



Province of the  
**EASTERN CAPE**  
EDUCATION

**NATIONAL  
SENIOR CERTIFICATE**

**GRADE 11**

**NOVEMBER 2016**

**MECHANICAL TECHNOLOGY**

**MARKS: 200**

**TIME: 3 hours**



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This question paper consists of 20 pages including a formula sheet.

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**INSTRUCTIONS AND INFORMATION**

1. Read ALL the questions carefully.
2. Answer ALL the questions.
3. Number the answers correctly according to the numbering system used in this question paper.
4. Start EACH question on a NEW page.
5. Show ALL calculations and units. Round off final answers to TWO decimal places.
6. Candidates may use non-programmable scientific calculators and drawing instruments.
7. The value of gravitational force should be taken as  $10 \text{ m/s}^2$ .
8. All dimensions are in millimetres, unless stated otherwise in the question.
9. A formula sheet for your use is attached at the back of this question paper.
10. Write neatly and legibly.
11. Use the criteria below to assist you in managing your time.

QUESTION	CONTENT	MARKS	TIME (minutes)
1	Multiple-choice questions	20	15
2	Safety	10	10
3	Tools and Equipment	12	10
4	Materials	13	10
5	Terminology	30	20
6	Joining Methods	25	25
7	Forces	30	30
8	Maintenance	15	15
9	Systems and Control	25	25
10	Turbines	20	20
	<b>TOTAL</b>	<b>200</b>	<b>180</b>

**QUESTION 1: MULTIPLE-CHOICE QUESTIONS**

Various options are provided as possible answers to the following questions. Choose the correct answer and write only the letter (A–D) next to the question number (1.1–1.20) in the ANSWER BOOK, for example 1.21 C.

1.1 Existing safety legislation aims to ...

- A protect the employee.
- B protect the employer.
- C make workshops as safe as possible.
- D All of the above.

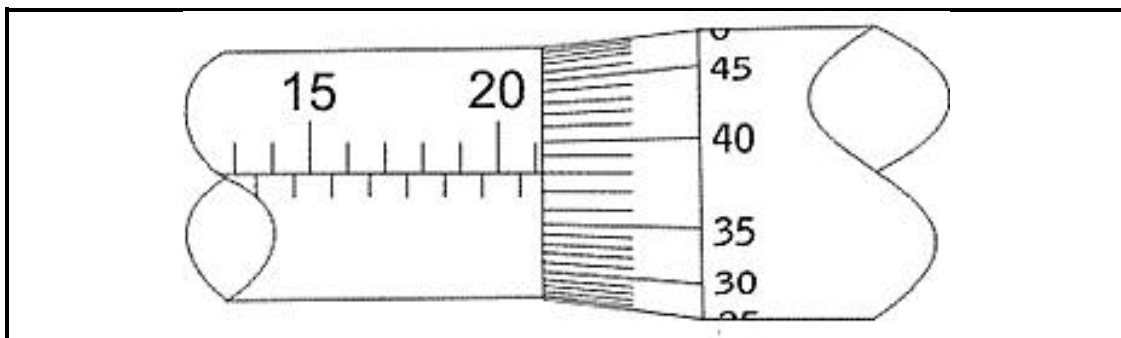
(1)

1.2 Which of the following is NOT part of the definition of an accident?

- A Unsafe conditions
- B Controlled conditions
- C Unplanned deeds
- D Unsafe acts

(1)

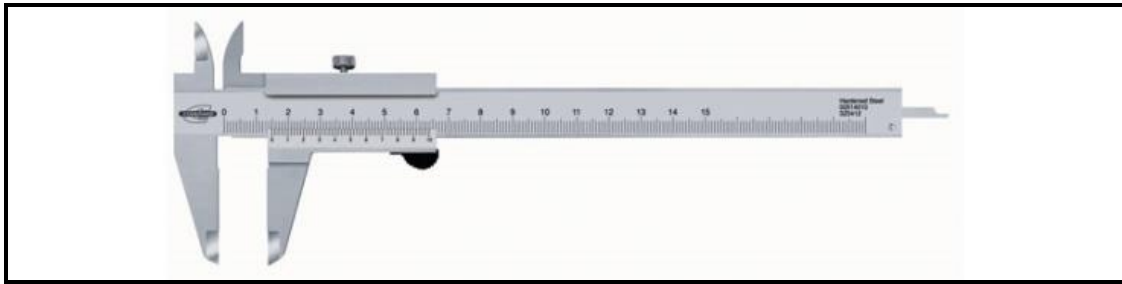
1.3 What is the reading on the outside micrometer, as shown below?



