basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

MECHANICAL TECHNOLOGY: FITTING AND MACHINING

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MARKING GUIDELINES

MARKS: 200

These marking guidelines consist of 24 pages.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS (GENERIC)

1.1 B ✓ (1)

1.2 A ✓ (1)

1.3 D ✓ (1)

1.4 A / C ✓ (1)

1.5 A ✓ (1)

1.6 C ✓ (1)
[6]

QUESTION 2: SAFETY (GENERIC)

2.1 **First-aid applications to an open wound:**

- Use surgical gloves. ✓
- Do not remove anything that is stuck to the wound. ✓
- Never use sticky plaster on the wound. ✓
- Cover the wound with a clean, lint-free cloth. ✓
- Avoid using any oily substances or lotions on wounds. ✓
- If necessary, cool wounds with cold water. ✓
- Apply pressure to prevent blood loss if necessary. ✓
- Avoid contact with blood from patient. ✓
- If the wound is on your arm, raise the arm above your head to stop the bleeding. ✓

(Any 2 x 1) (2)

2.2 **Surface grinder: (Already switched on**)

- Never leave the grinder unattended. ✓
- Switch off the machine when leaving. ✓
- Don't try to stop revolving emery wheel with your hand. ✓
- Don't adjust the machine while working. ✓
- Don't open any guard while the machine is on. ✓
- Do not force the grinding wheel on to the work piece. ✓
- Approach the work piece slowly and evenly. ✓
- Don't clean the machine while working. ✓
- Do not put hands near the work piece when grinder is in motion. ✓
- Don't clean or adjust the machine while working.✓
- Check for oil on the floor <u>while working</u> (spilling of cutting fluid on floor while working) ✓
- Check that he grinding wheel is running evenly. ✓

(Any 2 x 1) (2)

2.3 **Gauges calibrated:**

- To ensure accurate readings. ✓
- To prevent overloading. ✓

(Any 1 x 1) (1)

2.4 **Finger protectors' hazards on power driven guillotines:**

- The finger protector prevents the hazards of getting the fingers cut by the blades. ✓
- To be crushed by the hold-downs. ✓ (2)

2.5 **Welding or flame cutting operation safety:**

- An operator has been instructed on how to use the equipment safely. ✓
- A workplace is effectively partitioned off. ✓
- An operator uses protective equipment. ✓
- Ensure that all equipment is in safe working condition. ✓
- Ensure that here are no flammable materials around the welding area. ✓
- Weld area must be well ventilated. ✓
- Fire extinguisher must be in close proximity. ✓

(Any 2 x 1) (2)

2.6 **Workshop layout:**

Product layout. ✓ (1)

[10]

QUESTION 3: MATERIALS (GENERIC)

3.1 **File test:**

3.1.1 Difficult ✓ (1)

3.1.2 Easy ✓ (1)

3.1.3 Difficult ✓ (1)

3.2 **Heat treatment:**

A. – Grain growth. ✓
B. – Recrystallisation. ✓
C. – Recovery. ✓ (3)

3.3 **Bending test:**

- Bend the test piece through a specific angle or around a mandrel or bar, ✓ having a defined radius, ✓ until a rupture in the metal occurs.✓
- Place the material in a vice and bend it ✓ then observe ✓ the ductility of the material. ✓

(Any 1 x 3) (3)

3.4 **Purpose of case hardening:**

Creates a hard surface ✓ with a tough core. ✓ (2)

3.5 **Quenching media:**

- Water ✓
- Brine (saltwater) ✓
- Oil ✓
- Soluble oil and water ✓
- Nitrogen air-infused air ✓

(Any 3 x 1) (3)
[14]

QUESTION 4: MULTIPLE-CHOICE QUESTIONS (SPECIFIC)

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

[14]

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

5.1 **Advantages of compound slide method:**

- Tapers with large angles can be cut. ✓
- External and internal tapers can be cut. ✓
- The set-up is simple. ✓

(Any 2 x 1) (2)

5.2 **Taper cutting:**

5.2.1 **Length of taper:**

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

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

$$2\ell = \frac{92-50}{\tan 4°} \quad ✓$$

$$2\ell = \frac{42}{0{,}069926811} \quad ✓$$

$$\ell = \frac{600{,}6279909}{2} \quad ✓$$

$$= 300{,}31 \text{ mm} \quad ✓$$

(5)

