



Province of the
EASTERN CAPE
EDUCATION

**NATIONAL
SENIOR CERTIFICATE**

GRADE 11

NOVEMBER 2013

MECHANICAL TECHNOLOGY

MARKS: 200

TIME: 3 hours

This question paper consists of 20 pages, including an answer sheet
and a formula sheet.

INSTRUCTIONS AND INFORMATION

1. Write your centre number and examination number in the spaces provided on the answer book.
2. Answer ALL the questions.
3. Read all the questions carefully.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Write neatly and legibly.
6. Show ALL calculations and units.
7. Candidates are allowed to use non-programmable, scientific calculators and drawing/mathematical instruments.
8. The value of gravitational acceleration constant should be taken as 10 m/s^2 .
9. Use the criteria below to assist you in managing your time:

QUESTION	TOPIC	MARKS
1	Multiple-choice questions	20
2	Safety	10
3	Tools and equipment	12
4	Materials	13
5	Terminology (Manufacturing process)	30
6	Joining methods	25
7	forces	30
8	Maintenance	15
9	Systems and control	25
10	Pumps	20
	TOTAL:	200

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various possible options are provided as answers to the following questions. Choose the correct answer by crossing out the letter in the block of your ANSWER SHEET, for example:

1.21	A	B	C	D
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- 1.1 Which ONE of the following is NOT the responsibility of the person in charge of machinery?
- A This person must install and properly maintain machinery
 - B This person must not repair machinery
 - C This person must ensure that safety guards are in good condition and properly used
 - D This person should stop anyone from using a dangerous machine (1)
- 1.2 What needs to be taken into account when working with a drill press? Which one does NOT fit?
- A Choose the correct drill for the type of material.
 - B Small work pieces can be held by hand on the table during the drilling process
 - C Do not force a drill into the work piece
 - D Set the drill at the correct speed (r/min) (1)
- 1.3 In which class lever will you classify the pipe bending apparatus as shown in FIGURE 1.3?

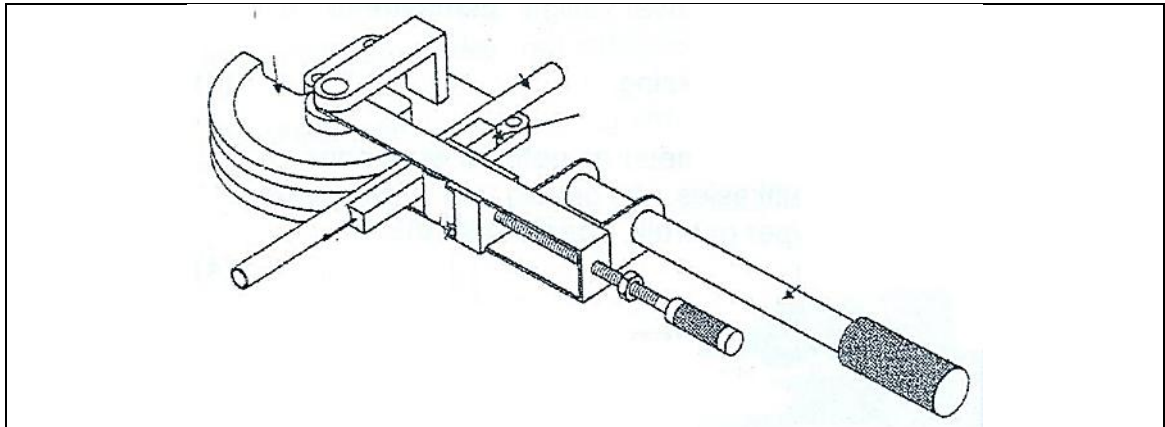


FIGURE 1.3

- A First class
- B Second class
- C Third class
- D None of the above (1)

1.4 Identify the part of the centre lathe that is shown in FIGURE 1.4.

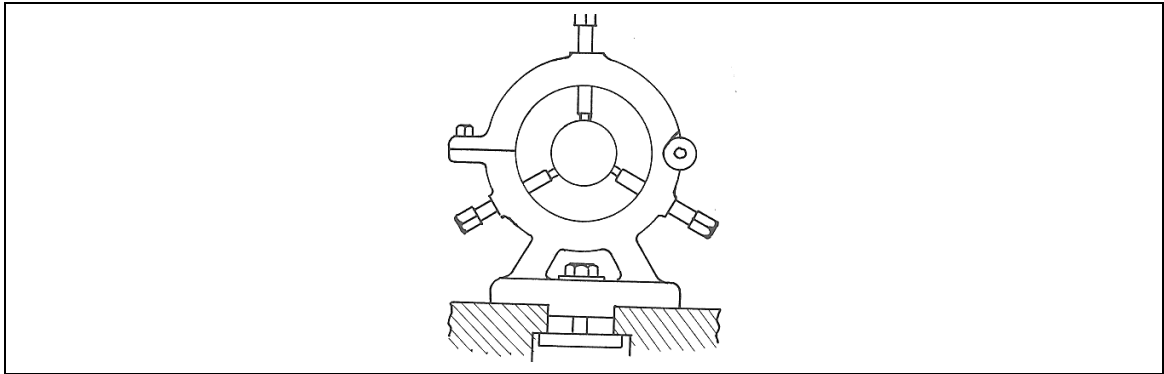


FIGURE 1.4

- A Tool post
- B Compound slide
- C Fixed lathe steady
- D Movable lathe steady

(1)

1.5 The definition for case hardening will be ...

- A to produce a wear resistant surface over a tough core.
- B to produce an extreme hard surface over a soft core.
- C to produce a high carbide surface over a hard core.
- D Not one of the above-mentioned.

(1)

1.6 When the annealing process is performed the hot work piece is ... cooled.

- A rapidly
- B moderately
- C slowly
- D not

(1)

1.7



FIGURE 1.7

The welding symbol marked FIGURE 1.7 indicates ...

- A weld on site.
- B round-shaped butt weld.
- C weld all around.
- D material removal prohibited.