- A 21,42
- B 21,38
- C 20,42
- D 20,38

(1)

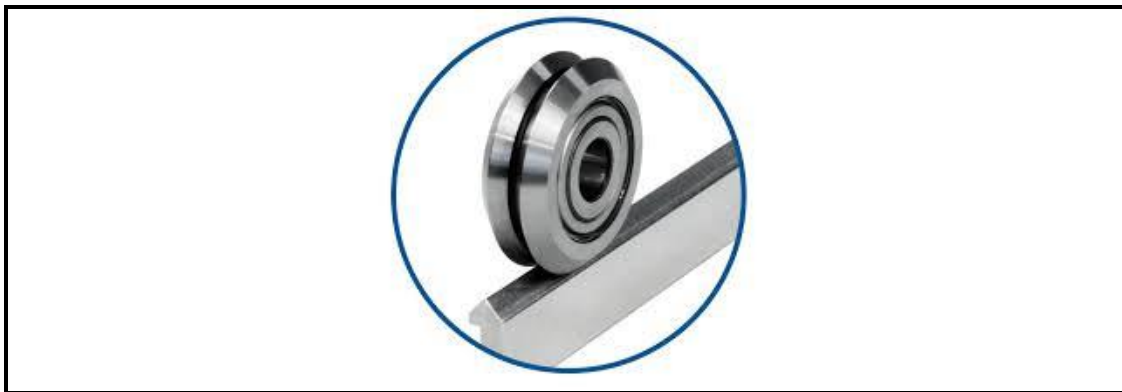
1.4 What do we use the vernier caliper for?



- A To measure the inside and outside diameter of pipes and rods.
- B To determine if a crankshaft is bent.
- C To check if a workpiece in a lathe is running true.
- D To determine the runout of a flywheel.

(1)

1.5 Linear motion is the motion along a ...



- A flywheel.
- B y-axis.
- C straight line.
- D grinding wheel.

(1)

1.6 Which of the following statements is the objective of case hardening?

- A To ensure maximum benefits.
- B To produce a hard case over a tough core.
- C To reduce the stresses in a metal after heat treatment.
- D To increase brittleness in metals.

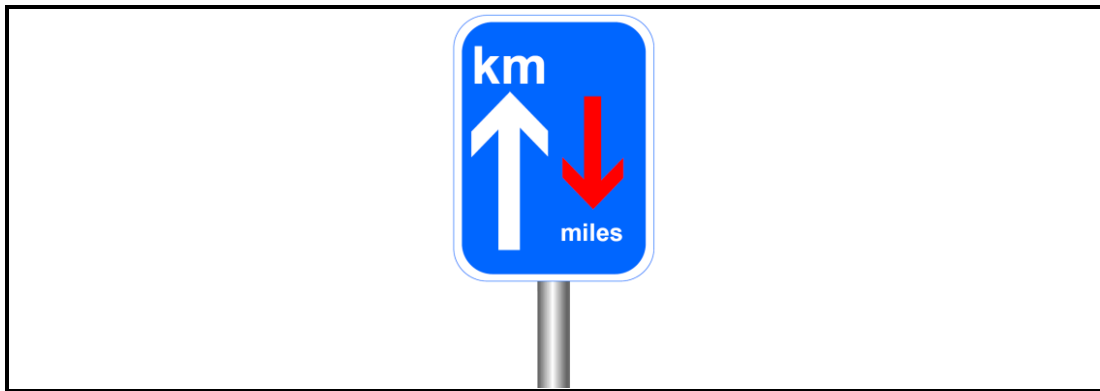
(1)

1.7 Which of the following is a heat treatment process?

- A Annealing
- B Hardening
- C Tempering
- D All of the above.

(1)

1.8 What is the British imperial system of measurement called?



- A Metric system
- B E-metric system
- C Inch system
- D E-inch system

(1)

1.9 Colour-coding of metals are standardised by the SABS (...) and are regularly used in the industry.

- A South African Breweries of Standards
- B South African Building of Standards
- C South African Bodies of Standards
- D South African Bureau of Standards

(1)

1.10 Which of the following statements are ways of making taper turning on a centre lathe?

- A The tailstock can be off set for longer external tapers.
- B The taper turning attachment can be used for external tapers and for short internal boring.
- C The compound slide rest can be rotated round for turning short internal and external tapers.
- D All of the above.

(1)

1.11 Flashback arrestors are used on oxygen and acetylene gas cylinders to ...



- A increase combustion.
- B support combustion.
- C improve the weld.
- D stop back feeding.

