WINTER– 18 EXAMINATION

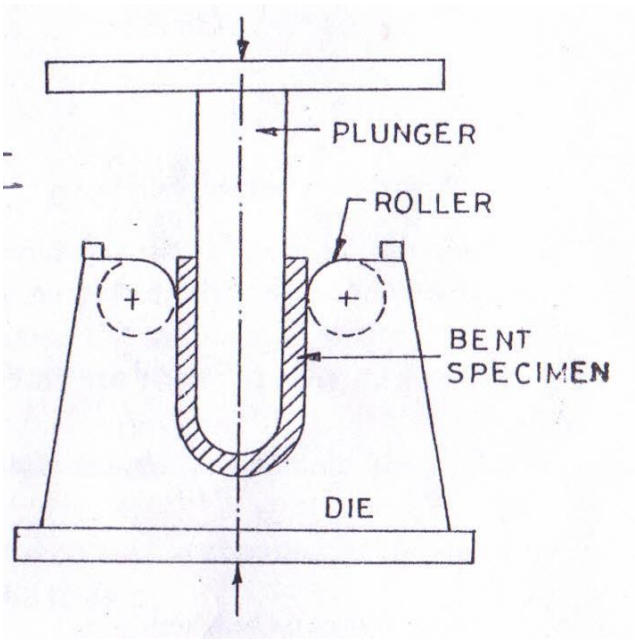
Subject Name: Quality Control & Inspection **Model Answe** Subject Code: 17555

Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q. No.	Sub Q. N.	Answer			Marking Scheme
1	a	Parameters	Line standard	End standard	1mark per point (any four)
		Accuracy of measurement	Limited to +- 0.2mm for high accuracy, scale have to be used in conjunction with microscope	Highly accurate for measurement of close tolerances up to +-0.001 mm.	
		Time measurement	Quick and easy	Time consuming	
		Effect of use	Scale marking not subjected to wear but end of the scale is worn. Thus, it may be difficult to assume zero of scale as datum.	Measuring faces get worn out. To take care of this end piece can be hardened. And of protecting type.	
		Other errors	Parallax error can occur	Improper wringing of step gauges may introduce error change in lab .temperature may lead to some error.	
		Manufacture and cost of equipment	Simple and low	Complex process and high	
		Example	Meter and yard ,etc.	Slip Gauges, Micrometres, etc.	

	b	**Selective assembly:** Under selective assembly, the components are produced under comparatively wider tolerance zone. Then these components are classified into different groups according to size. This is done for all the components. Then the corresponding groups of mating components are used for assembling into final product. This ensures the better precision in the completed assembly with consistency. e.g., if industry is producing any automobile components, it should be under wider tolerance zone and it should be matched with mating components.	4 mark
	c	**Definition of inspection :** Inspection is an act of checking materials, parts, components, or products at various stages in manufacturing and sorting out the faulty or defective items from good ones. **Importance of inspection in quality control.** 1. To detect faulty material and avoid wastage. 2. To remove defective or incorrectly made parts as soon as the fault occurs. 3. To discover and bring defects to the attention of persons concerned before the faults become serious. 4. To detect source of weakness or defect in the final product. 5. To ensure that no substandard or defective product reaches the customer. 6. To promote reputation for quality, thus minimizing customer complaints.	2mark for definition. 2 mark (four point)
	d	**TQM :** Total quality management refers to the total involvement of staff in an organization together with suppliers, distributors and even customers in bringing about quality satisfaction by promoting quality cultures through quality circles, job enrichment and effective purchasing. Advantages of TQM One of important thing in TQM is that it meets the customers' requirement. 1. Continuous improvement of quality at every level at every place and at every stage. 2. Reduce product cost.	2 mark-definition 2 mark (four point)

		3. Increase market share of the company. 4. Productivity improvement. 6. Satisfying workers emotional and intellectual needs for providing them to have better working conditions which ultimately results in better quality of the product. 7. Maintaining a sound quality system, to ensure each task, is performed correct.	
	e	Guided Bend Test  A guided bend test shows surface imperfections near and in the weld bead. A guided bend performed on specially designed jig (Fig). The specimen to be tested is first ground smooth so that all weld reinforcement is removed. The specimen is then placed across the die supports and bent by depressing the plunger until it forms the shape of a U.	1 mark Diagram. 3mark
	f	<u>Advantages of gamma radiography:</u> 1. A permanent record of defects in a welded object is obtained. 2. Reference standards for defects are available. 3. Low initial cost.	2mark-adv

		4. This is a very good method for testing at the site. Disadvantages of gamma radiography: 1. Trained operator is required. 2. The method involves radiation hazards. 3. ϒ-ray source loses strength continuously. 4. ϒ-ray radiography possesses lower sensitivity and definition than X-ray radiograph	2mark-disadv.
	g	DIN: Deutsches Institute for Normung ➢ In English-German institute for standardization. ➢ It is the German national organization for standardization. ➢ There are currently thirty thousand DIN standards, covering almost all fields of technology.	4 mark
2	a	Rockwell hardness test procedure : • Test piece is placed upon the machine. The machine dial is showing any reading. • Hand wheel is turned, thereby raising the test piece up against the steel ball indenter till the needle on the dial reads zero. This applies minor load. • Major load is applied by pressing the crank provided on the right hand side of the machine. • Crank is turned in the reverse direction thereby withdrawing major load. But leaving minor load applied. • Hand wheel is rotated and the test piece is lowered. • At this stage, the hardness of the test piece material can be directly read from the dial scale.	2 mark procedure

