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Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE EXAMINATIONS/ NATIONAL SENIOR CERTIFICATE EXAMINATIONS

MECHANICAL TECHNOLOGY: FITTING AND MACHINING

2022

MARKING GUIDELINES

MARKS: 200

These marking guidelines consist of 26 pages.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS (GENERIC)

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

QUESTION 2: SAFETY (GENERIC)**2.1 Rated speed of a grinding wheel:**

- Because the wheel could burst/break if it turns faster than its revolution range. / Avoid an accident. ✓
- Effectiveness of the grinding process will be compromised. ✓ **(Any 1 x 1)** (1)

2.2 Safety precautions of a band saw in operation:

- Never leave the band saw unattended. ✓
- Use a push stick when cutting. ✓
- Hold the work piece firmly and flat on the table. ✓
- Don't adjust the machine while working. ✓
- Don't open any guard while the machine is on. ✓
- Make relief cuts before cutting tight curves. ✓
- Don't force the material into the blade. ✓
- Keep hands clear from the action point. ✓
- Keep hands braced against the table. ✓
- Keep your hands on either sides of the blade and not in line with the cutting line and the blade. ✓
- Keep loose clothing clear from action point. ✓ **(Any 2 x 1)** (2)

2.3 Stages in which first aid is applied:

- Examination ✓
- Diagnosis ✓
- Treatment ✓ (3)

2.4 Causes of accidents:

- Unsafe acts ✓
- Unsafe conditions ✓ (2)

2.5 TWO advantages of the product layout:

- Handling of material is kept 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. ✓ **(Any 2 x 1)** (2)
- [10]**

QUESTION 3: MATERIALS (GENERIC)**3.1 Tempering:**

Tempering is a process generally applied to steel to relieve the strains/brittleness/improve ductility ✓ induced during the hardening process. ✓

(2)

3.2 Annealing:

- To relieve internal stresses ✓ that may have been set up during working of metal.
- To soften steel ✓ in order to facilitate the machining process.
- To refine their grain structure. ✓
- Reduce brittleness. ✓
- Make the steel ductile. ✓

(Any 3 x 1)

(3)

3.3 Normalising temperature:

- Above ✓ higher/upper critical temperature ✓
- Above ✓ AC₃ line. ✓

(Any 1 x 2)

(2)

3.4 Spark pattern for carbon steels:

3.4.1 High-carbon steel ✓

(1)

3.4.2 Low-carbon steel / Mild steel ✓

(1)

3.4.3 Cast-iron ✓

(1)

3.5 Carbon diagram:

- A. Temperature range / °C ✓
- B. AC₃ line / Higher/upper critical temperature line ✓
- C. AC₁ line / Lower critical temperature line ✓
- D. Carbon content / % carbon ✓

(4)

[14]

QUESTION 4: MULTIPLE-CHOICE QUESTIONS (SPECIFIC)

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

QUESTION 5: TERMINOLOGY (LATHE AND MILLING MACHINE) (SPECIFIC)**5.1 Disadvantages of using compound slide method:**

- The automatic feed of the machine cannot be used. ✓
- Only short tapers can be cut. ✓
- It causes fatigue in the operator. ✓
- Poor finish. ✓
- Take longer time to cut. ✓

(Any 2 x 1) (2)**5.2 Taper:****5.2.1 Length of taper:**

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

$$\tan \frac{12}{2} = \frac{72 - 40}{2 \times \ell} \quad \checkmark$$

$$2 \times \ell = \frac{32}{\tan 6^\circ} \quad \checkmark$$

$$\ell = \frac{304,46}{2} \quad \checkmark$$

$$\ell = 152,23 \text{ mm} \quad \checkmark$$

(5)**5.2.2 Tailstock set-over:**

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

$$x = \frac{(70 + 152,23)(72 - 40)}{2(152,23)} \quad \checkmark$$

$$x = 23,36 \text{ mm} \quad \checkmark$$

(3)

5.3 Parallel key:**5.3.1 Width:**

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

$$\text{Width} = \frac{102}{4} \checkmark$$

$$= 25,50 \text{ mm} \checkmark$$

(2)

5.3.2 Thickness:

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

$$\text{Thickness} = \frac{102}{6} \checkmark$$

$$= 17 \text{ mm} \checkmark$$

(2)

5.3.3 Length:

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

$$= 1,5 \times 102 \checkmark$$

$$= 153 \text{ mm} \checkmark$$

(2)

5.4 Disadvantages of gang milling:

- The gang of cutters place more stress on the machine spindle bearings. ✓
- The cutters make the milling machine work harder. ✓