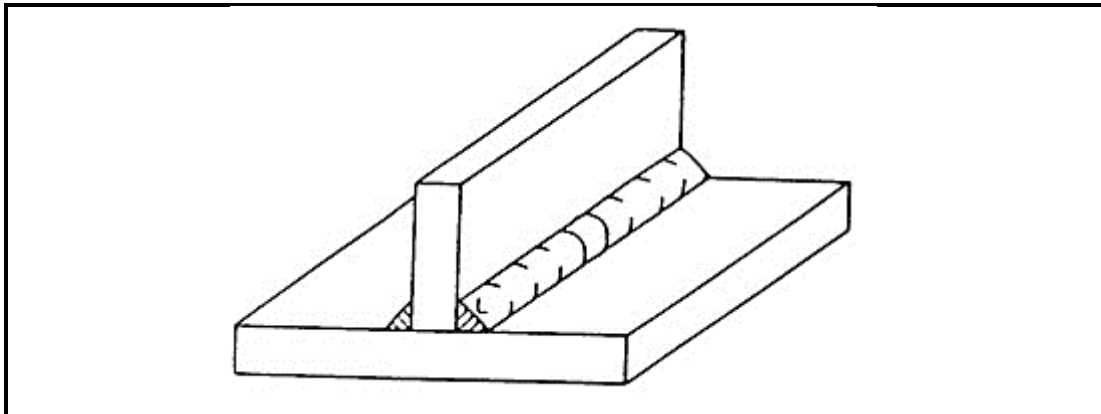
(1)

1.12 Identify the welding symbol for a square butt, from the four shown below.



(1)

1.13 Identify the type of welding joint shown in the figure below.



- A Corner joint
- B Lap joint
- C T-fillet joint
- D Edge joint

(1)

1.14 Which of the following units given below is used to determine stress?

- A Newton
- B Newton per meter
- C Joule
- D Newton per square meter

(1)

1.15 A steel girder is a rolled section such as an ...



- A angle iron.
- B lip channel.
- C round bar.
- D I-beam.

1.16 Which of the following statements describe rolling friction?



- A The resistance of motion as an object moves along a surface.
- B The force that prevents an object from moving.
- C Object moving through a fluid.
- D Retards the motion of a rolling object. (1)

1.17 The main cause of 'overheating' of engines is ...

- A too much oil.
- B faulty temperature.
- C operating at high speeds.
- D inadequate cooling. (1)

1.18 Which of the following types of gears are used to transmit drive between two shafts that are at right angles to each other?

- A Spur gears
- B Helical gears
- C Bevel gears
- D Rack and pinion gears (1)

1.19 A linkage is a mechanism made by connecting ... together.

- A belts
- B levers
- C wheels
- D axles

(1)

1.20 Which ONE of the pumps listed below, is a positive displacement pump?

- A Mono pump
- B Gear pump
- C Reciprocating pump
- D Centrifugal pump

(1)

**[20]**

**QUESTION 2: SAFETY**

- 2.1 Write down THREE safety precautions to be observed when handling and storing gas cylinders. (3)

2.2



List TWO safe ways to use a bench grinder. (2)

- 2.3 Mention THREE safety precautions for arc and spot welding. (3)

2.4



Give TWO safety precautions to be observed when using a centre lathe. (2)

[10]

**QUESTION 3: TOOLS AND EQUIPMENT**

3.1 Name TWO types of milling machines.

(2)

3.2



List TWO ways of taking care of a torque wrench.

(2)

3.3 Name THREE types of taps used to cut an internal screw thread.

(3)

3.4



State THREE ways of taking care of a drilling machine.

(3)

3.5 Which gasses are used when gas welding?

(2)

**[12]**

**QUESTION 4: MATERIAL**

- 4.1 What is meant by the term “*heat treatment*” in mechanical technology or engineering? (2)
- 4.2 List any TWO of the three types of plain carbon steels. (2)
- 4.3 Name TWO fluids used as quenching media. (2)
- 4.4 Choose a description from COLUMN A to match the process in COLUMN B. Write only the letter (A–D) down next to the question number (4.4.1–4.4.4) in your ANSWER BOOK.