(1)

1.8 Study the sketch of a taper turning procedure which can be carried out on a lathe.

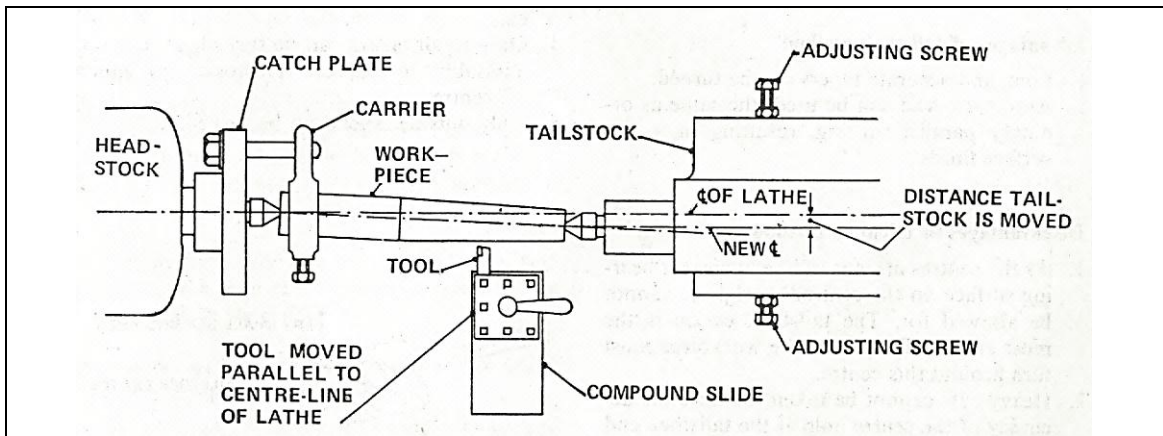


FIGURE 1.8

Which of the answers below represents the procedure in the sketch?

- A Setting over of the tailstock method
- B Compound slide method
- C Taper attachment method
- D Parallel method

(1)

1.9 Identify the type of welding joint shown in FIGURE 1.9.

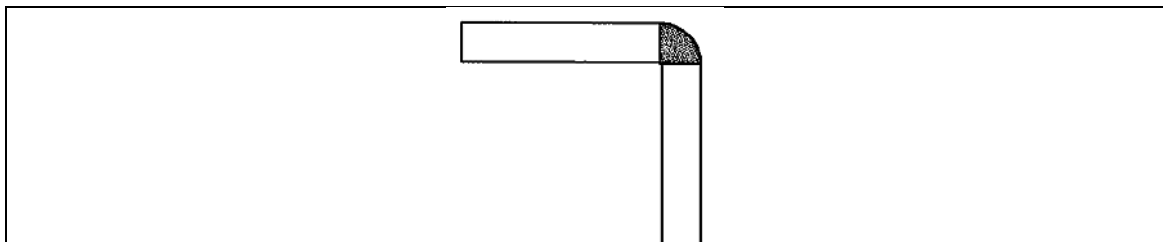


FIGURE 1.9

- A Corner joint
- B Edge joint
- C Butt joint
- D Lap joint

(1)

1.10 Which welding position is illustrated in FIGURE 1.10?

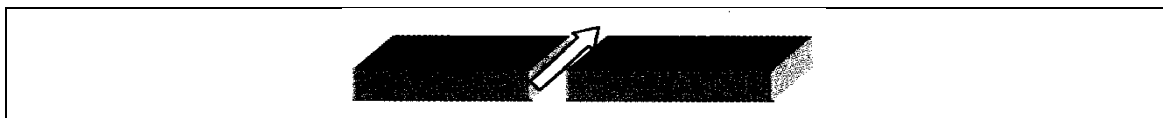


FIGURE 1.10

- A Flat position
- B Overhead position
- C Oblique position
- D Horizontal position

(1)

1.11 Which concept describes “UDLs” the best?

- A A concentrated falling load
- B A uniformly distributed load
- C A sensitive load
- D None of the above

(1)

1.12 What type of lathe method is shown in FIGURE 1.12?

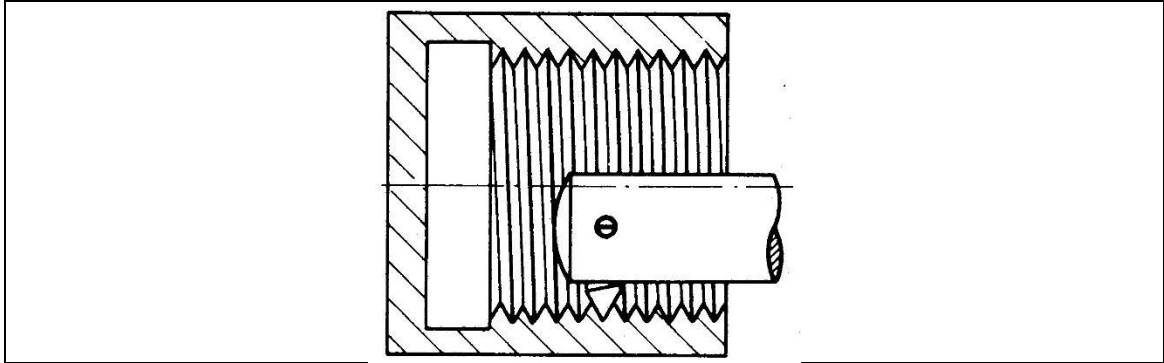


FIGURE 1.12

- A Groove cutting
- B External screw thread cutting
- C Internal screw thread cutting
- D Boring

(1)

1.13 Overheating of an engine can be because of the failure of the cooling system. Which reason(s) can it be?

- A Leakage on the system hoses
- B Leakage because of a damaged cylinder head gasket
- C A broken fan belt
- D All the above-mentioned

(1)

1.14 What will happen if the engine oil in a vehicle becomes too dirty?

- A The oil canals will become blocked
- B The dirty oil circulates and promotes further wear
- C The oil cannot disperse heat effectively
- D All the above-mentioned

(1)

1.15 What is the purpose of the non-return valve in a hydraulic system?

- A To lower the pressure in the system
- B To allow only a certain amount of oil through
- C To allow flow in one direction
- D A and C

(1)

1.16 Why must the battery be disconnected when performing arc welding on a modern vehicle?

- A The arc welder will not strike an arc
- B Electronic components may be damaged
- C The DC current can change to AC current
- D None of the above

(1)

1.17 Which ONE is NOT a basic screw thread application?

- A To hold parts together
- B Not to transmit motion
- C To transmit power
- D To adjust parts with reference to one another

(1)

