higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T630(E)(M25)T
APRIL EXAMINATION

NATIONAL CERTIFICATE

FITTING AND MACHINING THEORY N2

(11022032)

25 March 2014 (Y-Paper)
13:00–16:00

Candidates require drawing instruments.
Calculators may be used.

This question paper consists of 9 pages and 1 formula sheet.

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
FITTING AND MACHINING THEORY N2
TIME: 3 HOURS
MARKS: 100

NOTE: If you answer more than the required number of questions, only the required number of questions will be marked. All work you do not want to be marked must be clearly crossed out.

INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions in SECTION A.
2. Answer ONLY TWO questions in SECTION B.
3. Answer either QUESTION 1.1 or QUESTION 1.2 of QUESTION 1.
4. Read ALL the questions carefully.
5. Number the answers according to the numbering system used in this question paper.
6. Write neatly and legibly.

SECTION A

QUESTION 1: OCCUPATIONAL SAFETY

NOTE: Answer ONLY QUESTION 1.1 or QUESTION 1.2

1.1 State FIVE basic rules for preventing manual handling accidents. (5)

OR

1.2 State:

1.2.1 TWO safety regulations which apply to the use of self-propelled vehicles in a mine. (2)

1.2.2 THREE safety regulations which apply to lighting and the use of safety lamps in a mine. (3)
[5]

QUESTION 2: COUPLINGS

2.1 FIGURE 1 shows a sketch of a type of coupling with different types of misalignment.

Name the types of coupling misalignment shown in FIGURE 1. Write only the answer next to the question numbers (2.1.1 and 2.1.2) in the ANSWER BOOK. (2 × 1) (2)

