higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T620(E)(M24)T
APRIL EXAMINATION

NATIONAL CERTIFICATE

FITTING AND MACHINING THEORY N1

(11021871)

24 March 2014 (Y-Paper)
13:00–16:00

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

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
FITTING AND MACHINING THEORY N1
TIME: 3 HOURS
MARKS: 100

INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions in SECTION A, except QUESTION 1 where either QUESTION 1.1 or QUESTION 1.2 must be answered.
2. Answer any FOUR of the five questions in SECTION B.
3. Read ALL the questions carefully.
4. Number the answers according to the numbering system used in this question paper.
5. ALL the sketches must be neat, reasonably large and in good proportion.
6. Label ALL the sketches.
7. Start each question on a NEW page. Keep subsections of questions together.
8. Write neatly and legibly.

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SECTION A: GENERAL PRACTICE

NOTE: ALL the questions in this section must be answered, except QUESTION 1 where either QUESTION 1.1 or QUESTION 1.2 must be answered.

QUESTION 1: OCCUPATIONAL SAFETY

1.1 Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'true' or 'false' next to the question number (1.1.1–1.1.5) in the ANSWER BOOK.

1.1.1 Tools with sharp edges may be carried in one's pocket when working in a workshop.

1.1.2 Inspect the floors in the workshop for oil patches or grease and cover these with sawdust.

1.1.3 The colour green is the colour code used for pipelines containing air.

1.1.4 Colour codes can be used to identify walkways.

1.1.5 Persons under the influence of alcohol or drugs may enter any premises where machinery is used.

(5 × 1) (5)

OR

1.2 1.2.1 State THREE facts that must be taken into account when working with compressed air. (3)

1.2.2 Name TWO of the most important surface protection devices used when working in dangerous mining areas. (2)

[5]

QUESTION 2: MEASURING INSTRUMENTS

2.1 Name THREE types of micrometers that are used in the industry to measure workpieces accurately. (3)

2.2 State ONE advantage and ONE disadvantage of vernier callipers. (2)

2.3 Name the degree of accuracy of each of the following measuring instruments:

2.3.1 Vernier height gauge

2.3.2 Vernier protractor

(2 × 1) (2)

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2.4 Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'true' or 'false' next to the question number (2.4.1–2.4.4) in the ANSWER BOOK.

2.4.1 The dial test indicator can be used for setting up work pieces in a machine.

2.4.2 The feeler gauge can be used to check the clearance between a nut and a bolt.

2.4.3 The thread-pitch gauge can be used to check the radius on the point of a screw cutting tool.

2.4.4 The telescopic gauge provides a quick and accurate means of checking outside measurements.

(4 × 1) (4)
[11]

QUESTION 3: SCREW THREADS

Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'true' or 'false' next to the question number (3.1–3.6) in the ANSWER BOOK.

3.1 The included angle of a metric fine screw thread is 55 degrees.

3.2 The screw thread that is used to reduce backlash or play on a lead screw of a centre lathe is called a square thread.

3.3 Screw threads are used to assemble and dismantle components quickly and easily and are divided into two main categories, namely V-threads and metric screw threads.

3.4 The depth of a 12 mm screw thread with a pitch of 1,75 mm is 1,32 mm.

3.5 The pitch is the distance that a screw thread will move axially forward in one full revolution.

3.6 A metric coarse screw thread is used on a micrometer spindle.

(6 × 1) **[6]**

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QUESTION 4: HAND TOOLS

4.1 For what is a ball-peen hammer used? (1)

4.2 Name THREE types of punches used for various purposes in industry. (3)

4.3 State TWO safety precautions to be observed when working with a hacksaw. (2)
[6]

QUESTION 5: METALS AND PLASTICS

5.1 Name THREE general features to be observed when the spark test is executed on metal. (3)

5.2 Name ONE property and ONE use of the following non-ferrous metals:

5.2.1 Aluminium

5.2.2 Zinc

(2 x 2) (4)