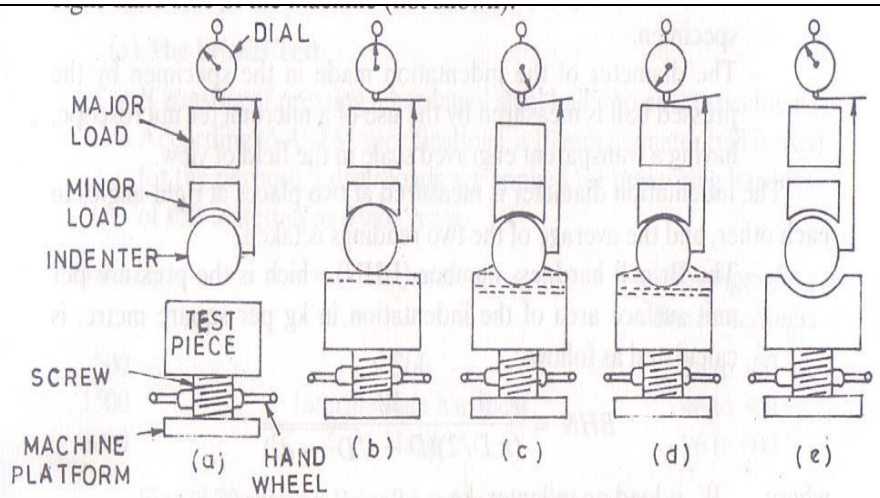


Fig. 38.21. Procedure for measuring rockwell hardness.

1 mark diagram.

(any two fig)

ROCKWELL HARDNES NUMBER :

The hardness of the test piece material can be directly read from the dial scale.

1 mark

b

Leak test under fluid pressure:

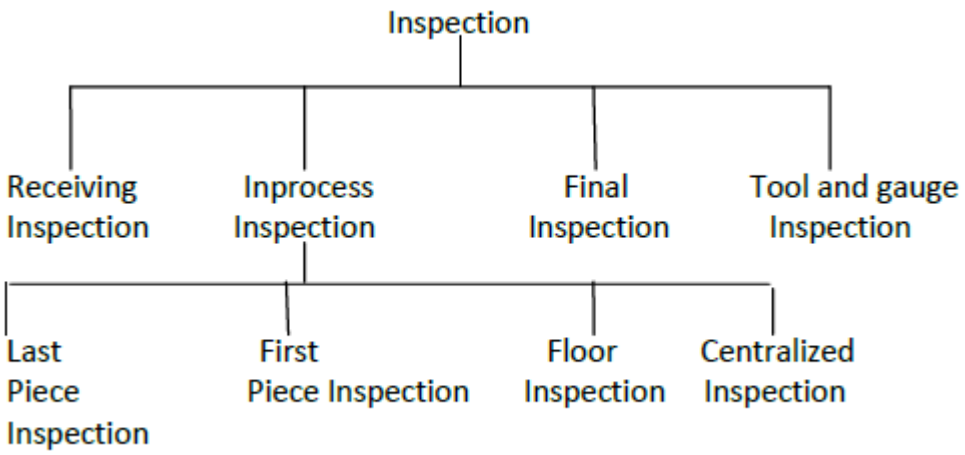
- Leak refers to an actual discontinuity or passage through which a fluid flows or permeates.
- The welded vessel, after closing all its outlets; is subjected to internal pressure using water, oil, air or gas (e.g. CO2),
- Hydraulic pressure, using water as the fluid, is the usual medium employed in this test.
- Oil if it is thin/hot will penetrate leaks that do not show up with water under equal pressure.
- Air will leak out more readily than water and gas (e.g. Hydrogen) will escape where air will not.
- Where feasible, it is better to use water or oil because there will be very less tendency for the parts to be violently thrown out in case of a sudden release of pressure.
- When using air/gas, failure of vessel can cause injuries to persons around.

