



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE EXAMINATIONS/ NATIONAL SENIOR CERTIFICATE EXAMINATIONS

MECHANICAL TECHNOLOGY: FITTING AND MACHINING

2021

MARKING GUIDELINES

MARKS: 200

These marking guidelines consist of 25 pages.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS (GENERIC)

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



QUESTION 2: SAFETY (GENERIC)**2.1 First aid basic treatment:**

- Examination ✓
- Diagnosis ✓
- Treatment ✓

(3)

2.2 Drill press (Already been switched on):

- Never leave the drill unattended while in motion. ✓
- Switch off the drill when leaving. ✓
- Use a brush or wooden rod to remove chips. ✓
- When reaching around a revolving drill, be careful that your clothes do not get caught in the drill or drill chuck. ✓
- Don't stop a revolving chuck with your hand. ✓
- Don't adjust the drill while working. ✓
- Don't open any guard while in motion. ✓
- Keep hands away from action points. ✓
- Do not force the drill bit into the material. ✓
- Apply cutting fluid if required. ✓

(Any 2 x 1) (2)

2.3 Isolation of electrode holder:

To prevent electric shock. ✓



(1)

2.4 Disadvantages of the process layout:

- Production is not always continuous. ✓
- Transportation costs between process departments may be high. ✓
- Additional time is spent in testing and sorting as the product moves to the different departments. ✓
- Damage to fragile goods may result from extra handling. ✓

(Any 2 x 1) (2)

2.5 Advantages of the product layout:

- Handling of material is limited to a minimum. ✓
- Time period of manufacturing cycle is less. ✓
- Production control is almost automatic. ✓
- Control over operations is easier. ✓
- Greater use of unskilled labour is possible. ✓
- Less total inspection is required. ✓
- Less total floor space is needed per unit of production. ✓
- Reduction in manufacturing costs. ✓

(Any 2 x 1) (2)

[10]

QUESTION 3: MATERIALS (GENERIC)

3.1 **Heat-treatment:**

- Heat the metal slowly to a certain temperature. ✓
 - Soak the metal for a certain period to ensure a uniform temperature. ✓
 - Cool the metal at a certain rate to room temperature. ✓
- (3)

3.2 **Quenching mediums:**

- Water ✓
- Brine ✓
- Liquid salts ✓
- Oil ✓
- Soluble oil and water ✓
- Sand ✓
- Molten lead ✓
- Air ✓
- Lime ✓

(Any 3 x 1) (3)

3.3 **Annealing:**

- To relieve internal stresses of the steel ✓
- Soften steel to make machining possible ✓
- Make steel ductile ✓
- Refine grain structure ✓
- Reduce brittleness ✓



(Any 1 x 1) (1)

3.4 **Carbon steels:**

- Low carbon steel ✓
- Medium carbon steel ✓
- High carbon steel ✓

(3)

3.5 **Iron-carbon equilibrium diagram:**

- A Percentage carbon / carbon content ✓
- B Temperature in °C ✓
- C AC3 line / Higher critical temperature ✓
- D AC1 line / Lower critical temperature ✓

(4)

[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 | B ✓ | (1) |
| 4.10 | C ✓ | (1) |
| 4.11 | B ✓ | (1) |
| 4.12 | B ✓ | (1) |
| 4.13 | A ✓ | (1) |
| 4.14 | D ✓ | (1) |
- [14]**



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

5.1 Disadvantages of compound slide method:

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

(Any 3 x 1) (3)

5.2 Taper calculations:

5.2.1 Diameter of taper:

$$\tan \frac{\theta}{2} = \frac{D-d}{2 \times l}$$
$$\tan \frac{10}{2} = \frac{165-d}{2 \times 210} \checkmark$$
$$420 \tan 5^\circ = 165 - d$$
$$d = 165 - 36,75$$
$$d = 128,25 \text{ mm } \checkmark$$

5.2.2 Tailstock set-over:

$$x = \frac{L(D-d)}{2 \times l} \checkmark$$
$$x = \frac{325(165-128,25)}{2 \times 210} \checkmark$$
$$x = 28,44 \text{ mm } \checkmark$$

5.3 Calculation of parallel key:

5.3.1

$$\text{Width} = \frac{D}{4}$$
$$= \frac{55}{4} \checkmark$$
$$= 13,75 \text{ mm } \checkmark$$

5.3.2

$$\text{Thickness} = \frac{D}{6}$$
$$= \frac{55}{6} \checkmark$$
$$= 9,17 \text{ mm } \checkmark$$