(2)

[18]

QUESTION 6: TERMINOLOGY (INDEXING) (SPECIFIC)**6.1 Spur gear:****6.1.1 Number of teeth:**

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

$$\text{Module} = \frac{168}{42} \quad \checkmark$$

$$\text{Module} = 4 \quad \checkmark$$

(2)

6.1.2 Circular pitch:

$$\begin{aligned} \text{CP} &= m \times \pi \\ &= 4 \times \pi \quad \checkmark \\ &= 12,57 \text{ mm} \quad \checkmark \end{aligned}$$

OR

$$\begin{aligned} \text{CP} &= \frac{\text{PCD} \times \pi}{T} \\ &= \frac{168 \times \pi}{42} \quad \checkmark \\ &= 12,57 \text{ mm} \quad \checkmark \end{aligned}$$

(2)

6.1.3 Outside diameter:

$$\begin{aligned} \text{OD} &= \text{PCD} + 2(m) \\ &= 168 + 2(4) \quad \checkmark \\ &= 176 \text{ mm} \quad \checkmark \end{aligned}$$

OR

$$\begin{aligned} \text{OD} &= m(T + 2) \\ &= 4(42 + 2) \quad \checkmark \\ &= 176 \text{ mm} \quad \checkmark \end{aligned}$$

(2)

$$6.2 \quad W = 135 + 2(y)$$

$$m = W - (2x) - (2R)$$

$$m = W - 2(x + R)$$

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

Calculate y:

$$\tan \theta = \frac{h}{y}$$

$$y = \frac{h}{\tan \theta} \quad \checkmark$$

$$y = \frac{35}{\tan 60^\circ} \quad \checkmark$$

$$y = 20,21 \text{ mm} \quad \checkmark$$

$$W = 135 + 2(y) \quad \checkmark$$

$$= 135 + 2(20,21) \quad \checkmark$$

$$= 135 + 40,42$$

$$= 175,42 \text{ mm} \quad \checkmark$$

$$\tan \theta = \frac{y}{35}$$

$$y = \tan \theta \times h \quad \checkmark$$

$$y = \tan 30^\circ \times 35 \quad \checkmark$$

$$= 20,21 \text{ mm} \quad \checkmark$$

(6)

6.2.2 Distance between the rollers (m):

Calculate x :

$$\tan \alpha = \frac{R}{x}$$

$$x = \frac{R}{\tan \alpha} \quad \checkmark$$

$$x = \frac{12}{\tan 30^\circ} \quad \checkmark$$

$$x = \frac{12}{0,5774}$$

$$x = 20,78 \text{ mm} \quad \checkmark$$

$$\tan \theta = \frac{x}{12}$$

$$x = \tan \theta \times 12 \quad \checkmark$$

$$x = \tan 60 \times 12 \quad \checkmark$$

$$= 20,78 \text{ mm} \quad \checkmark$$

OR

$$m = W - (2x) - (2R) \quad \checkmark$$

$$= 175,42 - (2 \times 20,78) - (2 \times 12) \quad \checkmark$$

$$= 175,42 - 41,56 - 24$$

$$= 109,86 \text{ mm} \quad \checkmark$$

OR

$$m = W - 2(x+R) \quad \checkmark$$

$$m = 175,42 - 2(20,78 + 12) \quad \checkmark$$

$$m = 175,42 - 65,56$$

$$m = 109,86 \text{ mm} \quad \checkmark$$

(6)

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

$$\text{Indexing} = \frac{40}{n}$$

$$\text{Indexing} = \frac{40}{113}$$

$$\text{Indexing} = \frac{40}{110} \quad \checkmark$$

$$\text{Indexing} = \frac{40}{110} \div \frac{5}{5}$$

$$\text{Indexing} = \frac{8}{22} \times \frac{3}{3} \quad \checkmark$$

$$\text{Indexing} = \frac{24}{66} \quad \checkmark$$

Approximate indexing: 24 holes on a 66-hole circle \checkmark

(4)

6.3.2 Change gears:

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

$$\frac{Dr}{Dn} = (110 - 113) \times \frac{40}{110} \quad \checkmark$$

$$\frac{Dr}{Dn} = -\frac{3 \times 40}{110}$$

$$\frac{Dr}{Dn} = -\frac{120}{110} \div \frac{5}{5}$$

$$\frac{Dr}{Dn} = \frac{-24}{22} \times \frac{2}{2} \quad \checkmark$$

$$\frac{Dr}{Dn} = \frac{48\checkmark}{44\checkmark}$$

(4)

