WINTER – 2022 EXAMINATION

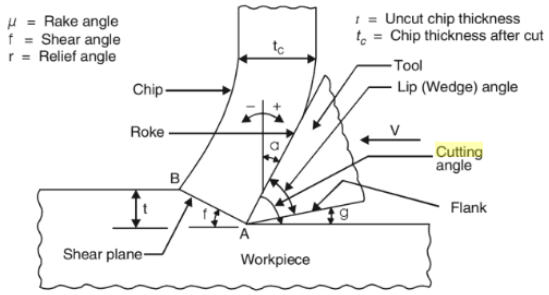
Model Answer

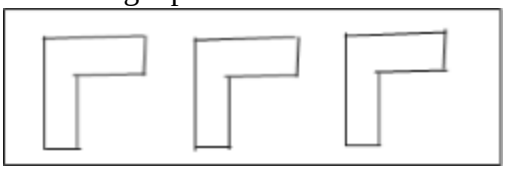
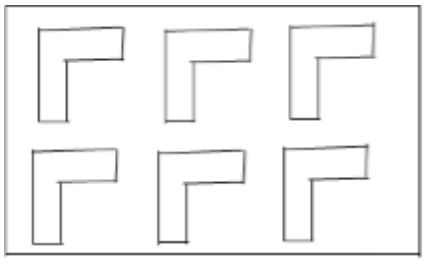
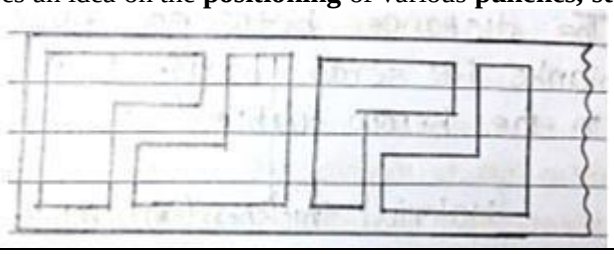
Subject Name: Tool Engineering **Subject 22565**

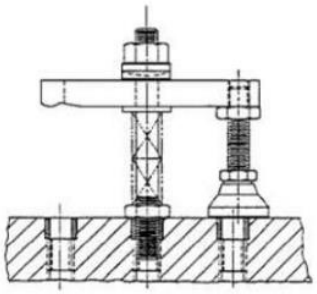
Important Instructions to examiners:

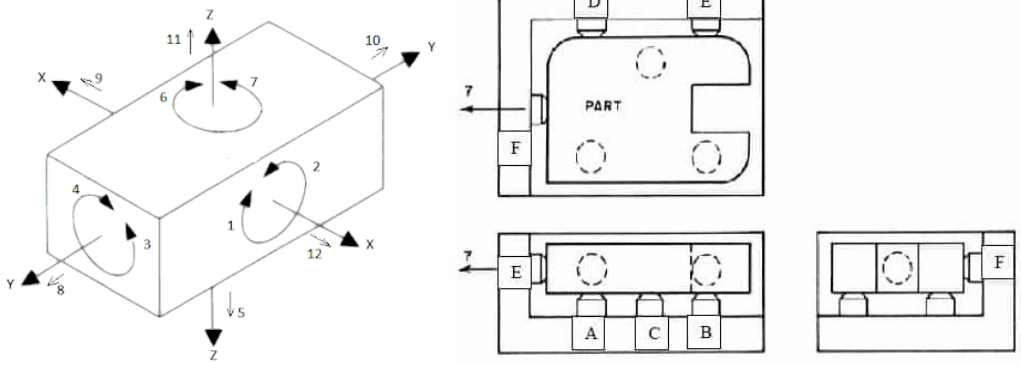
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling 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.
8) As per the policy decision of Maharashtra State Government, teaching in English/Marathi and Bilingual (English + Marathi) medium is introduced at first year of AICTE diploma Programme from academic year 2021-2022. Hence if the students in first year (first and second semesters) write answers in Marathi or bilingual language (English +Marathi), the Examiner shall consider the same and assess the answer based on matching of concepts with model answer.

