higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

MACHINES AND PROPERTIES OF METALS N4

28 November 2022

This marking guideline consists of 9 pages.

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QUESTION 1: POWER TRANSMISSION BELT DRIVES & ROPE DRIVES

1.1 Given data:

Driving pulley speed	900 r/min
Driving pulley diameter	235 mm
Tight side tension of belt	390 N
Ratio between tight and slack side	3

$T_1 = 400\text{N}$

$\frac{T_1}{T_2} = 3$

$T_2 = \frac{T_1}{3}$

$T_2 = \frac{390}{3}$

$= 130\text{ N}$

$V = \frac{\pi \times D \times N}{60}$

$V = \frac{\pi \times 0{,}235\text{m} \times 900\text{r/min}}{60}$

$V = 11{,}07\text{m/s}$

$\text{Power} = (T_1 - T_2) \times V$

$= (400\text{N} - 130\text{N}) \times 11{,}07\text{ m/s}$

$= 270\text{N} \times 11{,}07\frac{\text{m}}{\text{s}}$

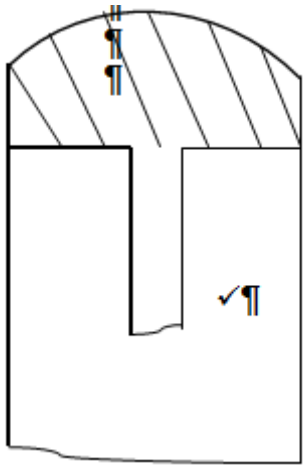
$= 2\,990\frac{\text{Nm}}{\text{s}}$

$= 2\,990\text{ Watts}$

$= 2{,}99\text{ kW}$ (5)

1.2
- Open belt drive
- Cross belt drive (2)

1.3 Rounding or crowning is done to keep the belts on the pulleys.✓ The belt takes the shape of the crowned rim and therefore cannot slip off easily.✓



(3)

1.4
- Cotton rope
- Wire rope

(2)

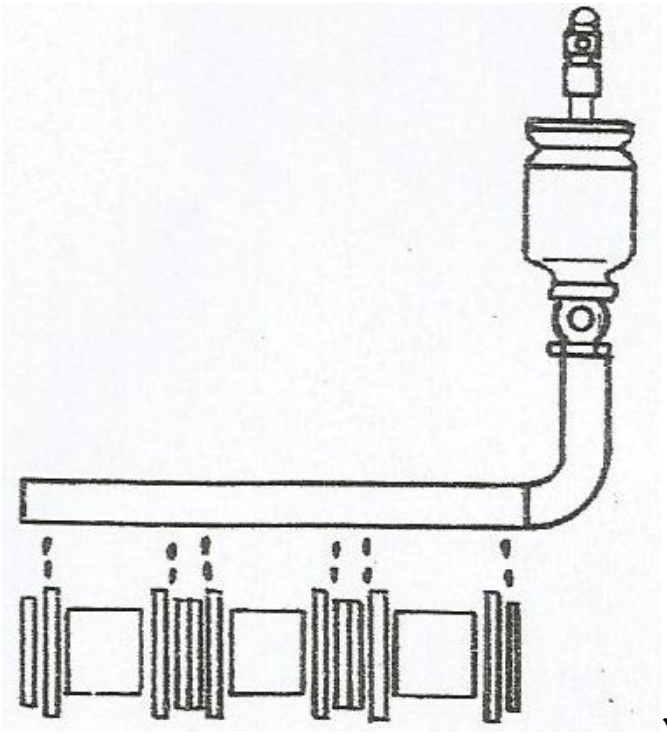
ADVANTAGES	DISADVANTAGES
• Cheaper than flat or V-belts • Less slippage occurs than in belt drive • Power can be transmitted over long distances	• No positive speed ratio • Slip still occurs

(Any 2 × 2) (4)
[16]

QUESTION 2: ROLLER CHAIN DRIVES

2.1
- It separates the pins and bushings to reduce friction.
- It provides a cushioning effect between pins and bushings, chains and sprockets.
- It cools and cleans the chain. (Any 2 × 1) (2)

2.2
- Drip-feed lubrication is used for speeds of up to 100 metres per minute.
- A drip lubricator is required to direct 4 to 10 drops per minute between the link plates of each chain strand.
- Depending on the operating conditions, this method may also be employed periodically.