5.3.3 Length = $1,5 \times \text{diameter of shaft}$
 = $1,5 \times 55$ ✓
 = 82,5 mm ✓

(2)

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

- Heavier cuts can be taken. ✓
- When hard steels are cut, the total cutting pressure is absorbed by the material at the back of the edge. ✓
- When milling material with a hard scale, the cut is started under the scale where material is softer, extending the life of the cutter. ✓
- A courser feed can be used. ✓
- The strain on the cutter and arbor is less. ✓
- Less vibration experienced on machine. ✓

(Any 2 x 1)

(2)
[18]



QUESTION 6: TERMINOLOGY (INDEXING) (SPECIFIC)

6.1 Gear calculations:

6.1.1 Number of teeth:

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

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

$$= \frac{136}{4} \\ = 34 \text{ teeth} \quad \checkmark$$

(2)

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:

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

$$= 136 + 2(4) \quad \checkmark$$

$$= 144 \text{ mm} \quad \checkmark$$

OR

$$= m(T + 2)$$

$$= 4(34 + 2) \quad \checkmark$$

$$= 144 \text{ mm} \quad \checkmark$$

(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 **Dove tail calculations:**

$$w = 190 - 2(DE)$$

$$M = w + 2(AC) + 2(R) \text{ or } M = w + 2(AC + R)$$

6.2.1 **Minimum width of dove tail (w):**

Calculate DE:

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

$$\begin{aligned} DE &= AD \tan \alpha \\ &= 38 \tan 30^\circ \checkmark \\ &= 21,94 \text{ mm } \checkmark \end{aligned}$$

$$\tan \theta = \frac{AD}{ED} \checkmark$$

$$\begin{aligned} \tan 60^\circ &= \frac{38}{ED} \\ ED &= \frac{38}{\tan 60^\circ} \checkmark \\ &= 21,94 \text{ mm } \checkmark \end{aligned}$$

OR

$$\begin{aligned} w &= 190 - 2(DE) \checkmark \\ &= 190 - 2(21,94) \checkmark \\ &= 190 - 43,88 \\ &= 146,12 \text{ mm } \checkmark \end{aligned}$$



(6)

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

Calculate AC:

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

$$\begin{aligned} AC &= \frac{BC}{\tan \alpha} \checkmark \\ &= \frac{15}{\tan 30^\circ} \\ &= 25,98 \text{ mm } \checkmark \end{aligned}$$

$$\tan \theta = \frac{CA}{BC} \checkmark$$

$$\begin{aligned} CA &= BC \tan \theta \checkmark \\ &= 15 \tan 60^\circ \\ &= 25,98 \text{ mm } \checkmark \end{aligned}$$

OR

$$\begin{aligned} M &= w + 2(AC) + 2(R) \checkmark \\ &= 146,12 + 2(25,98) + 2(15) \checkmark \\ &= 146,12 + 51,96 + 30 \\ &= 228,08 \text{ mm } \checkmark \end{aligned}$$

OR

$$\begin{aligned} M &= w + 2(AC + R) \checkmark \\ &= 146,12 + 2(25,98 + 15) \checkmark \\ &= 146,12 + 81,96 \\ &= 228,08 \text{ mm } \checkmark \end{aligned}$$

(6)

6.3 Milling of spur gear:

6.3.1 Indexing:

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

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:

$$\begin{aligned} \frac{D_{DR}}{D_{DN}} &= (A - n) \times \frac{40}{A} \quad \text{EcoleBooks} \\ \frac{D_{DR}}{D_{DN}} &= (160 - 163) \times \frac{40}{160} \quad \checkmark \\ &= -3 \times \frac{40}{160} \quad \checkmark \\ &= \frac{-120}{160} \\ &= \frac{3}{4} \times \frac{8}{8} \quad \checkmark \\ \frac{D_{DR}}{D_{DN}} &= \frac{24}{32} \quad \checkmark \end{aligned}$$

(5)
[28]

QUESTION 7: TOOLS AND EQUIPMENT (SPECIFIC)**7.1 Reading:**

Reading = $7,90$ mm (2)

7.2 Brinell hardness test:

- Select the desired load to apply to the specimen. ✓
- The specimen is raised to be in contact with the Brinell ball by turning the hand wheel. ✓
- The load is then applied for about 15 - 30 seconds ✓
- Release the load from the specimen. ✓
- Measure the diameter of the impression. ✓
- Determine the Brinell hardness number. ✓ (6)