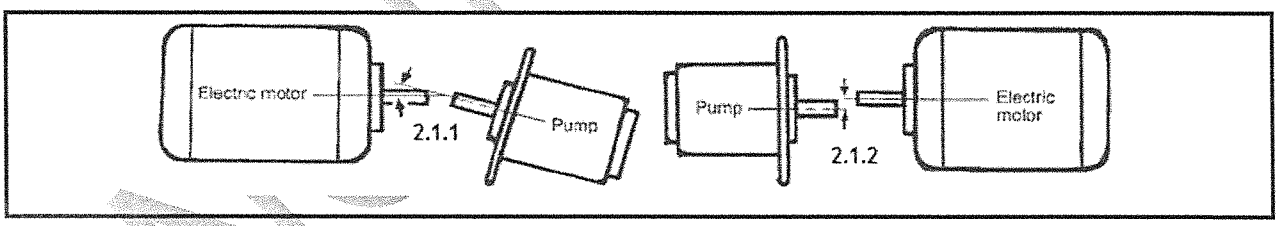


FIGURE 1

2.2 Name the classification of the coupling in FIGURE 2. (1)

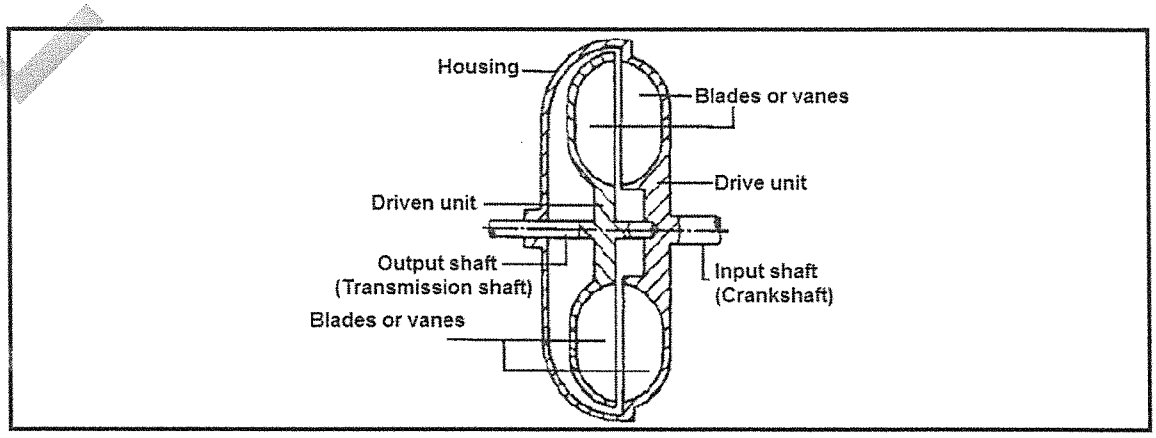


FIGURE 2

2.3 Name the type of coupling shown in FIGURE 2. (1)

2.4 Name TWO other types of couplings associated with the classification of the coupling shown in FIGURE 2. (2)
[6]

QUESTION 3: LIMITS AND FITS

3.1 Give ONE example of each of the following classifications of fits:

3.1.1 Clearance fit

3.1.1 Transition fit

(2 × 1) (2)

3.2 Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'true' or 'false' next to the question number (3.2.1–3.2.5) in the ANSWER BOOK.

3.2.1 Basic size is NOT the same as nominal size.

3.2.2 An interference fit is a fit in which a shaft could be larger or smaller than the hole.

3.2.3 The hole-basis system is used when a hole is machined according to a fixed shaft size.

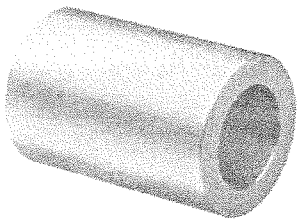
3.2.4 Tolerance is the fit which is on one side of the basic size only

3.2.5 Allowance is the difference in size between a hole and a shaft.

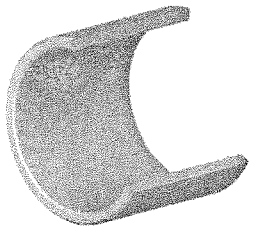
(5 × 1) (5)
[7]

QUESTION 4: BEARINGS

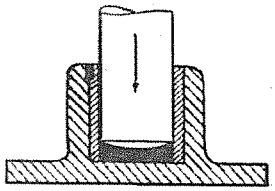
4.1 Name the plain bearings shown in FIGURE 3 below. Write only the name of the bearing next to the question number (4.1.1–4.1.4) in the ANSWER BOOK.



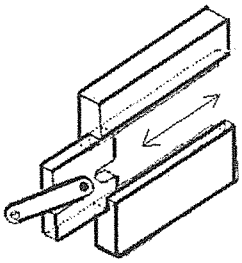
4.1.1



4.1.2



4.1.3



4.1.4

FIGURE 3

(4 × 1) (4)

4.2 List THREE points to consider when placing oil holes and grooves in plain bearings. (3)
[7]

QUESTION 5: LUBRICATION AND VALVES

5.1 Explain the lubricating action of a bottle-oiler (or needle) lubricating device. (4)

5.2 Give TWO examples of a solid-type lubricant. (2)

5.3 Explain the working principle of the gate valve with rising stem. (1)

5.4 Explain the working principle of the gate valve with the non-rising stem. (1)
[8]

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

6.1 Name FOUR important guidelines to ensure the proper fitting of o-rings and seals in hydraulic systems. (4 × 1) (4)

6.2 Give FOUR advantages of using thermo-plastic and thermo-setting plastic pipe in water systems. (4 × 1) (4)
[8]

QUESTION 7: PUMPS

7.1 Give ONE function of a stuffing box assembly in centrifugal and reciprocating pumps. (1)

7.2 FIGURE 4 shows a sketch of a vane pump.

Name the parts of the pump numbered (7.2.1–7.2.4). Write only the answer next to the question number in the ANSWER BOOK.