Q. No.	Sub Q. N.	Answer	Marking Scheme
1		**Attempt any FIVE**	**5 x 2 =10**
	a	**Define chip reduction coefficient** It is also known as cutting ratio. The ratio of the thickness of the chip before removal to its thickness after removal from the material being cut $r_c = t_1/t_2$	**02**
	b	What is meant by press tonnage. The tonnage of a pressure to the force that the press ram is able to exert safely. Press tools are specified according to tonnage. Ex 400 T press it means press ram will exert force of 400 tonns.	**02**
	c	**List out desirable characteristics of cutting tool material.** desirable characteristics of cutting tool materials are:- 1. Tool material must be at least 30 to 50% harder than the work piece material. 2. Tool material must have high hot hardness temperature. 3. High toughness. 4. High wear resistance. 5. High thermal conductivity. 6. Lower coefficient of friction. 7. Easiness in fabrication and cheap. 8. Resist Shock loads.	**Any Four ½Mark Each**

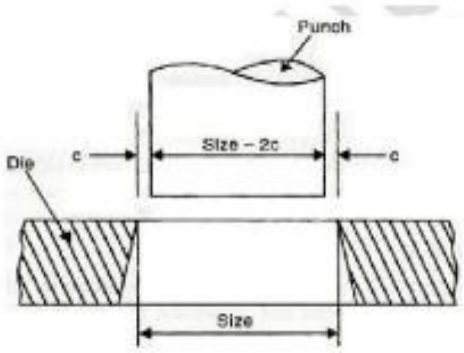
	d	**What is importance of strip layout in press working** -Strip layout will decide the effective utilization of a material . Also scrap will be minimum. -Strip layout will decide the size of raw material.	**02**
	e	**Define Jigs and Fixture** A fixture is a work-holding or support device used in the manufacturing industry. Fixtures are used to securely locate (position in a specific location or orientation) and support the work, ensuring that all parts produced using the fixture will maintain conformity and interchangeability. A jig is a device which is device which holds, supports work piece also it has tool guiding element.	**02**
	f	**State the function of locating devices** Locating devices ensures the position of work piece with reference surface or reference plane.	**02**
	g	**Define Bending. List various methods.** Bending is defined as shaping metal around a straight axis which extends completely across the material. Methods of bending 1. V bending. 2. Wiping 3. Edge bending	**02**
2		**Attempt any THREE**	**3 x 4 =12**
	a	**Explain the mechanics of metal cutting with simple sketch.**  **Fig.** Schematic Representation of Machining. **The Mechanics Of Chip Formation** A typical metal culling process can be schematically represented as in Fig. A wedge- shaped tool is made to move relative to the workpiece . As the tool makes contact with the melal, It exerts a pressure on it resulting in the compression of the metal near the tool tip.This induces shear-type deformation within the metal and it starts moving upward along the top face of the tool. As the tool advances, the material ahead of it is sheared continuously along a plane called the Shear plane. This shear plane is actually a narrow zone and extends from the cuning edge of the tool to the surface of the workpiece.	**O2 Marks Explanation** **02 Marks Sketch**