1.18 Which of the following descriptions represents the type of pump's **operating principle** as shown in FIGURE 1.18?

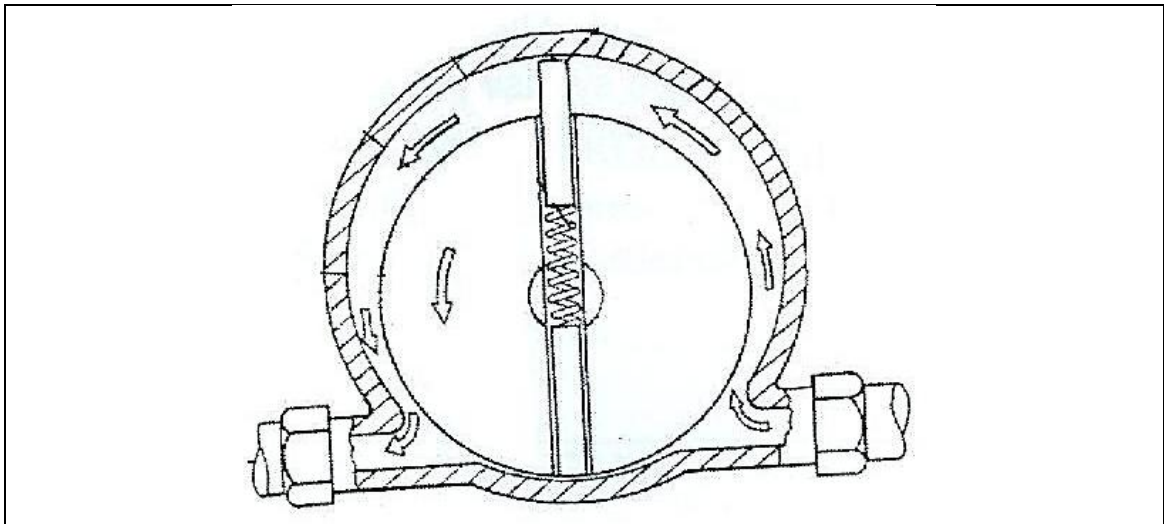


FIGURE 1.18

- A Reciprocating movement
- B Rotating wheel with vane
- C An air current
- D Slinging or rotating blades in a casing

(1)

1.19 Which of the following gear will be found in a car's differential?

- A Worm gear
- B Bevel gear
- C Spur gear
- D Single helical gear

(1)

- 1.20 FIGURE 1.20 shows a beam with three point loads. The left reaction force is 3,25 N.

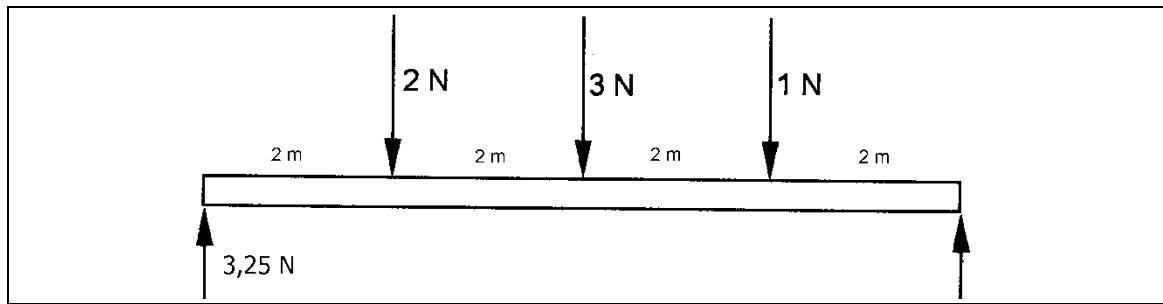


FIGURE 1.20

What will the right reaction force be?

- A 2,125 N
- B 2,46 N
- C 3,67 N
- D 2,75 N

(1)
[20]

QUESTION 2: SAFETY

- 2.1 Explain TWO causes of an accident in a workshop environment. (2)
- 2.2 After welding a joint, you need to grind the joint smooth to give it a perfect finish using an angle grinder. Identify any TWO safety measures to be observed during the use of the angle grinder. (2)
- 2.3 The schools oxy-acetylene welding apparatus needs refilling. Identify THREE safety precautions when handling this equipment. (3)
- 2.4 Express the importance of the following safety factor in a workshop:
- 2.4.1 Lighting (1)
 - 2.4.2 Ventilation (1)
- 2.5 Transmission drives play an important role in machining, but can also be very dangerous if not protected. How would you prevent accidents from happening when working around transmission belts, chains or sprockets? (1)

[10]

QUESTION 3: TOOLS AND EQUIPMENT

3.1 FIGURE 3.1 below shows a precision measuring tool.

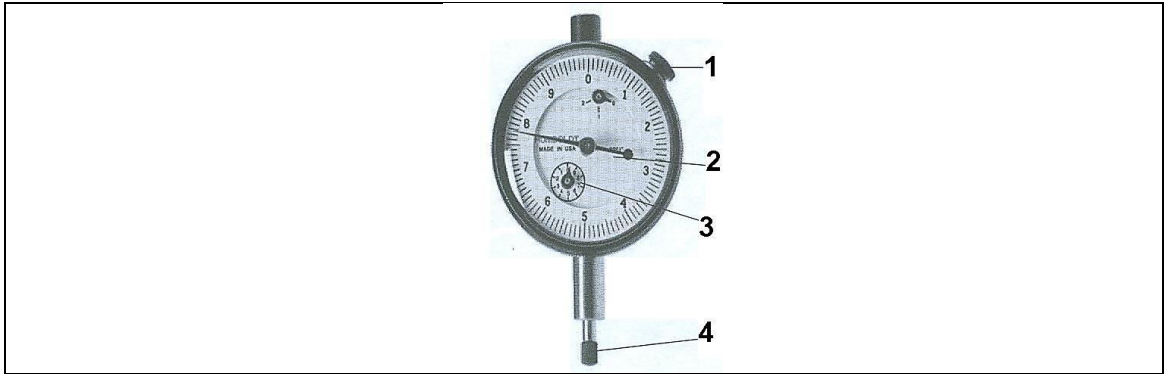


FIGURE 3.1

3.1.1 Identify the measuring tool represented in FIGURE 3.1 above. (1)

3.1.2 Label the parts numbered 1 to 4. (4)

3.1.3 Care must be applied to ensure a long life span of the instrument. State TWO care instructions to promote a long lifespan of this measuring tool. (2)

3.2 FIGURE 3.2 below shows an inside micrometre reading.

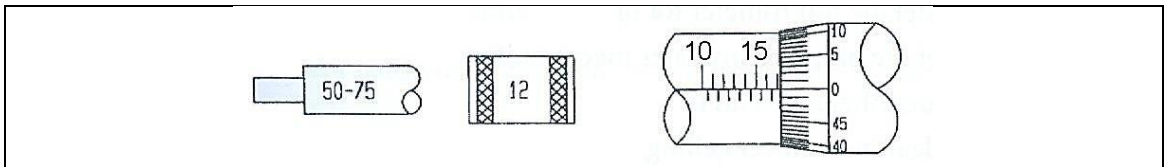


FIGURE 3.2

Write down the reading in the correct order. (1)