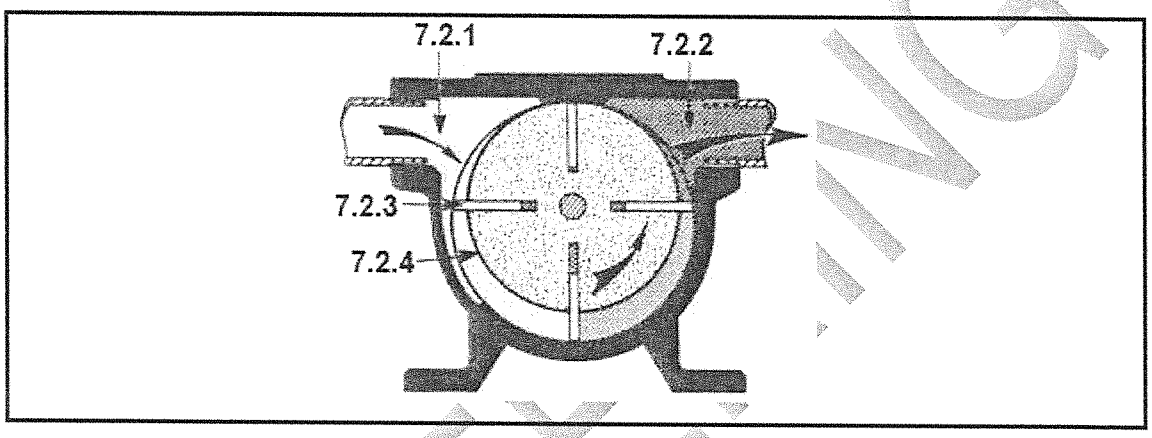


FIGURE 4 (4)
[5]

QUESTION 8: COMPRESSORS

8.1 Explain the function and operating principle of each of the following compressor components:

8.1.1 After-cooler

8.1.2 Water separator

8.1.3 Start-and-stop control switch

(3 × 1) (3)

8.2 Explain the purpose of a compressor used in the manufacturing and engineering industry. (2)
[5]

QUESTION 9: V-BELT, GEAR AND CHAIN DRIVES

9.1 Give THREE examples of the use of belt drives in the manufacturing and engineering industry. (3)

9.2 Give THREE advantages that belt drives have over chain drives. (3)

9.3 State THREE safety measures when maintaining belt drives. (3)
[9]

TOTAL SECTION A: 60

SECTION B

Answer only TWO questions in SECTION B.

QUESTION 10: HYDRAULICS AND PNEUMATICS

10.1 Give TWO examples of the use of a hydraulic motor in the manufacturing and engineering industry. (2)

10.2 Name the parts numbered (10.2.1–10.2.4) as shown in FIGURE 4. Write only the answer next to the question number (10.2.1–10.2.4) in the ANSWER BOOK.

