basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE EXAMINATIONS/ NATIONAL SENIOR CERTIFICATE EXAMINATIONS

MECHANICAL TECHNOLOGY: FITTING AND MACHINING

MAY/JUNE 2026

MARKING GUIDELINES

MARKS: 200

These marking guidelines consist of 27 pages.

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Instructions to marker: Mechanical Technology – Fitting and Machining

1. General marking instructions:

1.1 During 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 required number of responses will be accepted. E.g. if the question states 'Name THREE …' and the candidate stated four different responses, ONLY the first three will be accepted and recognised and remaining responses marked wrong.

1.3 When the question states that the candidate is expected (a) to describe step by step and (b) to explain:
(a) If a candidate is required to describe step by step, e.g. a process in 4 steps, only the first 4 responses should be considered.
(b) However, if for example a candidate is required to explain a process, we need to consider that a candidate may write a long description, but not necessarily well organised. In this case the marker needs to evaluate the complete statement to judge if the candidate explained the required outcome satisfactorily and allocate marks on merit.

1.4 If question numbering of subquestions is not correct according to question paper sequence, the responses can be accepted if a sequence pattern can be identified.

1.5 Attention must be given to mark allocation in questions where two (2) marks were allocated to one response, e.g. (**Any 1 x 2**).

1.6 ONE tick must be allocated for each mark awarded and no global marking is allowed.

1.7 Unanswered and incorrect responses of questions must be indicated with a cross (X).

1.8 All blank pages in an ANSWER BOOK must be crossed out to indicate that the pages have been seen by the marker.

1.9 Attention must be given to questions where the candidate did not complete the answer but continued the answer(s) on subsequent pages in the answer book. Continue marking such questions and award marks, if applicable. If a question is answered twice, mark the first response.

1.10 During calculation marking, pay attention to the position of the tick mark(s) in the marking guideline.

1.11 If a candidate skipped a step where a tick mark is allocated in the marking guideline, but 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 assistants can verify marks awarded.

1.12 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.

1.13 If an incorrect unit is stated in the candidates answer during calculations, the answer will be marked incorrect even if the value itself is correct.

1.14 Attention must be given to calculation-type questions when different methods are used by candidates to obtain the correct answer. Consider answers where candidates have rounded off in subquestions and it affects the final answer.

1.15 Attention must be given to special marking instructions to the marker which are stated for specific questions in the marking guideline.

1.16 A red line must be drawn by the marker to indicate the end of each question.

1.17 Marks of subquestions must be indicated in the outside margins of the ANSWER BOOK pages and NOT in the inside margins.

1.18 When subquestion marks are allocated in the outside margins they must be in line with the subquestion and NOT be circled.

1.19 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.

1.20 Marker must transfer marks to cover page and ensure correctness of transfer.

1.21 Markers should familiarise themselves with the question and answer before evaluating the responses of candidates.

1.22 Always interpret the responses of the candidates within the context of the question.

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1.23 Mark what the candidate wrote and do not interpret or predict responses.

1.24 Accept incorrect spelling in answers unless the spelling changes the meaning of the answer.

1.25 Pencil work is normally acknowledged as rough work and should not be considered/marked.

1.26 As a rule, marks are not awarded for formulas that are found in the attached formula sheet. Only when a formula has been correctly manipulated, can a mark be awarded. Marks will also be awarded for correct formulas given by candidates if the particular formula is not found in the formula sheet. Marks are awarded for correct substitution.

1.27 Incorrect value from previous calculations substituted, in the right place in the formula, will be awarded marks.

2. Specific marking instructions:

2.1 In QUESTIONS 2.2.1.and 2.2.2, special attention must be given to answers from candidates as the question specifically ask WHILE the machines are working and not before it has been switched ON or after it has been switched OFF.

2.2 Answer for QUESTION 7.4 – pay attention to the mark allocation. One mark before the comma and one mark after the comma for the reading. The reading must be precise.