5.2.2 **Tailstock set-over:**

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

$$= \frac{425{,}31(92-50)}{2\times 300{,}31} \quad ✓ \quad ✓$$

$$= 29{,}74 \text{ mm} \quad ✓$$

(3)

5.3 **Key ways:**

5.3.1 **Width:**

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

$$\text{Width} = \frac{75}{4} \checkmark$$

$$= 18{,}75\,\text{mm} \checkmark$$

(2)

5.3.2 **Thickness:**

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

$$\text{Thickness} = \frac{75}{6} \checkmark$$

$$= 12{,}50\,\text{mm} \checkmark$$

(2)

5.3.3 **Length:**

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

$$= 1{,}5 \times 75 \checkmark$$

$$= 112{,}50\,\text{mm} \checkmark$$

(2)

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

- Vibration in the arbor is unavoidable. ✓
- A fine feed must be used. ✓
- When milling material with hard scale, the cutter teeth come directly in contact with the scale, which can damage the cutter. ✓
- The process is time consuming. ✓

(Any 2 x 1) (2)

[18]

QUESTION 6: TERMINOLOGY (INDEXING) (SPECIFIC)

6.1 **Gear terminology:**

6.1.1 **Pitch-circle diameter:**

$$PCD = m \times T$$
$$= 1,5 \times 200 \ \checkmark$$
$$= 300\,mm \checkmark$$

OR

$$CP = m \times \pi$$
$$= 1,5 \times \pi$$
$$= 4,71mm \ \checkmark$$
$$PCD = \frac{CP \times T}{\pi}$$
$$= \frac{4,71 \times 200}{\pi}$$
$$= 299,85mm \ \checkmark$$

(2)

6.1.2 **Dedendum:**

$$Dedendum = 1,157 \times m$$
$$= 1,157 \times 1,5 \ \checkmark$$
$$= 1,74\,mm \ \checkmark$$

OR

$$Dedendum = 1,25 \times m$$
$$= 1,25 \times 1,5 \checkmark$$
$$= 1,88\,mm \ \checkmark$$

(2)

6.1.3 **Outside diameter:**

$$OD = PCD + 2 \times m$$
$$= 300 + 2(1,5) \ \checkmark$$
$$= 303\,mm \ \checkmark$$

OR

$$OD = m(T + 2)$$
$$= 1,5(200 + 2) \checkmark$$
$$= 303\,mm \checkmark$$

(2)

6.1.4 **Working depth:**

$$WD = 2 \times m$$
$$= 2 \times 1,5 \ \checkmark$$
$$= 3\,mm \ \checkmark$$

OR

$$WD = 2 \times a$$
$$= 2 \times 1,5 \ \checkmark$$
$$= 3\,mm \ \checkmark$$

(2)

6.2 **Dovetails:**

W = 210 + 2(DE)
m = W – 2(AC) – 2(R)

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

Calculate DE or y:

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

$$DE = \tan\theta \times AD \quad ✓$$

$$= \tan 30° \times 45 \quad ✓$$

$$= 25{,}98\,mm \quad ✓$$

$$W = 210 + 2(DE) \quad ✓$$
$$= 210 + 2(25{,}98) \quad ✓$$
$$= 210 + 51{,}96$$
$$= 261{,}96\,mm \quad ✓$$

(6)

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

Calculate AC or x:

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

$$AC = \frac{BC}{Tan\theta} \quad ✓$$

$$AC = \frac{17}{Tan30°} \quad ✓$$

$$= 29{,}44\,mm \quad ✓$$

$$m = W - 2(AC) - 2(R) \quad ✓$$
$$= 261{,}96 - 2(29{,}44) - 2(17) \quad ✓$$
$$= 261{,}96 - 58{,}88 - 34$$
$$= 169{,}08\,mm \quad ✓$$

(6)

6.3 **Milling of spur gear:**

6.3.1 **Indexing:**

$$\text{Indexing} = \frac{40}{N} = \frac{40}{137}$$

$$= \frac{40}{A} = \frac{40}{140} \quad ✓$$

$$= \frac{4}{14} \times \frac{2}{2}$$

$$= \frac{8}{28} \quad ✓$$

Indexing: 8 holes on a 28-hole circle ✓

OR

12 holes on a 42-hole circle ✓

OR

14 holes on a 49-hole circle. ✓

(3)

6.3.2 **Change gears: (Markers to note alternative answers and calculations to award full marks if the answer is correct)**