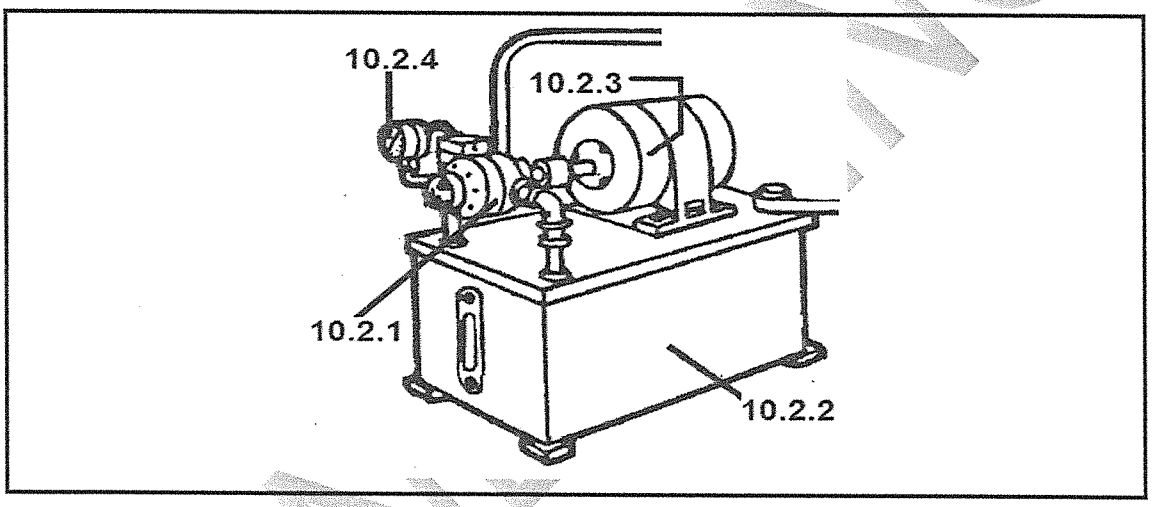


FIGURE 4 (4)

10.3 Give the THREE main functions of valves in a hydraulic flow system. (3)

10.4 Name TWO basic components of a hydraulic system. (2)

10.5 FIGURE 5 shows the sketch of a hydraulic reservoir.

Name the parts numbered (10.5.1–10.5.4). Write only the answer next to the question number (10.5.1–10.5.4) in the ANSWER BOOK.

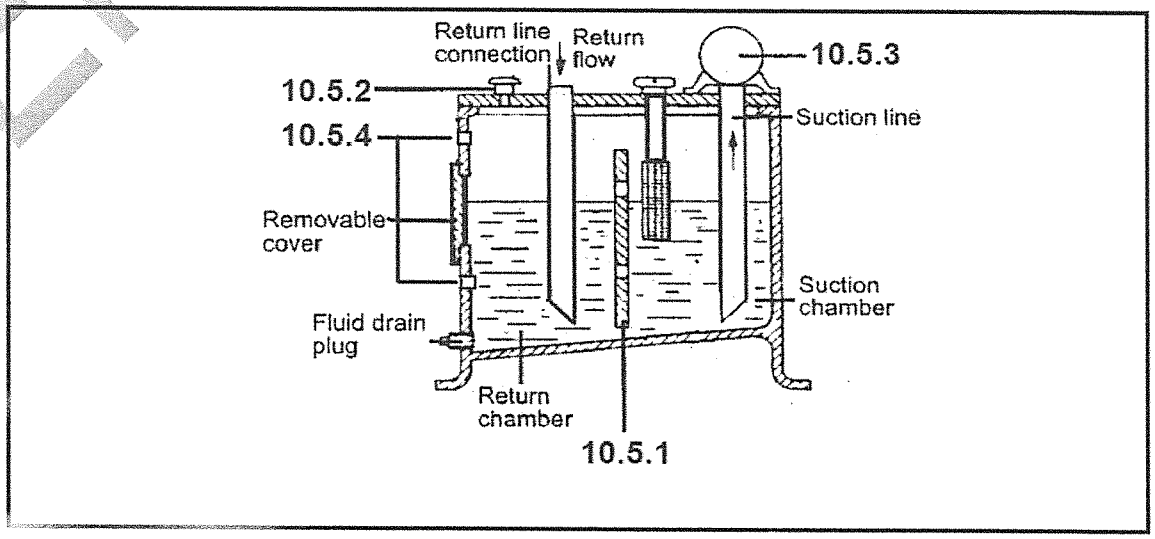


FIGURE 5 (4)

10.6 Make neat freehand sketches of the symbols representing the following hydraulic components:

10.6.1 Hydraulic motor

10.6.2 Shut-off valve

10.6.3 Accumulator

10.6.4 Pressure gauge

10.6.5 Pump

(5 × 1) (5)
[20]

QUESTION 11: CENTRE LATHES

11.1 Upon which part of the lathe would the following attachments be mounted?

11.1.1 Fixed steady

11.1.2 Travelling steady

(2 × 1) (2)