COLUMN A		COLUMN B	
4.4.1	Normalising	A	This is a follow on process from hardening
4.4.2	Annealing	B	Relieves internal stresses which may have been set up during previous workings of the metal
4.4.3	Case hardening	C	Relieves the internal stresses produced by machining, forging or welding
4.4.4	Tempering	D	The objective is to produce a hard case over a tough core

(4 x 1) (4)

- 4.5 Name the THREE steps in all the heat treatment processes. (3)

**[13]**

**QUESTION 5: TERMINOLOGY**

5.1



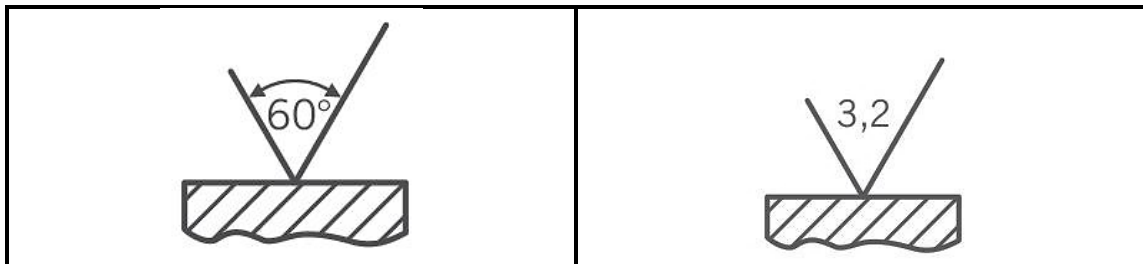
Name TWO arbor and TWO shank cutters used on the milling machines.

(4)

5.2 What is the function of the dividing head?

(2)

5.3 What instruction is carried out by each of the following surface texture symbols below?

**FIGURE 5.3.1****FIGURE 5.3.2**

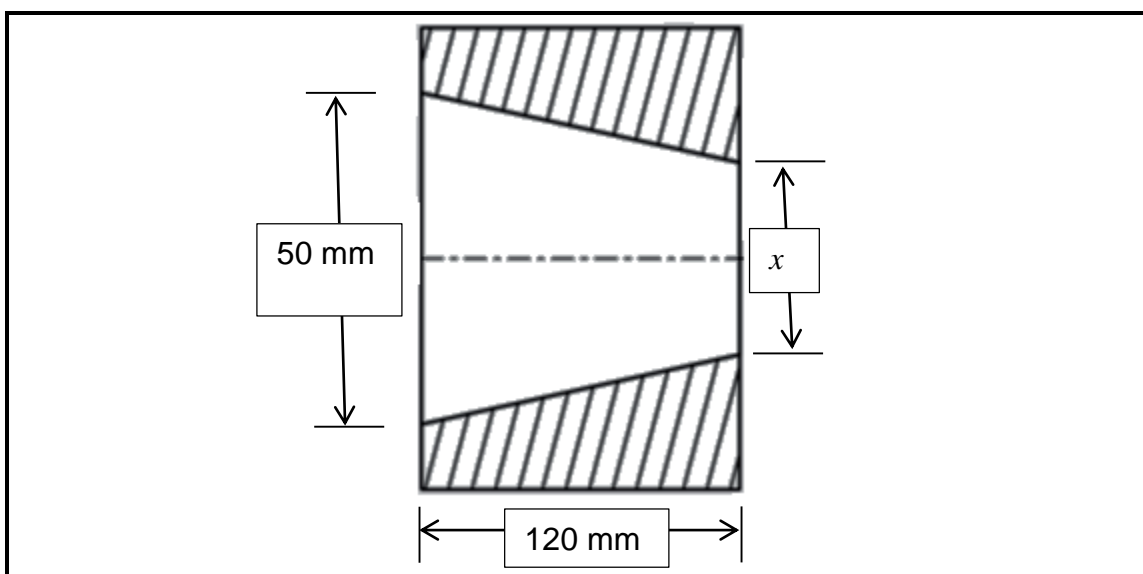
(2)

5.4 Which TWO types of indexing are carried out using a dividing head?

(2)

