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**NATIONAL CERTIFICATE**

**FITTING AND MACHINING THEORY N2**

**30**

**July 2021**

**This marking guideline consists of 9 pages.**



**MARKING GUIDELINE**

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**SECTION A**

# QUESTION 1: OCCUPATIONAL SAFETY

1.1 1.1.1 True

1.1.2 False

1.1.3 True 1.1.4 True

1.1.5 True

(5 × 1) **[5]**

**OR**

1.2 1.2.1 True

1.2.2 True 1.2.3 True

1.2.4 False

1.2.5 True

(5 × 1) **[5]**

# QUESTION 2: COUPLINGS

2.1 A coupling is a permanent connection between a drive and a driven shaft 

whereas a clutch is a coupling where the drive shaft and the driven shaft can

be engaged and disengaged by the operator. (2)

2.2 • Spider coupling

* Bibby/resilient coupling
* Metal-disc coupling
* Pin and rubber bush coupling
* Rubber belt coupling
* Nylon sleeve coupling
* Tyre coupling
* Raffard coupling • Fluid drive coupling (Any 2 × 1) (2)

2.3 • Axial misalignment

* Radial misalignment • Angular misalignment (Any 2 × 1) (2)

# [6] QUESTION 3: LIMITS AND FIT

3.1 3.1.1 C

3.1.2 A

3.1.3 B

1. × 1) (3)

* 1. 3.2.1 Unilateral tolerance
     1. Unilateral tolerance
     2. 0,03 mm
     3. 0,04 mm

1. × 1) (4)

**[7]**

# QUESTION 4: BEARINGS

4.1 A – Inner / outer raceway / shaft / housing ring

1. – Ball/rolling elements
2. – Cage (3)

4.2 • Faulty maintenance and assembly

* Insufficient lubricant
* Incorrect lubricant
* Dirt or grit in the lubricant
* High operating temperature
* Wear/fatigue of bearing material
* Faulty design
* Corrosion of the bearing material
* Water contamination (Any 2 × 1) (2)

**[5]**

# QUESTION 5: LUBRICATION AND VALVES

5.1 • Solids

* Liquids
* Semi-solids (grease) (Any 3 × 1) (3)

5.2 A ball valve consists of a ball with a hole through it. When the opening in the ball coincides with that of the pipeline, the fluid will flow. If the handle is turned

through 90° to the pipeline no flow will take place. (3)

**[6]**

# QUESTION 6: PACKING, STUFFING BOXES, JOINTS AND WATER-PIPE SYSTEMS

6.1 • Prevent leaks in the different types of machinery.

* Acts as seal or joining when connecting pipelines to allow continuous flow of fluid.
* Prevent dust and foreign matter from entering machines and equipment.
* Maintains pressure within the system. (Any 1 × 1) (1)

6.2 • Clean all surfaces.

* Check that the seal housing is free from damage.
* Ensure the correct seal is used.
* Ensure no damage while installing seal.
* Lubricate the seal before installing.
* Use a protective sheath over a threaded section to protect the seal.
* Ensure that the seals are not subjected to any misalignment.
* Always tighten up lightly in the beginning for squaring up the seal.

(Any 5 × 1) (5)

6.3 6.3.1 Plug

* + 1. Union

* + 1. Nipple

(3 × 1) (3)

**[9]**

# QUESTION 7: PUMPS

7.1 • Casing or housing

* Impeller
* Stuffing box assembly
* Bearings
* Shaft assembly (Any 2 × 1) (2)

* 1. When the piston moves out, liquid is drawn into the cylinder.  When the piston moves inwards, the liquid is forced out of the cylinder.  (2)

* 1. In a positive displacement pump a fixed amount of fluid is displaced with every stroke of the pump, whereas in a non-positive displacement pump the amount

of fluid displaced varies with every rotation of the pump. (2)

# [6] QUESTION 8: COMPRESSORS

8.1 • Vane compressors

* Lobe compressors
* Rotary-screw compressors
* Centrifugal compressors (Any 3 × 1) (3)

8.2 • Pascal (Pa) / Kilopascal (KPa) / Megapascal (MPa) (Any 1 × 1) (1)

**[4]**

# QUESTION 9: V-BELT, GEAR DRIVES, CHAIN DRIVES AND REDUCTION GEARBOXES

9.1 • Solid sprocket

* Solid sprocket with spokes
* Split sprocket with spokes (3)

9.2 9.2.1 • Velocity ratio is the relationship between the speeds of the drive

gear to the speed of the driven gear.