5.3 Name THREE types of plain steel known to you. (3)

5.4 We use Tufnol in engineering because it has specific properties.

Name TWO of these properties. (2)
[12]

QUESTION 6: MARKING OFF

6.1 Explain the meaning of the following marking-off terms when marking off holes in a pipe flange:

6.1.1 Reference line

6.1.2 Reference point

(2 x 1) (2)

6.2 Name TWO marking-off fluids that can be used on cleaned machined surfaces to be able to clearly identify the marking-off lines. (2)

6.3 Name the TWO pieces of equipment used to support a round shaft on the marking-off table. (2)
[6]

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QUESTION 7: KEYS AND KEYWAYS

7.1 Keys are used to locate pulleys and couplings on a shaft to prevent movement between them.

Identify FOUR different types of keys used in industry. (4)

7.2 In order to make a feather key in the workshop, the height and the width of the feather key must be calculated.

A 30 mm diameter shaft must be keyed to a pulley. Calculate the dimensions of this key. (2)
[6]

QUESTION 8: FASTENERS

8.1 Locking devices or nuts are used to prevent screwed fasteners from working loose.

Explain the difference between positive locking and frictional locking. (2)

8.2 State TWO types of screws that produce their own thread. (2)
[4]

QUESTION 9: HAND TAPS, STOCK AND DIES AND REAMERS

9.1 Name any THREE different types of reamers which can be used in a workshop to enlarge a hole. (3)

9.2 Explain the function of stock and dies. (1)
[4]

TOTAL SECTION A: 60

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SECTION B: MACHINE CUTTING TOOLS AND MACHINES

Answer any FOUR of the five questions in this section.

QUESTION 10: DRILLING MACHINES

10.1 Drilling machines are the most used equipment in the machine workshop.

State the function of the following components found on the drilling machine:

10.1.1 Spindle

10.1.2 Table

10.1.3 Chuck

(3 × 1) (3)

10.2 Identify FOUR causes for a drill to break during the drilling operation on a workpiece. (4)

10.3 The cutting speed for mild steel is 30 metres per minute and the diameter of the drill is 12 mm.

Calculate the drilling machine spindle speed in revolutions per second to drill the hole. (3)

[10]

QUESTION 11: GRINDING MACHINES AND MACHINE CUTTING TOOLS

11.1 When you are replacing a grinding wheel, compressible washers are used and form part of the grinding wheel assembly.

Explain TWO reasons for using compressible washers when assembling a grinding wheel. (2)

11.2 What is the purpose of using a left-hand as well as a right-hand screw tread on the spindle of a pedestal machine? (1)

11.3 Differentiate between the purpose and function of the following TWO terms when working on a grinding machine:

11.3.1 Trueing

11.3.2 Dressing

(2 x 1) (2)

11.4 State the centre lathe tool that you would use to cut off the completed workpiece. (1)

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11.5 When working in a machine shop you will use various types of drilling processes. Identify the types of cutting tools shown in FIGURE 1. Write only the word(s) next to the letter (A–D) in the ANSWER BOOK.