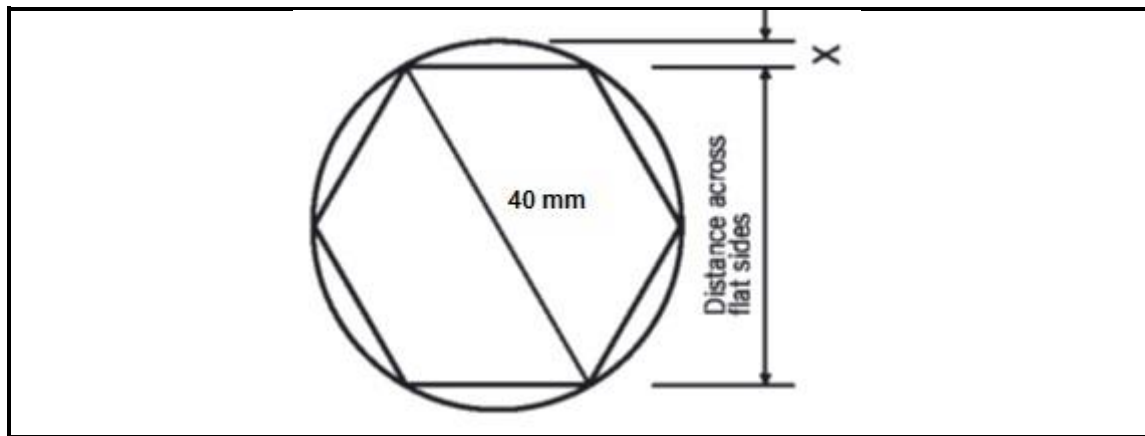
5.5 An internal taper 120 mm long has to be bored in a bush. The large diameter of the bush is 50 mm.

Calculate the small diameter of the taper hole if the included angle is  $6^\circ$ .



(6)

- 5.6 The mechanical learners have to accurately cut a hexagon at the end of a 40 mm shaft.  
Determine by using calculations, how much the cutter must be fed into the work piece (depth of cut) to cut the biggest hexagon.



- 5.7 A spur gear with 20 teeth must be machined on a workpiece.  
Calculate the indexing needed for the operation. (3)
- 5.8 Fill in the missing word or symbol in the table below and indicate the SI-base units. (6)

Quantity	Name	Symbol
5.8.1	Newton	N
Pressure / Stress	Pascal	5.8.2
Power	5.8.3	W

- 5.9 Define "*Bow's notation*". (2)
- [30]

**QUESTION 6: JOINING METHODS**

6.1 With the aid of simple sketches indicate the following welded joints, as indicated on a reference line:

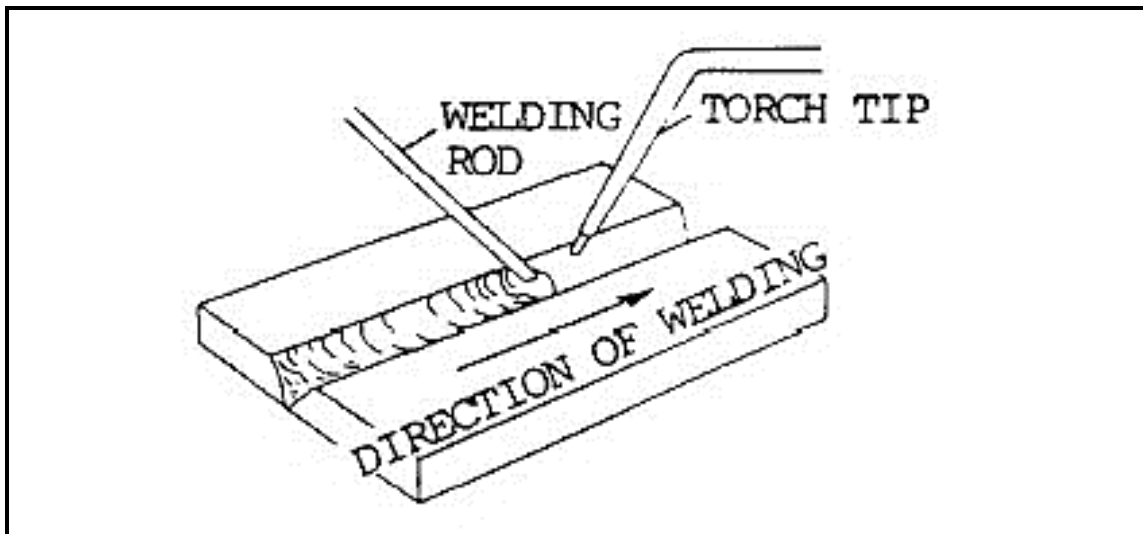
6.1.1 Square butt joint (2)

6.1.2 Double-V-butt joint (2)

6.1.3 Single-J-butt joint (2)

6.2 Name any FOUR different types of welding positions. (4)

6.3



Explain the *rightward gas welding process*. (4)