6.4 **Unbalanced work piece:**

- Unnecessary bearing loads ✓
- Excessive vibration ✓
- A bad finish ✓
- Work that is not perfectly round ✓
- Danger to the operator ✓
- Clatter on the gear teeth ✓
- A tendency to bend the spindle ✓

(Any 2 x 1)

(2)

[28]

QUESTION 7: TOOLS AND EQUIPMENT (SPECIFIC)**7.1 Tensile tester:**

- Yield stress ✓
- Ultimate tensile stress / Maximum stress ✓
- Elongation percentage / Ductility ✓
- Limit of proportionality ✓
- Limit of elasticity ✓
- Break stress ✓

(Any 3 x 1) (3)**7.2 Brinell hardness tester:**

- A - Work piece / Test piece ✓
- B - Steel Carbide ball / Indenter ✓
- C - Indentation diameter ✓

(3)**7.3 Calculate cutting depth:**

$$\begin{aligned}\text{Cutting depth} &= 0,613 \times \text{pitch} \\ &= 0,613 \times 1,75 \checkmark \\ &= 1,07 \text{ mm } \checkmark\end{aligned}$$

(2)**7.4 Depth micrometer reading:**

✓ ✓
17,36 mm

(2)**7.5 Function of moment tester:**

To determine the reactions ✓ on either side ✓ of a simply loaded ✓ beam.

**(3)
[13]**

QUESTION 8: FORCES (SPECIFIC)**8.1 System of forces:****HORIZONTAL COMPONENT:**

$$\sum HC = 50\cos 30^\circ - 85\cos 0^\circ + 75\cos 70^\circ$$

$$\sum HC = 43,30 - 85 + 25,65$$

$$\sum HC = -16,05 \text{ N}$$

VERTICAL COMPONENT:

$$\sum VC = 50\sin 30^\circ - 25\sin 90^\circ - 75\sin 70^\circ$$

$$\sum VC = 25 - 25 - 70,48$$

$$\sum VC = -70,48 \text{ N}$$

OR

Force	θ	VC/y = $F\sin\theta$		HC/x = $F\cos\theta$	
50 N	30°	VC = $50\sin 30^\circ$	25 N ✓	HC = $50\cos 30^\circ$	43,30 N ✓
85 N	180°	VC = $85\sin 180^\circ$	0 N	HC = $85\cos 180^\circ$	-85 N ✓
25 N	270°	VC = $25\sin 270^\circ$	-25 N ✓	HC = $25\cos 270^\circ$	0 N
75 N	290°	VC = $75\sin 290^\circ$	-70,48 N ✓	HC = $75\cos 290^\circ$	25,65 N ✓
		Total	-70,48 N ✓		-16,05 N ✓

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

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

$$\sqrt{R^2} = \sqrt{(-70,48)^2 + (-16,05)^2}$$

$$\theta = \tan^{-1} \left(\frac{-70,48}{-16,05} \right)$$

$$\sqrt{R^2} = \sqrt{5225,033}$$

$$\theta = \tan^{-1}(4,39)$$

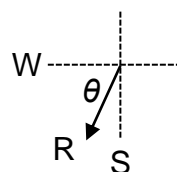
$$R = 72,28 \text{ N}$$

$$\theta = 77,17^\circ \text{ OR } 77^\circ 10' 12''$$

$$R = 72,28 \text{ N } 77,17^\circ \text{ South from West}$$

$$\text{OR}$$

$$R = 72,28 \text{ N } 12,83^\circ \text{ West from South}$$



(15)

8.2 Moments:**8.2.1 Point load for UDL:**

$$6 \times 11 = 66 \text{ kN} \checkmark \quad (1)$$

8.2.2 Calculate A
Take moments about B:
 $\sum \text{RHM} = \sum \text{LHM}$

$$(A \times 11) = (12 \times 2,5) + (66 \times 5,5) + (75 \times 11) \checkmark$$

$$11A = 30 + 363 + 825$$

$$A = \frac{1218}{11} \checkmark$$

$$A = 110,73 \text{ kN} \checkmark$$

(3)

8.2.3 Calculate B
Take moments about A:
 $\sum \text{LHM} = \sum \text{RHM}$

$$B \times 11 = (75 \times 0) + (66 \times 5,5) + (12 \times 8,5) \checkmark$$

$$11B = 0 + 363 + 102$$

$$B = \frac{465}{11} \checkmark$$

$$B = 42,27 \text{ kN} \checkmark$$

OR

$$A + B = 75 + 66 + 12 \checkmark$$

$$B = 153 - 110,73 \checkmark$$

$$B = 42,27 \text{ kN} \checkmark$$

(3)