2.3 Calculation in QUESTION 8.1.1 – Vertical and Horizontal components: the mark can be allocated either to the calculated value or force indicated with cos/sin and correct angle, e.g. 75cos45° or 53,03.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS (GENERIC)

1.1 B ✓ (1)

1.2 A ✓ (1)

1.3 A ✓ (1)

1.4 C ✓ (1)

1.5 B ✓ (1)

1.6 B ✓ (1)
[6]

QUESTION 2: SAFETY (GENERIC)

2.1 **Identify safety device:**

2.1.1 **Vertical band saw:**
- Wheel guard ✓
- Adjustable guard ✓
- Blade guard ✓

(Any 1 x 1) (1)

2.1.2 **Power-driven guillotine:**
- Rear view mirror ✓
- Fixed guard ✓
- Finger protectors ✓
- Automatic sweep-away ✓
- Rear light curtain ✓
- Two hand control devices ✓
- Emergency stop buttons ✓
- Electronic presence-sensing devices (air curtains) ✓

(Any 1 x 1) (1)

2.1.3 **Drill press:**
- Belt cover ✓
- Chuck cover ✓

(Any 1 x 1) (1)

2.1.4 **Bench grinder:**
- Perspex shield ✓
- Wheel guard ✓

(Any 1 x 1) (1)

2.2 **Safety rules of the following machines:**

2.2.1 **Horizontal band saw:**
- Do not adjust the machine. ✓
- Do not force feed. ✓
- Do not remove the cuttings/swarf. ✓
- Do not adjust coolant supply. ✓
- Keep your fingers away from moving parts. ✓
- Do not leave the machine unattended. ✓

(Any 2 x 1) (2)

2.2.2 **Arc welding equipment:**
- Do not leave the machine unattended. ✓
- Use tongs/pliers to hold the hot metal. ✓ (2)

2.3 **Workshop layouts:**

2.3.1 Product layout ✓ (1)

2.3.2 Process layout ✓ (1)

[10]

QUESTION 3: MATERIALS (GENERIC)

3.1 **Types of tests/Test results:**

3.1.1 Mild steel ✓ (1)

3.1.2 Tends to crack ✓ (1)

3.1.3
- Cast steel ✓
- High speed steel ✓
- Tool steel ✓
- High carbon steel ✓

(Any 1 x 1) (1)

3.1.4 Cuts easily ✓ (1)

3.2 **Iron-carbon equilibrium diagram:**

A. Carbon content ✓
B. Temperature ✓
C. AC3/Upper critical temperature ✓
D. AC1/Lower critical temperature ✓ (4)

3.3 **Quenching media used in extreme cooling:**
- Brine/Salt water ✓
- Water ✓
- Liquid Nitrogen ✓

(Any 1 x 1) (1)

3.4 **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 2 x 1) (2)

3.5 **Annealing process:**

A. Grain growth ✓
B. Recrystallization ✓
C. Recovery ✓ (3)

[14]

QUESTION 4: MULTIPLE-CHOICE QUESTIONS (SPECIFIC)

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

[14]

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

5.1 **Screw-cutting dial:**

A. Dial ✓
B. Worm wheel/Gear ✓
C. Lead screw ✓ (3)

5.2 **Taper calculations:**

5.2.1 **Length of taper:**

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

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

$$l = \frac{70 - 40}{2 \times \tan 2°} \checkmark \checkmark$$

$$= 429{,}54 \text{ mm} \checkmark$$ (4)

5.2.2 **Tailstock set-over:**

$$x = \frac{\text{L}(\text{D} - \text{d})}{2 \times l}$$

$$x = \frac{549{,}54(70 - 40)}{2 \times 429{,}54} \checkmark \checkmark$$

$$x = 19{,}19 \text{ mm} \checkmark$$ (3)

5.3 **Key ways:**

5.3.1 **Width:**

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

$$\text{Width} = \frac{80}{4} \checkmark$$

$$= 20{,}00\ \text{mm} \checkmark$$ (2)

5.3.2 **Thickness:**

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

$$\text{Thickness} = \frac{80}{6} \checkmark$$

$$= 13{,}33\ \text{mm} \checkmark$$ (2)

5.3.3 **Length:**

Length = 1,5 x D
= 1,5 x 80 ✓
= 120,00 mm ✓ (2)

5.4 **Disadvantages of up-cut milling:**

- There is always a tendency for the cutter to lift the job. ✓
- The finish of the job is not of a high standard/Poor finish. ✓
- Greater chance of vibration and chatter. ✓
- Increased tool wear. ✓

(Any 2 x 1) (2)
[18]

QUESTION 6: TERMINOLOGY (INDEXING) (SPECIFIC)

6.1 **Gear calculations:**

6.1.1 **Circular pitch:**

$$CP = m \times \pi$$
$$= 3 \times \pi \ \checkmark$$
$$= 9,42 \text{ mm} \checkmark$$