4 m

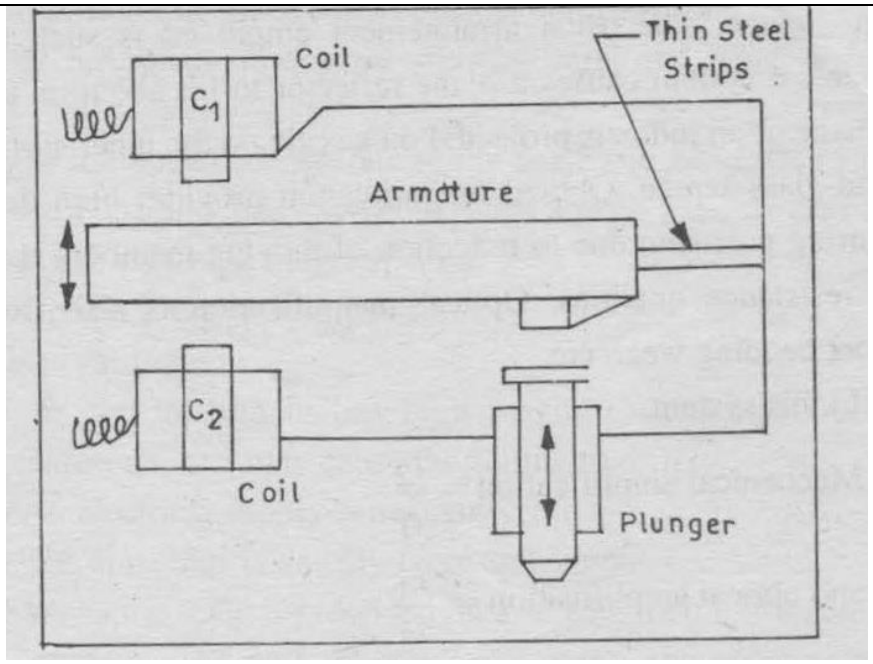
c

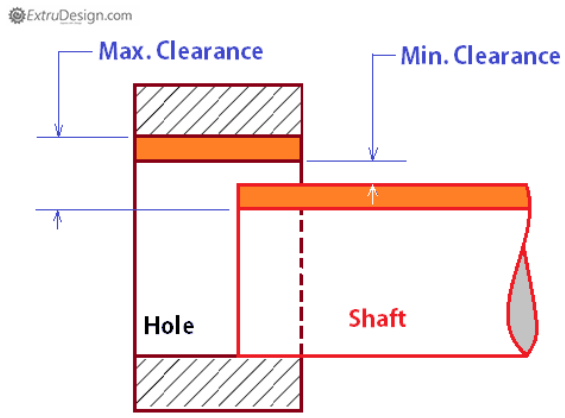
Parameters	Inspection	Quality control
Scope	Inspection is a part of quality control.	Quality control is a broad term, it involves Inspection at particular stages.
Definition	Inspection is an act of checking materials, parts, components, or products at various stages in	QC is an effective system for integrating Quality development, maintenance and improvement

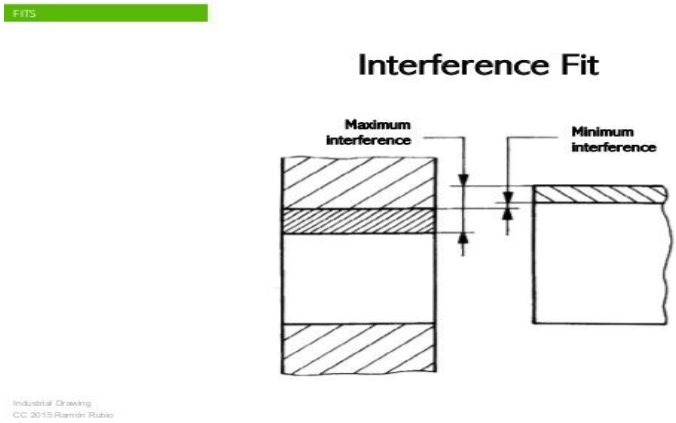
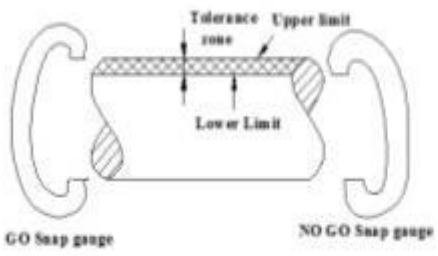
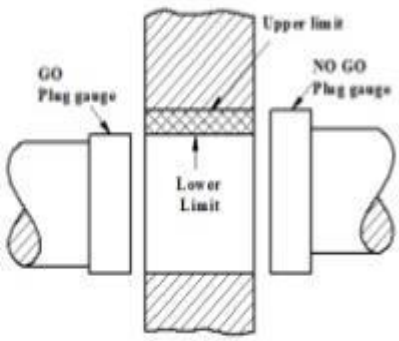
1mark-1 point(any 4)

			manufacturing and sorting out the faulty or defective items from good ones.	efforts of various groups of an organization to enable the productions to be carried out at most economic level.	
		Devices used	It involves use precision measuring devices like venire callipers, micrometre, etc. and devices such as tool maker's, microscope, profile projector, flaw detector, etc.	QC uses devices such as statistics, control charts, acceptance sampling, process capability study, YQR,YR, quality audits, etc.	
		Application	It is concerned with quality of past production to judge conference with specifications and sorting out defective items from good ones.	It is concerned with quality of future production. What is learnt from inspection is used as a basis to ascertain. Whether the quality meets the specifications or not.	
	d	 Objective of Receiving Inspection: • To prevent goods which don't fulfill the quality requirements from the production process and their by causing production problems and delays. • The inspection takes place before the goods are stored or go to manufacture.		2 marks classification 1/2 mark (any one pt)