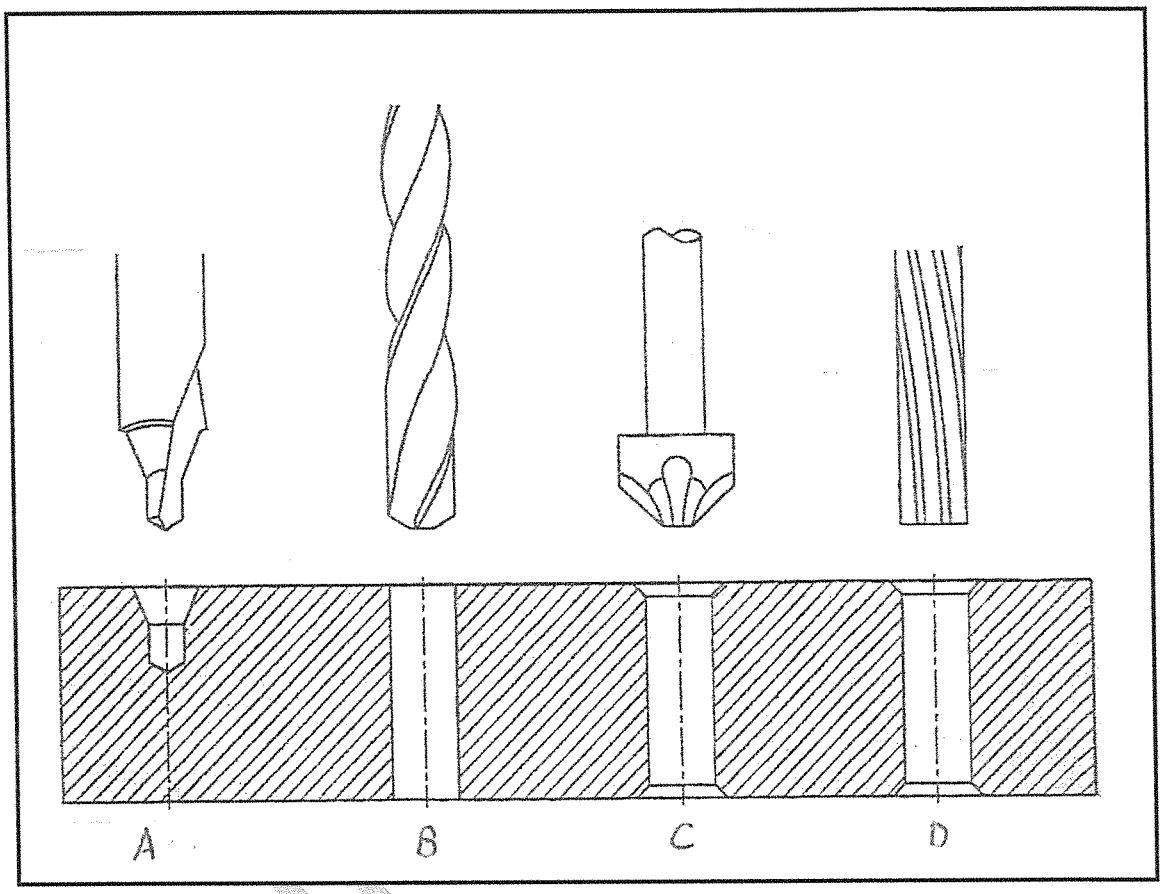

FIGURE 1

(4)
[10]

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QUESTION 12: SHAPING MACHINE

12.1 Name the THREE basic components of the ram head. (3)

12.2 Name the THREE methods that are used in industry when setting the machine vice on the shaping machine. (3)

12.3 A carbide-tipped tool is used to machine a cast-iron block of 450 mm long and 200 mm wide. A feed of 5,5 mm per stroke is used. The cutting speed is 30 metres per minute and the stroke ratio is 3 : 2.

Calculate the time it would take to cut across the width of the block. (4)
[10]

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QUESTION 13: CENTRE LATHE

13.1 The centre lathe can be used to perform various types of operations.

Name THREE types of operations. (3)

13.2 Lathe steadies are mostly used on a centre lathe to support a work piece for various reasons.

Name TWO types of steadies. (2)