(2)

6.1.2 **Number of teeth:**

$$PCD = m \times T$$
$$T = \frac{PCD}{m} \ \checkmark$$
$$= \frac{285}{3} \ \checkmark$$
$$= 95 \text{ teeth} \checkmark$$

OR

$$PCD = \frac{CP \times T}{\pi}$$
$$285 = \frac{9,42 \times T}{\pi} \ \checkmark$$
$$T = \frac{285 \times \pi}{9,42} \checkmark$$
$$= 95 \text{ teeth} \checkmark$$

(3)

6.1.3 **Dedendum:**

$$\text{Dedendum} = 1,157 \times m$$
$$= 1,157 \times 3 \ \checkmark$$
$$= 3,47 \text{ mm} \ \checkmark$$

OR

$$\text{Dedendum} = 1,25 \times m$$
$$= 1,25 \times 3 \ \checkmark$$
$$= 3,75 \text{ mm} \ \checkmark$$

(2)

6.2 **Dovetail calculations:**

W = w + 2(DE)

M = w + 2 (AC) + 2 (R)

6.2.1 **Maximum width of dovetail (W):**

Calculate DE or y:

$$\tan\alpha = \frac{DE}{AD}$$
$$DE = AD\tan\alpha \ \checkmark$$
$$= 40\ \tan 30° \checkmark$$
$$= 23{,}09\ mm \ \checkmark$$

OR

$$\tan\theta = \frac{AD}{DE}$$
$$DE = \frac{AD}{\tan\theta} \checkmark$$
$$= \frac{40}{\tan 60°} \checkmark$$
$$= 23{,}09\ mm \checkmark$$

$$W = w + 2(DE) \checkmark$$
$$= 150 + 2(23{,}09) \checkmark$$
$$= 150 + 46{,}18$$
$$= 196{,}18\ mm \ \checkmark$$

(6)

6.2.2 **Distance over the rollers (M):**

Calculate AC or x:

$$\tan\alpha = \frac{BC}{AC}$$
$$AC = \frac{BC}{\tan\alpha} \ \checkmark$$
$$= \frac{8}{\tan 30°} \checkmark$$
$$= 13{,}86\ mm \checkmark$$

OR

$$\tan\theta = \frac{AC}{BC}$$
$$AC = BC\tan\theta \ \checkmark$$
$$= 8\tan 60° \checkmark$$
$$= 13{,}86\ mm \checkmark$$

$$M = w + 2(AC) + 2(R) \checkmark$$
$$= 150 + 2(13{,}86) + 2\ (8) \checkmark$$
$$= 150 + 27{,}72 + 16$$
$$= 193{,}72\ mm \checkmark$$

(6)

6.3 **Milling of spur gear:**

6.3.1 **Indexing:**

$$\text{Indexing} = \frac{40}{n}$$
$$= \frac{40}{71}$$
$$\text{Indexing} = \frac{40}{A}$$
$$= \frac{40}{70} \checkmark$$
$$= \frac{4}{7} \times \frac{4}{4}$$
$$= \frac{16}{28} \checkmark$$

Approximate indexing:

No full turns and 16 ✓ holes on a 28 ✓-hole circle

OR

No full turns and 24 ✓ holes on a 42 ✓-hole circle

OR

No full turns and 28 ✓ holes on a 49 ✓-hole circle (4)

6.3.2 **Change gears:**

$$\frac{Dr}{Dn} = (A - n) \times \frac{40}{A}$$
$$\frac{Dr}{Dn} = (70 \checkmark - 71) \times \frac{40}{70} \checkmark$$
$$= -1 \times \frac{40}{70}$$
$$= \frac{4}{7} \times \frac{8}{8} \checkmark$$
$$\frac{Dr}{Dn} = \frac{32}{56} \checkmark \checkmark$$

(5)

[28]

QUESTION 7: TOOLS AND EQUIPMENT (SPECIFIC)

7.1 **Size of screw thread micrometer:**

7.1.1 **Size:**
25 mm ✓ (1)

7.1.2 **Function of A:**
Lock the spindle ✓ (1)

7.2 **Reading:**

15,00 + 0,5 + 0,13 = 15, 63 mm ✓ ✓ (2)

7.3 **Tensile tester:**

7.3.1 **Type of tester:**
Tensile tester ✓ (1)