3.3 Which tool would you use to determine an unknown screw thread pitch on a bolt? (1)

3.4 In what unit is torque indicated/calculated? (1)

3.5

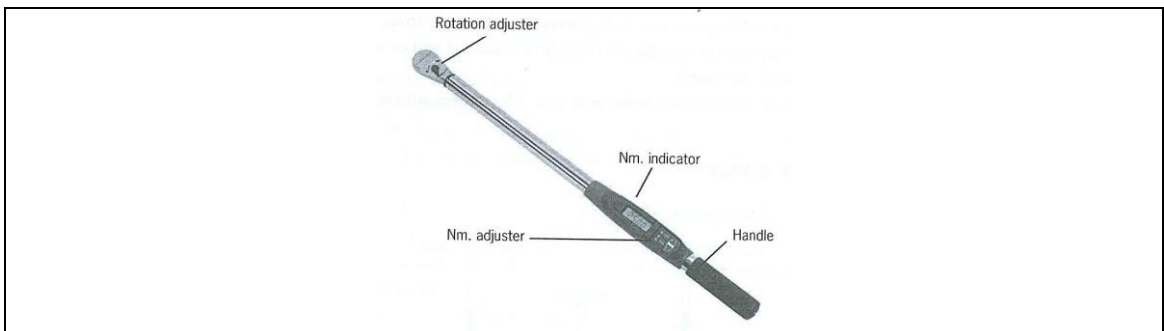


FIGURE 3.5

Give TWO reasons for the use of a torque wrench on an engine. (2)

QUESTION 4: MATERIALS

4.1 Explain the term *heat treatment*. (2)

4.2 In the workshop metals must meet certain requirements and therefore needs to have certain properties.

Give the definition of the following metal property: *ELASTICITY*. (2)

4.3 Tabulate the following heat treatment processes and identify ONE PROPERTY.

PROCESSES		PROPERTY
4.3.1	Hardening	(1)
4.3.2	Tempering	(1)
4.3.3	Annealing	(1)
4.3.4	Normalising	(1)

4.4 The cam shaft is one part that is case-hardened. There are three methods of case-hardening. Name any TWO methods of case hardening. (2)

4.5 What will happen if high-carbon steel is case-hardened? (2)

4.6 The quenching of steel from temperatures above 7 000 °C is a very drastic treatment and is often responsible for cracking and distortion of the work. Give a reason why brine is preferred above tap water. (1)

[13]

QUESTION 5: TERMINOLOGY (MANUFACTURING PROCESS)

5.1 You must cut a taper on your work piece using the compound slide method. The dimensions of the taper are as follows:

The big diameter must be 39,6 mm and the small diameter must be 22 mm and the length of the taper is 50 mm. Calculate the angle to which the compound slide must be set at to cut this taper. (5)

5.2 State TWO advantages of cutting a taper with the compound slide method. (2)

5.3 Sipho is an artisan operating a milling machine at *Gearmax*. Determine by means of calculation the indexing in each of the following cases that he will follow:

5.3.1 A gear with 23 teeth (Simple indexing) (3)

5.3.2 A pentagon (5) (3)

5.4 Complete the following:

5.4.1 Give the unit for *pressure/stress*. (1)

5.4.2 Give the unit for *area*. (1)

5.4.3 Give the unit for *speed/velocity*. (1)

5.4.4 Seven kilometre = ... meters. (convert) (1)

5.4.5 Give the meaning of *RPM*. (1)

5.4.6 Give the meaning of *PCD*. (1)

5.5

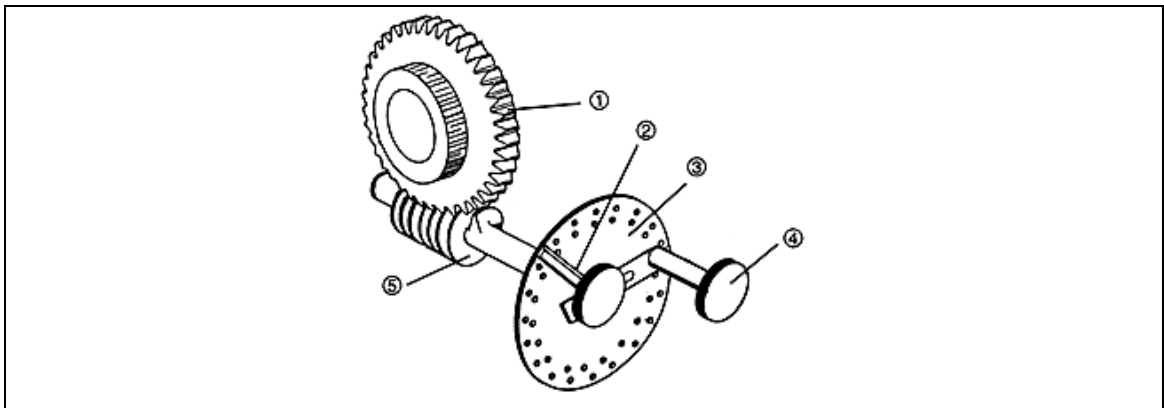


FIGURE 5.5

FIGURE 5.5 shows the functioning components of the dividing head. Label the components numbered 1–5. (5)

5.6 Describe in SIX logical steps how to centre a milling cutter using a dial test indicator. (6)

[30]

QUESTION 6: JOINING METHODS

6.1

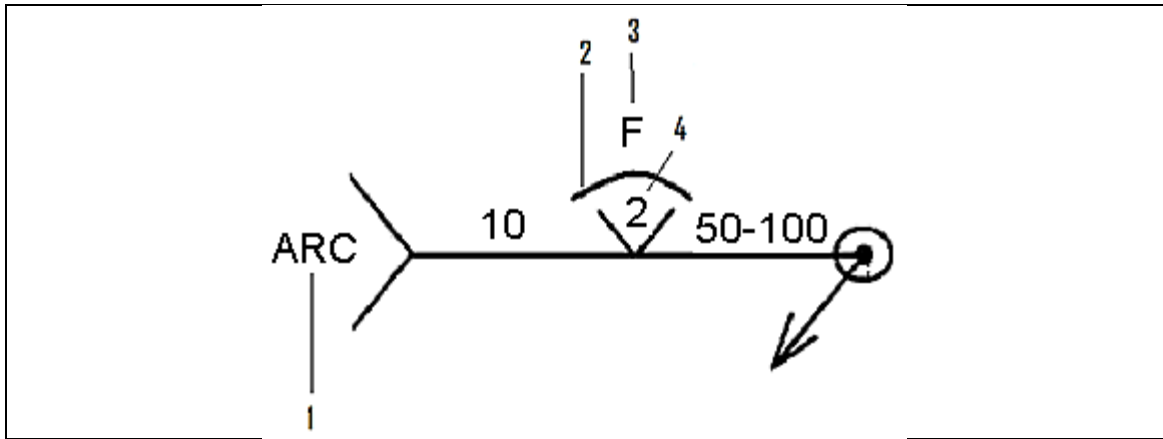


FIGURE 6.1

What is the meaning of the welding symbols as indicated in FIGURE 6.1 marked 1-4? (4)