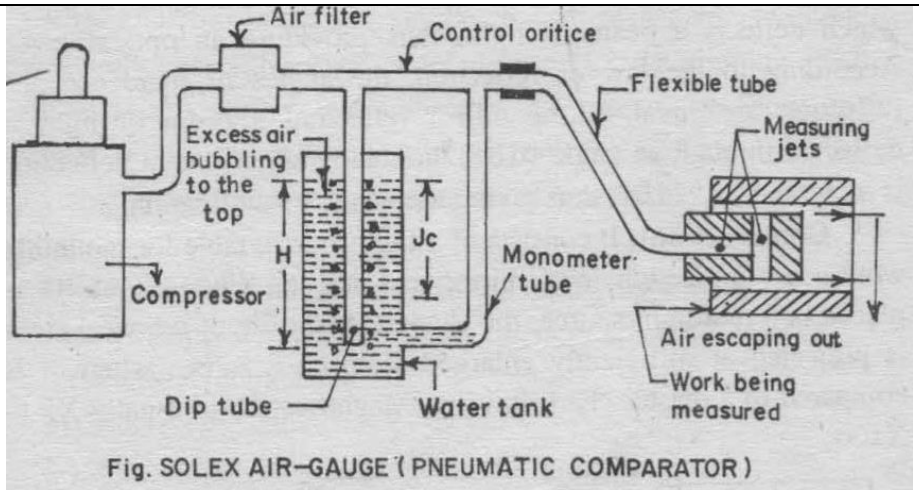
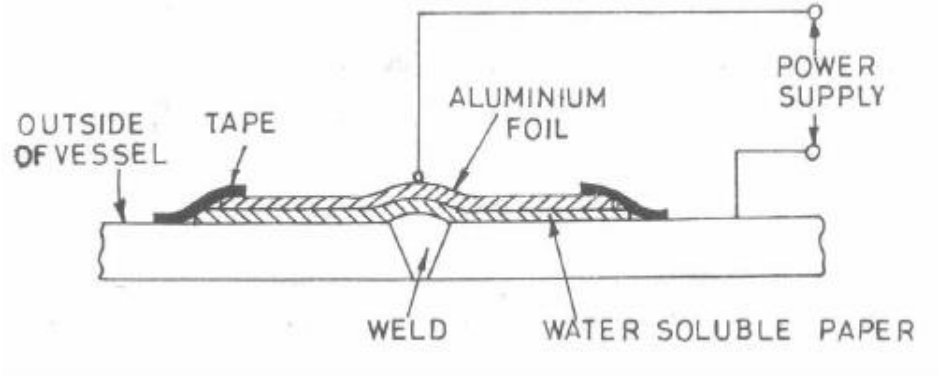
		Objective of Inprocess Inspection: • Wastage is minimizing in the early stage, thereby reducing cost of production. • Defects may be quickly discovered and corrected. • Avoids further working on defective products. Objective of Final Inspection: • An unthrough inspection of finish and final goods may permit faulty products to be dispatched to the customer because it is a last chance of detecting inspection in the products manufacturing. • Functional to ensure that the product will work to specification. Objective of Tool and Gauges Inspection: Tools and gauges should provide physical means of attaching volume of production and at the sometime facilitated inspection, testing of parts, and component to the required degree of uniformity.	1/2 mark (any one pt) 1/2 mark (any one pt) 1/2 mark (any one pt)
	e	Quality of conformance: The quality of conformance is concerned with how well the manufactured product conforms to the quality of design. Requirements for good quality conformance: • The incoming raw materials are of adequate quality. The machines and tools for job and the measuring instruments are adequate for their purposes and are kept at high level of maintenance. • Proper selection of the process and adequate process control. • The operators should be well trained, experienced and motivated for Quality consciousness. • Proper care should be taken in shipment and storage of finished goods. • Inspection program is such that it gives accurate measure of the efficiency or the whole system and ensures to reduce and sort out defective products from the lot during processing.	2mark meaning 2m (any 4 pt)

		• Feedback from both the internal inspection and the customers, are obtained regarding quality for taking corrective action. • S.Q.C. techniques should be used to control variability in manufacturing process. • - Higher quality of design usually costs more, higher quality of conformance usually costs less, by reducing the number of defective products produced.	
	f	 In electric comparators, the movement of the measuring contact is converted into an electrical signal. This electrical signal is recorded by an instrument which can be calibrated in terms of plunger movement. This can be obtained by an AC Wheatstone bridge circuit incorporating a galvanometer. The principle of an electrical comparator is explained as follows. An armature supported on this steel strips is suspended between two coils C1 and C2. For the equal distance of the armature surface from the two coils, the Wheatstone bridge circuit is in balanced condition and no current flows through its galvanometer. Slight movement of the measuring plunger unbalances the bridge resulting in the flow of current through the galvanometer. The scale of the galvanometer is calibrated to give the movements of the plunger	Sketch – 2 mark Explanatation -2mark
3	a	Advantages of electronics Comparator are as follows: 1. The electronics comparator has very few moving parts, so less wears and tears.	2mark-adv

		2. It is possible to have high magnification and the same instrument can have two or more magnifications. Thus, wide range is available. 3. The mechanism carrying pointer is very light and not sensitive to vibrations. 4. As these instruments are usually operated on A.C. supply, the cycle vibration substantially reduces errors due to sliding friction. Disadvantage: 1) It requires on external agency to operate i.e.AC/DC electric supply. 2)This is usually more expansive than mechanical comparator 3) The variations in voltage or frequency of electrical supply may affect the accuracy. 4)Heating of coil in the measuring unit may alter calibration	2 mark – disadv.
	b i	Clearance Fit: E.g. Sliding Fits, Running Fits, Shaft Running in Bush. 	2 mark
	ii	Interference fit : E.g. Bearing bushes in their housing small end of connecting rod.	2 mark

			
	c	Following are the different factors on which quality of a product depends. 1) The materials 2) Manufacturing process 3) Operators skill 4) Design of product. 5) Products including packing and packaging 6) Machine and tools.	01 mark for each factor. (ANY FOUR)
	d	Taylor's principle is applied in designing GO and NO GO gauges for checking maximum and minimum limits as - i) GO limit: This designation is applied to that limit of the two limits of size which corresponds to maximum material limit consideration, i.e. the upper limit of a shaft and lower limit of a hole. The form of the GO gauge should be such that it checks one feature of the component in one pass. ii) NO GO limit: This designation is applied to that limit of the two limits of size which corresponds to minimum material limit condition, i.e. the lower limit of a shaft and higher limit of a hole. “NO GO" gauges should check only one part or feature of the component at a time.  	4mark