7.3.2 **Type of tests:**
- Yield stress ✓
- Tensile stress/strength ✓
- Elongation ✓
- Strain ✓

(Any 2 x 1) (2)

7.4 **How to conduct the Brinell hardness tester:**

7.4.1 load ✓ (1)

7.4.2 clean ✓ (1)

7.4.3 raised ✓ (1)

7.4.4 steel ✓ (1)

7.4.5 diameter ✓ (1)

7.4.6 calculation ✓ (1)

[13]

QUESTION 8: FORCES (SPECIFIC)

8.1 **Forces:**

8.1.1 **∑ Horizontal components:**

$$\sum HC = 45\cos 0^\circ + 15\cos 30^\circ - 75\cos 45^\circ - 5\cos 55^\circ$$

✓ ✓ ✓ ✓

$$\sum HC = 45 + 12,99 - 53,03 - 2,87$$

$$\sum HC = 2,09\text{N} \ ✓$$ (5)

∑ Vertical components:

$$\sum VC = 45\sin 0^\circ + 15\sin 30^\circ + 75\sin 45^\circ - 5\sin 55^\circ$$

✓ ✓ ✓

$$\sum VC = 0 + 7,5 + 53,03 - 4,1$$

$$\sum VC = 56,43\ \text{N} \ ✓$$ (4)

OR

Force	θ	∑VC/y = Fsinθ		∑HC/x = Fcosθ	
45N	0º	VC = 45sin0º	0 N	HC = 45cos0º	45 N ✓
15N	30º	VC = 15sin30º	7,5 N ✓	HC = 15cos30º	12,99 N ✓
75N	135º	VC = 75sin135º	53,03 N ✓	HC = 75cos135º	-53,03 N ✓
5N	235º	VC = 5sin235º	-4,1 N ✓	HC = 5cos235º	-2,87 N ✓
		Total	**56,43 N** ✓		**2,09N** ✓

(9)

8.1.2 **Magnitude of resultant:**

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

$$\sqrt{R^2} = \sqrt{56,43^2 + 2,09^2} \ ✓$$

$$R = 56,47\ \text{N} \ ✓$$ (2)

8.1.3 **Angle of resultant:**

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

$$\theta = \tan^{-1}\left(\frac{56,43}{2,09}\right) \checkmark$$

$$\theta = \tan^{-1}(27)$$

$$\theta = 87,88° \textbf{ OR } 87°53' \checkmark$$

OR

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

$$\alpha = \tan^{-1}\left(\frac{2,09}{56,43}\right) \checkmark$$

$$\alpha = \tan^{-1}(0,037037)$$

$$\alpha = 2,12° \textbf{ OR } 2°7' \checkmark$$

Angle and direction:

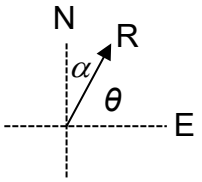
R = 56,47 N at 87,88° North from East ✓

OR

R = 56,47 N at 2,12° East from North ✓

OR

R = 56,47 N at a bearing of 2,12° ✓



(3)

8.2 **Calculations, UDL and supports A and B:**

8.2.1 **Distributed load:**
UDL:

UDL = 20 N/m x 5 m ✓
UDL = 100 N ✓ (2)

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

Σ LHM = ΣRHM

$$(250 \times 3) + (100 \times 17{,}5) + (120 \times 20) = (A \times 20)$$ ✓ ✓ ✓

$$750 + 1\,750 + 2400 = 20A$$

$$A = \frac{4\,900}{20}$$

$$A = 245 \text{ N}$$ ✓

Reaction in support B:
Take moments about A:

Σ LHM = ΣRHM

$$(B \times 20) = (120 \times 0) + (100 \times 2{,}5) + (250 \times 17)$$ ✓ ✓

$$20B = 0 + 250 + 4250$$

$$B = \frac{4\,500}{20}$$

$$B = 225 \text{ N}$$ ✓ (7)