* The number of teeth of the driven gear to the number of teeth of

the drive gear. (Any 1 × 1) (1)

9.2.2 Mechanical advantage is the resultant effect between two meshing gears and can be obtained by varying the velocity ratio between

them. (1)

9.3 • Slip will take place in the event of overloading

* No lubrication is required
* Operation is more silent • They require very little attention
* In the case of multiple drives, when one belt breaks, the drive will continue

to run, using the remaining belts. (Any 4 × 1) (4)

9.4 • Single-reduction gearbox

* Double-reduction gearbox
* Worm and worm-wheel gearbox (3)

**[12]**

**TOTAL SECTION A:** **60**

**SECTION B**

Only TWO questions to be answered in SECTION B.

# QUESTION 10: HYDRAULICS AND PNEUMATICS

10.1 • Pump

* Reservoir
* Actuator
* Valves or pressure relief valve or control valve
* Piping (Any 3 × 1) (3)

10.2 • Transmits energy

* Lubricates
* Prevents corrosion
* Removes dirt
* Acts as a coolant (Any 3 × 1) (3)

10.3 A – Reservoir

1. – Hydraulic motor
2. – Pressure relief valve
3. – Check valve / One-way valve
4. – Actuator / Cylinder (5)

10.4 • Compressed air supply is readily available.

* They are more reliable and durable than hydraulic systems.
* They are more easily adaptable than hydraulic systems.
* They are safer than hydraulic systems.
* Reciprocating motion is easily and cheaply achieved.
* Variable speeds can be obtained in pneumatic systems.
* They are more economical as they have lower set-up and maintenance

costs. (Any 5 × 1) (5)

* 1. Ensures that the normal working pressure is not exceeded by relieving excess

fluid pressure in the tank. (1)

* 1. • Check for leaks/cracks
* Check for kinks
* Check for perished rubber
* Check for blockages (Any 3 × 1) (3)

# [20] QUESTION 11 : CENTRE LATHES

11.1 • Supporting long, slender workpieces between centres

* Maintaining concentricity of long workpieces while machining
* Reducing vibration or chatter, ensuring a better finish of the workpiece
* Supporting workpieces against the pressure of heavy machining

(Any 3 × 1) (3)

11.2 11.2.1 𝐷𝐷 − 𝑑𝑑 𝑙𝑙𝑆𝑆𝑙𝑙𝑙𝑙𝑆𝑆ℎ 𝑜𝑜𝑜𝑜 𝑤𝑤𝑜𝑜𝑜𝑜𝑤𝑤𝑤𝑤𝑤𝑤𝑆𝑆𝑤𝑤𝑆𝑆

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45 − 30 250

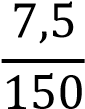
= × 

2 150

= 12,5 𝑚𝑚𝑚𝑚  (2)

11.2.2 θ x tan =

2 L

 = 

= 0,05

 = 2,86° 

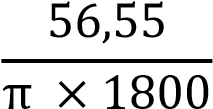
θ = 5,72°

= 5° 43′  (3)

11.3 S = πDN

S

D =  π × N

= 

= 10 mm (3)

11.4 L = f × N × t

L

t =  f × N

250

= 

0,5 × 199

= 2,513 min

= 2 min 30,8 seconds  (3)

11.5 11.5.1 Lead = Number of starts × pitch of thread

= 2 × 12

= 24 mm

pitch

Mean diameter (Dm) = Outside diameter −

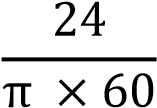
2

= 66 − 

= 60 mm

Lead

tan θ = π × Dm

= 

= 0,127 

θ = 7,24°  (4)

11.5.2 Leading angle = 90°- (helix angle + clearance angle)

= 90°- (7,256°+ 3°)

= 79,744 mm (1)

11.5.3 Following angle = 90°+ (helix angle - clearance angle)

= 90°+ (7,256-3°)

= 94,256 mm (1)

**[20]**

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# QUESTION 12: MILLING MACHINES AND SURFACE GRINDERS

12.1 12.1.1 A – Up-cut milling

B – Down-cut milling

12.1.2 A – The workpiece is fed against the direction of rotation of the

milling cutter.

B – The work piece is fed with the direction of rotation of the milling cutter.

12.1.3 • There is a chance of the cutter lifting the work piece.

* The finish on the work piece is not of a high standard.

12.1.4 • Deeper cuts can be made.

* A good finish is obtained.

(4 × 2) (8)

12.2 40

Indexing =

N

= 



= 4

= 4  × 



= 4 

Indexing = four full turns of the crank handle and 8 holes in an 18-hole plate. (5)

12.3 • Costs less

* Less vibration on the arbour
* Higher arbour speed may be used
* Less power needed to drive the cutter
* Less chance of shearing the key (5)

12.4 12.4.1 Aluminium oxide/A

12.4.2 Silicon carbide/C

(2 × 1) (2)

# [20]

**TOTAL SECTION B:** **40**

**GRAND TOTAL:** **100**