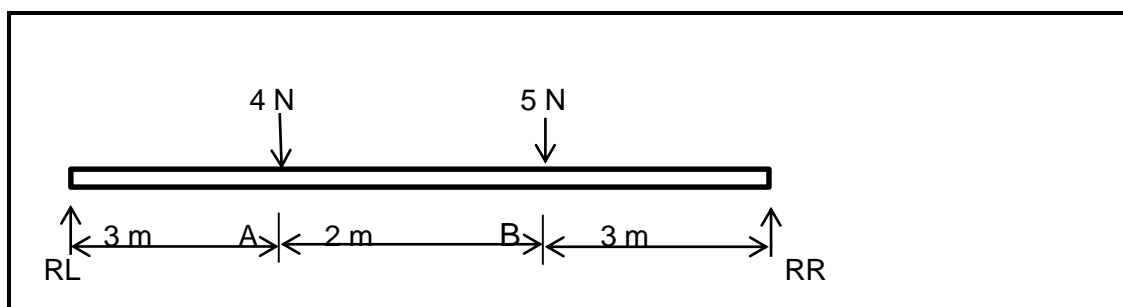
6.4 Mention the FIVE steps, in the correct order, of the shut-down procedure of the oxy-acetylene equipment. (5)

6.5 Name any SIX welding symbol elements. (6)

**[25]**

**QUESTION 7: FORCES**

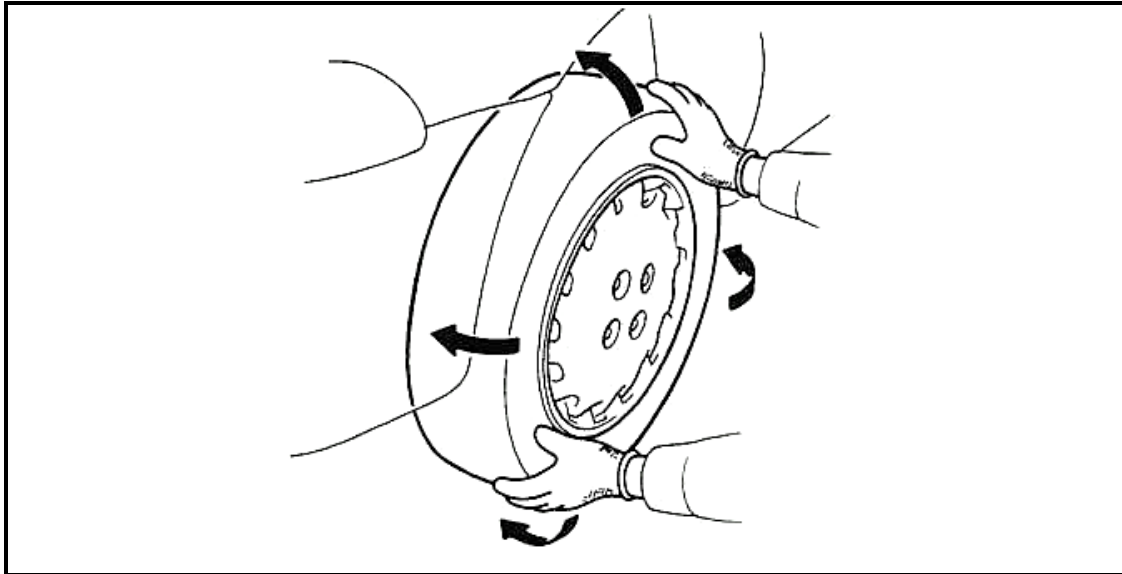
- 7.1 Explain the term “*resultant*” of forces. (2)
- 7.2 Name THREE types of forces found in engineering components. (3)
- 7.3 Calculate the tensile stress in a 25 mm round tube if it is subjected to a tensile load of 12 kN. (6)
- 7.4 Calculate the compressive stress in a 20 x 20 x 200 mm square tube if it is subjected to a compressive load of 10 kN. (7)
- 7.5 The figure below shows a beam with TWO forces acting upon it. It is supported at both ends.



- 7.5.1 Calculate the magnitude of  $R_L$  and  $R_R$ . (8)
- 7.5.2 Calculate the bending moments at points **A** and **B**. (5)
- [30]**