7.3 The tensile tester:

- Yield stress ✓
- Ultimate / maximum tensile stress ✓
- Elongation percentage ✓
- Break stress ✓
- Limit of proportionality ✓
- Elastic limit ✓
- Strain ✓
- Ductility ✓



(Any 3 x 1) (3)

7.4 Screw thread micrometer:**Identify:**

7.4.1 Screw thread micrometer ✓ (1)

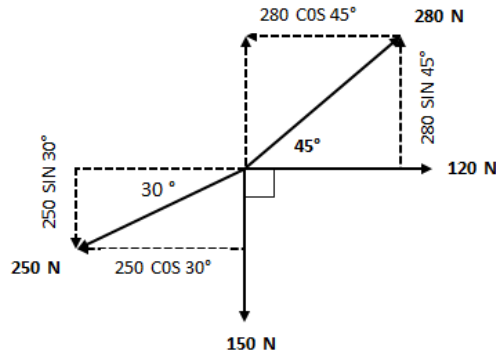
Function:

7.4.2 Measure the pitch diameter ✓ of a screw thread. (1)

[13]

QUESTION 8: FORCES (SPECIFIC)

8.1 Magnitude and direction of the equilibrant:



8.1.1 Sum of the horizontal components (HC):

$$\begin{aligned} \sum HC &= 280 \cos 45^\circ + 120 \cos 0^\circ - 150 \cos 90^\circ - 250 \cos 30^\circ \\ &= 197,99 + 120 - 0 - 216,51 \\ &= 101,48 \text{ N } \checkmark \end{aligned}$$



Force	HC (x)	Total
120 N	$120 \cos 0^\circ$ ✓	120N
280 N	$280 \cos 45^\circ$ ✓	197,99 N
250 N	$250 \cos 210^\circ$ ✓	-216,51 N
150 N	$150 \cos 270^\circ$	0 N
Total:		101,48 N ✓

(4)

8.1.2 Sum of the vertical components (VC):

$$\begin{aligned} \sum VC &= 280 \sin 45^\circ + 120 \sin 0^\circ - 150 \sin 90^\circ - 250 \sin 30^\circ \\ &= 197,99 + 0 - 150 - 125 \\ &= -77,01 \text{ N } \checkmark \end{aligned}$$

OR

Force	VC (y)	Total
120 N	$120 \sin 0^\circ$	0N
280 N	$280 \sin 45^\circ$ ✓	197,99 N
250 N	$250 \sin 210^\circ$ ✓	-125 N
150 N	$150 \sin 270^\circ$ ✓	-150 N
Total:		-77,01 N ✓

(4)

8.1.3 Magnitude of the equilibrium force:

$$E^2 = VC^2 + HC^2 \quad \checkmark$$

$$E = \sqrt{(77,01)^2 + (101,48)^2} \quad \checkmark$$

$$= 127,39 \text{ N} \quad \checkmark$$

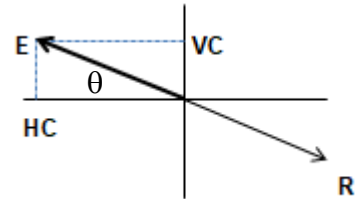
(3)

