higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

MECHANOTECHNICS N4

2 April 2020

This marking guideline consists of 8 pages.

QUESTION 1

1.1
- Finding a suitable locality.
- Dividing the locality into various work areas.
- Placing all equipment and services in the relevant areas.
- Comparing possible layout designs before adopting the most effective one. (4)

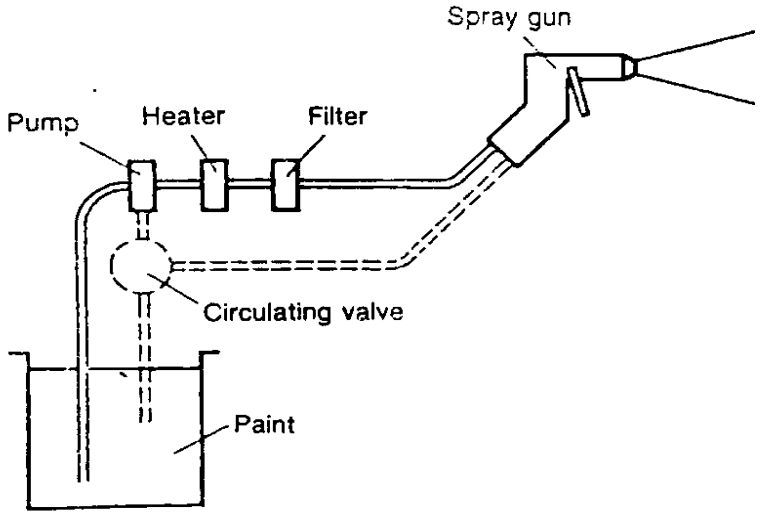
1.2
- Production is not continuous.
- There is extensive handling of workpieces being transported to other sections.
- Costs are higher due to specialised inspection methods.
- More floor space is required for storage of in-process material.
- Control is difficult.
- Careful, detailed scheduling of working activities is required. (6)

1.3
- Gravity feed
- Grease lubrication
- Splash lubrication
- Forced lubrication
- Pressure-feed lubrication (5)

1.4
- They have lower torque resistance.
- They require less resistance.
- They can support both radial and axial loads.
- They require little axial space.
- They are easy to replace.
- They require very little maintenance.
- They can take heavy overloads.
- They give warning, by becoming noisy, when they begin to fail.
- They can maintain high rotational speeds.
- The bearings can be pre-packed and sealed with a lubricant. (Any 5 × 1) (5)

1.5
- There is an excessive use of paint.
- Large quantities of paint are kept in paint dip troughs.
- There is a considerable loss of thinners through evaporation.
- Dip-painting is only for mass production.
- If paint is left overnight in dip troughs, continual, thorough agitation is needed the following day. (5)

1.6



(Any 3 labels, but 'Heater' must be one of them) (3 × 1) (3)
(Drawing) (2)
[30]

QUESTION 2

2.1

$$v = \frac{\pi(D+t)\times n}{60}$$
$$= \frac{\pi(1{,}2+0{,}006)250}{60} \checkmark$$
$$= 15{,}787 m/s \checkmark$$

$$T_1 = \sigma \times w \times t$$
$$T_1 = 900\times10^3 \times 0{,}3 \times 0{,}006 \checkmark$$
$$T_1 = 1620N \checkmark$$

$$\frac{T_1}{T_2} = 3{,}5$$
$$T_2 = \frac{T_1}{3{,}5}$$
$$= \frac{1620}{3{,}5} \checkmark$$
$$T_2 = 462{,}857N \checkmark$$

$$P = (T_1 - T_2)v$$
$$= (1620 - 462{,}857)15{,}787 \checkmark$$
$$P = 18267{,}814W$$
$$P = 18{,}268kW \checkmark$$

(8)

2.2

$$L = \frac{\pi}{2}(D+d) + \frac{(D-d)^2}{4C} + 2C$$
$$= \frac{\pi}{2}(1{,}2+0{,}4) + \frac{(1{,}2-0{,}4)^2}{4\times 1{,}5} + 2\times 1{,}5 \checkmark$$
$$= 2{,}513 + 0{,}107 + 3 \checkmark$$
$$= 5{,}62m \checkmark$$

(3)

2.3

$$L = \frac{\pi}{2}(D+d) + \frac{(D+d)^2}{4C} + 2C$$
$$= \frac{\pi}{2}(1{,}2+0{,}4) + \frac{(1{,}2+0{,}4)^2}{4\times 1{,}5} + 2\times 1{,}5 \checkmark$$
$$= 2{,}513 + 0{,}427 + 3 \checkmark$$
$$= 5{,}94m \checkmark$$

(3)
[14]