**QUESTION 8: MAINTENANCE**

8.1



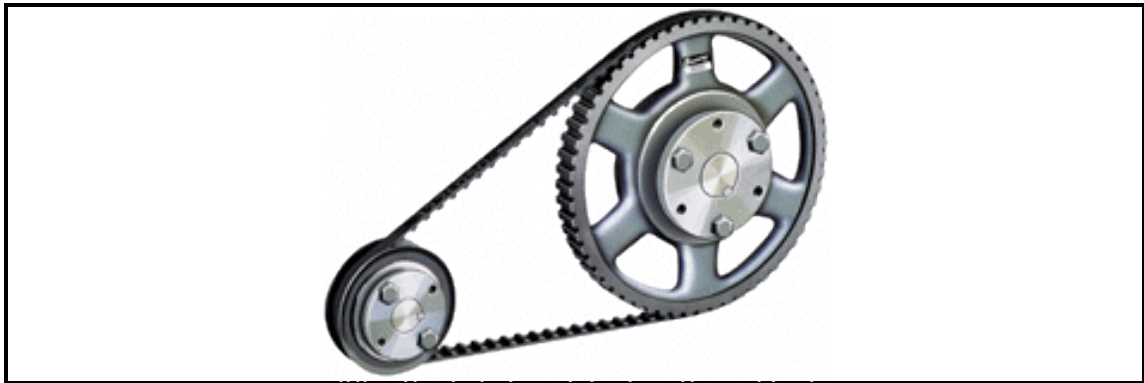
- Give TWO reasons for doing wheel alignment. (2)
- 8.2 State TWO effects of unbalanced revolving parts in a motor car engine. (2)
- 8.3 Mention any TWO types of balancing used when the balancing of the wheels of cars takes place. (2)
- 8.4 Briefly explain the following types of friction:
- 8.4.1 Fluid friction (2)
  - 8.4.2 Rolling friction (2)
  - 8.4.3 Sliding friction (2)
- 8.5 Why is the Ackerman principle used on the steering system of motor vehicles? (2)
- 8.6 What do you understand by the term “*engineering calamities*”? (1)

**[15]**

**QUESTION 9: SYSTEM AND CONTROL**

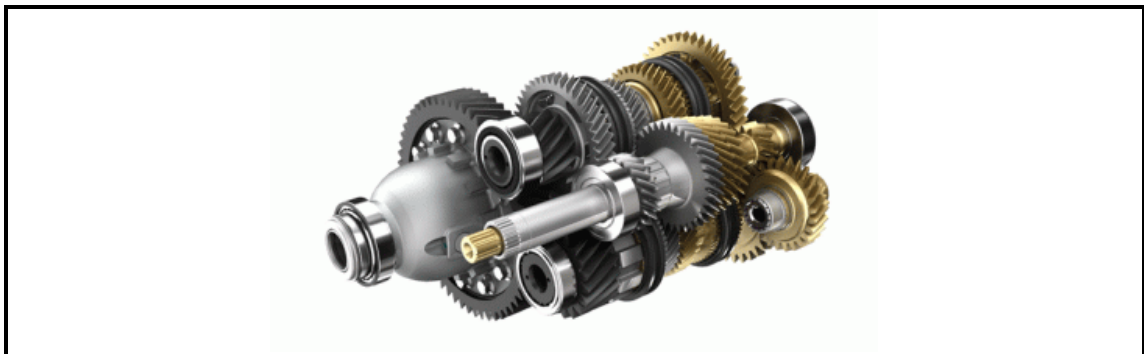
9.1 Which THREE factors determine the potential of the grip of belt drives? (3)

9.2



Mention TWO advantages of belt drives. (2)

9.3



Mention TWO disadvantages of gear drives. (2)

9.4 Explain any TWO functions of a valve in the hydraulic system. (2)

9.5 A shaft revolving at 700 rpm has a 250 mm diameter pulley, which drives a 120 mm diameter pulley on a second shaft by means of a driving belt.

Calculate the speed of the driven shaft in rpm. (4)

9.6 The ram of a hydraulic press has a diameter of 320 mm. It is able to push a force of 12 kN.

Calculate the pressure in the hydraulic fluid. (5)

- 9.7 A machinist is required to design a compound gear train as shown in the figure below.