8.1.4 Direction of the equilibrium force:

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

$$\tan \theta = \frac{77,01}{101,48}$$

$$\theta = 37,19^\circ \quad \checkmark$$

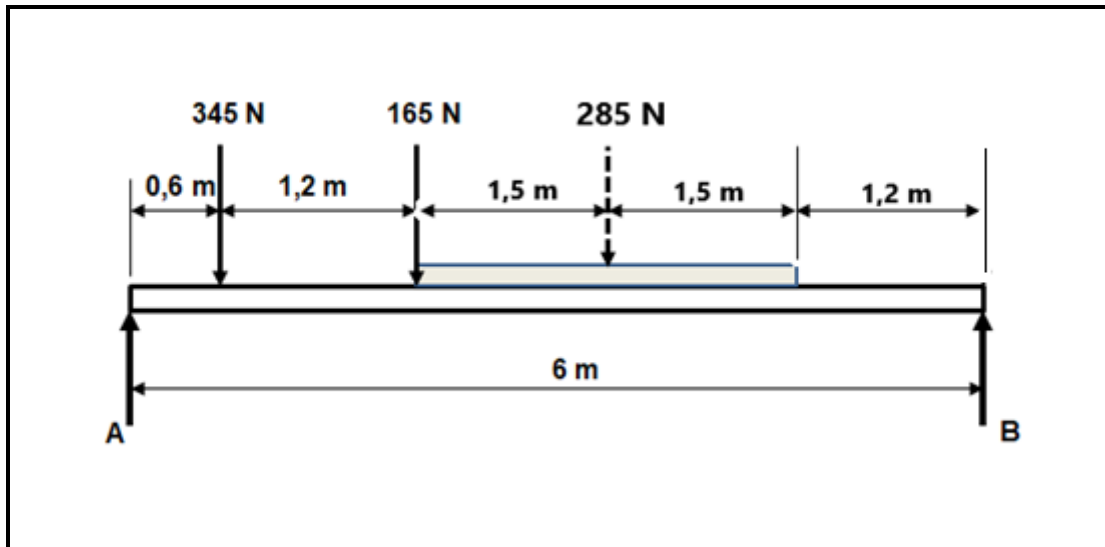


$$E = 127,39 \text{ N at } 37,19^\circ \text{ N of W} \quad \checkmark$$

(3)



8.2 Magnitudes of the reactions in supports A and B:

**Calculate A:****Take moments about B:**

$$\sum CWM = \sum ACM$$

$$A \times 6 = (285 \times 2,7) + (165 \times 4,2) + (345 \times 5,4) \checkmark$$

$$A \times 6 = 769,5 + 693 + 1863 \checkmark$$

$$A \times 6 = 3325,5$$

$$A = \frac{3325,5}{6} \checkmark$$

$$A = 554,25 \text{ N} \checkmark$$

Calculate B:**Take moments about A:**

$$\sum CWM = \sum ACM$$

$$(345 \times 0,6) + (165 \times 1,8) + (285 \times 3,3) = 6 \times B \checkmark$$

$$207 + 297 + 940,5 = 6 \times B \checkmark$$

$$1444,5 = 6 \times B$$

$$\frac{1444,5}{6} = B \checkmark$$

$$240,75 \text{ N} = B \checkmark$$

(8)

8.3 **Stress and Strain:**8.3.1 **The resistance area of the bush:**

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

$$A = \frac{\pi(0,058^2 - 0,042^2)}{4} \checkmark$$

$$A = 1,26 \times 10^{-3} \text{ m}^2 \checkmark$$

(2)

8.3.2 **The stress in the material:**

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

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

$$= 39682539,68 \text{ Pa}$$

$$= 39,68 \text{ MPa} \checkmark$$

(3)

8.3.3 **Strain:**

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

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

$$= 14,34 \times 10^{-3} \checkmark$$

**(If any unit indicated, then NO mark for final answer)**

(3)

8.3.4 **Young's modulus:**

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

$$= \frac{39,68 \times 10^6}{14,34 \times 10^{-3}} \checkmark$$

$$= 2,77 \times 10^9 \text{ Pa} \checkmark$$

$$= 2,77 \text{ GPa}$$

(3)

[33]

QUESTION 9: MAINTENANCE (SPECIFIC)

9.1 **Lack of preventative maintenance:**

- Risk of injury or death. ✓
- Financial loss. ✓
- Damage to parts. ✓
- Loss of production time. ✓

(Any 2 x 1) (2)

9.2 **Malfunctioning of chain drives:**

- Uncovered chain drives not cleaned. ✓
- Tensioning device is not working efficiently. ✓
- Chain is not inspected regularly for elongation. ✓
- Chain drive is not aligned. ✓
- Wear and tear of chain. ✓
- Wear of sprocket teeth. ✓
- Lack of lubrication. ✓
- Chain drive has been overloaded. ✓

(Any 2 x 1) (2)

9.3 **Wear on a gear drive system:**

- Checking and replacement of lubrication levels. ✓
- Ensuring that gears are properly secured to shaft. ✓
- Cleaning and replacement of oil filter. ✓
- Reporting excessive noise, wear, vibration and overheating for expert attention. ✓
- Cleaning of gears regularly. ✓

(Any 2 x 1) (2)

9.4 **Property of materials:**

9.4.1 **Polyvinyl chloride (PVC):**

- Can be re-heated and re-shaped ✓
- Flexible ✓
- Rubber like substance and makes a dull sound when dropped. ✓
- Can be modified to suit most applications. ✓
- Can be welded (plastic welding). ✓
- Can be bonded with an adhesive. ✓
- Weather resistant ✓
- Water proof ✓
- Easy to work with. ✓
- Light weight ✓
- Recyclable ✓
- Corrosion resistant ✓