8.3 **Calculations on Stress and Strain:**

8.3.1 **Stress in MPa:**

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

$$\sigma = \frac{50\,000}{1{,}26 \times 10^{-3}} \checkmark \checkmark$$

$$\sigma = 39\,682\,539{,}68\,\text{Pa}$$

$$\sigma = 39{,}68\,\text{MPa} \checkmark \quad (3)$$

8.3.2 **Strain in the material:**

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

$$\varepsilon = \frac{0{,}975}{68} \checkmark \checkmark$$

$$\varepsilon = 0{,}014 \checkmark \quad (3)$$

8.3.3 **Young's modulus:**

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

$$E = \frac{39{,}68 \times 10^{6}}{0{,}014} \checkmark \checkmark$$

$$E = 2\,834\,285\,714\,\text{Pa}$$

$$E = 2{,}83\,\text{GPa} \checkmark \quad (3)$$

8.4 **Stress and strain diagram, Label A:**
Limit of proportionality ✓ (1)
[33]

QUESTION 9: MAINTENANCE (SPECIFIC)

9.1 **Failure to conduct proper preventative maintenance:**

- Risk of injury or death. ✓
- Financial loss. ✓
- Damage to equipment/machines/materials. ✓
- Loss of valuable production time. ✓
- Shortened lifespan of machines and equipment. ✓

(Any 3 x 1) (3)

9.2 **Types of preventative maintenance procedures:**

- Planned or scheduled maintenance ✓
- Conditional-based maintenance ✓ (2)

9.3 **Corrective maintenance measure:**

9.3.1
- Correct the tension/Use tensioner to tension belt. ✓
- Replace the belt. ✓

(Any 1 x 1) (1)

9.3.2
- Checking and replenishment of lubrication levels. ✓
- Ensuring that gears are properly secured to shafts. ✓
- Cleaning and replacing of oil filters. ✓
- Reporting excessive noise and wear, vibration and overheating for expert attention.✓

(Any 1 x 1) (1)

9.3.3 Replace the chain. ✓ (1)

9.3.4 Replace the sprocket. ✓ (1)

9.4 **Uses of the materials:**

9.4.1 **Vesconite:**

- Thrust washer ✓
- Wear ring ✓
- Guide strips ✓
- Bushes ✓
- Gears ✓
- Wear strips ✓
- Wheels ✓
- Rollers ✓
- Vanes ✓

(Any 2 x 1) (2)

9.4.2 **Carbon fibre:**

- Vehicle body parts ✓
- Blades ✓
- Gears ✓
- Fibre sheets ✓
- Frame works ✓
- Beams ✓
- Prosthetics ✓

(Any 2 x 1) (2)

9.4.3 **Fibre glass:**

- Motor vehicle bodies ✓
- Roof sheeting ✓
- Petrol tanks ✓

(Any 2 x 1) (2)

9.5 **Thermo-hardened/Thermosetting or Thermoplastic composite:**

9.5.1 Thermoplastic ✓ (1)

9.5.2 Thermo-hardened/Thermosetting ✓ (1)

9.5.3 Thermo-hardened/Thermosetting ✓ (1)
[18]

QUESTION 10: JOINING METHODS (SPECIFIC)

10.1 **Uses of multiple threads:**

- Fire hydrants ✓
- Valves ✓
- Aircraft landing gear ✓
- Machines (identify specific machines) ✓
- Lids of containers/jars ✓
- Fly press ✓

(Any 3 x 1) (3)

10.2 **Advantages of multiple screw threads:**

- They provide more load-bearing surface than single-start screw thread. ✓
- Do not strip easily. ✓
- To provide faster linear movement. ✓
- They are more efficient as they lose less power to friction compared to single-start screw threads. ✓

(Any 3 x 1) (3)

10.3 **Square Thread:**

10.3.1 **Pitch diameter:**

$$\text{Pitch} = \frac{\text{Lead}}{\text{Number of starts}}$$
$$= \frac{30}{1} \quad ✓$$
$$= 30 \text{ mm} \quad ✓$$

$$D_m = OD - \frac{P}{2}$$
$$= 92 - \frac{30}{2} \quad ✓$$
$$= 77{,}00 \text{ mm} \quad ✓$$

(4)

10.3.2 **Helix angle of the thread:**

$$\tan\theta = \frac{\text{Lead}}{\pi \times D_M}$$
$$= \frac{30}{\pi \times 77} \quad ✓ \quad ✓$$
$$\theta = \tan^{-1}(0{,}1240168388) \quad ✓$$
$$= 7{,}07° \quad \textbf{OR} \quad 7°4' \quad ✓$$

(4)

10.3.3 **Leading tool angle:**

$$\begin{aligned}\text{Leading tool angle} &= 90° - (\text{helix angle} + \text{clearance angle}) \\ &= 90° - (7{,}07° + 3°) \quad ✓ \\ &= 79{,}93° \quad \textbf{OR} \quad 79°56' ✓\end{aligned}$$