13.3 State THREE advantages of a CNC lathe when compared to a conventional centre lathe. (3)

13.4 What is the purpose of the gap in the 9+bed on a centre lathe? (1)

13.5 State ONE advantage when using the setting-over of the tailstock to turn tapers. (1)
[10]

QUESTION 14: MILLING MACHINE

14.1 Study FIGURE 2 below and write down the correct name next to the letters (A–E) in the ANSWER BOOK.

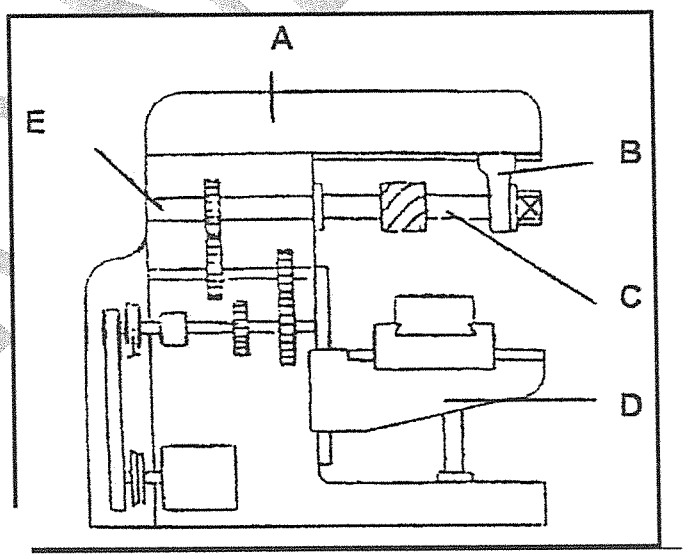

FIGURE 2 (5)

14.2 Name THREE uses of the milling machine. (3)

14.3 State TWO safety precautions that are applicable before or while working on a milling machine. (2)
[10]

TOTAL SECTION B: 40
GRAND TOTAL: 100

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FORMULA SHEET

Any applicable formula may also be used.

1. $V = \pi \times D \times N$

2. $w = feed/stroke \times strokes/min \times t$

3. $Strokes/min = \dfrac{S}{length\ of\ stroke} \times ratio$

4. $h = \dfrac{D}{6}$

5. $w = \dfrac{D}{4}$

6. $Depth\ (d) = 0{,}613 \times P$

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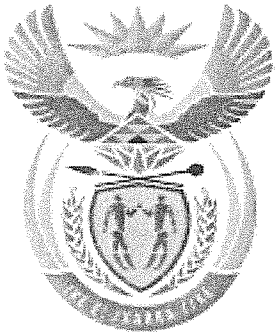

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Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

APRIL EXAMINATION

FITTING AND MACHINING THEORY N1

24 MARCH 2014

This marking guideline consists of 9 pages.

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SECTION A: GENERAL PRACTICE

QUESTION 1: OCCUPATIONAL SAFETY

1.1 1.1.1 False
1.1.2 True
1.1.3 False
1.1.4 True
1.1.5 False

(5 × 1) (5)

OR

1.2 1.2.1
- It must not cause the dissemination of a harmful amount of dust.
- It must not cause injury to any person.
- It must not be used to clean the body of a person or clothes worn by him or her. (3)

1.2.2
- Lifelines
- Hard hats
- Safety harnesses (2)

[5]

QUESTION 2: MEASURING INSTRUMENTS

2.1
- Inside micrometer
- Outside micrometer
- Depth micrometer (3)

2.2 The advantage of the vernier callipers is that inside, outside and depth measurements can be taken with the same instrument.

The disadvantage is that if the measuring faces or fixed and moveable jaws are worn, the instrument will give inaccurate readings. (2)

2.3 2.3.1 0,02 mm

2.3.2 5 minutes of a degree

(2 x 1) (2)

2.3 2.4.1 True
2.4.2 False
2.4.3 True
2.4.4 False

(4 × 1) (4)

[11]

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QUESTION 3: SCREW THREADS

3.1 False
3.2 False
3.3 False
3.4 True
3.5 True
3.6 False

(6 × 1) **[6]**

QUESTION 4: HAND TOOLS

4.1
- To rivet the ends of solid rivets and pins
- To shape hollow objects
- To drive in pins

(Any 1 × 1) (1)

4.2
- Centre punch
- Dotting punch
- Pin punch
- Hollow punch

(Any 3 × 1) (3)

4.3
- When you have finished using the hacksaw, wipe it clean.
- Before you put it away, loosen the tension wing nut on the blade.
- Do not store the hacksaw in a toolbox with other tools on top of it.