(Any 2 x 1) (2)

9.4.2 **Carbon fibre:**

- Cannot be re-heated and re-shaped ✓
- Tough and strong material. ✓
- Light weight ✓
- Weather resistant ✓
- Heat resistant ✓
- Enhance strength of plastic by entrenchment. ✓
- Highly electrically conductive ✓

(Any 2 x 1) (2)

9.4.3 **Bakelite:**

- Electrically non-conductor (electrical insulator) ✓
- Heat resistant ✓
- Well moulded into specific shapes ✓
- Weather resistant ✓
- Cannot be re-heated and re-shaped ✓

(Any 2 x 1) (2)

9.5 **Thermoplastic composites or thermo-hardened (thermosetting) composites:**9.5.1 **Vesconite:**

Thermoplastic ✓

(1)

9.5.2 **Glass fibre:**

Thermo-hardened/Thermosetting ✓

(1)

9.5.3 **Carbon fibre:**

Thermo-hardened/Thermosetting ✓

(1)

9.6 **Uses of materials.**9.6.1 **Teflon:**

- Orthopaedic and prosthetic appliances ✓
- Hearing aids ✓
- Joints ✓
- Upholstery ✓
- Mechanical parts (e.g., taps and bearings) ✓
- Electrical insulation ✓
- Non-stick coatings ✓

(Any 1 x 1) (1)

9.6.2

Carbon fibre:

- Sporting and leisure equipment like: Tennis rackets, squash rackets, badminton rackets, golf clubs, hockey sticks ✓
- Model airplanes ✓
- Bicycle frames ✓
- Ski's ✓
- Surf boards ✓
- Boat masts ✓
- Compressor blades ✓
- Self- lubricating gears ✓
- Artificial satellites ✓
- Helicopter blades ✓
- Car bodies
- Airplane parts (fuselage) ✓

(Any 1 x 1) (1)

9.6.3

Nylon:

- Bushes ✓
- Gears ✓
- Pulleys ✓
- Fishing line ✓
- Ropes ✓

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

QUESTION 10: JOINING METHODS (SPECIFIC)**10.1 Square Thread:****10.1.1 Mean diameter:**

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

$$= \frac{40}{2} \checkmark$$

$$= 20 \text{ mm} \checkmark$$

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

$$= 85 - \frac{20}{2} \checkmark$$

$$= 75 \text{ mm} \checkmark$$

(4)

10.1.2 Helix angle of the thread:

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

$$= \frac{40}{\pi \times 75} \checkmark$$

$$\theta = \tan^{-1}(0,169765272)$$

$$= 9,63^\circ \text{ or } 9^\circ 38' \checkmark$$

(4)

10.1.3 Leading tool angle:

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

$$= 90^\circ + (9,63^\circ + 3^\circ) \checkmark$$

$$= 77,37^\circ \text{ or } 77^\circ 22' \checkmark$$

(2)

10.1.4 Following tool angle:

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

$$= 90^\circ + (9,63^\circ - 3^\circ) \checkmark$$

$$= 96,63^\circ \text{ or } 96^\circ 38' \checkmark$$

(2)

10.2 **Screw thread label:**

- A. Pitch diameter/mean/effective ✓
- B. Helix angle ✓
- C. Pitch / Lead ✓
- D. Root/Root length ✓

(4)

10.3 **Uses of square thread:**

- Vice screws ✓
- Brake screws ✓
- Lead screws of lathe machines ✓
- Scissor jacks ✓
- Milling machine table feed screws ✓
- Hydraulic jacks (Adjustable top) ✓

(Any 2 x 1)

(2)

[18]



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

$$\begin{aligned}A_A &= \frac{\pi D_A^2}{4} \\ &= \frac{\pi (0,025)^2}{4} \checkmark \\ &= 0,49 \times 10^{-3} \text{ m}^2 \quad \text{OR} \quad 4,91 \times 10^{-4} \text{ m}^2 \checkmark\end{aligned}$$

Pressure:

$$\begin{aligned}P &= \frac{F}{A} \\ &= \frac{1,32 \times 10^3}{0,49 \times 10^{-3}} \checkmark \\ &= 2,69 \times 10^6 \text{ Pa} \\ &= 2,69 \text{ MPa} \checkmark\end{aligned}$$