(2)

10.3.4 **Following tool angle:**

$$\begin{aligned}\text{Following tool angle} &= 90° + (\text{helix angle} - \text{clearance angle}) \\ &= 90° + (7{,}07° - 3°) \quad ✓ \\ &= 94{,}07° \quad \textbf{OR} \quad 94°4' ✓\end{aligned}$$

(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:**

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

$$A = \frac{\pi\ (0,250)^2}{4}\ \checkmark$$

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

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

$$P = \frac{22\ 000\ \checkmark}{4,91 \times 10^{-2}\ \checkmark}$$

$$P = 448\,065,17\,Pa$$

$$P = 0,45\,MPa\ \checkmark$$ (5)

11.1.2 **Applied force on the plunger:**

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

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

$$f=\frac{22\ 000\times 3,14\times 10^{-4}}{4,91\times 10^{-2}}\ \checkmark$$

$$f=140,98N\ \checkmark$$

OR

$$P=\frac{f}{a}$$

$$f=P\times a\ \checkmark$$

$$f=448\ 065,17\times 3,14\times 10^{-4}\ \checkmark$$

$$f=140,69N\ \checkmark$$ (3)

11.2 **Advantages of belt drive over gear drive:**

- Produces less noise than gear drives. ✓
- Produces less vibration than gear drives. ✓
- More cost effective. ✓
- Belt drives will slip under a sudden load/overload to protect the drive. ✓
- Do not need lubrication like gear drives. ✓
- Suitable when centre distance between shafts is large. ✓
- Easier to repair than gear drives. ✓

(Any 2 x 1) (2)

11.3 **Functions of a reservoir in a hydraulic system:**

- Fluid storage tank. ✓
- Promotes air separation from the fluid. ✓
- Support for the pump and electric motor. ✓
- Promotes heat dispersion. ✓
- Acts as a base for mounting control equipment. ✓

(Any 3 x 1) (3)

11.4 **Applications for pneumatic systems:**

- Drills ✓
- Brake systems ✓
- Jack hammers ✓
- Nail guns ✓
- Missiles ✓
- Doors ✓
- Spray guns ✓
- Blow guns ✓

(Any 2 x 1) (2)

11.5 **Belt drive:**

11.5.1 **The diameter of the driven pulley:**

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

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

$$D_{DN} = \frac{360 \times 295}{1\,800} \checkmark$$

$$D_{DN} = 59 \text{ mm} \checkmark$$

(3)

11.5.2 **Speed ratio:**

$$\text{Speed ratio} = \frac{D_{DN}}{D_{DR}}$$

$$= \frac{59}{295} \checkmark \checkmark$$

$$= 0,2 : 1 \checkmark$$

OR

$$\text{Speed ratio} = \frac{N_{DR}}{N_{DN}}$$

$$= \frac{360}{1800} \checkmark \checkmark$$

$$= 0,2 : 1 \checkmark$$

(3)

11.6 **Gear drive:**

11.6.1 **Rotation frequency of the output shaft:**

$$\frac{N_{Input}}{N_{Output}} = \frac{\text{Product of the number of teeth on driven gear}}{\text{Product of the number of teeth on driving gear}}$$

$$\frac{3500}{N_{Output}} = \frac{55 \times 60}{30 \times 25} \checkmark \checkmark$$

$$\frac{N_{Output}}{3500} = \frac{30 \times 25}{55 \times 60}$$

$$N_{Output} = \frac{30 \times 25 \times 3500}{55 \times 60} \checkmark$$

$$N_{Output} = 795,45 \text{ r/min} \checkmark$$

(4)

11.6.2 **Gear ratio:**

$$\text{Gear ratio} = \frac{\text{Product of teeth on driven gear}}{\text{Product of teeth on driver gear}}$$

$$\text{Gear ratio} = \frac{55 \times 60}{30 \times 25} \checkmark \checkmark$$

$$\text{Gear ratio} = 4,4 : 1 \checkmark$$

OR

$$\text{Speed ratio} = \frac{N_{DR}}{N_{DN}}$$

$$\text{Speed ratio} = \frac{3500}{795,45} \checkmark \checkmark$$

$$\text{Speed ratio} = 4,4 : 1 \checkmark$$

(3)
[28]

TOTAL: 200

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