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

$$\frac{Dr}{Dn} = (140 - 137) \times \frac{40}{140} \quad ✓$$

$$= 3 \times \frac{40}{140}$$

$$= \frac{120}{140} \quad ✓$$

$$= \frac{12}{14}$$

$$= \frac{12}{14} \times \frac{2}{2} \quad ✓$$

$$\frac{Dr}{Dn} = \frac{24}{28} \; ✓ \; ✓ \quad \textbf{OR} \quad \frac{48}{56} \; ✓ \; ✓$$

(5)

[28]

QUESTION 7: TOOLS AND EQUIPMENT (SPECIFIC)

7.1 **Functions of a moment and force tester:**

- To determine the reaction on either side of a simple loaded beam. ✓
- To illustrate the concept of the triangle of force. ✓ (2)

7.2 **TWO hardness testers:**

- Brinell ✓
- Rockwell ✓
- Vickers ✓

(Any 2 x 1) (2)

7.3 **Precision measuring instrument:**

- Depth micrometer ✓
- Vernier caliper ✓

(Any 1 x 1) (1)

7.4 **Identify tester:**

Tensile tester ✓ (1)

7.5 **There are THREE ways that hardness is measured:**

- Resistance to penetration. ✓
- Elastic hardness. ✓
- Resistance to abrasion / scratching / file test.
- Sound test (dropping it on the floor and listen to the sound).✓

(Any 3 x 1) (3)

7.6 **Screw thread height:**

$$H = 0{,}866 \times P$$
$$= 0{,}866 \times 2 \ \checkmark$$
$$= 1{,}73\,mm \ \checkmark$$

(2)

7.7 **Measuring instrument:**

Vernier caliper ✓ (1)

7.8 **Interchangeable extension:**

To measure depths greater than 25 mm. ✓ (1)

[13]

QUESTION 8: FORCES (SPECIFIC)

8.1 **Calculate resultant:**

VERTICAL COMPONENT:

$$\sum VC = -45\sin 90° - 70\sin 30° + 185\sin 45°$$

$$\sum VC = -45 - 35 + 130{,}82 \quad (\checkmark\ \checkmark\ \checkmark)$$

$$\sum VC = 50{,}82\text{N} \quad \checkmark$$

HORIZONTAL COMPONENT:

$$\sum HC = 120\cos 0° - 70\cos 30° - 185\cos 45°$$

$$\sum HC = 120 - 60{,}62 - 130{,}82 \quad (\checkmark\ \checkmark\ \checkmark)$$

$$\sum HC = -71{,}44\text{N} \quad \checkmark$$

OR

VC/y = Fsinθ		**HC/x = Fcosθ**	
-45sin90° **OR** 45sin270°	-45 N ✓	120cos0°	120 N ✓
-70sin30° **OR** 70sin210°	-35 N ✓	-70cos30° **OR** 70cos210°	-60,62 N ✓
185sin45° **OR** 185sin135°	130,82 N ✓	-185cos45° **OR** 185cos135°	-130,82 N ✓
Y =	**50,82 N ✓**	**X =**	**-71,44 N ✓**

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

$$\sqrt{R^2} = \sqrt{(50{,}82)^2 + (-71{,}44)^2} \quad \checkmark$$

$$\sqrt{R^2} = \sqrt{7686{,}37}$$

$$R = 87{,}67\text{ N} \quad \checkmark$$

$$R = 87{,}67\text{N}\ \ 35{,}43°\ \text{N of W} \quad \checkmark$$

OR

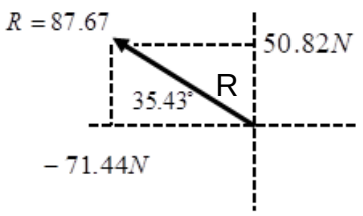
$$R = 87{,}67\text{N}\ \ 54{,}57°\ \text{W of N} \quad \checkmark$$