✓ (4)
[6]

QUESTION 3: POWER TRANSMISSION GEAR DRIVES

3.1
- A very large speed ratio is obtained between the first and last gear wheels.
- A large number of engagements are available. (2)

3.2 A rack and pinion may be used when it is necessary to convert rotary motion to straight-line motion✓ which is desirable for table feed of milling and plaining machines.✓ (2)

3.3
- Whole depth is the total depth of the tooth.
- Whole depth = addendum + dedendum. (2)

[6]

QUESTION 4: POWER TRANSMISSION COUPLINGS AND CLUTCHES

4.1
- Grease or oil on contact surfaces
- Faulty adjustment of links and levers
- Glazing of the frictional surfaces
- Insufficient end thrust (Any 2 × 1) (2)

4.2
- Body slippers
- Body
- Clutch shell (3)

4.3
- Difficult to roll into long lengths
- Difficult to keep it straight
- Difficult to handle weight
- Difficult to transport long lengths (Any 3 × 1) (3)

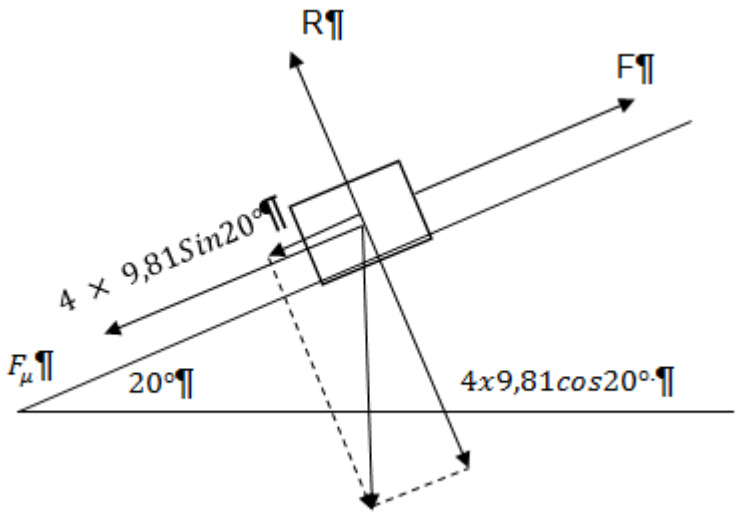
[8]

QUESTION 5: FRICTION

5.1
- Holding workpieces in a vice
- Clamping work on a machine table
- Brakes
- Belts and pulleys
- Clutches (Any 2 × 1) (2)

5.2
$$\text{Coefficient of static friction} = \frac{\text{Frictional force}}{\text{Perpendicular force}}\checkmark$$
$$= \frac{F}{mg}$$
$$= \frac{7N}{5kg \times 9{,}81\ m/sec}\checkmark$$
$$= 0{,}14$$ (2)

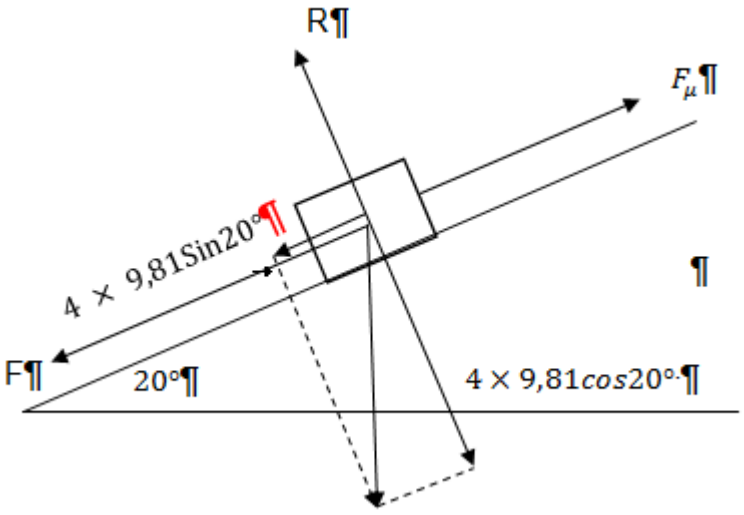
5.3 5.3.1 GIVEN:



4 × 9,81 N

$F = F_\mu + mg \sin\theta$ ✓ ✓
$F = 20N + 4 \times 9{,}81 \sin 20°$ ✓
$= 33{,}42\ N$ ✓

5.3.2 GIVEN:



4 × 9,81 N

$F = F_\mu + mg \sin\theta$ ✓ ✓
$F = 20N - 4 \times 9{,}81 \sin 20°$ ✓
$= 6{,}42\ N$ ✓

(2 × 4) (8)
[12]

QUESTION 6: SAFETY PRECAUTIONS/DEVICES

6.1 6.1.1 No person working in close proximity to moving or rotating machinery shall wear✓ or be allowed to wear loosely✓ fitting clothing, jewellery, ornaments, watch or key chains or straps.✓

