higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

MECHANOTECHNICS N4

30 JULY 2019

This marking guideline consists of 8 pages.

NOTE: √ = ½ mark
✓ = 1 mark

QUESTION 1

1.1 Workshop layout is the arrangement, storage and planning of different elements of a workshop. (3)

1.2
- Storage facilities
- Supply of services
- Transport routes and aisles
- Handling of workpieces
- Carrying capacity of the floor
- Space around and above each machine (Any 5 × 1) (5)

1.3 Excessive paint spray (1)
- The viscosity of the paint is too low.
- The atomising air pressure is too high.
- The distance between the spray gun and the workpiece is too great.

(Any TWO) (2)

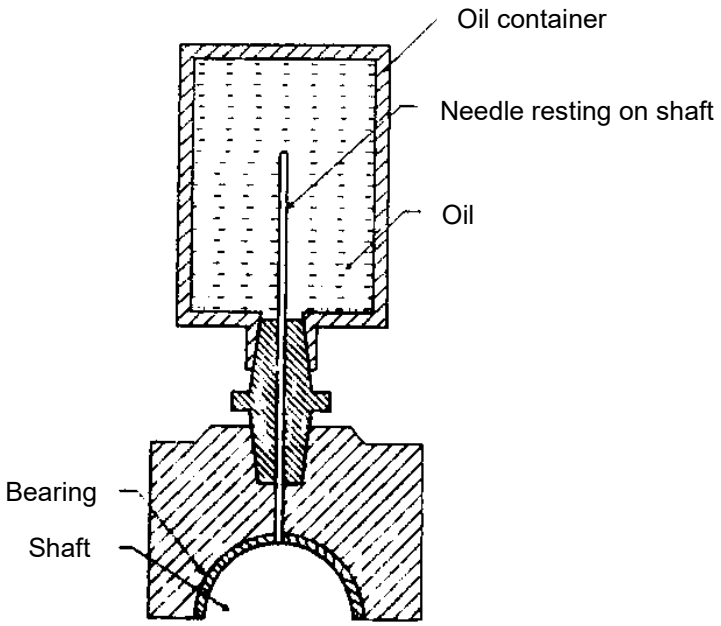
Uneven spray-painting (1)
- There is insufficient air pressure.
- The spray nozzle is no longer effective because of obstructions, damage or a faulty adjustment.
- Blocked pipes reduce the paint supply. (Any TWO) (2)

Sagging surface (1)
- The spray gun moves too slowly.
- Too much paint is applied to the surface.
- The spray gun is held too close to the surface.
- The paint is too thin. (Any TWO) (2)

Speckle or orange-peel effect (1)
- Wrong thinners or solvents are used.
- Paint is not mixed properly before use.
- Surface is prepared incorrectly.
- The air pressure is wrong. (Any TWO) (2)

1.4
- Minimal frictional resistance
- Strength
- Resistance to wear
- Thermal conductivity
- Resistance to corrosion (5)

1.5



(5)
[30]

QUESTION 2

2.1
$$v = \frac{\pi(D+t)N}{60}$$
$$= \frac{\pi(0,6+0,02)\times 600}{60} \checkmark$$
$$= 19,478\ m/s \checkmark$$
$$T_C = mv^2$$
$$= 0,5(19,478)^2$$
$$= 189,696\ N \checkmark$$
(3)

2.2
$$T_1 = \sigma.w.t$$
$$= 4\times 10^6 \times 0,155 \times 0,02 \checkmark$$
$$= 12\ 400N \checkmark$$
(2)

2.3
$$\frac{T_1 - T_C}{T_2 - T_C} = e^{\mu\theta}$$
$$\frac{12400 - 189,696}{T_2 - 189,696} = e^{0,2\times 2,792} \checkmark$$
$$\frac{12210,304}{T_2 - 189,696} = 1,747 \checkmark$$
$$12210,304 = 1,747T_2 - 331,398 \checkmark$$
$$T_2 = \frac{12541,702}{1,747} \checkmark$$
$$\therefore T_2 = 7178,994N \checkmark$$
(5)

2.4 $P = (T_1 - T_2)v$
$= (12\,400 - 7178{,}994)19{,}478$ ✓
$= 101694{,}755\ W$ ✓ (2)

