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**NATIONAL CERTIFICATE**

**FITTING AND MACHINING THEORY N2**

**9**

**APRIL 2021**

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

**MARKING GUIDELINE**



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**SECTION A**

# QUESTION 1: OCCUPATIONAL SAFETY

NOTE: Candidates need answer only QUESTION 1.1 or QUESTION 1.2.

1.1 1.1.1 False

1.1.2 False 1.1.3 True 1.1.4 True

1.1.5 False

(5 × 1) **[5]**

# OR

1.2. 1.2.1 True

1.2.2 False 1.2.3 True 1.2.4 False

1.2.5 True

(5 × 1) **[5]**

# QUESTION 2: COUPLINGS

2.1 2.1.1 Metal disc coupling

2.1.2 Flexible couplings

2.1.3 Floating disc

(3 × 1) (3)

2.2 2.2.1 Permanent coupling

2.2.2 Flexible coupling

2.2.3 Self-aligning coupling

(3 × 1) (3)

**[6]**

# QUESTION 3: LIMITS AND FITS

3.1 3.1.1 Push fit – parts will move relative to each other when slight hand pressure is applied to move the two parts.

3.1.2 Running fit – The two mating parts fit into each other smoothly but not loosely.

3.1.3 Sliding fit – The two parts slide freely relative to each other.

3.1.4 Press fit – Pressure is applied mechanically or hydraulically to fit the one part tightly into the other.

(4 × 1) (4)

3.2 3.2.1 Bilateral tolerance – The limits of a dimension are on both sides of the basic size.

3.2.2 Unilateral tolerance –The limits of a dimension are only on one side of the basic size.

3.2.3 High limit – Is the maximum permissible size allowed relative to the basic size of the work-piece.

(3 × 1) (3)

**[7]**

# QUESTION 4: BEARINGS

4.1 • Insufficient lubrication

* Contamination in the bearing
* Bearing slipping in the housing or on the shaft
* Flattened roller or ball • Different sizes of rollers or balls • Indentation of races

(Any 3 × 1) (3)

4.2 • They cannot be repaired

* They are noisy in operation at high speeds
* Less capacity to withstand shock
* High initial costs

(Any 2 × 1) (2)

**[5]**

# QUESTION 5: LUBRICATION AND VALVES

5.1 5.1.1 Rubbing speed – It is the speed at which a shaft turns inside a

bearing.

5.1.2 Adhesion – It is the ability a substance has to cling to another material or substance.

5.1.3 Viscosity – The speed of flow or resistance to flow or thickness of the liquid.

(3 × 1) (3)

5.2 When the pressure in a system exceeds the spring tension of the valve,  the valve opens and allows fluid to flow. When the pressure drops below the

spring tension, the valve closes  and stops the flow of fluid. (3)

**[6]**

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

6.1 • To prevent heat loss due to radiation

* To prevent or minimise condensation in the pipelines
* To minimise hammer shocks in the system • To have more accurate gauge readings

* To prevent water entering reciprocating machines
* Saves energy
* Prevents water pipes from freezing in winter (Any 5 × 1) (5)

6.2 • Bell-and-spigot

* Welded
* Soldered or brazed
* Screwed (threaded)
* Flanged
* Butt-and-strap
* Fillet welding (Any 4 × 1) (4)

**[9]**

# QUESTION 7: PUMPS

7.1 7.1.1 A – Piston pump

B – Plunger pump (2)

7.1.2 Reciprocating pumps (1)

7.1.3 Positive displacement (1)

7.2 • To slow the liquid down

* To increase the pressure energy
* To prevent overloading of the impeller motor (Any 2 × 1) (2)

**[6]**

# QUESTION 8: COMPRESSORS

8.1 Air filter – It prevents dust and foreign matter in the air from entering the cylinder.

8.2 High pressure cylinder – It compresses the air to the required pressure.

8.3 Drain valve – It is used to drain all the water in the air receiver.

8.4 Cotter – It tightens up the bearing holes as wear takes place between the bearing halves and the crank.

(4 × 1) **[4]** **QUESTION 9: V-BELTS, GEAR DRIVES, CHAIN DRIVES AND REDUCTION**

# GEARBOXES

9.1 The main function of a V-belt is to transfer driving motion from one shaft to

another. (1)

9.2 9.2.1 Arc of contact – It is the portion of the pulley that is in contact with the V-belt along its circumference.