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

$$\theta = \tan^{-1}\left(\frac{50{,}82}{71{,}44}\right) \quad \checkmark$$

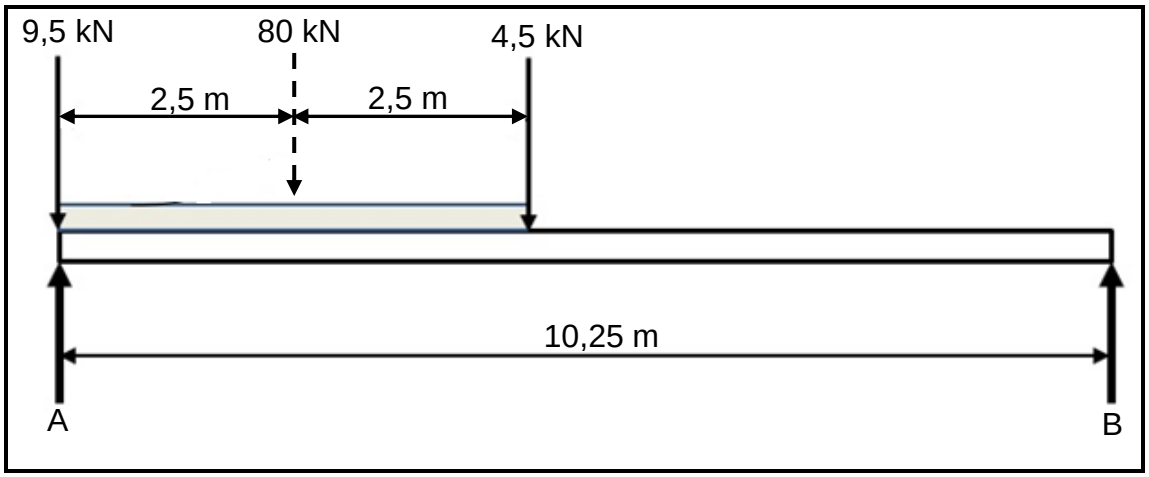
$$\theta = \tan^{-1}(0{,}711)$$

$$\theta = 35{,}43° \quad \checkmark$$



(15)

8.2 **Moments:**



8.2.1 **Point load for UDL:**

$16\text{kN/m} \times 5\text{m}$ ✓

80kN ✓

(2)

8.2.2 **Take moments about B:**

$$A \times 10{,}25) = (4{,}5 \times 5{,}25) + (80 \times 7{,}75) + (9{,}5 \times 10{,}25) \quad ✓$$

$$10{,}25A = 23{,}625 + 620 + 97{,}375$$

$$A = \frac{741}{10{,}25} \quad ✓$$

$$A = 72{,}29\,\text{kN} \quad ✓$$

(3)

8.2.3 **Take moments about A:**

$$B \times 10{,}25) = (9{,}5 \times 0) + (80 \times 2{,}5) + (4{,}5 \times 5) \quad ✓$$

$$10{,}25B = 0 + 200 + 22{,}5$$

$$B = \frac{222{,}5}{10{,}25} \quad ✓$$

$$B = 21{,}71\,\text{kN} \quad ✓$$

(3)

8.3.1 **The stress in the material in MPa:**

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

$$\sigma = \frac{90 \times 10^3}{6{,}17 \times 10^{-3}} \checkmark$$

$$\sigma = 14586709{,}89 \text{ Pa}$$

$$\sigma = 14{,}59 \text{ MPa} \checkmark$$

(2)

8.3.2 **The diameter of the mild steel shaft:**

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

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

$$\frac{\pi d^2}{4} = \frac{90 \times 10^3}{14{,}59 \times 10^6} \checkmark$$

$$\pi d^2 = \frac{90 \times 10^3 \times 4}{14{,}59 \times 10^6}$$

$$\pi d^2 = 0{,}0247$$

$$\sqrt{d^2} = \sqrt{\frac{0{,}0247}{\pi}}$$

$$d = \sqrt{7{,}85 \times 10^{-3}} \checkmark$$

$$d = 0{,}08863 \text{ m} \checkmark$$

$$d = 88{,}63 \text{ mm} \checkmark$$

OR

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

$$A \times 4 = \pi d^2$$

$$d^2 = \frac{A \times 4}{\pi} \checkmark$$

$$d = \sqrt{\frac{A \times 4}{\pi}}$$

$$d = \sqrt{\frac{\left(6{,}17 \times 10^{-3}\right) \times 4}{\pi}} \checkmark$$

$$d = \sqrt{0{,}007855887} \checkmark$$

$$d = 0{,}088633441 \text{ m} \checkmark$$

$$d = 88{,}63 \text{ mm} \checkmark$$

(5)

8.3.3 **Original length:**

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

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

$$OL = \frac{0,012}{1,64 \times 10^{-3}} \checkmark$$

$$OL = 7,32 \text{ mm} \checkmark$$

(3)
[33]