	e	Penetrameter like x ray in radiography testing worked as follows. X rays are produced in X ray tube where cathode produce electron which move towards the anode. A part of K.E.is converted to energy of radiation on X rays. 1. The portion of weld metal where defects are to be suspected is exposed to X rays emitted from the tube. 2. X-rays are produced in X-ray tube were a cathode produced electrons which move towards anode. A part of K.E is converted to energy of rotation of x-rays 3. A cassette containing X ray film is place behind and in contact with weld ment perpendicular to the rays. 4. During expose X rays penetrated the welded object and thus affect welded X- ray film. 5. The X- Ray photograph shows the existence of flaw, internal crack, Leak or any deformity with their exact location.	4 MARK
	f	**Leak test by gas** Procedure: The welded vessel, after closing all its outlets; It is subjected to internal pressure using gas (e.g. CO2), helium, and hydrogen. The internal pressure may be raised to two times the working pressure. And pressure gauge may be noted immediately after applying the internal pressure, And after 12 to 24 hours any drop in pressure indicates a leak. Air will leak out more readily than water and gas (e.g. Hydrogen) will escape where air will not. Where feasible, it is better to use water or oil because there will be very less tendency for the parts to be violently thrown out in case of a sudden release of pressure. When using air/gas, failure of vessel can cause injuries to persons around. Applications: 1. To determine the leakage from the pressure vessels, boiler, tank, heat exchanger etc... 2. To find out the cracks, discontinuity from close vessels.	3mark-explanation. 1 mark application.

4	a	 Fig. SOLEX AIR–GAUGE (PNEUMATIC COMPARATOR) Working Principle: This is designed for internal and external measurements. The arrangement used in the pneumatic comparator [Solex pneumatic gauge] is to pass high pressure air after filtering through a flow valve. There is a tank in which water is filled up to a certain level; a dip tube is immersed into it up to a depth corresponding to the air pressure required. Since the air is sent at a higher pressure than the required one, some of it will leak out of the dip tube and the air moving towards the control orifice will be at the desired and constant pressure (H). The air at reduced pressure then passes through the control orifice and escapes from the measuring jets. The back pressure in the circuit is indicated by the head of water displaced in the manometer tube. The tube is graduated to show changes of pressures resulting from changes in the internal diameter of the work being measured. This instrument is capable of measuring to the accuracy of microns.	2 mark- DIAGRAM 2 mark- EXPLANATION
	b	Leak test by water soluble paper with Aluminium foil. In this method the vessel to be tested is pressurized with water and Al foil is laid over the widest strip of water soluble paper and bath are struck with a tape over a welded seam. If a leak exists the water soluble strip will dissolve and the Al foil strip will be in electrical contact with the vessel the flow of current indicates leakage in the pressure vessel. 	3mark 1 MARK DIA

c

Destructive testing	Non Destructive testing
1.Mesurement are direct and reliable	1.Mesurement are indirect and reliability is to verified
2.Usually quantities measurement	2.Usually qualities measurement and measurement can also be done quantitavely
3. Correlation between test measurement and material properties are direct.	3. Skilled judgment and experience are required to interpret indication.
4. Test is not made on the object directly hence correlation between the sample specimens use and object need to be project.	4. Test are made directly on the object 100% testing on actual component is possible.
5.Single test may measurement only one are few of the properties	5.Many NDT methods can be applied on the same part and hence may or all properties can be measured
6.measuement of properties are a cumulative period of time cannot readily be possible	6. Repeated checks over a period of time are possible.
7 Preparation of test specimen is costly	7.Very little preparation is sufficient
8. Time requirements are generally high.	8. Most test method is rapid.

1 MARK -1 POINT

(any four pt)

d

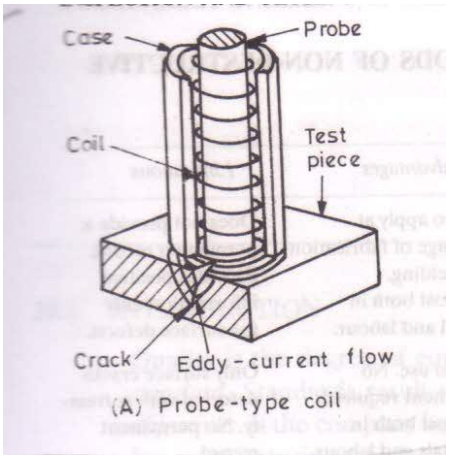
Compare charpy test and izod test.

Charpy test	Izod test
1.Specimen is placed in the vice so that it is simple beam	1.Specimen is placed in the vice so that it is cantilever beam
2.Specimen is hit behind the V notch	2.Specimen is hit above the V