2.5 $P_i = \frac{P_o}{\eta}$
$P_i = \frac{101694{,}755}{0{,}8}$ ✓
$= 127118{,}444\ W$ ✓ (2)
[14]

QUESTION 3

3.1 3.1.1 $Cutting\ \ Area = Feed/\mathrm{Re}v \times Cutting\ \ depth$
$= 0{,}5 \times 3{,}5$
$= 1{,}75\ mm^2$ ✓
$F = P \times A$
$= 1\,000 \times 1{,}75$
$= 1\,750N$ ✓
$v = \frac{\pi.D.N}{60}$
$= \frac{\pi \times 0{,}5x30}{60}$
$= 0{,}785\ m/s$ ✓
$P_o = F \times v$
$= 1750 \times 0{,}785$
$= 1374{,}446\ W$ ✓ (4)

3.1.2 $P_i = \frac{P_o}{\eta}$
$P_i = \frac{1374{,}446}{0{,}85}$ ✓✓
$= 1616{,}996\ W$ ✓ (3)

3.2 3.2.1 $\mu = \frac{F_f}{N_R}$
$F_f = \mu \times N_R$
$= 0{,}07 \times 200 \times 9{,}81$ ✓✓
$= 137{,}34N$ ✓ (3)

3.2.2
$$\mu = \frac{F_f}{N_R}$$
$$\mu = \frac{137{,}34 + (137{,}34x0{,}3)}{200 \times 9{,}81} \checkmark\checkmark$$
$$\mu = \frac{178{,}542}{1\,962} \checkmark$$
$$= 0{,}091 \checkmark$$

(4)
[14]

QUESTION 4

4.1 4.1.1
$$C = \frac{m}{2}(T_A - T_B)$$
$$45 = \frac{1{,}5}{2}(T_A + 30) \checkmark$$
$$90 = 1{,}5T_A - 45) \checkmark$$
$$T_A = \frac{135}{1{,}5}$$
$$= 90 \ \ teeth \checkmark$$

4.1.2
$$PCD_A = mxT_A$$
$$= 1{,}5 \times 90 \checkmark\checkmark$$
$$= 135 \ mm \checkmark$$

(2 × 3) (6)

4.2

CONDITION	PINION A	GEAR WHEEL B	ARM C
Fix arm C and rotate gear B by +1 rev	$\frac{80}{-20} = -4\sqrt{}$	$= +1\sqrt{}$	$0\sqrt{}$
Multiply by x and add y	$-4x + y\sqrt{}$	$x + y\sqrt{}$	$+ y\sqrt{}$
$N_A = ?$ $N_B = 0r/\min$ $N_C =$	$N_A = ?\sqrt{}$	$N_B = 0\sqrt{}$	$N_C = +100\sqrt{}$

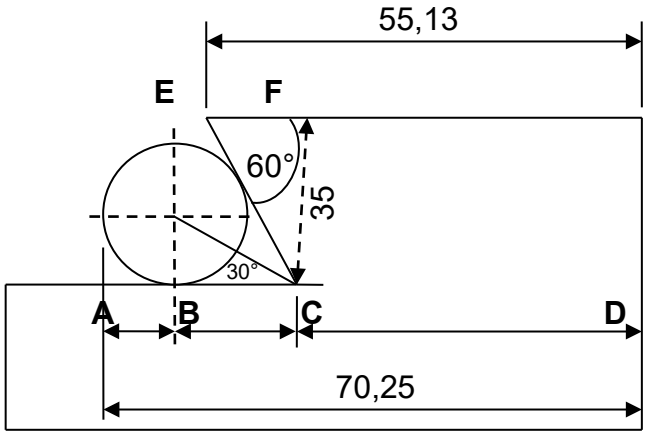
$$x + y = 0.....1$$
$$y = 100.....2$$

Substitute ...2 in 1
$$x = -y\sqrt{}$$
$$x = -100 \checkmark$$
$$N_A = -4x + y$$
$$N_A = -4(-100) + 100 \checkmark$$
$$N_A = +500 \ r/\min \ \ clockwise \checkmark$$

(8)
[14]