8.3.1 The resistance area:

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

$$A = \frac{\pi (0,05)^2}{4} \checkmark$$

$$A = 0,00196 \text{ m}^2 \text{ or } 1,96 \times 10^{-3} \text{ m}^2 \checkmark \quad (2)$$

8.3.2 The stress in the material in MPa:

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

$$\sigma = \frac{50 \times 10^3}{1,96 \times 10^{-3}} \checkmark$$

$$\sigma = 25510204,082 \text{ Pa}$$

$$\sigma = 25,51 \text{ MPa} \checkmark \quad (3)$$

8.3.3 Strain in material:

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

$$\varepsilon = \frac{0,005}{3} \checkmark$$

$$\varepsilon = 0,0017 \text{ OR } 1,67 \times 10^{-3} \checkmark$$

(No unit! If unit indicated, answer is wrong) (2)

8.4 Label stress and strain diagram:

A – Limit of proportionality ✓

B – Elastic limit ✓

C – Yield point ✓

D – Maximum stress ✓

(4)
[33]

QUESTION 9: MAINTENANCE (SPECIFIC)

- 9.1 **Main purpose of maintenance:**
To ensure that the machinery always operates at an optimal level. ✓ (1)
- 9.2 **Preventative maintenance:**
- 9.2.1 **Chain drives:**
- Cleaning uncovered drives. ✓
 - Check sprocket teeth and link plate wear. ✓
 - Check lubricants. ✓
 - Checking the functioning of tensioning devices. ✓
 - Inspecting chains regularly for elongation. ✓
- (Any 2 x 1) (2)
- 9.2.2 **Belt drives:**
- Checking the wear and tear on belt. ✓
 - Checking belt alignment. ✓
 - Checking the tension setting. ✓
 - Checking the tensioning devices. ✓
- (Any 2 x 1) (2)
- 9.3 **Properties of EACH of the following nylon products:**
- 9.3.1 **Polyethylene (PET):**
- Stiff ✓
 - Strong ✓
 - Hard ✓
 - Chemical resistance ✓
- (Any 2 x 1) (2)
- 9.3.2 **Polypropylene (PP):**
- Good fatigue resistance ✓
 - Heat resistance ✓
 - Tough ✓
 - Semi rigid ✓
 - Good chemical resistant ✓
- (Any 2 x 1) (2)
- 9.3.3 **Polystyrene (PS):**
- Good insulation properties ✓
 - Water resistant ✓
 - Odourless properties ✓
 - Light weight ✓
- (Any 2 x 1) (2)

9.4 Factors influencing coefficient of friction:

- Surface roughness/texture ✓
- Temperature ✓
- Type of lubricant ✓
- Type of friction ✓

(Any 3 x 1) (3)**9.5 Thermo-hardened composites:**

This type of plastic goes through a chemical change during moulding that prevents reheating. ✓

(1)**9.6 Types of belt drive systems:**

- V-belt ✓
- Wedge belt / Cog belt ✓
- Flat belt ✓
- Multi-groove belt ✓
- Toothed / Timing belt ✓
- Circular belt / Round belt ✓
- Poly V-belt ✓

**(Any 3 x 1) (3)
[18]**

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

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

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

$$\text{Pitch} = \frac{36}{3} \quad \checkmark$$

$$\text{Pitch} = 12 \text{ mm} \quad \checkmark$$

(3)

10.1.2 Pitch diameter:

$$D_p = OD - \frac{P}{2}$$

$$D_p = 70 - \frac{12}{2} \quad \checkmark$$

$$D_p = 64 \text{ mm} \quad \checkmark$$

(2)

10.1.3 Helix angle of the thread:

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

$$\tan \theta = \frac{36}{\pi \times 64} \quad \checkmark$$

$$\tan \theta = 0,179049311$$

$$\theta = 10,15^\circ \text{ OR } 10^\circ 9' \quad \checkmark$$

(3)

10.1.4 Leading angle:

$$\begin{aligned}
 \text{Leading angle} &= 90^\circ - (\text{helix angle} + \text{clearance angle}) \\
 &= 90^\circ - (10^\circ 9' + 3^\circ) \checkmark \\
 &= 76^\circ 51' \text{ or } 76,85^\circ \checkmark
 \end{aligned}$$

(2)