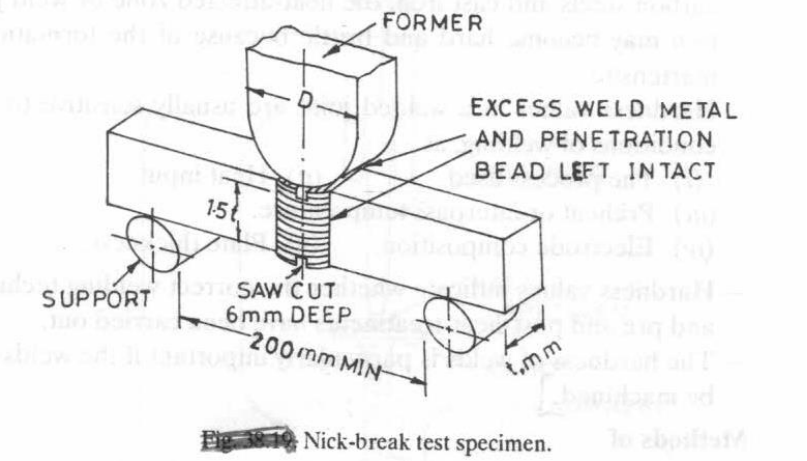
1mark-1point

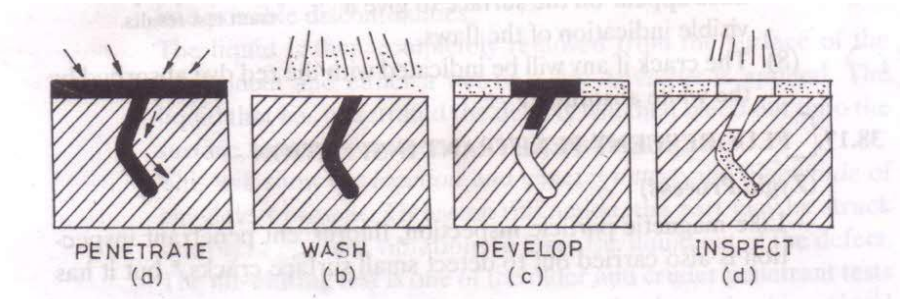
			notch	
		3.Dimensions of specimen is 55x10x10mm	3.Dimensions of specimen is 64x12.7x3.2 mm	
		4. Materials tested are metals only.	4. Materials tested are plastic and metals.	
	e	**IBR** INDIAN BOILER REGULATION **Reg.1** Short Title, Extent, Application and Commencement **Reg.2** Definitions **Reg.3** General Requirements, Applications of Standard Conditions and Expectations thereto **Reg.3A** Inspection of Boiler to comply into any foreign code **Reg.4** Standard Requirements-Material, Construction, Inspecting Authority's Certificates and Maker's Stamp **Reg.4A** Application for Recognition **Reg.4B** Scrutiny of applications by the Evaluation Committee **Reg.4C** Recognition of a firm as Competent Authority, Inspecting Authorities, etc. **Reg.4D** Validity of Certificate of Recognition **Reg.4E** Renewal of Certificate of Recognition **Reg.4F** Application for registration of existing competent authority **Reg.4G** Appeal **Reg.4H** Function of Evaluation committee Note: any other regulation should be considered. ASTM International, formerly known as the American Society for Testing and Materials (ASTM), is a globally recognized leader in the development and delivery of international voluntary consensus standards. Today, some 12,000 ASTM standards are used around the world to improve product quality, enhance safety, facilitate market access and trade, and build consumer confidence.	2 mark-IBR 2 mark-ASTM
	f	ASME Codes for pipes B31 Code for pressure piping, developed by American Society of Mechanical Engineers - ASME, covers Power Piping, Fuel Gas Piping, Process Piping, Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids, Refrigeration Piping and Heat Transfer Components and Building Services Piping. ASME B31 was earlier known as ANSI B31. B31.1 - 2001 - Power Piping B31.2 - 1968 - Fuel Gas Piping	2 MARK (ANY 2

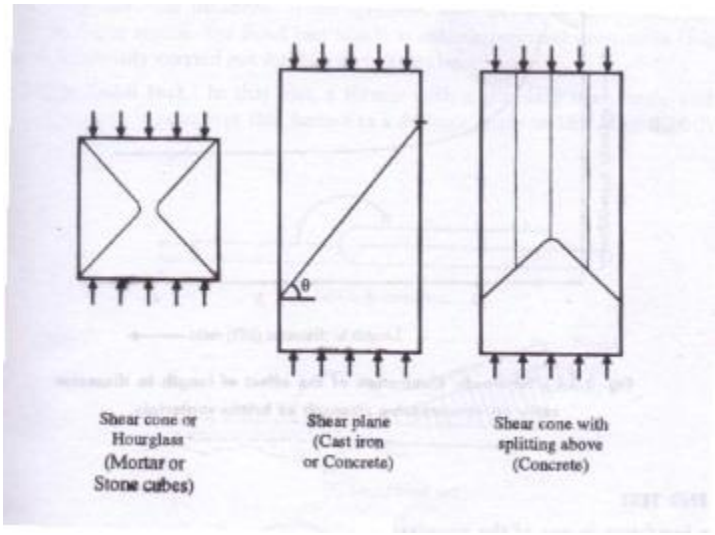
		B31.3 - 2002 - Process Piping B31.4 - 2002 - Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids B31.5 - 2001 - Refrigeration Piping and Heat Transfer Components B31.8 - 2003 - Gas Transmission and Distribution Piping Systems B31.8S-2001 - 2002 - Managing System Integrity of Gas Pipelines B31.9 - 1996 - Building Services Piping B31.11 - 2002 - Slurry Transportation Piping Systems B31G - 1991 - Manual for Determining Remaining Strength of Corroded Pipelines ANY CODES OTHER THAN ABOVE ARE ACCEPTED <u>ASME Codes for pressure vessels</u> ASME:B36.19M stainless steel pipe this standard provides dimensions of welded and seamless wrought stainless steel pipe for high or low temperature and pressure application ASME B36.10M — Welded and Seamless Wrought Steel Pipe ASME B46.1 — Surface Texture (Surface Roughness, Waviness and Lay) ASME B18.2.2 --Square and Hex Nuts ANY CODES OTHER THAN ABOVE ARE ACCEPTED.	CODE) PIPES 2 MARK (ANY 2 CODE) PRESSURE VESSELS
5	a	EDDY CURRENT TESTING - An A.C. coil is brought up close to the weldment to be tested. - The A.C. Coil induces eddy currents in the welded object. -These eddy currents produce their own magnetic field which opposes the field of the A.C. coil. -The result is an increase in the impedance (resistance) of the A.C. Coil. Coil impedance can be measured. -If there is a flaw in the weldment, as soon as the coil passes over the flow, there	4mark-procedure