QUESTION 9: MAINTENANCE (SPECIFIC)

9.1 **Preventative maintenance:**

- Planned or scheduled maintenance. ✓
- Condition-based maintenance. ✓ (2)

9.2 **Preventative maintenance of gear drive systems:**

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

(Any 3 x 1) (3)

9.3 **Purpose of jockey pulley:**

- The jockey pulley helps setting the tension on the system. ✓
- To increase the angle of contact in an open belt drive. ✓

(Any 1 x 1) (1)

9.4 **Properties of materials:**

9.4.1 **Teflon:**

- Water resistant. ✓
- Resistant to grease. ✓
- Resistant to heat. ✓
- Resistant to corrosion. ✓
- Can withstand high temperatures. ✓
- Need no lubricants. ✓
- Electrical insulator ✓
- Thermoplastic /Easy to be reshaped / recycled.✓

(Any 2 x 1) (2)

9.4.2 **Nylon:**

- Tough. ✓
- Hard-wearing. ✓
- Cheap. ✓
- Needs no or little maintenance. ✓
- Can withstand high temperatures. ✓
- Need no or little lubricants. ✓
- Is light. ✓
- Can absorb shock. ✓
- Resistant to chemicals. ✓
- Non-toxic. ✓
- Thermoplastic /Easy to be reshaped.✓
- Has high load-bearing strength ✓

(Any 2 x 1) (2)

9.4.3 **Vesconite:**

- Wear resistant. ✓
- Low friction. ✓
- Operate with little or no lubrication. ✓
- Easy to machine. ✓
- Load carry higher than white metal. ✓
- Cost effective material. ✓
- Gives long life span. ✓
- Performs well, in unhygienic, dirty and un-lubricated environments. ✓
- Low maintenance. ✓
- Low or no water absorption ✓
- High chemical resistance ✓
- Versatile ✓
- Can handle high temperatures ✓
- Thermoplastic /Easy to be reshaped ✓

(Any 2 x 1) (2)

9.5 **Use of material:**

9.5.1 **Polyvinyl chloride (PVC): (*Due to the large number of alternatives, marker discretion must be used - discuss with IM*).**

- Electrical cable isolation.✓
- Electrical pipes. ✓
- Water pipes. ✓
- Artificial leather. ✓
- Cling wrap. ✓
- Credit / bank / phone cards.✓
- Window frames. ✓
- Fences. ✓
- Furniture. ✓

(Any 1 x 1) (1)

9.5.2 **Glass fibre: (*Due to the large number of alternatives, marker discretion must be used - discuss with IM).***

- Boats.✓
- Motor vehicles bodies. ✓
- Transparent roof sheeting. ✓
- Petrol tanks. ✓
- Swimming pools. ✓
- Furniture. ✓
- Fruit and salad bowls. ✓
- Ornaments. ✓
- Fishing equipment. ✓

(Any 1 x 1) (1)

9.6 **Difference between thermoplastic and thermo-hardened composites:**
Thermoplastic can be re-heated ✓ and reshaped again ✓ where a thermo-hardened plastic cannot be re-heated, ✓ to be softened, shaped ✓ and moulded again.

(4)
[18]

QUESTION 10: JOINING METHODS (SPECIFIC)

10.1 **Screw thread:**

- Square thread ✓
- Acme thread ✓
- V-screw thread ✓
- Trapezium thread / Buttress thread ✓

(Any 3 x 1) (3)

10.2 **Square Thread:**

10.2.1 **Pitch diameter:**

$$\text{Pitch} = \frac{\text{Lead}}{\text{Numberof starts}}$$
$$= \frac{36}{2} \quad ✓$$
$$= 18\,\text{mm} \quad ✓$$

$$\text{PD} = \text{OD} - \frac{\text{P}}{2}$$
$$= 80 - \frac{18}{2} \quad ✓$$
$$= 71\,\text{mm} \quad ✓$$

(4)

10.2.2 **Helix angle of the thread:**

$$\text{Tan}\theta = \frac{\text{Lead}}{\pi \times \text{PD}}$$
$$\text{Tan}\theta = \frac{36}{\pi \times 71} \quad ✓ \quad ✓$$
$$\theta = \tan^{-1}(0{,}16139656) \quad ✓$$
$$= 9{,}17° \quad ✓$$

(4)

10.2.3 **Leading angle:**

Leading angle = 90° - (helix angle + clearance angle)
= 90° - (9,17° + 3°) ✓
= 77,83° ✓