QUESTION 3

3.1

$$\mu = \frac{horozontal\ \ force\ F_1}{N_R}$$
$$N_R = magnetic\ \ force\ F_2 + mg$$
$$0{,}25 = \frac{900}{F_2 + (12\times 9{,}81)} \checkmark\checkmark$$
$$0{,}25F_2 + 29{,}43 = 900 \checkmark\checkmark$$
$$F_2 = \frac{870{,}57}{0{,}25} \checkmark$$
$$= 3482{,}28N \checkmark$$

(6)

3.2

$$\mu = \frac{F_f}{load\ \ on\ bearing\ \ F}$$
$$F_f = \mu \times F$$
$$F_f = 0{,}03\times 90\times 10^3 \checkmark\checkmark$$
$$F_f = 2700N \checkmark$$

$$T_f = F_f \times r$$
$$T_f = 2700\times 0{,}25 \checkmark$$
$$= 675N.m \checkmark$$

$$P_f = \frac{2\pi NT_f}{60}$$
$$P_f = \frac{2\times \pi \times 450\times 675}{60} \checkmark\checkmark$$
$$= 31808{,}626W \checkmark$$

OR

$$\mu = \frac{F_f}{load\ \ on\ bearing\ \ F}$$
$$F_f = \mu \times F$$
$$F_f = 0{,}03\times 90\times 10^3 \checkmark\checkmark$$
$$F_f = 2700N \checkmark$$

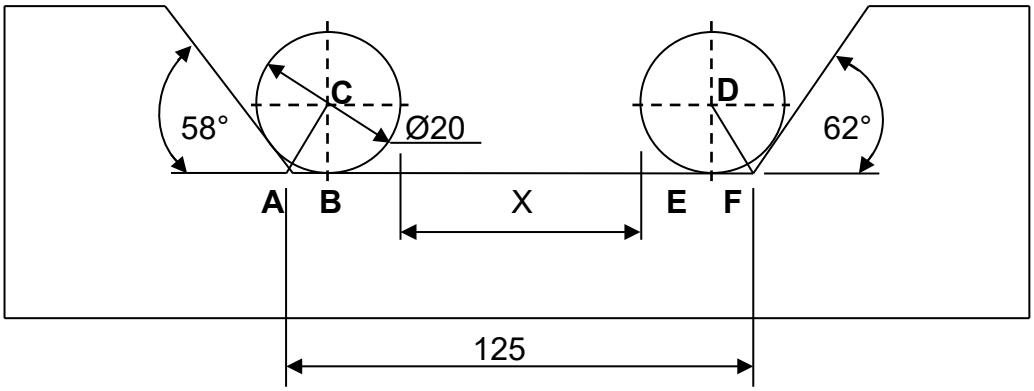
$$v = \frac{\pi DN}{60}$$
$$= \frac{\pi \times 0{,}5\times 450}{60} \checkmark\checkmark$$
$$= 11{,}781m/s \checkmark$$

$$P_f = F_f \times v$$
$$= 2700\times 11{,}781 \checkmark$$
$$= 31808{,}626W \checkmark$$

(8)
[14]

QUESTION 4

4.1



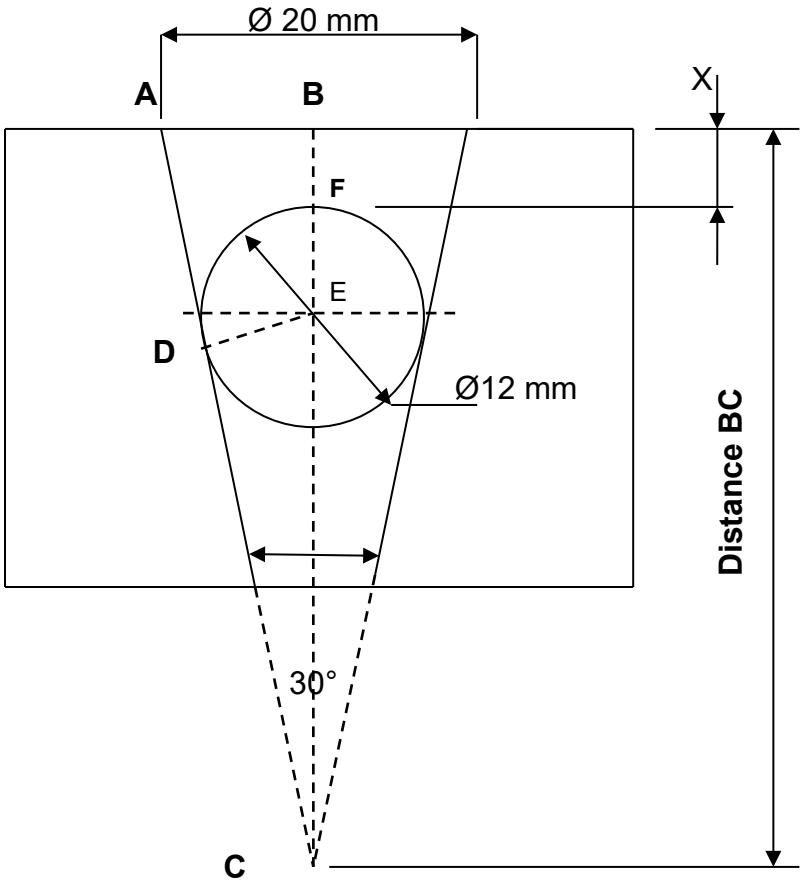
$$X = 125 - 2r - AB - EF$$
$$r = 12{,}5$$

