ | (1)        |
| 1.2 | C ✓ | (1)        |
| 1.3 | B ✓ | (1)        |
| 1.4 | D ✓ | (1)        |
| 1.5 | B ✓ | (1)        |
| 1.6 | A ✓ | (1)        |
|     |     | <b>[6]</b> |

## QUESTION 2: SAFETY (GENERIC)

### 2.1 Manual guillotine:

- Care must therefore be taken to never bring the operator's hands near the shearing blade. ✓
- Blade guard or back of the machine to catch the cut material must be fitted. ✓
- Cut material must be allowed to fall to the floor to be collected when safe to do so. ✓
- The guillotine must never be adjusted during operation. ✓
- The guillotine must never be lubricated during operation. ✓
- The guillotine must never be serviced during operation. ✓
- Care must be taken not to cut material that is thicker than the specified limit or harder materials. ✓
- Do not lean on the machine while operating. ✓

(Any 3 x 1) (3)

### 2.2 Examination procedures for First Aid:

- Environmental observation ✓
- Visible signs ✓
- Visible symptoms ✓
- Indicators to diagnosis ✓
- Vital functions ✓

(Any 3 x 1) (3)

### 2.3 Acetylene cylinders key:

So that the valve can be quickly closed./In case of an emergency. ✓ (1)

### 2.4 Product layout or a process layout:

2.4.1 Process layout ✓ (1)

2.4.2 Process layout ✓ (1)

2.4.3 Product layout ✓ (1)

[10]

### QUESTION 3: MATERIALS (GENERIC)

3.1 **Heat treatment:**

- Work piece size ✓
- Quenching rate ✓
- Carbon content ✓

(3)

3.2 **Machining test:**

3.2.1 Easy to cut ✓

(1)

3.2.2 Hard/Difficult to cut ✓

(1)

3.2.3 Easy to cut ✓

(1)

3.3 **Annealing:**

- To relieve internal stresses of the steel ✓
- Soften steel to allow for easy machining ✓
- Make steel ductile ✓
- Refine grain structure ✓
- Reduce brittleness ✓

(Any 1 x 1)

(1)

3.4 **Normalising:**

3.4.1 above ✓

(1)

3.4.2 soaking ✓

(1)

3.4.3 cooling ✓

(1)

3.4.4 room ✓

(1)

3.5 **Rapid cooling:**

- To increase the hardness of the metal. ✓
- To produce fine grain structure. ✓
- To maximise tensile strength. ✓
- To minimise ductility. ✓

(Any 1 x 1)

(1)

3.6 **Processes which cause internal stress:**

- Machining ✓
- Forging ✓
- Welding ✓
- Bending/Rolling ✓
- Twisting ✓
- Extreme/rapid heating ✓
- Flame/plasma cutting ✓
- Hardening ✓
- Rapid/uneven cooling ✓

(Any 2 x 1)

(2)

[14]

**QUESTION 4: MULTIPLE-CHOICE QUESTIONS (SPECIFIC)**

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

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

5.1 **Engage the lead screw half-nuts accurately:**  
Screw-cutting dial gauge ✓ (1)

5.2 **Check the correct cutting angles:**  
The centre gauge ✓ (1)

5.3 **Machine multi-start screw threads:**  
Graduated collar/Graduated driving plate ✓ (1)

5.4 **Taper calculations:**

5.4.1 **Included angle:**

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

$$\tan \frac{\theta}{2} = \frac{97 - 60}{2 \times 235} \checkmark$$

$$\tan \frac{\theta}{2} = \frac{37}{470}$$

$$\frac{\theta}{2} = \tan^{-1}(0,0787) \checkmark$$

$$\frac{\theta}{2} = 4,50 \quad \checkmark$$

$$\theta = 4,50 \times 2$$

$$\theta = 9^\circ \checkmark$$

(4)

5.4.2 **Tailstock set-over:**

$$\begin{aligned} \text{Set-over} &= \frac{L(D - d)}{2 \times l} \\ &= \frac{287(97 - 60)}{2 \times 235} \checkmark \\ &= 22,59 \text{ mm } \checkmark \end{aligned}$$

(3)



**5.5 Calculation of parallel key:**

**5.5.1 Width:**

$$\begin{aligned}\text{Width} &= \frac{D}{4} \\ &= \frac{87}{4} \quad \checkmark \\ &= 21,75 \text{ mm} \quad \checkmark\end{aligned}\quad (2)$$