11.2 A spindle is to be turned to the dimensions given in FIGURE 6.

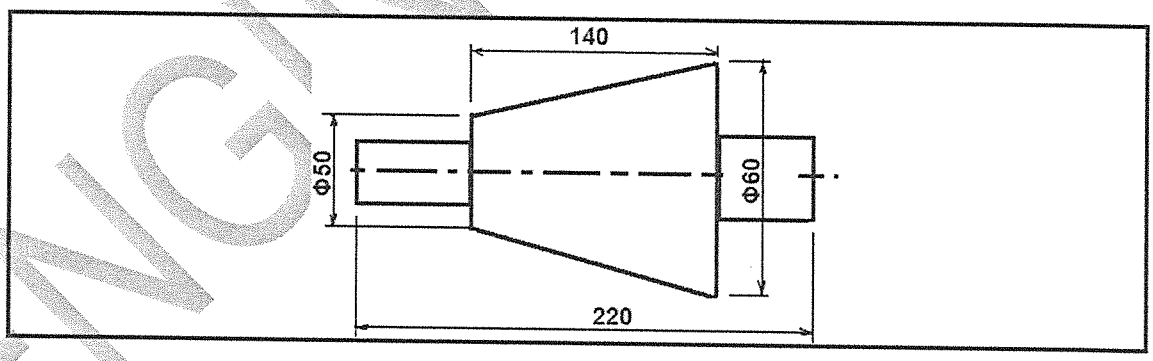


FIGURE 6

11.2.1 Calculate the amount of tailstock set-over. (3)

11.2.2 Calculate the included angle of the tapered portion. Give the answer in degrees and minutes. (2)

11.3 Calculate the time taken in minutes and seconds, to take one cut over a length of 250 mm if the automatic feed of the cutting tool is 0.5 mm/revolution. The spindle speed is 199 r/min. (3)

11.4 Calculate the helix angle of three-start square thread with an outside diameter of 40 mm and a pitch of 6 mm. (3)

11.5 Explain the following terms applicable to CNC machining:

11.5.1 Incremental programming

11.5.2 Absolute programming

11.5.3 G-codes

11.5.4 M-codes

(4 × 1) (4)

11.6 State THREE advantages of the use of mandrels on a centre lathe. (3)
[20]

QUESTION 12: MILLING MACHINES AND SURFACE GRINDERS

12.1 Identify the milling processes in FIGURE 7. Write the answer next to the question number (12.1.1–12.1.3) in the ANSWER BOOK.

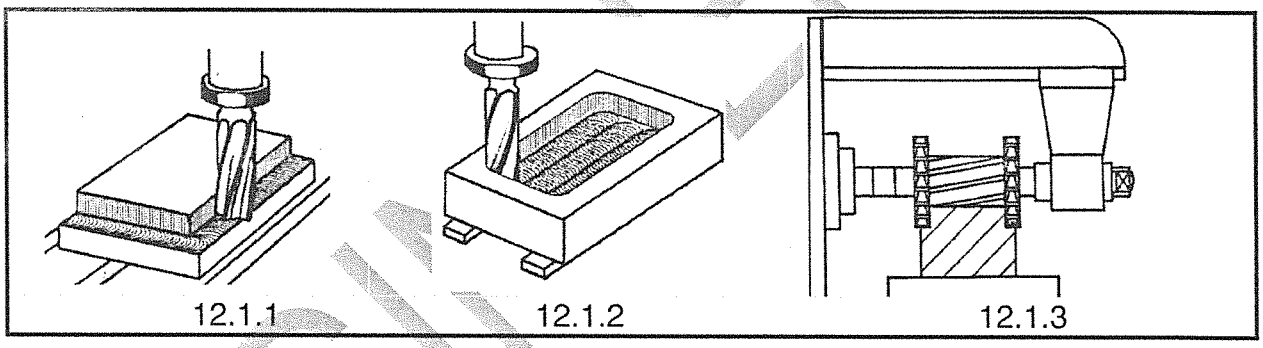


FIGURE 7 (3)

12.2 Name FOUR methods of indexing on a milling machine. (4)

12.3 State THREE possible factors, which cause the scratching of the workpiece when surface grinding. (3)

12.4 Calculate the cutting speed of the cutter in meters per minute, when using a cutter of 35 mm in diameter at a speed of 360 r/min. (3)