6.1.2 Sufficient clear and unobstructed space be provided and maintained at every machine✓ to enable work to be done without danger to persons.✓ A minimum of 2,25 square meters of clear floor space must be allowed for each person working in the room.✓

(2 × 3) (6)

6.2
- Welding equipment can be dangerous and should be handled with care.
- The equipment must be in good condition and must not be used on a wet floor.
- A face shield should be worn to protect the operator's eyes against flashes.
- Precautions should also be taken to protect other people from being injured by welding flashes.
- Gloves should always be worn during the welding process. (Any 4 × 1) (4)

6.3
- The user shall cause every shaft, pulley, wheel, gear, coupling, collar, clutch, friction drum and the like to be securely fenced or guarded✓ unless it is in such a position and of such construction as to be as safe to every person as it would be if securely fenced or guarded.✓
- Set screw, key or bolt on every revolving shaft, coupling, collar, friction drum, clutch, wheel, pulley, gear and the like to be countersunk, enclosed or otherwise guarded to prevent danger✓ unless it is so situated to be as safe as it would be if completely encased, unless it is not possible to guard such moving parts or machinery by virtue of the nature of the operation thereof.✓
- No user shall require or permit a pulley to be used which is in any way damaged.✓ (Any 3 × 1) (3)

6.4
- No employer shall allow anybody to work at night unless there is enough lighting (artificial) provided for such work to be carried out.
- The employer shall ensure that no employee shall work in a factory where that factory was constructed after current regulations were brought into effect, that has natural light of less than 15% of the floor area
- Any doorways that are not provided with glass doors shall not be classified as avenues of natural light.
- The employer shall ensure that any means of providing light such as windows, roof lights, etc., shall be kept clean and in good repair at all times.

(Any 2 × 1) (2)

[15]

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QUESTION 7: BRAKES

7.1 **Advantages**

- The surface on which heat is generated is directly exposed to the air, therefore easier dissipating of heat is obtained to prevent brake fade.
- Disc brakes are self-adjusting.
- Disc pads are easily replaced.
- Heat does not affect the pedal travel as in the case of drum brakes.
- Disc brakes are independent of self-energising action and a more progressive braking action is obtained
- Braking is proportional to the applied force. (Any 4 × 1)

Disadvantages

- A booster is necessary to increase the applied force.
- Braking area is smaller and lining material wears faster.
- Brake noise is sometimes a problem. (Any 3 × 1)

(4 + 3) (7)

7.2 7.2.1 The function of a drain valve is to release the water and condensate in the reservoir✓ and to drain the reservoir and pipelines.✓

7.2.2 Quick-release valve rapidly exhausts the line✓ to the brake actuators.✓

(2 × 2) (4)

[11]

QUESTION 8: ALLOY METALS

8.1 8.1.1

- Copper
- Tin
- Antimony

- An anti-friction alloy
- Corrosion resistant
- Wear resistant
- Soft
- Low in strength

(Any 2 × 2) (4)

8.2

- To obtain greater hardness
- To obtain greater toughness and strength
- To enable the steel to retain its size and shape during heat treatment
- To enable the steel to retain its hardness at high temperatures
- To produce a steel that is extremely hard and tough (Any 2 × 1) (2)

[6]

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QUESTION 9: HEAT TREATMENT OF CARBON STEEL

9.1 A ferrous metal is a metal that contains iron as a basic metal✓ which can be alloyed with other elements to give certain properties,✓ while a nonferrous metal a metal that does not contain iron✓ as a basic metal.✓ (2 × 2) (4)

9.2
- Very hard
- Wear resistant
- Shock resistant
- Has good cutting properties
- Can be hardened and used for tools (Any 4 × 1) (4)

[8]

QUESTION 10: ENGINEERING MATERIALS: MANUFACTURING PROCESSES

- Grey cast iron✓ – Cast machine parts✓
- White cast iron✓ – Impellers for slurry pumps✓
- Malleable cast iron✓ – pipe fittings✓ (2 × 3) **[6]**

QUESTION 11: FLUID DRIVES

11.1
- Impeller or (driving member)
- Stator or (stationary member)
- Turbine or (driven member) (3)

11.2
- The working of a press or lift usually only takes a few seconds.
- The work-piece must then be removed and replaced by another.
- The press, therefore, requires the intermittent supply of high-pressure water.
- To avoid the installation and operation of large pumps which must work intermittently, hydraulic systems are generally fitted with accumulators.
- While the pump is supplying water faster than it is being used, the plunger rises, but if the demand for water is greater than the output of the pump, the plunger descends. (Any 3 × 1) (3)

[6]

TOTAL: 100

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