**5.5.2 Thickness:**

$$\begin{aligned}\text{Thickness} &= \frac{D}{6} \\ &= \frac{87}{6} \quad \checkmark \\ &= 14,50 \text{ mm} \quad \checkmark\end{aligned}\quad (2)$$

**5.5.3 Length:**

$$\begin{aligned}\text{Length} &= 1,5 \times \text{diameter of shaft} \\ &= 1,5 \times 87 \quad \checkmark \\ &= 130,5 \text{ mm} \quad \checkmark\end{aligned}\quad (2)$$

**5.6 Depth of screw thread:**

$$\begin{aligned}\text{Depth} &= 0,613 \times \text{pitch} \\ &= 0,613 \times 3 \quad \checkmark \\ &= 1,84 \text{ mm} \quad \checkmark\end{aligned}\quad (2)$$

**[18]**

**QUESTION 6: TERMINOLOGY (INDEXING) (SPECIFIC)**

**6.1 Gear calculations:**

**6.1.1 Number of teeth:**

$$\text{Module} = \frac{\text{PCD}}{T}$$

$$\text{Teeth} = \frac{\text{PCD}}{m} \quad \checkmark$$

$$= \frac{384}{4} \quad \checkmark$$

$$= 96 \text{ teeth} \quad \checkmark$$

(3)

**6.1.2 Dedendum:**

$$\text{Dedendum} = 1,157 (m)$$

$$= 1,157 \times 4 \quad \checkmark$$

$$= 4,63 \text{ mm} \quad \checkmark$$

**OR**

$$= 1,25 (m)$$

$$= 1,25 \times 4 \quad \checkmark$$

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

(2)

**6.1.3 Outside diameter:**

$$\text{OD} = \text{PCD} + 2(m)$$

$$= 384 + 2(4) \quad \checkmark$$

$$= 392 \text{ mm} \quad \checkmark$$

**OR**

$$= m (T + 2)$$

$$= 4 (96 + 2) \quad \checkmark$$

$$= 392 \text{ mm} \quad \checkmark$$

(2)

**6.1.4 Circular pitch:**

$$\text{CP} = m \times \pi$$

$$= 4 \times \pi \quad \checkmark$$

$$= 12,57 \text{ mm} \quad \checkmark$$

(2)

6.2 **Dovetails:**

6.2.1 **Minimum width of dovetail: (w)**

**Calculate DE or y:**

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

$$\begin{aligned} DE &= \tan \alpha \times AD \checkmark \\ &= \tan 30^\circ \times 30 \checkmark \\ &= 17,32 \text{ mm} \checkmark \end{aligned}$$

**OR**

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

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

$$\begin{aligned} DE &= \frac{30}{\tan 60^\circ} \checkmark \\ &= 17,32 \text{ mm} \checkmark \end{aligned}$$

$$\begin{aligned} w &= W - 2(DE) \checkmark \\ &= 200 - 2(17,32) \checkmark \\ &= 200 - 34,64 \\ &= 165,36 \text{ mm} \checkmark \end{aligned}$$

(6)

6.2.2 Distance over the rollers: (M)

Calculate AC or x:

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

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

$$= \frac{8}{\tan 30^\circ} \checkmark$$

$$= 13,86 \text{ mm} \checkmark$$

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

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

$$= \tan 60^\circ \times 8 \checkmark$$

$$= 13,86 \text{ mm} \checkmark$$

OR

$$\begin{aligned} M &= w + [2(AC) + 2(R)] \checkmark \\ &= 165,36 + [2(13,86) + 2(8)] \checkmark \\ &= 165,36 + (27,72 + 16) \\ &= 209,08 \text{ mm} \checkmark \end{aligned}$$

OR

$$\begin{aligned} M &= w + 2(AC + R) \checkmark \\ &= 165,36 + 2(13,86 + 8) \checkmark \\ &= 165,36 + 27,72 + 16 \\ &= 209,08 \text{ mm} \checkmark \end{aligned}$$

OR

$$\begin{aligned} M &= w + 2(AC) + 2(R) \checkmark \\ &= 165,36 + 2(13,86) + 2(8) \checkmark \\ &= 165,36 + 27,72 + 16 \\ &= 209,08 \text{ mm} \checkmark \end{aligned}$$

(6)