12.5 State FOUR advantages of using milling cutters with coarse teeth. (4)

12.6 Give THREE reasons why it is more desirable for using small diameter milling cutter. (3)
[20]

TOTAL SECTION B: 40
GRAND TOTAL: 100

FITTING AND MACHINING THEORY N2

FORMULA SHEET

$L = ft \times T \times N$

$S = \frac{\pi DN}{60}$

$S = \pi DN$

$\frac{40}{N}$

$\frac{N}{9°}$

$Set - over = \frac{D - d}{2} \times \frac{length\ of\ workpiece}{length\ of\ taper}$

$\tan \frac{\theta}{2} = \frac{X}{L}$

$Leading\ angle = 90° - (Helix\ angle + clearance\ angle)$

$Following\ angle = 90° + (Helix\ angle - clearance\ angle)$

$Lead = No\ of\ starts \times pitch$

$Dm = OD - ½ \times pitch$

$\tan\theta = \frac{lead}{\pi \times D_m}$

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MARKING GUIDELINE

NATIONAL CERTIFICATE

APRIL EXAMINATION

FITTING AND MACHINING THEORY N2

25 MARCH 2014

This marking guideline consists of 10 pages.

SECTION A

QUESTION 1

NOTE Candidates need ONLY QUESTION 1.1 or QUESTION 1.2

1.1
- Do not attempt to lift a load that is awkward or too heavy ✓
- Use the correct lifting technique ✓
- Correct body position when lifting ✓
- Wear appropriate clothing and safety shoes with strong caps at all times. ✓
- Depending on the nature of the load, it may be necessary to use gloves, hand leathers or goggles. ✓
- Aprons must be worn when lifting chemicals. ✓
- The area through which the load is to be moved must be clear and provide adequate space. ✓
- All handling operations should be supervised. ✓
- Determine how many persons are required to move a load safely. ✓
- The supervisor must give clear instruction and signals. ✓ (Any 5 × 1) (5)

OR

1.2 1.2.1
- No person is allowed to drive any vehicles unless authorised in writing by the manager of the mine. ✓
- No person is allowed on or in a self-propelled vehicle attached to haulage equipment. ✓ (2 × 1) (2)

1.2.2
- No person must work or travel in an un-illuminated mine unless they carry a light✓
- Machinery with moving parts must be lighted in such a way that the moving parts are clearly visible ✓
- No light or lamp are allowed in a mine unless approved by the director of the mines ✓ (3 × 1) (3)

[5]

QUESTION 2

2.1 2.1.1 Angular misalignment✓ (1)

2.1.2 Radial misalignment✓ (1)

2.2 Fixed or permanent or rigid couplings (1)

2.3 Fluid-drive coupling (1)

2.4
- Flange coupling ✓
- Marine coupling ✓
- Chain coupling ✓
- Gear coupling ✓
- Oldham coupling ✓

(Any 2 × 1) (2)

[6]

QUESTION 3

3.1 3.1.1 Washer **OR** any example of a Slide-, Push-, Running-, Clearance-fit types (1)

3.1.2 Bush, bearing fitting within a casing **OR** any example of a Force-, Drive-, Press-fit types (1)

3.2 3.2.1 False
3.2.2 False
3.2.3 False
3.2.4 False
3.2.5 True

(5 × 1) (5)
[7]

QUESTION 4

4.1 4.1.1 Radial bearing/plain journal bearing/bush ✓
4.1.2 Part bearing ✓
4.1.3 Footstep ✓
4.1.4 Guide bearing or machine slide ✓

(4 × 1) (4)

4.2
- Oil should be distributed over as wide an area as possible ✓
- Lubrication should provide for adequate cooling ✓
- Oil groove must not be cut over the overall length of the bearing (to avoid oil leakage) ✓
- Sharp and raised edges should be cleaned up ✓
- Entry of lubricant to be at the lowest pressure for free flow of oil ✓
- Vertical bearings to have a spiral groove against shaft rotation – forcing oil upwards ✓
- Guide bearings should have patterned grooves on sliding edges ✓