(Any 2 applicable answers)(2 x 1) (2)
[6]

QUESTION 5: METALS AND PLASTICS

5.1
- The colour of the spark
- The shape of the spark
- The distance from the emery wheel at which the spark ignite

(3)

5.2 5.2.1 ALUMINIUM PROPERTIES
- Brittle
- Good conductor
- Resists tarnishing in air

(Any 1 × 1) (1)

ALUMINIUM USES
- Bullets
- Battery plates
- Alloy in babbit bearings
- Toys

(Any 1 × 1) (1)

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5.2.2 ZINC PROPERTIES
- Soft
- Brittle
- Corrosion-resistant
- Low tensile strength (Any 1 × 1) (1)

ZINC USES
- Galvanised roof coverings
- Galvanised water tanks
- Galvanised water pipes (Any 1 × 1) (1)

5.3
- Low-carbon steel
- Medium-carbon steel
- High-carbon steel (3)

5.4
- It has a very high friction resistance
- It is very light in weight
- It is very easy to handle
- It provides a smooth surface
- It is non-magnetic (Any 2 × 1) (2)

[12]

QUESTION 6: MARKING OFF

6.1 6.1.1 Reference line is a line from which marking off is done.

6.1.2 Reference point is a specific point from which a construction or marking off is done.

(2 x 1) (2)

6.2
- Copper sulphate
- Marking blue (2)

6.3
- V-blocks
- U-shaped clamp (2)

[6]

QUESTION 7: KEYS AND KEYWAYS

7.1
- Rectangular key
- Gib-head taper key and ordinary tapered key
- Feather key
- Woodruff key and a normal tapered key (4)

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7.2 RTC height(H) and width (W)

D = 30 mm

$$H = \frac{D}{6} = \frac{30}{6} = \underline{5 \text{ mm}}$$

$$W = \frac{D}{4} = \frac{30}{4} = \underline{7{,}5 \text{ mm}}$$

(2)
[6]

QUESTION 8: FASTENERS

8.1
- Positive locking nuts are physically prevented from getting loose due to vibration
- Frictional locking nuts are held in place by friction only (2)

8.2
- Thread-cutting screw
- Self-tapping screw
- Drive screw (Any 2 × 1) (2)

[4]

QUESTION 9: HAND TAPS, STOCK AND DIES AND REAMERS

9.1
- Parallel hand reamer
- Tapered reamer
- Expanding reamer
- Adjustable reamer
- Machine reamer (Any 3 × 1) (3)

9.2 Used to cut external threads on a shaft or rod (1)

[4]

TOTAL SECTION A: 60

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SECTION B: MACHINE CUTTING TOOLS AND MACHINES

QUESTION 10: DRILLING MACHINES

10.1 10.1.1 Spindle – It gives driving motion to the cutting tools or to hold the cutting tool in position

10.1.2 Table – To clamp or hold a workpiece in position to be drilled

10.1.3 Chuck – To hold the cutting tool in position

(3 × 1) (3)

10.2
- Workpiece insufficiently supported or secured to table
- When the feed is too heavy
- Lands that are being worn away cause the drill to blind the hole
- The drill is clogged with chips causing fracture to drill
- An incorrect ground angle or blunt drill point
- When the feed is too rapid or incorrect
- When insufficient coolant is being used (Any 4 × 1) (4)

10.3 D = 12 mm = 0,012 m

$$S = 30 \text{ metres/minute} = \frac{30}{60} = 0,5 \text{ metres/sec}$$

$S = \pi DN$

$$N = \frac{S}{\pi D}$$

$$N = \frac{0,5 \text{ metres/second}}{\pi \times 0,012 \text{ r/sec}}$$

N = 13,263 r/sec

OR

$$N = \frac{1000S}{\pi D}$$

$$= \frac{1\,000 \times 30}{\pi \times 12}$$

$$= 795,418\ r/\min \div 60$$

$$= 13,257\ r/s$$

(3)
[10]