### 6.3 Milling of spur gear:

#### 6.3.1 Indexing:

$$\begin{aligned}\text{Indexing} &= \frac{40}{n} \\ &= \frac{40}{157} \\ \text{Indexing} &= \frac{40}{A} \\ &= \frac{40}{160} \quad \checkmark \\ &= \frac{1}{4} \times \frac{6}{6} \\ &= \frac{6}{24} \quad \checkmark\end{aligned}$$

Approximate indexing:

No full turns and 6 holes on a 24-hole circle ✓

**OR**

No full turns and 7 holes on a 28-hole circle ✓

(3)

#### 6.3.2 Change gears:

$$\begin{aligned}\frac{D_{DR}}{D_{DN}} &= (A - n) \times \frac{40}{A} \\ \frac{D_{DR}}{D_{DN}} &= (160 - 157) \times \frac{40}{160} \quad \checkmark \\ &= 3 \times \frac{40}{160} \\ &= \frac{120}{160} \quad \checkmark \\ &= \frac{3}{4} \times \frac{8}{8} \quad \text{OR} \quad \frac{3}{4} \times \frac{16}{16} \\ \frac{D_{DR}}{D_{DN}} &= \frac{24}{32} \quad \checkmark \quad \frac{48}{64} \quad \checkmark\end{aligned}$$

(4)  
[28]

**QUESTION 7: TOOLS AND EQUIPMENT (SPECIFIC)**

- 7.1 **Resist deformation:**  
Hardness ✓ (1)
- 7.2 **Selection of indenter:**  
• The type of material to be tested ✓  
• Hardness ✓  
(Any 1 x 1) (1)
- 7.3 **Load applied:**  
• 1 500 kg ✓  
• 500 kg ✓  
(Any 1 x 1) (1)
- 7.4 **Tensile tester: To measure ...**  
• the yield stress. ✓  
• ultimate tensile stress. ✓  
• elongation percentage. ✓  
(Any 2 x 1) (2)
- 7.5 **Care of force tester:**  
• All nuts and bolts on the tester should be secured properly. ✓  
• Store the equipment in a dry place ✓ to prevent any rust.  
• Add different mass pieces very gently. ✓  
• Remove all mass pieces before storage. ✓  
• Do not bump the load cell ✓ as this may cause damage.  
• Do not overload the equipment. ✓  
(Any 4 x 1) (4)
- 7.6 **Purpose of ratchet:**  
• To limit the maximum force applied. ✓  
• To obtain accurate readings. ✓  
• To provide a (standard) universal feel. ✓  
(Any 1 x 1) (1)
- 7.7 **Tester:**  
Moment tester ✓ (1)
- 7.8 **Function screw thread micrometer:**  
To measure ✓ the pitch diameter ✓ of a screw thread. (2)
- [13]**

## QUESTION 8: FORCES (SPECIFIC)

### 8.1 Forces:

#### 8.1.1 $\Sigma$ Horizontal components:

$$\Sigma HC = 75\cos 35^\circ - 15\cos 45^\circ - 5\cos 0^\circ - 45\cos 60^\circ$$

✓          ✓          ✓          ✓

$$\Sigma HC = 61,44 - 10,61 - 5 - 22,5$$

$$\Sigma HC = 23,33 \text{ N} \checkmark \quad (5)$$

#### 8.1.2 $\Sigma$ Vertical components:

$$\Sigma VC = 75\sin 35^\circ + 15\sin 45^\circ - 5\sin 0^\circ - 45\sin 60^\circ$$

✓          ✓          ✓

$$\Sigma VC = 43,02 + 10,61 - 0 - 38,97$$

$$\Sigma VC = 14,66 \text{ N} \checkmark \quad (4)$$

OR

Force	$\theta$	8.1.1 $\Sigma HC/x = F\cos\theta$	8.1.2 $\Sigma VC/y = F\sin\theta$
25N	90°	HC = $75\cos 35^\circ$	VC = $75\sin 35^\circ$
40N	0°	HC = $15\cos 135^\circ$	VC = $15\sin 135^\circ$
55N	290°	HC = $5\cos 180^\circ$	VC = $5\sin 180^\circ$
120N	210°	HC = $45\cos 240^\circ$	VC = $45\sin 240^\circ$
		<b>Total</b>	
		<b>23,33 N</b> ✓	<b>14,66 N</b> ✓

(9)

#### 8.1.3 Resultant:

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

$$R = \sqrt{(14,66)^2 + (23,33)^2} \checkmark$$

$$R = \sqrt{759,20}$$

$$R = 27,55 \text{ N} \checkmark$$

(2)