(Any 3 × 1) (3)
[7]

QUESTION 5

5.1 Consists of an inverted glass bottle filled with oil, closed off with a plug. The needle passes through the plug and touches the shaft. When the shaft rotates, the needle vibrates. This vibration causes the oil to flow down the needle onto the shaft . (4)

5.2
- Graphite ✓
- Zinc oxide ✓
- Soapstone ✓
- Talc ✓
- Wax ✓
- Mica ✓
- French chalk ✓

(Any 2 × 1) (2)

5.3 Rising stem-type, in which the stem and hand wheel rise with the gate. (1)

5.4 Non-rising stem type, in which the stem and hand wheel do not rise as the gate is opened. (1)
[8]

QUESTION 6

6.1
- Always clean all surfaces - remove all burrs.
- Check for correct seal.
- Gently stretch the seal and push it into its groove
- Make sure that the seal is not torn or twisted.
- Lubricate the seal.
- Fit protective sheath or sleeve - protect the seal over thread.
- Tighten up lightly, ensure fits squarely.
- Tighten up fully only after final assembly of all components.

(Any 4 × 1) (4)

6.2
- Unaffected by many fluid mediums
- Cheaper than steel
- Fitting is easy
- Light and portable
- High insulating qualities
- Corrosion resistant
- No machining required

(Any 4 × 1) (4)
[8]

QUESTION 7

7.1
- Houses the packing or sealing material
- Guides the linear movement of the shaft or piston rod
- Prevents the escape of fluid past the piston rod

(Any 1 × 1) (1)

7.2
7.2.1 Inlet port

7.2.2 Outlet port

7.2.3 Vane

7.2.4 Rotor

(4 × 1) (4)
[5]

QUESTION 8

8.1 8.1.1
- Cools pressurized air between the high pressure cylinder (Second stage) and the receiver.✓
- Acts as a dryer (dries the air) by removing moisture from the air before entering the receiver.✓

8.1.2
- prevents water entering tools and machinery ✓
- allows water to be tapped in a container (being heavier than air) and air to continue on its normal pathway ✓
- Centrifugal force allows air (which is lighter) to continue on its flow-path. Water (which is heavier) is allowed to drop into a trap/ container/vessel – from where it can be tapped off. ✓

8.1.3 ON/OFF Switch - the switch is used to electrically isolate the compressor. This is commonly used to switch the compressor OFF at night or over weekends.

(Any 3 × 1) (3)

8.2 A compressor is used to compress air and store it in a container✓ so that the energy in the compressed air may be used for driving different tools and pneumatically operated machines✓

(2)
[5]

QUESTION 9

9.1
- Milling machines
- Lathes
- Compressors
- Ventilators
- Heat exchanges
- Motor vehicles/cars
- Drilling machines
- Pumps

(Any 3 × 1) (3)

9.2
- Slip occurs
- No lubrication required
- Quiet operation
- Little maintenance (attention) required
- On multiple V-belt drives the machine may still continue to operate if one belt breaks

(Any 3 × 1) (3)

9.3
- Always fit guards
- During maintenance switch off at mains and lockout
- Never adjust tension while machine is running
- Keep belt free of grease and oil
- Use correct size belt
- Do not join a broken belt
- Ensure correct installation procedure – a belt jumping off can seriously harm others
- Make sure pulleys are tightly fitted on their shafts
- Use tensioning pulleys to adjust the slackness of the belt

(Any 3 × 1) (3)
[9]

TOTAL SECTION A: 60

SECTION B

QUESTION 10

10.1
- Hydraulic cranes – rotation of driver compartment
- Stamping machines
- Parts orientation
- Welder robots

(Any 2 × 1) (2)

10.2
10.2.1 Hydraulic pump
10.2.2 Reservoir
10.2.3 Electric Motor
10.2.4 Pressure Gauge

(4 × 1) (4)

10.3
- Controls energy flow
- Opens or closes flow path
- Directs the flow
- Regulates the flow rate
- Regulates the pressure