9.2.2 Driven pulley – It is the pulley that is attached to the working part of the machine.

(2 × 1) (2)

9.3 • They are expensive to manufacture

* They are not repairable
* They require constant lubrication
* The drive and driven shafts need to be close together
* If anything goes wrong, slippage does not occur to prevent damage to the

machine (Any 3 × 1) (3)

9.4 9.4.1 To transmit power from one shaft to another when the distance between shafts is too large to use gears.

9.4.2 Used when positive transmission is desired (i.e., no slippage).

(2 × 1) (2)

9.5 • They are relatively noisy

* Wear causes elongation of the chain
* The sprockets need replacing due to wear
* They have speed limitations
* They break without warning (Any 2 ×1) (2)

9.6 • Ensure bearings are lubricated with grease.

* Check bearings for wear by listening for excessive noise. (2)

**[12]**

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

**SECTION B**

NOTE: Candidates need answer only TWO of the following questions

# QUESTION 10: HYDRAULICS AND PNEUMATICS

10.1 10.1.1 C

10.1.2 A

10.1.3 E

10.1.4 B

10.1.5 D

(5 × 1) (5)

10.2 10.2.1 Double acting cylinder or cylinder

10.2.2 Spring loaded non-return valve or non-return valve

10.2.3 Throttle valve 10.2.4 Sequence valve

10.2.5 Air receiver

(5 × 1) (5)

10.3

|  |  |
| --- | --- |
| **HYDRAULIC SYSTEM** | **PNEUMATIC SYSTEM** |
| Uses hydraulic oil | Uses air |
| Uses a pump to generate power | Uses a compressor to generate power |
| Closed circuit – oil returns to the tank | Open circuit – air is released to the atmosphere |
| Higher system pressure | Lower system pressure |
| Slower operation | Faster operation |
| Minimum power loss | Power loss occurs over long distances |
| Higher operating costs | Lower operating costs |
| Self-lubricating | Requires lubrication |

(Any 3 × 2) (6)

10.4 Positive displacement pumps are used in hydraulics. (1)

10.5 • Power transmission

* Lubrication
* Cooling (3)

# [20] QUESTION 11: CENTRE LATHES

11.1 • Plain or solid mandrels

* Cone mandrels
* Screw mandrels
* Expanding mandrels (4)

11.2 • Only external tapers can be turned

* Due to centres being misaligned, uneven wear takes place on the centres

and centre holes (2)

11.3 𝑆𝑆 = 𝜋𝜋DN

𝑆𝑆

𝑁𝑁 =

𝜋𝜋D

45

# = 

𝜋𝜋×0.085

𝑁𝑁 = 168.517 𝑟𝑟/𝑚𝑚𝑚𝑚𝑚𝑚 

𝐿𝐿 = 𝑓𝑓 × 𝑁𝑁 × 𝑡𝑡

= 0.8 × 168.517 × 5 

𝐿𝐿 = 674.068 𝑚𝑚𝑚𝑚  (4)

11.4 11.4.1 𝐷𝐷 − 𝑑𝑑 𝑙𝑙𝑆𝑆𝑚𝑚𝑙𝑙𝑡𝑡ℎ 𝑜𝑜𝑓𝑓 𝑤𝑤𝑜𝑜𝑟𝑟𝑤𝑤𝑤𝑤𝑚𝑚𝑆𝑆𝑤𝑤𝑆𝑆

𝑆𝑆𝑆𝑆𝑡𝑡 − 𝑜𝑜𝑜𝑜𝑆𝑆𝑟𝑟 = ×

2 𝑙𝑙𝑆𝑆𝑚𝑚𝑙𝑙𝑡𝑡ℎ 𝑜𝑜𝑓𝑓 𝑡𝑡𝑡𝑡𝑤𝑤𝑆𝑆𝑟𝑟

# = × 

= 17.5 × 1.52

𝑆𝑆𝑆𝑆𝑡𝑡 − 𝑜𝑜𝑜𝑜𝑆𝑆𝑟𝑟 = 26.515 mm  (2)