6.2

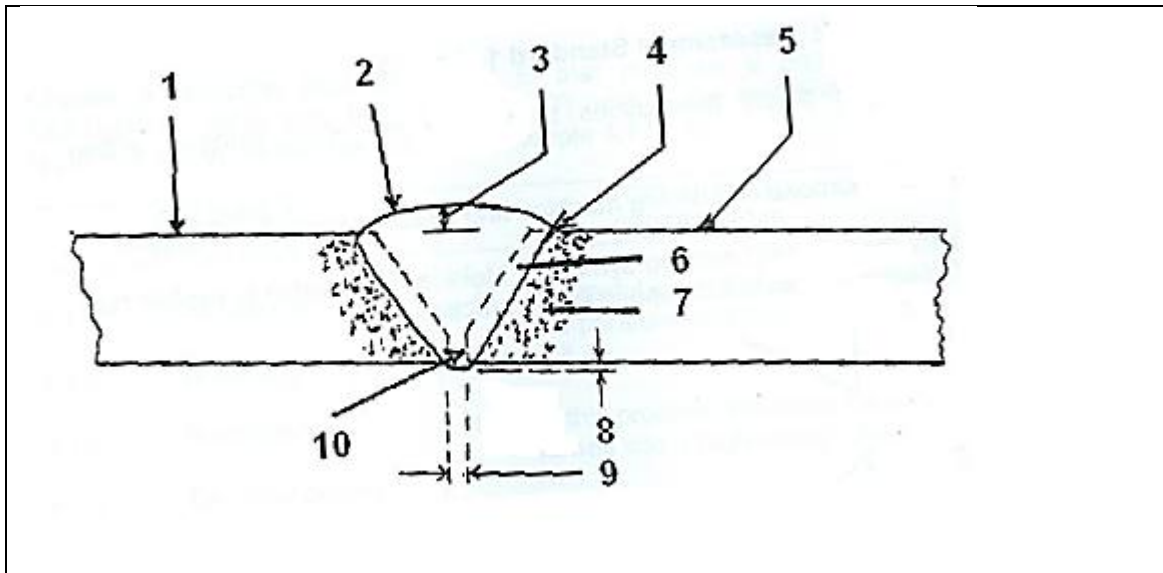


FIGURE 6.2

FIGURE 6.2 above shows a sectional view of an arc welded joint. Label the parts numbered 1-10. (10)

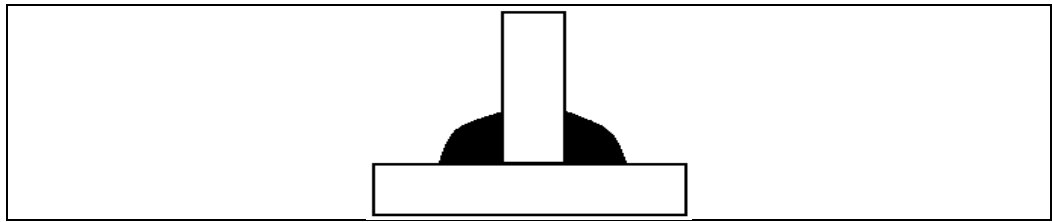
6.3 6.3.1 Describe in SIX steps how the start-up (ignite) procedure will work for the oxy-acetylene apparatus. (6)

6.3.2 Which gas bottle uses left-hand screw thread? (1)

6.3.3 What does it mean to SNIFF a cylinder? (1)

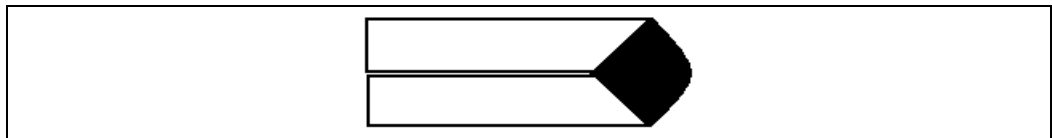
6.4 There are FIVE main types of welding joints. These joints can be brazed, gas welded or arc welded. IDENTIFY the THREE welding joints illustrated below.

6.4.1



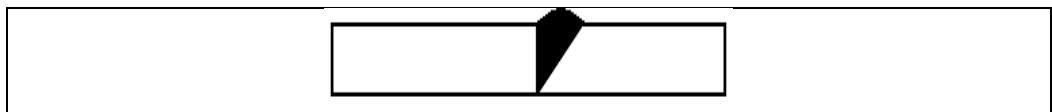
(1)

6.4.2



(1)

6.4.3



(1)

[25]