(Any 3 × 1) (3)

10.4
- Electric motor
- Pump
- Pressure relief valve
- Reservoir
- Filter
- Pressure gauge
- Check valve

(Any 2 × 1) (2)

10.5
10.5.1 Weir/Separator/Dividing Plate

10.5.2 Air filler/Breather

10.5.3 Pump/Electric motor

10.5.4 Min and Max Sight Glass Indicator levels

(4 × 1) (4)

10.6
10.6.1  HYDRAULIC MOTOR

10.6.2  SHUT OFF VALVE

10.6.3  ACCUMULATOR

10.6.4  PRESSURE GAUGE

10.6.5  MECHANICAL PUMP

(5 × 1) (5)
[20]

QUESTION 11

11.1 11.1.1 Lathe bed

11.1.2 Saddle

(2 × 1) (2)

11.2 11.2.1

$$Set-over = \frac{D-d}{2} \times \frac{length\ of\ workpiece}{length\ of\ taper} \checkmark$$

$$= \frac{60-50}{2} \times \frac{220}{140} \checkmark$$

$$= 7.86\,mm \checkmark$$

(3)

11.2.2

$$\tan\frac{\theta}{2} = \frac{5}{140} = 2{,}045 \checkmark$$

$$\theta = 4{,}09° = 4°\,5' \checkmark$$

(2)

11.3

$$L = f_t \times N \times t$$

$$t = \frac{L}{f_t \times N} \checkmark$$

$$= \frac{250}{0.5 \times 199} \checkmark$$

$$= 2\ minutes\ 31\ seconds \checkmark$$

(3)

11.4

$$Lead = No\ of\ starts \times pitch$$
$$= 3 \times 6$$
$$= 18 \checkmark^{½}$$

$$D_{mean} = OD - \frac{1}{2} \times pitch$$
$$= 40 - \frac{1}{2} \times 6$$
$$= 37 \checkmark^{½}$$

$$\tan\theta = \frac{lead}{\pi \times D_m}$$

$$= \frac{18}{\pi \times 37} \checkmark$$

$$\theta = \tan^{-1} 0{,}0516 \checkmark^{½}$$

(3)

$= 8{,}8° = 8° 48'$ ✓½

11.5 11.5.1 INCREMENTAL – each tool movement makes reference to the previous tool position

11.5.2 ABSOLUTE – each tool movement makes reference to a fixed point or origin.

11.5.3 G-codes: indicates tool movement

11.5.4 M-codes: indicates machine function or movement.

(4 × 1) (4)

11.6
- Time saving – no setting up required
- Concentricity is guaranteed
- Batch production is possible
- Mandrels can be modified to suit later work
- Setting up can be delegated to unskilled operators
- Workpieces are easily mounted and dismounted

(Any 3 × 1) (3)
[20]

QUESTION 12

1.2.1 12.1.1 End-milling cutter

12.1.2 Slotting cutter

12.1.3 Gang-milling

(3 × 1) (3)

12.2
- Simple
- Rapid
- Differential
- Angular

(4)

12.3
- Too slow a speed
- Metal clogging the space between abrasive particles
- Wrong wheel
- Insufficient coolant
- Dirty coolant
- Grinding wheel is too soft
- Incorrect wheel dressing

(Any 3 × 1) (3)

12.4 D = 0,035 meter (35 mm)
S = ? m/min
N = 360 rpm

S = π D N ✓
= π x 0 ,035 × 360 ✓

(3)

= 39,58 m/min ✓

12.5
- Less power consumption
- More easily sharpened when worn
- Cheaper to manufacture – fewer teeth
- Less vibration/chattering is reduced
- Coarse feed is possible
- Less friction

(Any 4 × 1) (4)

12.6
- Cheaper
- Chattering is reduced
- Higher speeds can be used
- They save on power consumption
- Less chance of the key being sheared off

(Any 3 × 1) (3)
[20]

TOTAL SECTION B: 40
GRAND TOTAL: 100