10.1.5 Following angle:

$$\begin{aligned}
 \text{Following angle} &= 90^\circ + (\text{helix angle} - \text{clearance angle}) \\
 &= 90^\circ + (10^\circ 9' - 3^\circ) \checkmark \\
 &= 97^\circ 9' \text{ or } 97,15^\circ \checkmark
 \end{aligned}$$

(2)

10.2 Square thread cutting tool angles:

10.2.1 Square thread \checkmark (1)

10.2.2 A - Clearance angle \checkmark
 B - Leading angle \checkmark
 C - Following angle \checkmark
 D - Helix angle \checkmark (4)

10.3 Included angle of Metric V-thread:

60° \checkmark (1)

[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:**

$$A_{\text{RAM}} = \frac{\pi d^2}{4}$$

$$A = \frac{\pi (0,120)^2}{4} \quad \checkmark$$

$$A = 11,31 \times 10^{-3} \text{ m}^2 \quad \checkmark$$

NOTE: Force of Ram = $4\,500 \text{ kg} \times 10 \text{ m/s}^2$
 $= 45 \times 10^3 \text{ N}$

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

$$P = \frac{45 \times 10^3}{11,3 \times 10^{-3}} \quad \checkmark$$

$$P = 3,98 \text{ N} \quad \checkmark$$

(4)

11.1.2 Force to be applied on the plunger:

$$A_{\text{Plunger}} = \frac{\pi d^2}{4}$$

$$A = \frac{\pi (0,032)^2}{4} \quad \checkmark$$

$$A = 0,80 \times 10^{-3} \text{ m}^2 \quad \checkmark$$

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

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

$$F = 3,98 \times 10^6 \times 0,80 \times 10^{-3} \quad \checkmark$$

$$F = 3184 \text{ N} \quad \checkmark$$

OR

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

$$\frac{F_A}{0,8 \times 10^{-3}} = \frac{45 \times 10^3}{11,31 \times 10^{-3}} \quad \checkmark$$

$$F_A = \frac{(45 \times 10^3)(0,8 \times 10^{-3})}{11,31 \times 10^{-3}} \quad \checkmark$$

$$= 3184 \text{ N} \quad \checkmark$$

(5)

- 11.2 **Function hydraulic non-return valve:**
Used to provide one-directional oil flow and the fluid is not allowed to flow back. ✓ (1)
- 11.3 **Spring-loaded double-action control valve is used in a water line:**
- Protect water supplies from back flow. ✓
 - Prevent water contamination. ✓
 - Safety device if one valve is jammed. ✓
- (Any 2 x 1) (2)
- 11.4 **Pressure gauges:**
- Bourdon tube gauge. ✓
 - Schrader gauge. ✓
- (2)
- 11.5 **Belt drive:**
- 11.5.1 **The rotational frequency:**
- $$N_{DN} \times D_{DN} = N_{DR} \times D_{DR}$$
- $$N_{DN} = \frac{N_{DR} \times D_{DR}}{D_{DN}} \quad \checkmark$$
- $$N_{DN} = \frac{1320 \times 0,085}{0,375} \quad \checkmark$$
- $$N_{DN} = \frac{299,2}{60} \quad \checkmark$$
- $$N_{DN} = 4,99 \text{ r/sec} \quad \checkmark \quad (4)$$

11.5.2 Power transmitted in Watt:

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

$$P = (275 - 120) \pi \times 0,375 \times 4,99$$

$$P = 911,199 \text{ Watt}$$

OR

$$P = (T_1 - T_2) \pi D N$$

$$= \frac{(275 - 120) \times \pi \times 0,085 \times 1320}{60}$$

$$= 910,59 \text{ Watt}$$

(3)

11.6 Gear drive:

11.6.1 Number of teeth on T_A :

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

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

$$\frac{720}{320} = \frac{T_A \times 45 \times 50}{20 \times 25 \times 20} \quad \checkmark$$

$$2,25 = \frac{2250 \times T_A}{10000} \quad \checkmark$$

$$2250 \times T_A = 2,25 \times 10000$$

$$T_A = \frac{22500}{2250}$$

$$T_A = 10 \quad \checkmark$$

(4)

11.6.2 **Gear ratio:**

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

$$\text{Gear ratio} = \frac{20 \times 25 \times 20}{10 \times 45 \times 50} \checkmark \checkmark$$

$$\text{Gear ratio} = 0,44:1 \checkmark$$

OR

$$\text{Speed Ratio} = \frac{N_A}{N_F}$$

$$= \frac{320}{720} \checkmark \checkmark$$

$$= 0,44:1 \checkmark$$

(3)
[28]**TOTAL: 200**