8.1.4 **Angle and direction of resultant:**

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

$$\theta = \tan^{-1} \left( \frac{14,66}{23,33} \right) \checkmark$$

$$\theta = \tan^{-1} (0,284)$$

$$\theta = 32,14^\circ \checkmark$$

**OR**

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

$$\theta = \tan^{-1} \left( \frac{23,33}{14,66} \right) \checkmark$$

$$\theta = \tan^{-1} (1,591)$$

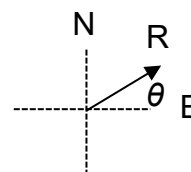
$$\theta = 57,86^\circ \checkmark$$

**Direction:**

R = 27,55 N 32,14° North from East ✓

**OR**

R = 27,55 N 57,86° East from North ✓



(3)

8.2 **Moment:**

8.2.1 **Distributed load:**

$$10 \times 5 \text{ m} = 50 \text{ N} \checkmark$$

(1)

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

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

$$(260 \times 2) + (50 \times 13,5) + (50 \times 16) = (A \times 16)$$

$$520 + 675 + 800 = 16A$$

$$A = \frac{1995}{16}$$

$$A = 124,69 \text{ N} \checkmark$$

(5)



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

$$(B \times 16) = (50 \times 0) + (50 \times 2,5) + (260 \times 14)$$

$$16B = 0 + 125 + 3640$$

$$B = \frac{3765}{16}$$

$$B = 235,31 \text{ N}$$

(4)

### 8.3 Stress and Strain:

#### 8.3.1 Force exerted:

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

$$F = \sigma \times A$$

$$F = (56,5 \times 10^6) \times (4 \times 10^{-4})$$

$$F = 22600 \text{ N}$$

(3)

#### 8.3.2 Strain:

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

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

$$\epsilon = \frac{56,5 \times 10^6}{90 \times 10^9}$$

$$\epsilon = 6,28 \times 10^{-4}$$

(3)

#### 8.3.3 Change in length:

$$\epsilon = \frac{\Delta L}{L_0}$$

$$\Delta L = \epsilon \times L_0$$

$$\Delta L = (6,28 \times 10^{-4}) \times 270$$

$$\Delta L = 0,17 \text{ mm}$$

(3)

[33]

### QUESTION 9: MAINTENANCE (SPECIFIC)

9.1 **Coefficient of friction:**

- Contact force ✓
- Surface roughness ✓
- Temperature ✓
- Sliding velocity ✓
- Type of material ✓
- Lubricant used ✓

(Any 3 x 1) (3)

9.2 **Type of maintenance:**

9.2.1 Planned ✓ (1)

9.2.2 Condition-based ✓ (1)

9.2.3 Condition-based ✓ (1)

9.3 **Correct slack:**

- Tensioner/Tensioning device ✓
- Jockey ✓
- Spring loaded tensioner ✓
- Off-set tensioner ✓

(Any 1 x 1) (1)

9.4 **Material to make gears:**

Vesconite ✓ (1)

9.5 **Label A–C:**

- A. Flat belt ✓
  - B. Toothed belt ✓
  - C. V–belt ✓
- (3)

9.6 **Preventative maintenance measures on chain drives:**

- Cleaning uncovered chain drives. ✓
- Check sprockets teeth. ✓
- Check the chain link plates wear. ✓
- Refilling reservoirs lubricant. ✓
- Lubricating chain drives. ✓
- Checking the functioning of tensioning devices. ✓
- Inspect chain regularly for elongation. ✓

(Any 4 x 1) (4)

9.7 **Thermoplastic composites or thermo hardened composites:**

- |       |                                     |             |
|-------|-------------------------------------|-------------|
| 9.7.1 | Thermoplastic composite ✓           | (1)         |
| 9.7.2 | Thermo hardened/setting composite ✓ | (1)         |
| 9.7.3 | Thermoplastic composite ✓           | (1)         |
|       |                                     | <b>[18]</b> |

## QUESTION 10: JOINING METHODS (SPECIFIC)

### 10.1 Screw thread terminology:

#### 10.1.1 Lead:

It is the axial distance ✓ that the nut on a screw thread will move/advance, ✓ when turned through one complete revolution/turn. ✓ (3)

#### 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. ✓ (3)

### 10.2 Square thread:

#### 10.2.1 Pitch:

Lead = Pitch × Number of starts

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

$$= \frac{38}{2} \quad \checkmark$$

$$= 19\text{mm} \quad \checkmark$$

(3)