QUESTION 5

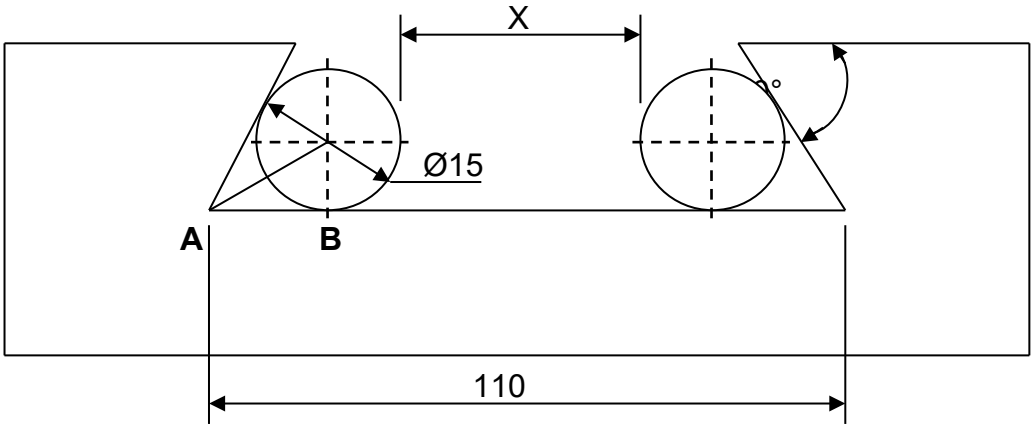
5.1



$$AD = AB + BC + CD$$
$$AB = r$$
$$\tan 30° = \frac{r}{BC}$$
$$0{,}577 = \frac{r}{BC}$$
$$BC = 1{,}732r \checkmark$$
$$CD = 55{,}13 - EF$$
$$\tan 60° = \frac{35}{EF}$$
$$EF = \frac{35}{\tan 60°} \checkmark$$
$$EF = 20{,}207 \checkmark$$
$$CD = 55{,}13 - 20{,}207$$
$$CD = 34{,}923 \checkmark$$
$$AD = AB + BC + CD$$
$$70{,}25 = r + 1{,}732 + 34{,}923$$
$$35{,}327 = 2{,}732r \checkmark$$
$$r = \frac{35{,}327}{2{,}732}$$
$$r = 12{,}931 \checkmark$$
$$D = 25{,}862\ mm \checkmark$$

(7)

5.2



$$X = 110 - 2AB - 2r \checkmark$$
$$r = 7{,}5 \checkmark$$
$$\tan 20° = \frac{7{,}5}{AB}$$
$$AB = \frac{7{,}5}{\tan 20°} \checkmark$$
$$AB = 20{,}606 \checkmark$$
$$X = 110 - 2AB - 2r$$
$$X = 110 - 2 \times 20{,}606 - 2 \times 7{,}5 \checkmark$$
$$X = 110 - 56{,}212 \checkmark$$
$$X = 53{,}788\ mm \checkmark$$

(7)
[14]

QUESTION 6

6.1
$$v_t = \sqrt{2gh}$$
$$= \sqrt{2 \times 9{,}81 \times 35{,}5}$$
$$= 26{,}391\ m/s \checkmark$$

$$Q_t = v_t \times A_t$$
$$= 26{,}391 \times \frac{\pi(0{,}032)^2}{4} \checkmark$$
$$= 0{,}0212\ m^3/s \checkmark$$
$$C_d = \frac{Q_a}{Q_t}$$
$$= \frac{0{,}0128}{0{,}0212}$$
$$= 0{,}605 \checkmark$$

(4)

6.2

$$C_c = \frac{A_a}{A_t}$$
$$= \frac{(0,027)^2}{(0,032)^2} \checkmark\checkmark$$
$$= 0,712 \checkmark$$

(3)

6.3

$$v_a = \frac{Q_a}{A_t}$$
$$= \frac{0,0128}{5,725 \times 10^{-4}} \checkmark$$
$$= 22,358\ m/s \checkmark$$
$$C_v = \frac{v_a}{v_t}$$
$$= \frac{22,358}{26,391} \checkmark$$
$$= 0,847 \checkmark$$

(4)

6.4

$$h_2 = \frac{(v_2)^2}{2g}$$
$$= \frac{22,358^2}{2 \times 9,81} \checkmark$$
$$= 25,478\ m \checkmark$$
$$Head\ loss = h_1 - h_2$$
$$= 35,5 - 25,478$$
$$= 10,022\ m \checkmark$$

(3)
[14]

TOTAL: 100