(2)

10.2.4 **Following angle:**

Following angle = 90° + (helix angle - clearance)
= 90° + (9,17° - 3°) ✓
= 96,17° ✓

(2)

10.3 **Multiple screw threads:**

- They provide more bearing surface than single start screw thread / does 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. ✓ (3)

[18]

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

11.1 Hydraulics:

11.1.1 The fluid pressure:

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

$$P = \frac{25 \times 10^3}{9{,}62 \times 10^{-4}} \checkmark$$

$$P = 25984480{,}5 \text{ Pa}$$

$$P = 25{,}98 \text{ MPa} \checkmark$$

$$A\ (\text{Plunger}) = \frac{\pi d^2}{4}$$

$$A = \frac{\pi (0{,}035)^2}{4} \checkmark$$

$$A = 9{,}62 \times 10^{-4} \text{ m}^2 \checkmark$$

(4)

11.1.2 Force at ram:

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

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

$$F = \frac{(25 \times 10^3) \times (11{,}31 \times 10^{-3})}{9{,}62 \times 10^{-4}} \checkmark$$

$$F = 293918{,}92 \text{ N} \checkmark$$

OR

$$F = 293{,}92 \text{ kN} \checkmark$$

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

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

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

OR

$$\frac{F}{D^2} = \frac{f}{d^2}$$

$$\frac{F}{120^2} = \frac{25}{35^2} \checkmark$$

$$F = \frac{25 \times 120^2}{35^2} \checkmark \checkmark \checkmark$$

$$F = 293{,}88 \text{kN} \checkmark$$

(5)

11.2 **Functions 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.
- Permits contaminants to settle at the bottom in order to be drained. ✓

(Any 1 x 1) (1)

11.3 **Efficiency of pneumatic systems:**

- Pneumatic tools are environmentally friendly. ✓
- Last long. ✓
- It is robust (powerful / less force required) ✓
- Easy to use. ✓
- It is compact. ✓
- Easy to maintain as there are so few working parts. ✓

(Any 2 x 1) (2)

11.4 **Applications for pneumatic systems: (Due to the large number of alternatives, marker discretion must be used - discuss with IM).**

- Drills. ✓
- Brake systems. ✓
- Jackhammers ✓
- Nail guns ✓
- Missiles ✓
- Doors ✓
- Spray guns ✓
- Air blow guns ✓
- Air socket wrench ✓
- Grinders ✓

(Any 2 x 1) (2)

11.5 **Belt drives:**

11.5.1 **Rotation frequency:**

$$N_1 \times D_1 = N_2 \times D_2 \quad \checkmark$$

$$N_2 = \frac{N_1 \times D_1}{D_2} \quad \checkmark$$

$$N_2 = \frac{7{,}2 \times 0{,}6}{0{,}8}$$

$$N_2 = 5{,}4 \text{ r/sec} \quad \checkmark$$

(3)

11.5.2 **Power transmitted:**

$$\text{Ratio} = \frac{T_1}{T_2} \qquad P = \frac{(T_1 - T_2)\pi DN}{60}$$

$$T_2 = \frac{T_1}{\text{Ratio}} \checkmark \qquad P = (300 - 120)\pi \times 0{,}8 \times 5{,}4 \checkmark$$

$$T_2 = \frac{300}{2{,}5} \qquad P = 2442{,}90 \text{ Watt}$$

$$T_2 = 120 \text{ N} \checkmark \qquad P = 2{,}44 \text{ kW} \checkmark$$ (4)

11.6 **Gear drives:**

11.6.1 **Rotation frequency:**

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

$$N_{(D)OUTPUT} = \frac{T_A \times T_C \times N_A}{T_B \times T_D} \checkmark$$

$$N_{(D)OUTPUT} = \frac{30 \times 20 \times 2300}{40 \times 60} \checkmark \checkmark$$

$$N_{(D)OUTPUT} = 575 \text{ r/min} \checkmark$$ (4)

11.6.2 **Gear ratio:**

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

$$\text{Gear ratio} = \frac{40 \times 60}{30 \times 20} \quad \checkmark \checkmark$$

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

OR

$$\text{Speed ratio} = \frac{N_A}{N_D}$$

$$= \frac{2300}{575} \quad \checkmark \checkmark$$

$$= 4:1 \quad \checkmark$$

(3)
[28]

TOTAL: 200