QUESTION 7: FORCES

7.1 The beam is subjected to two point loads and is supported at both ends by RL and RR as indicated in FIGURE 7.1.

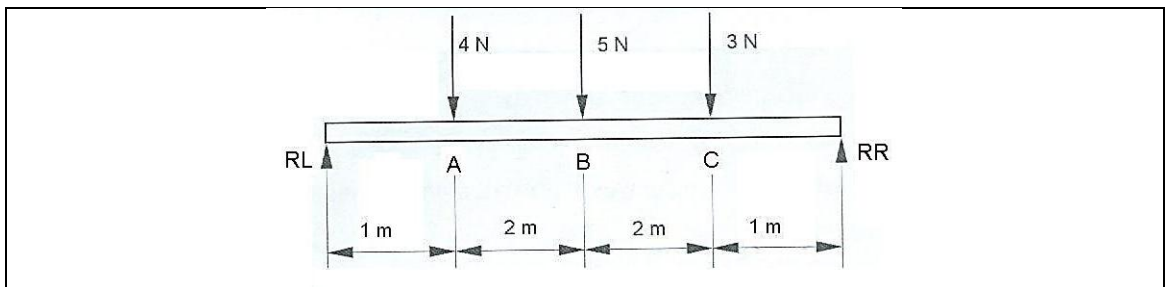


FIGURE 7.1

7.1.1 Calculate the magnitudes of RL and RR. (6)

7.1.2 Test if the beam is in equilibrium. (2)

7.2 FIGURE 7.2 shows an open-end spanner which is used to tighten a nut.

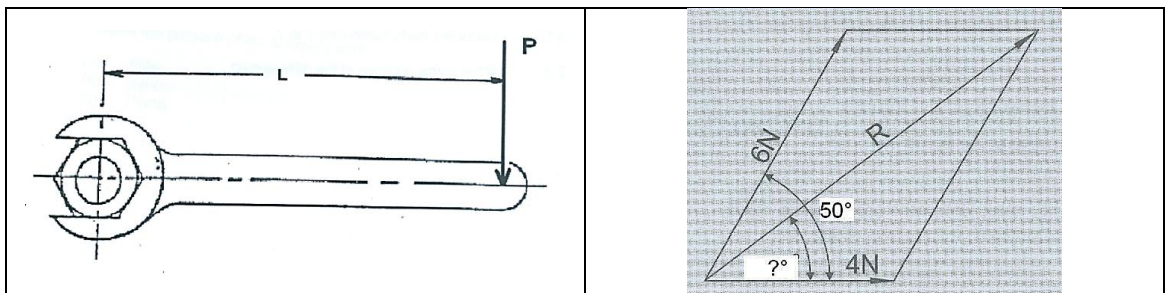


FIGURE 7.2

HINT:

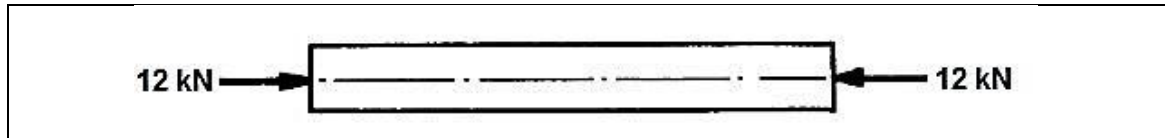
Calculate the force (P) that must be applied to create a torque of 21,6 N.m if the length of the spanner is 350 mm. (4)

7.3 Calculate the magnitude and direction of the resulting force (R) in the force parallelogram below.

FORCE	VERTICAL		HORIZONTAL	
6 N	Y = ...		X = ...	
4 N	$Y = 4 \sin 0^\circ$	0 N	$X = 4 \cos 0^\circ$	4 N
TOTAL				

(12)

7.4



CALCULATE the compressive stress in a 25 mm round steel shaft if subjected to a compressive load of 12 kN. The answer must be in MPa.

(6)
[30]

QUESTION: 8 MAINTENANCE

8.1 In a motor gearbox the components is in contact with each other and friction can never be completely eliminated, but can be drastically reduced by using lubricants. Answer the following questions.

8.1.1 What is the purpose of any lubricant? (1)

8.1.2 What does the term *friction* mean? (1)

8.2 Aluminium moving/sliding over steel has a co-efficient of friction (μ) of 0,4. Calculate the frictional force (F) if the aluminium has a mass of 7 kg.

8.3 Explain the following lubrication terms/abbreviation:

8.3.1 Viscosity (1)

8.3.2 Oiliness (1)

8.3.3 SAE (1)

8.4 Any object in a motor engine or on a motor vehicle which rotates must cause the least possible vibration when it is revolving at speed.

8.4.1 How do you balance parts that are out of balance? Name TWO methods. (2)

8.4.2 Name FOUR important aspects you should know about wheel alignment before setting wheel alignment. (4)

[15]

QUESTION 9: SYSTEMS AND CONTROL

9.1 The FIGURE shows a compound gear drive.

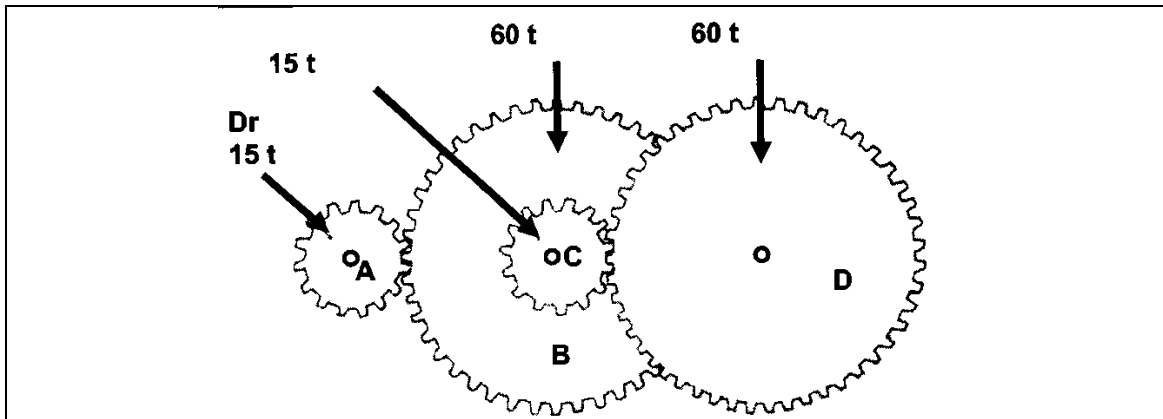


FIGURE 9.1

- 9.1.1 If gear A rotates clockwise, in which direction will gear D rotate? (1)
- 9.1.2 Identify gear A in this compound gear system. (1)
- 9.1.3 Calculate the speed of gear D in r/min if gear A rotates at 480 r/min. (4)

9.2 Screw threads are fundamental to industrial progress. FIGURE 9.2 is an external metric screw thread which can be manufactured by cutting on a lathe.