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QUESTION 11: GRINDING MACHINES AND MACHINE CUTTING TOOLS

11.1
- They tend to cushion flanges against high point or uneven surfaces and distribute the pressure evenly.
- The compressible washers prevent damage to the surface of the flange from the abrasive surface of the wheel.
- They provide better control of friction between the flange and the wheel, thereby providing power to the wheel. (Any 2 × 1) (2)

11.2 In both cases the nut will tend to tighten as the spindle turns. (1)

11.3 11.3.1 Trueing means getting an out of shape wheel to be perfectly round again.

11.3.2 Dressing means to sharpen a blunt wheel, it improves the wheel's cutting action.
(2 × 1) (2)

11.4 Parting-off tool (1)

11.5 A – Centre drill
B –Spiral steel drill (drilling)
C – Countersinking hole (90°)
D – Reaming (4)
[10]

QUESTION 12: SHAPING MACHINE

12.1 RAM HEAD
- Tool slide
- Clapper box
- Tool post (3)

12.2
- Trueing
- Setting the vice parallel to the movement of the ram
- Setting the vice at the right angle to the movement of the ram (3)

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12.3 Length of stroke = 450 mm = 0,45 km
Width = 200 mm
Feed = 0,15 mm per stroke
Cutting speed = 30 metres/minute
Stroke ratio = 3 : 2
Cutting stroke ratio = 3/5

$$\text{Strokes / minute} = \frac{\text{cutting speed m/min x stroke ratio}}{\text{length of stroke (m)}}$$

$$= \frac{30 \text{ m/min}}{0{,}45 \text{ m}} \times \frac{3}{5}$$

$$= 40 \text{ strokes/min}$$

$$\text{Time} = \frac{\text{width of work (mm)}}{\text{feed/stroke x 40 strokes/min}}$$

$$= \frac{200 \text{ mm}}{0{,}15 \text{ mm/stroke x 40 strokes/min}}$$

= 33,3 min or 33 minutes 20 seconds (4)
[10]

QUESTION 13: CENTRE LATHE

13.1
- General diameter turning operations
- Taper turning
- Internal turning
- Drilling operation
- Facing
- Screw-thread cutting (Any 3 × 1) (3)

13.2
- Fixed steady
- Travelling steady (2)

13.3
- A higher manufacturing speed can be achieved
- The finished part is more accurate
- It gives a better surface finish
- It can easily machine complex shapes
- The CNC lathe does not require skilled operators to operate it
- It has a lower running cost
- The life of a CNC cutting tool is much greater due to its features such as constant surface speed and backlash compensation (Any 3 × 1) (3)

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13.4 The gap bed is a removable short piece of the bed, directly underneath the chuck which allows the machining of bigger workpieces than would normally swing over the bed. (1)

13.5
- You can cut long tapers
- You can use automatic feed

(Any 1 × 1) (1)
[10]

QUESTION 14: MILLING MACHINE

14.1 A – Over-arm
B – Arbor support
C – Arbor
D – Knee
E – Spindle (5)

14.2
- To machine flat surfaces or profile or shaped surfaces.
- You can drill accurately with it.
- You can use it for boring gears.
- You can adapt it for vertical work
- It can produce slots and grooves on a shaft

(Any 3 × 1) (3)

14.3
- Clean the milling machine, like all machine tools after each work period.
- Never use air hose to remove chips.
- Make sure that you are thoroughly familiar with the machine before you attempt to use it.
- Wear proper clothing and approved safety goggles
- Never reach over or near the rotating cutter

(Any 2 × 1) (2)
[10]

TOTAL SECTION B : 40
GRAND TOTAL : 100

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