		is a change in the coil impedance which can be wired to give a warning light or sound and thus the flaw and its location can be deter- mined. -Flaws at or close to the surface such as cracks, weld porosity, poor fusion or any linear discontinuity can be detected  APPLICATIONS: 1. Surface inspection is used extensively in the aerospace industry and petrochemical industry. 2. The technique is very sensitive and can detect tight cracks. 3. Surface inspection can be performed both on ferromagnetic and non-ferromagnetic 4. Conventional ECT is used for inspecting steam generator tubing in nuclear plants and heat exchangers tubing in power and petrochemical industries. 5. The technique is very sensitive to detect and size pits. 6. Wall loss or corrosion can be detected.	2m DIA 2M application (any 2pt)
	b i	Principle: 1) When a specimen is magnetized the magnetic lines of force are periodically inside ferrous magnetic material. 2) The lines of magnetic flux get intersection by a discontinuity magnetic poles are induced either side of discontinuity. 3) When magnetic particles are sprinkled unto the specimen these particles are attendee by magnetic poles to create visual indication approximating the size and shape of flux. 4) The discontinuity causes an abrupt change in the path of magnetic flux.	2mark

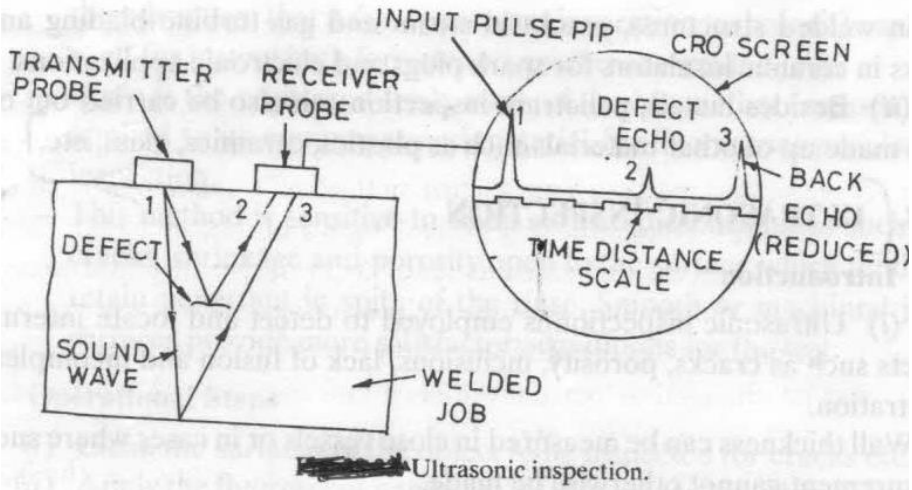
	ii	Flaws detected: Magnetic particle inspection can detect both production discontinuities like • seams • laps, • grinding cracks • quenching cracks • In-service damage (fatigue cracks and overload cracks). • Nonmetallic inclusion	2mark
	iii	***Scope and limitations:*** • *It can detect only surface opening and sub-surface defects in ferromagnetic materials.* • *Cannot inspect non-ferrous materials such as aluminum, magnesium or most stainless steels.* • *Inspection of large parts may require use of equipment with special power requirements.* • *Some parts may require removal of coating or plating to achieve desired inspection sensitivity.* • *Limited subsurface discontinuity detection capabilities. Maximum depth sensitivity is approximately 0.6" (under ideal conditions).* • *Post cleaning, and post demagnetization is often necessary.*	2mark (any two)
	iv	Sensitivity : MPT methods are sensitive means of locating small and shallow surface cracks in ferromagnetic articles. Many incipient fatigue cracks and fine grinding cracks having size less than0.02mm deep and surface opening of one tenth of that or less can be located using MPT.	2mark

	c	 Fig. 38.19 Nick-break test specimen. THE NICK-BREAK TEST Purpose A nick-break test involves breaking the weld joint to examine the fractured surfaces for internal defects such as: (i) Gas pockets (ii) Slag inclusions (iii) Porosity. The test also determines weld ductility and the degree of fusion. Preparation - The test specimen shall be cut transversely to the welded joint and shall have the full thickness of the plate t at the joint. The excess weld metal and penetration bead shall be left intact. - Slots are sawed at each end of the specimen to be tested. Procedure - The specimen is then placed upright on two supports and the force on the weld is applied either by a press or by the sharp blows of a hammer until a fracture occurs between the two slots. - A visual inspection of the fractured surfaces is carried out in order to find defects (as mentioned earlier), if any. If any defect exceeds 1.5 mm in size or the number of gas pockets exceeds one per square cm, the piece has failed the test.	**1mark-dia** **2mark-Purpose** **2mark-Preparation** **3mark-Procedure**
6	a i	Types of etch tests: (i) Micro Etch Test (ii) Macro Etch Test Concept and purpose of etch test : It gives a broad picture of the specimen by studying relatively large sectioned	2 mark-types