#### 10.2.2 Pitch diameter:

$$\begin{aligned} D_m &= OD - \frac{P}{2} \\ &= 80 - \frac{19}{2} \quad \checkmark \\ &= 70,50 \text{ mm} \quad \checkmark \end{aligned}$$

(2)

#### 10.2.3 Helix angle of the thread:

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

$$\tan \theta = \frac{38}{\pi \times 70,50} \quad \checkmark$$

$$\theta = \tan^{-1} 0,171571286 \quad \checkmark$$

$$\theta = 9,74^\circ \quad \checkmark$$

(3)

10.2.4 **Leading tool angle:**

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

$$= 90^\circ - (9,74^\circ + 3^\circ) \checkmark$$

$$= 77,26^\circ \checkmark$$

(2)

10.2.5 **Following tool angle:**

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

$$= 90^\circ + (9,74^\circ - 3^\circ) \checkmark$$

$$= 96,74^\circ \checkmark$$

(2)

[18]

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

### 11.1 Hydraulic calculations :

#### 11.1.1 The fluid pressure in MPa:

$$A_{\text{Ram}} = \frac{\pi D^2}{4}$$

$$A_A = \frac{\pi (0,15)^2}{4} \checkmark$$

$$A_A = 17,67 \times 10^{-3} \text{ m}^2 \checkmark$$

$$P = \frac{F}{A_A}$$

$$P = \frac{20000}{17,67 \times 10^{-3}} \checkmark$$

$$P = 1131861,91 \text{ Pa}$$

$$P = 1,13 \text{ MPa} \checkmark$$

(5)

#### 11.1.2 The force exerted:

$$\frac{F_A}{A_A} = \frac{F_B}{A_B}$$

$$F_B = \frac{F_A \times A_B}{A_A} \checkmark$$

$$F_B = \frac{20000 \times 0,005}{17,67 \times 10^{-3}} \checkmark$$

$$F_B = 5659,31 \text{ N} \checkmark$$

$$P = \frac{F_B}{A_B}$$

$$F_B = P \times A_B \checkmark$$

OR

$$F_B = (1,13 \times 10^6) \times 0,005 \checkmark$$

$$F_B = 5650 \text{ N} \checkmark$$

(4)

11.2 **Application of hydraulic system:**

- Hydraulic press ✓
- Guillotine ✓
- Clamping devices ✓
- Controlling devices ✓
- Lifting equipment/Jacks/Hydraulic lift ✓
- Brake systems on cranes ✓
- Bending press ✓
- Punch and cropper machine ✓
- Forging machines ✓

(Any 3 x 1) (3)

11.3 **Belt drive:**

11.3.1 **The rotational frequency in r/s:**

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

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

$$N_{DN} = \frac{32,39 \times 0,09}{0,5} \quad \checkmark$$

$$N_{DN} = \frac{2,915}{0,5}$$

$$N_{DN} = 5,83 \text{ r/s} \quad \checkmark$$

(3)

11.3.2 **Power transmitted in watts:**

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

$$P = (1900 \checkmark - 450 \checkmark) \pi \times 0,09 \checkmark \times 32,39 \checkmark$$

$$P = 13279,18 \text{ Watt} \quad \checkmark$$

**OR**

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

$$P = (1900 \checkmark - 450 \checkmark) \pi \times 0,5 \checkmark \times 5,83 \checkmark$$

$$P = 13278,73 \text{ Watt} \quad \checkmark$$

(4)

11.4 **Disadvantages of pulley systems:**

- For a long distance pull, the object moves only a short distance. ✓
- Requires long ropes that can be susceptible to stretching. ✓
- Must be inspected regularly for rope stretch. ✓
- Must be inspected regularly for pulley breakage. ✓
- Must be inspected regularly for pulley spindle shear. ✓

(Any 2 x 1) (2)

11.5 **Gear drive:**

11.5.1 **Amount of teeth on T<sub>B</sub>:**

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

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

$$T_B = \frac{3712 \times 28 \times 25}{896 \times 50} \checkmark$$

$$T_B = 58 \text{ teeth } \checkmark$$

(4)

11.5.2 **The power transmitted:**

$$P = \frac{2 \times \pi \times N \times T}{60} \checkmark$$

$$P = \frac{2 \times \pi \times 896 \times 6780}{60} \checkmark$$

$$P = 636159,95 \text{ W } \checkmark$$

(3)

[28]

**TOTAL: 200**