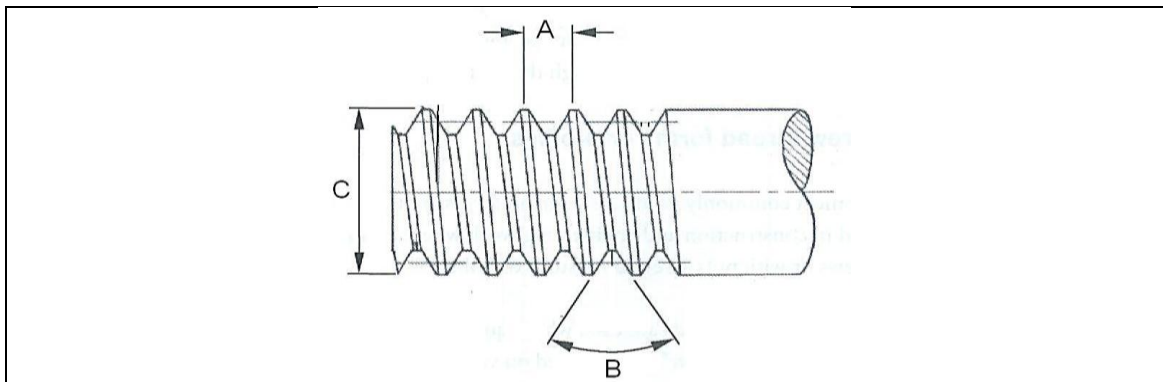


FIGURE 9.2

IDENTIFY the labels (A, B and C) on the screw thread as shown in FIGURE 9.2 and write down each one's DEFINITION. (3 + 3) (6)

9.3 A clutch is a device in which two shafts or rotating members may be connected or disconnected. Clutches can be divided into three types, according to the means of power transmission. Name the THREE categories. (3)

- 9.4 A force of 300 N is applied on piston A of the hydraulic press.

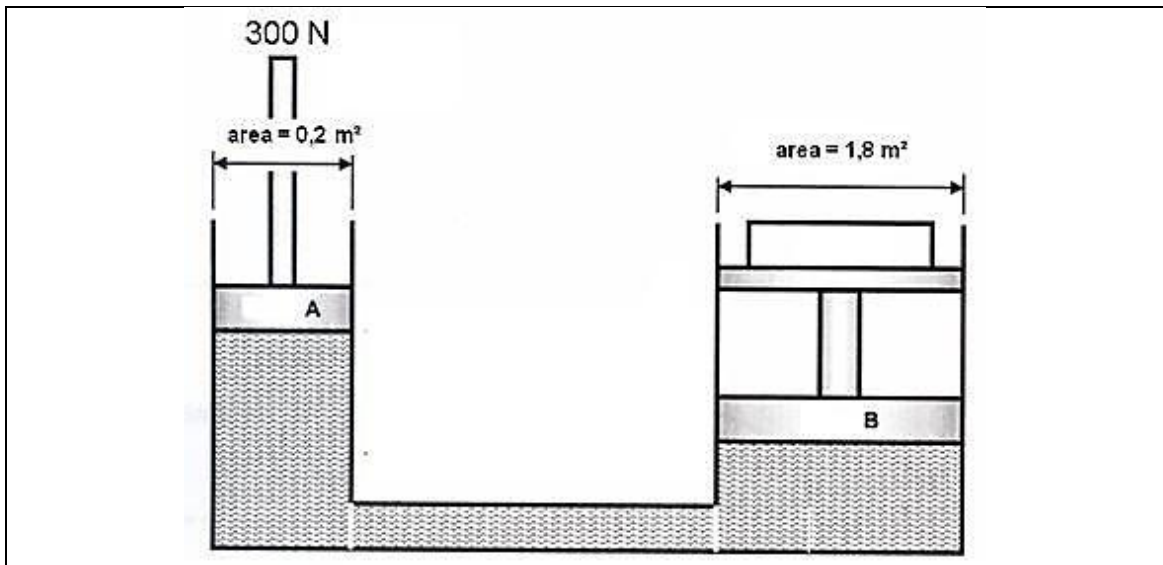


FIGURE 9.4

Calculate the:

- 9.4.1 pressure created in the system in kPa. (3)
- 9.4.2 load that can be lifted by the hydraulic press in kN. (4)
- 9.5 The cam mechanism is commonly used to operate valves in motor vehicle engines.

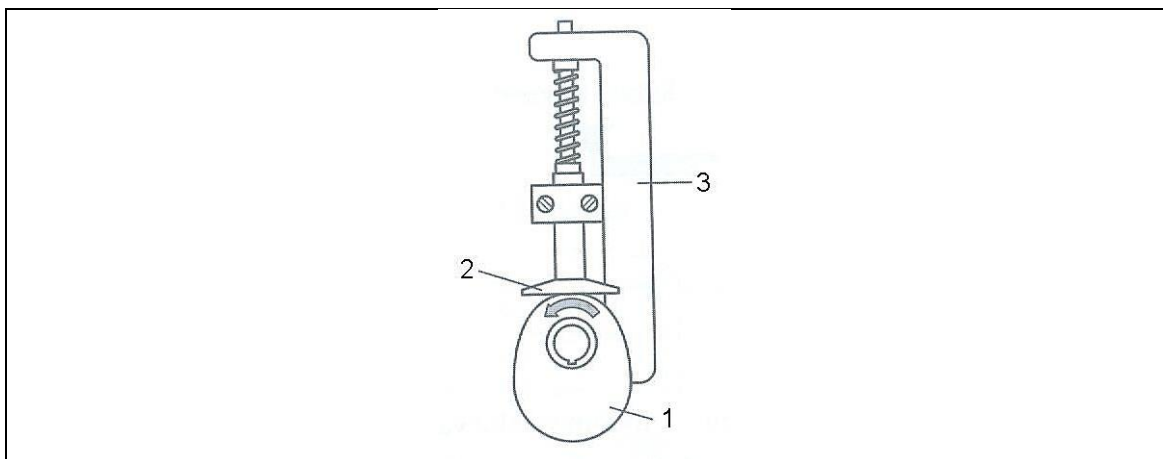


FIGURE 9.5

Identify the THREE parts labelled 1–3.

(3)
[25]

QUESTION 10: PUMPS

10.1 The operating principle of a reciprocating pump is a backward and forward, or up and down movement developed from a circular movement.