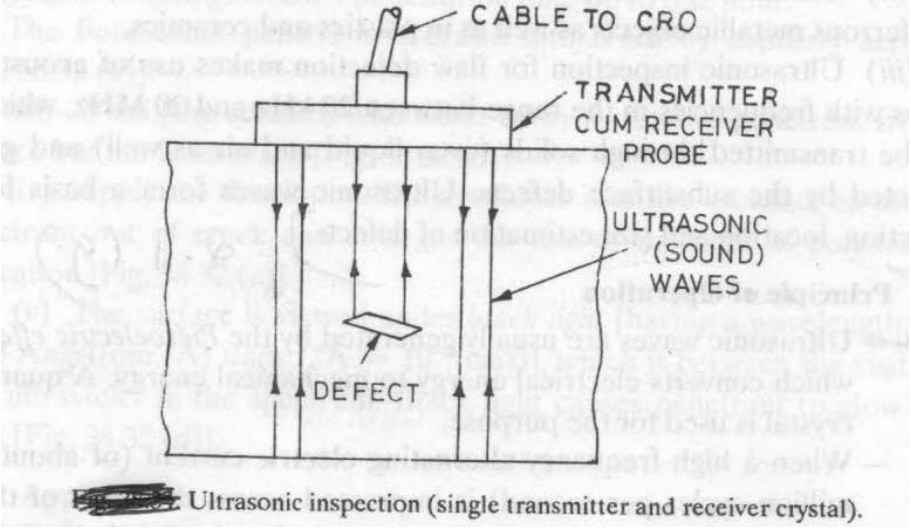
		areas. - Macro-examination reveals in welded specimen (i) Cracks, (ii) Slag inclusion, (iii) Blowholes, (iv) Shrinkage porosity, (v) Penetration of the weld, (vi) The boundary between the weld metal and the base metal, etc.	2 mark-purpose
	ii	FLUORESCENT-PENETRANT INSPECTION - Like magnetic particle inspection, fluorescent penetrant inspection is also carried out to detect small surface cracks, but it has the advantage that it can be used for testing both ferrous and nonferrous welded jobs. Operational Steps involved:- (i) Clean the surfaces of the object to be inspected for cracks etc. (ii) Apply the fluorescent penetrant on the surface by either dipping, spraying or brushing. Allow a penetration time up to one hour. The fluorescent penetrant is drawn into crack by capillary action [Fig. (a)]. (iii) Wash the surface with water spray to remove penetrant from surface but not from crack [Fig. (b)]. (iv) Apply the developer. The developer acts like a blotter to draw Penetrant out of crack and enlarges the size of the area of penetrant indication [Fig. (c)]. (v) The surface is viewed under black light [having a wavelength of 3650 Angstrom (A) units (1A = 10 8 cms)], which is between the visible and ultraviolet in the spectrum. Black light causes penetrant to glow in dark [Fig. (d)].  	4m-procedure

	b i	Principal of COMPRESSION TEST • Theoretically, compression test is merely the opposite of the tension test with respect to the reaction of applied stress. • The compression test can be done on the same machine on which the tension test is done like universal testing machine or some other machine which is designed specifically for the purpose. • In general, brittle materials are good in compression than in tension and therefore, they are used for compressive loads. Due to this, compression test is mainly used to test brittle materials such as cast irons, concrete, stones, bricks and ceramic products. • During testing, fracture occurs in brittle materials and therefore, the ultimate strength is determined corresponding to the fracture point; but no fracture occurs for ductile materials and hence ultimate strength is found out for some arbitrary amount of deformation)  	2 mark- PRINCIPLE
	ii	Test Specimens specification: Test Specimen can be square, Rectangle or Circular in crossection, circular section is preferred for uniform application of load. The length to diameter(l/d)ratio is between 1.5 to 10 for different materials but a ratio of 2 is commonly employed	2 mark
	iii	INFORMATION GAINED BY THIS TEST: These include the elastic limit which for "Hooke "material is approximately equal to the proportional limit and also known as yield points or yield strength, Young	2 mark-

		Modules(These although mostly associated with tensile testing may have compressive analogs)and compressive strength. 1)Assess the strength of components 2)Characterise the compressive properties of material e.g. foam, metal, PET and other plastic and rubber 3)Assess the performance of product e.g. the expression force of syringes or the load displacement characteristics of tennis ball	
	iv	compression test due to the following practical difficulties: 1. Since the top and bottom faces of the specimen are perfectly parallel to each other and there is always tendency for bending the specimens during testing, it is very difficult to apply truly axial load. 2. Since the length of the specimen is kept short enough (not more than twice its diameter to avoid its bucking. 3. The friction between the ends of the specimen and the heads ends of the testing machine prevent the deformation of specimen.	2 mark-Practical aspect.
6	c	<u>Principle of Operation:</u> Ultrasonic waves are usually generated by the Piezoelectric effect which converts electrical energy to mechanical energy. A quartz crystal is used for the purpose. - When a high frequency alternating electric current (of about 1 million cycles per second) is impressed across tile faces of the quartz crystal, the crystal will expand during the first half of the cycle and contract when the electric field is reversed. In this manner the mechanical vibrations (sound waves) are produced in the crystal. - - Ultrasonic inspection employs separate probes (or search units), one for transmitting the waves and other to receive them after passage through the welded jobs (Fig.); alternatively, since the ultrasonic waves are transmitted as a series of intermittent pulses, the same crystals may be employed both as the transmitter and receiver (Fig.)	3mark-principle



Ultrasonic inspection.



Ultrasonic inspection (single transmitter and receiver crystal).

2 mark- Diagram

Advantage:

1. It is a fast and reliable method of non-destructive inspection.
2. This method of locating flaws with metal objects is more sensitive than radiography.
3. The minimum flaw size which can be detected is equal to about 0.1% of the distance from the probe to the defect.
4. Big weldments can be systematically scanned for initial detection of major defects.
5. Ultrasonic inspection involves low cost and high speed of operation.
6. The sensitivity of ultrasonic flaw detection is extremely high, being at a maximum when using waves of highest frequency.

1 mark advantages (any two)

Limitations

1. Surface to be tested must be ground smooth and clean.
2. Skilled and trained operator is required.

1 mark limitations (any two)

		3. It is not suited to the examination of weldments of complex shape or configurations. Applications: 1. Inspection of large weldments, castings and forging, for internal soundness, before carrying out expensive machining operations. 2. Inspection of moving strip or plate (for laminations) as regards its thickness.	1mark-application (any one)