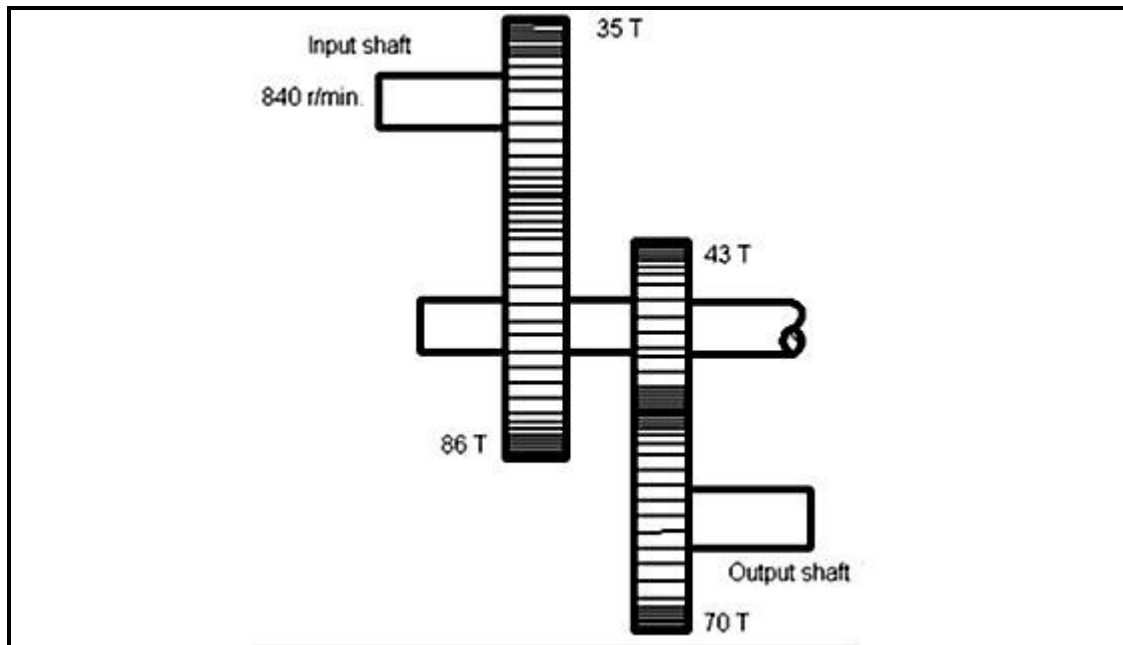


FIGURE 9.7

Calculate the output speed of the output shaft.

(3)

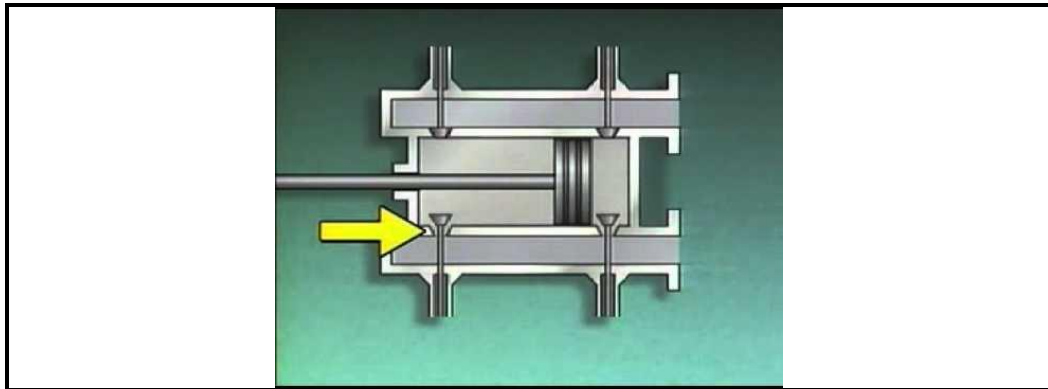
- 9.8 Describe the FOUR basic applications of screw threads.

(4)

**[25]**

**QUESTION 10: PUMPS**

10.1



Name the THREE main parts of a reciprocating pump as shown above. (3)

10.2 Mention THREE advantages of a gear pump. (3)

10.3 Mention THREE disadvantages of a vane pump. (3)

10.4 What causes water hammer? (2)

10.5 Explain the term “*water hammer*”. (2)

10.6 Which faults in the pump system will result in pump slip? (5)

10.7



Name TWO types of pressure relieve valves. (2)  
[20]

**TOTAL: 200**

**GRADE 11****FORMULA SHEET****1. TERMINOLOGY**

$$\text{Depth of cutter} = \frac{\text{Diameter} - x}{2}$$

$$\sin \theta = \frac{x}{\text{Dia}}$$

Where  $x$  = depth of cut.

**2. FRICTION:**

Clockwise moments = Anti-clockwise moments

Upward forces = Downward forces

$$\text{Stress} = \frac{\text{Force / Load}}{\text{Area}}$$

$$\text{Cross Sectional Area} = \frac{\pi D^2}{4} \text{ for round objects.}$$

Cross Sectional Area =  $s \times s$  for square objects

Cross Sectional Area =  $l \times b$  for rectangular objects

**3. SYSTEMS AND CONTROL**

$$\pi D_A \times N_A = \pi D_B \times N_B$$

$$T_A \times N_A = T_B \times N_B = T_C \times N_C$$

$$\text{Pressure} = \frac{\text{FORCE}}{\text{AREA}}$$