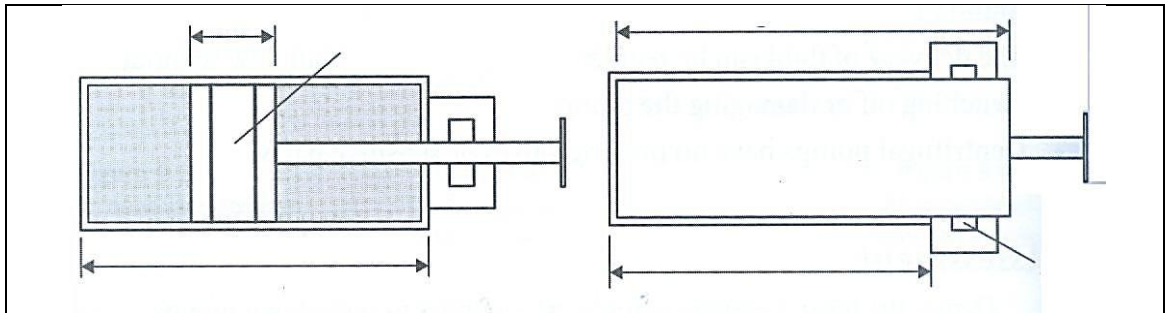


FIGURE 10.1

Name the TWO **main** differences between a piston pump and plunger pump. (2)

10.2 Pump slip is a measure of the amount of fluid that is not delivered but is lost during the operation. List FOUR reasons for pump slip. (4)

10.3

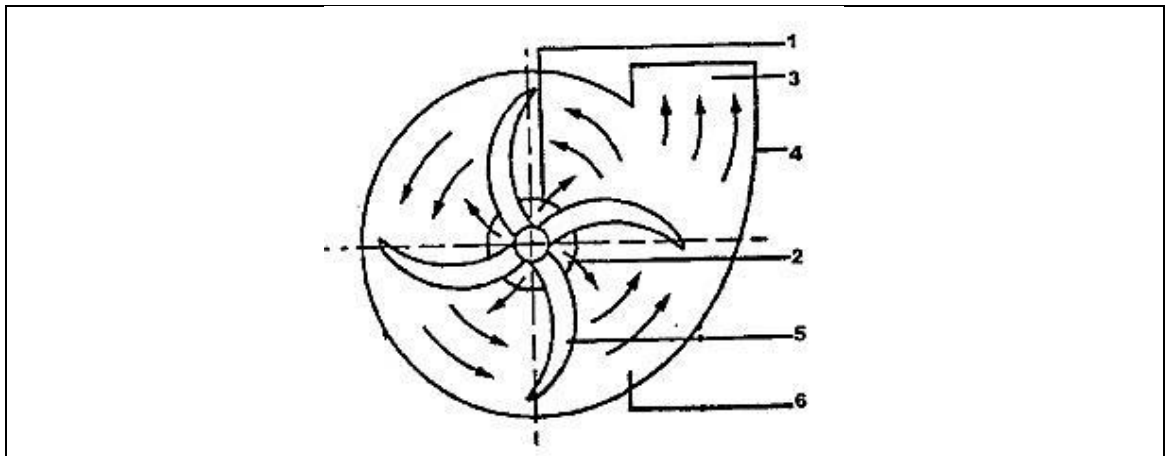


FIGURE 10.3

Label the centrifugal pump used in a motor vehicle as a water pump from 1–6. (6)

10.4 Write down FOUR advantages a centrifugal pump provides above that of a reciprocating pump. (4)

10.5 The monopump is a rotary pump with a helical metal worm that turns inside a rubber stator. Name TWO typical application areas for the use of a monopump. (2)

10.6 The function of engine oil is to prevent metal to metal contact between engine parts. EXPLAIN the necessity of oil pressure in an engine. (2)

[20]

TOTAL: 200

GRADE 11

NOVEMBER 2013

FORMULA SHEET

1. GAUGE BLOCKS

Set nr. M.50

Range	increment in mm	number of blocks
1,0025 to 1,0075	0,0025	3
1,01 to 1,09	0,01	9
1,1 to 1,9	0,1	9
1 to 25	1,0	25
50; 75; 100		3
0,5		1

2. FRICTION:

 $F = \text{force of friction}$ $\mu = \text{co-efficient of friction}$ $N = \text{Normal force}$

$$F = \mu \times N$$

3. TORQUE: T

 $T = \text{Force} \times \text{Distance}$ where

$$T = N.m$$

4. BELT DRIVES

4.1	Belt speed = $\frac{\pi DN}{60}$
4.2	Belt speed = $\frac{\pi(D+t)N}{60}$ (t = belt thickness)
4.3	Belt mass/kilogram = Area \times length \times density (A = thickness \times width)
4.4	Speed ratio = $\frac{\text{Dia.of driven pulley}}{\text{Dia.of driver pulley}}$
4.5	Output speed = $\frac{\text{drive pulley}}{\text{driven pulley}} \times \frac{\text{drive pulley}}{\text{driven pulley}} \times \text{input speed}$
4.6	Open-belt length = $\frac{\pi(D+d)}{2} + \frac{(D-d)^2}{4c} + 2c$
4.7	Crossed-belt length = $\frac{\pi(D+d)}{2} + \frac{(D+d)^2}{4c} + 2c$
4.8	Power (P) = $\frac{2\pi NT}{60}$
4.9	Ratio of tight side to slack side = $\frac{T_1}{T_2}$
4.10	Power (P) = $\frac{(T_1 - T_2)\pi DN}{60}$
4.11	Width = $\frac{T_1}{\text{Permissible tensile force}}$
4.12	$\text{Dia}_A \times N_A = \text{Dia}_B \times N_B$

5. GEAR DRIVES: SPUR GEAR

5.1	Power (P) = $\frac{2\pi NT}{60}$
5.2	Gear ratio = $\frac{\text{product of driven gears teeth}}{\text{product of drive gears teeth}}$
5.3	$\frac{N_{in}}{N_{out}} = \frac{\text{product of driven gears teeth}}{\text{product of drive gears teeth}}$
5.4	Torque = force \times radius
5.5	Torque transmitted = gear ratio \times input torque
5.6	$T_A \times N_A = T_B \times N_B$

6. HYDRAULIC

6.1	Pressure = $\frac{\text{Force (F)}}{\text{Area (A)}}$
6.2	Volume = cross-sectional area \times stroke length (l or s)
6.3	Work done = force \times distance

QUESTION 1 is to be answered on this answer sheet.

NAME: _____

ANSWER SHEET

QUESTION	1	MULTIPLE-CHOICE QUESTIONS
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Example

1.21	A	B	C	D
------	--------------	---	---	---

1.1	A	B	C	D
1.2	A	B	C	D
1.3	A	B	C	D
1.4	A	B	C	D
1.5	A	B	C	D
1.6	A	B	C	D
1.7	A	B	C	D
1.8	A	B	C	D
1.9	A	B	C	D
1.10	A	B	C	D
1.11	A	B	C	D
1.12	A	B	C	D
1.13	A	B	C	D
1.14	A	B	C	D
1.15	A	B	C	D
1.16	A	B	C	D
1.17	A	B	C	D
1.18	A	B	C	D
1.19	A	B	C	D
1.20	A	B	C	D

TOTAL	
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Tear off this page and submit with answer book.