11.4.2 𝜃𝜃 𝑋𝑋

𝑡𝑡𝑡𝑡𝑚𝑚 =

2 𝐿𝐿

𝜃𝜃 17.5

𝑡𝑡𝑡𝑡𝑚𝑚 =

2 330

𝜃𝜃

𝑡𝑡𝑡𝑡𝑚𝑚 = 0.053  2

𝜃𝜃 = 𝑡𝑡𝑡𝑡𝑚𝑚−1 0.053 × 2 

𝜃𝜃 = 6.068°

𝜃𝜃 = 6° 04′  (3)

11.5 • Material type

* Tooling required
* Dwell time
* Stock length
* Coolant application
* Cutting speed
* Information from a drawing
* Operating sequence • Sizes according to dimensioning sizes

(Any 5 × 1) (5)

**[20]**

## QUESTION 12: MILLING MACHINES AND SURFACE GRINDERS

12.1 12.1.1 Dovetail cutter – Is used to manufacture dovetail slides that are used on various machines.

12.1.2 Slotting cutter – It is used only for cutting slots, grooves and keyways.

12.1.3 End mill cutter – It is used for milling slots, cutting profiles and facing narrow surfaces.

12.1.4 Slot drill – It is used to cut keyways and blind slots

(4 × 1) (4)

12.2 • It prevents the continuous forming of shavings

* It reduces chattering
* It helps in the removal of shavings
* It gives a better cutting action
* It is more economical in terms of power consumption
* It allows an easier flow of coolant
* It improves the finish on the work-piece

(Any 3 × 1) (3)

-9-

12.3 𝑁𝑁

𝐼𝐼𝑚𝑚𝑑𝑑𝑆𝑆𝐼𝐼𝑚𝑚𝑚𝑚𝑙𝑙 =

9°

=  

= 4 

1 2

= 4 × 

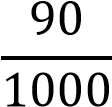
9 2

= 4  

𝐼𝐼𝑚𝑚𝑑𝑑𝑆𝑆𝐼𝐼𝑚𝑚𝑚𝑚𝑙𝑙

= 4 𝑓𝑓𝑓𝑓𝑙𝑙𝑙𝑙 𝑡𝑡𝑓𝑓𝑟𝑟𝑚𝑚𝑡𝑡 𝑜𝑜𝑓𝑓 𝑡𝑡ℎ𝑆𝑆 𝑤𝑤𝑟𝑟𝑡𝑡𝑚𝑚𝑤𝑤 ℎ𝑡𝑡𝑚𝑚𝑑𝑑𝑙𝑙𝑆𝑆  𝑡𝑡𝑚𝑚𝑑𝑑 2 ℎ𝑜𝑜𝑙𝑙𝑆𝑆𝑡𝑡 𝑚𝑚𝑚𝑚 𝑡𝑡 18 ℎ𝑜𝑜𝑙𝑙𝑆𝑆 𝑤𝑤𝑙𝑙𝑡𝑡𝑡𝑡𝑆𝑆 

(5)

12.4

𝐷𝐷 =

𝐷𝐷 = 0.09 𝑚𝑚

𝑆𝑆 = 𝜋𝜋𝐷𝐷𝑁𝑁

𝑆𝑆

# 𝑁𝑁 = 

𝜋𝜋𝜋𝜋

23

# = 

𝜋𝜋×0.09

𝑁𝑁 = 81.346 𝑟𝑟/𝑚𝑚𝑚𝑚𝑚𝑚  (3)

12.5 12.5.1 Grit size – It is the actual size of the abrasive particles on a grinding wheel.

12.5.2 Grade – It is the hardness of the wheel or the strength of the bond holding the abrasive particles in place.

12.5.3 Structure – It is the spacing of the grit in the wheel.

(3 × 1) (3)

12.6 • Use coarser grit wheels

* Use an open structure wheel
* Use a softer grade wheel
* Increase work speed

(Any 2 × 1) (2)

## [20]

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

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