(4)

11.1.2 The diameter of piston B:

$$P_B = P_A$$

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

$$\frac{6,45 \times 10^3}{A_B} = \frac{1,32 \times 10^3}{0,49 \times 10^{-3}} \checkmark$$

$$\frac{6,45 \times 10^3}{A_B} = 2,69 \times 10^6$$

$$A_B = \frac{6,45 \times 10^3}{2,69 \times 10^6} \checkmark$$

$$A_B = 2,40 \times 10^{-3} \checkmark$$

$$A_B = \frac{\pi D_B^2}{4}$$

$$D_B = \sqrt{\frac{4A_B}{\pi}} \checkmark$$

$$= \sqrt{\frac{4(2,40 \times 10^{-3})}{\pi}} \checkmark$$

$$= 0,05528 \text{ m}$$

$$= 55,28 \text{ mm} \checkmark$$

(6)

11.2 Advantages of chain drive system over belt drive systems:

- No slipping or creep occurs. ✓
- Higher efficiency. ✓
- Longer life span. ✓
- Does not generate heat. ✓
- Does not undergo the same degrading effects of what time has on belts. ✓
- Much stronger. ✓
- Faster speeds can be obtained. ✓

(Any 2 x 1) (2)

11.3 Functions of hydraulic reservoir:

- A fluid storage tank. ✓
- Promotes air separation from the fluid. ✓
- Support for the pump and electric motor. ✓
- Promotes heat dispersion. ✓
- Acts as a base plate for mounting control equipment. ✓
- It allows for expansion or contraction of the hydraulic system. ✓

(Any 2 x 1) (2)**11.4 Application for hydraulic systems:**

- Machine tools ✓
- Clutch systems ✓
- Brake systems ✓
- Aircraft ✓
- Jacks ✓
- Missiles ✓
- Ships ✓
- Earth moving equipment ✓
- Punch machines ✓
- Turbines ✓
- Tractor lifts ✓
- Car lifts ✓
- Machine vices ✓
- Jaws of life ✓
- Trains ✓

**(Any 1 x 1) (1)****11.5 Belt drive:****11.5.1 Rotational frequency:**

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

$$N_{DR} \times 95 = 85 \times 255 \quad \checkmark$$

$$N_{DR} = \frac{85 \times 255}{95} \quad \checkmark$$

$$N_{DR} = 228,16 \text{ r/min}$$

OR

$$N_{DR} = 3,8 \text{ r/sec} \quad \checkmark$$

(3)

11.5.2 **Speed ratio:**

$$\text{Speed ratio} = \frac{\text{Diameter of driven pulley}}{\text{Diameter of driver pulley}}$$

$$\text{Speed ratio} = \frac{255}{95} \checkmark$$

$$\text{Speed ratio} = 2,68 : 1 \checkmark$$

OR

$$\text{Speed ratio} = \frac{\text{Frequency of driven pulley}}{\text{Frequency of driver pulley}}$$

$$\text{Speed ratio} = \frac{228}{85} \checkmark$$

$$\text{Speed ratio} = 2,68 : 1 \checkmark$$

(3)



11.6 Gear drive:

11.6.1 Rotation frequency:

$$\frac{N_A}{N_F} = \frac{\text{Product of the number of teeth on driven gears}}{\text{Product of the number of teeth on driving gears}}$$

$$\frac{N_F}{N_A} = \frac{\text{Product of the number of teeth on driving gears}}{\text{Product of the number of teeth on driven gears}}$$

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

$$= \frac{30 \times 20 \times 50 \times 2500}{40 \times 60 \times 70} \quad \checkmark$$

$$= 446,43 \text{ r/min}$$

OR

$$= 7,44 \text{ r/sec} \quad \checkmark$$

(4)

11.6.2 Gear ratio:



$$\text{Gear Ratio} = \frac{\text{Product of the number of teeth on driven gears}}{\text{Product of the number of teeth on driving gears}}$$

$$= \frac{40 \times 60 \times 70}{30 \times 20 \times 50} \quad \checkmark$$

$$= \frac{168000}{30000}$$

$$= 5,6 : 1 \quad \checkmark$$

OR

$$\text{Speed ratio} = \frac{N_{\text{input}}}{N_{\text{output}}}$$

$$= \frac{2500}{446,43} \quad \checkmark$$

$$= 5,6 : 1 \quad \checkmark$$

(3)

[28]

TOTAL: 200