$$In\ \Delta ABC\ \tan 61° = \frac{10}{AB}$$
$$AB = \frac{10}{\tan 61°} \checkmark$$
$$AB = 5{,}543mm \checkmark$$

$$In\ \Delta DEF\ \tan 59° = \frac{10}{EF}$$
$$EF = \frac{10}{\tan 59°} \checkmark$$
$$EF = 6{,}009mm \checkmark$$
$$X = 125 - 2r - AB - EF \checkmark$$
$$X = 125 - 2(10) - 5{,}543 - 6{,}009 \checkmark$$
$$X = 93{,}448mm \checkmark$$

(7)

4.2



(Sketch = 1 mark for the right-angled triangle ΔEDC ✓) (1)

$X = BC - CE - EF$

Find BC

In ΔABC

$\tan 15° = \frac{AB}{BC}$

$BC = \frac{10}{\tan 15°}$ ✓

$= 37{,}321mm$ ✓

Find CE

In ΔCDE

$\sin 15° = \frac{DE}{CE}$

$CE = \frac{6}{\sin 15°}$ ✓

$= 23{,}182mm$ ✓

$X = BC - CE - EF$

$X = 37{,}321 - 23{,}182 - 6$ ✓

= 8,139 mm✓ (6)

[14]

QUESTION 5

5.1
$$m = \frac{PCD}{T_B}$$
$$8 = \frac{PCD}{40}$$
$$PCD = 320mm \checkmark$$
$$VR = \frac{3,5}{1}$$
$$\frac{T_A}{T_B} = \frac{3,5}{1}$$
$$\frac{T_A}{40} = \frac{3,5}{1} \checkmark$$
$$T_A = 140 \checkmark$$
$$m = \frac{PCD}{T_A}$$
$$8 = \frac{PCD}{140}$$
$$PCD = 1120mm \checkmark$$ (4)

5.2
$$C = \frac{m}{2}(T_A + T_B)$$
$$= \frac{8}{2}(140 + 40) \checkmark$$
$$= 4 \times 180 \checkmark$$
$$= 720mm \checkmark$$ (3)

5.3
$$D_{OA} = m(T_A + 2)$$
$$= 8(140 + 2) \checkmark$$
$$= 8 \times 142$$
$$= 1136mm \checkmark$$
$$D_{OB} = m(T_B + 2)$$
$$= 8(40 + 2) \checkmark$$
$$= 8 \times 42$$
$$= 336mm \checkmark$$ (4)

5.4
$$addendum = m \checkmark$$
$$addendum = 8$$
$$dedendum = 1,157 \text{ x } m$$
$$= 1,157 \text{ x } 8$$
$$= 9,256 \text{ mm} \checkmark$$
$$total\ depth = addendum + dedendum$$
$$= 8 + 9,256$$
$$= 17,256 \text{ mm} \checkmark$$ (3)

[14]

QUESTION 6

$$Q_1 = v_1 x A_1$$

$$v_1 = \frac{Q_1}{A_1}$$

$$v_1 = \frac{0,09}{\pi / 4(0,1)^2} \checkmark$$

$$v_1 = 11,46 m/s \checkmark$$

$$Q_2 = v_2 x A_2$$

$$v_2 = \frac{Q_2}{A_2}$$

$$v_2 = \frac{0,09}{\pi / 4(0,18)^2} \checkmark\checkmark$$

$$v_2 = 3,54 m/s \checkmark$$

$$\frac{P_1}{\rho g} + \frac{v_1^2}{2g} + h_1 = \frac{P_2}{\rho g} + \frac{v_2^2}{2g} + h_2$$

$$\frac{230000}{10^3 x 9,81} + \frac{(11,46)^2}{2x9,81} + 0 = \frac{P_2}{10^3 x 9,81} + \frac{(3,54)^2}{2x9,81} + 15 \checkmark\checkmark$$

$$23,445 + 6,693 = \frac{P_2}{9810} + 0,64 + 15 \checkmark\checkmark$$

$$\frac{P_2}{9810} = 30,138 - 15,64 \checkmark\checkmark$$

$$\frac{P_2}{9810} = 14,501 \checkmark$$

$$P_2 = 142251,008 Pa$$

$$P_2 = 142,251 kPa \checkmark$$

[14]

TOTAL: 100