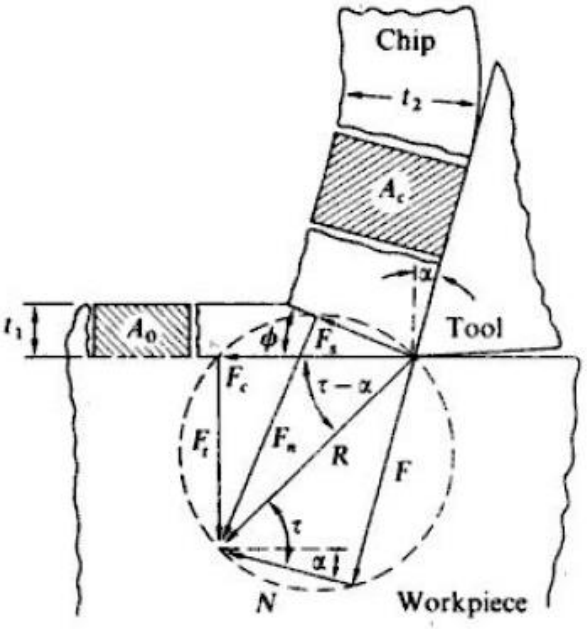
	b	**How carbide tipped tools are specified?** **Name cutting tool materials used on it.** The various coating materials used are 1. Titanium carbide 2. Titanium Nitride 3. Hafnium Nitride 4. Aluminum oxide 5. Multi Coatings. Carbide tipped tools are specified by standard method known as tool signature Example 0-7-7-7-15-15-0.8 Back rake angle 0, Side rake angle 7, end relief angle 7, Side relief angle 7, End cutting edge angle 15, Side cutting angle15, Nose radius 08	**02 marks for materials. 02 marks for specification**
	c	**a) Explain with neat sketch importance of 'Scrap strip layout'.** In the blanking die-set design, the first step is to prepare blanking layout i.e. the positionof the work pieces in the strip and their orientation with respect to each other. This is known as Scrap Strip Layout. Importance of scrap strip layout due to following factors **1. Economy of Material:** As per arrangement in below fig.below it can be worked atsingle row, single pass with a single punch.  **2.** By feeding the material as per below fig. there **is increase in maximum material utilization** up to some extent.  **3.** Below figure shows a single row, double pass strip. Here, strip will have to be passed throughthe dies once turned over and passed through dies second time. Hence, there is a maximum utilization of the material and **reduction in scrap** **4.** Scrap strip layout gives an idea on the **positioning** of various **punches, stops and pilots** 	**(02 Marks Explanation** **02 Marks Sketch)**

	d	**Explain the construction of an adjustable step clamp of a milling machine.**  A **step clamp** is a type of serrated-edged clamp used in conjunction with step blocks in machining to fix an object in place during milling operations. strep is the simplest and most common clamp. Figure 8-1. Force is applied to the fastening device. The force is then transferred through the strap to the workpiece. The heel support acts as a pivot and support for the back end of the strap.	**(02 Marks Explanation 02 Marks Sketch)**
3		**Attempt any THREE**	**3 x 4 =12**
	a	**Bend Allowance:** When a blank or sheet is to be bent, it is necessary to consider the effect of stretching the metal at the outside of the bend. Since there is no stretch in the neutral plane, the length if the formed part along the neutral plane will be the correct length. The curved neutral plane of the bend area is called bend allowance. **The bend allowance formula : B = (A/360) X 2π(R+ KT)** Where, B – Bend Allowance A – bend angle in degrees R – inside bend radius in mm K – constant of neutral axis location t –metal thickness in mm	**02 marks for explanation 02 marks for formula**

	b	**3-2-1 principle of Location:** It is also known as a six-pin or six-point location principle. Considering the rectangular block in space as shown in Figure .the work-piece is assumed to have true and flat faces. It may move in either of the two opposed directions along three mutually perpendicular axes, XX, YY and ZZ. The work-piece can rotate in either of two opposed directions around each axis, clockwise and anticlockwise. The sum of these two types of movements gives the twelve degrees of freedam of a workpiece in space. Motion is restricted using clamps and locators are as follows: -The workpiece is resting on three pins A, B, and C which are inserted in the base of the fixed body. -The workpiece cannot rotate about the axes XX and YY and also cannot move downward. -In this way, the five degrees of freedom 1,2,3,4 and 5 have been arrested. -Two pins D and E are inserted in the fixed body, in a plane perpendicular to the plane containing pins A, B & C. -Now the workpiece cannot rotate about the Z-axis and also it cannot move towards the left. -Hence the addition of pins D and E restrict three more degrees of freedom, namely 6, 7, and 8. - Another pin F in the second vertical face of the fixed body, arrests **degree of freedom 9.** The above method of locating a workpiece in a fixture is called the **3-2-1 Principle.** 	**02 marks for explanation 02 marks for sketch**
	c	**Spring Back:-**After bending a sheet when force is removed there is an elastic recovery by the material. As a result the bend angle decreases. This effect is known as spring back effect. Causes – It is due to following factors. a) Elasticity of material b) Thickness of material c) Hardness of material d) Bend radius	**02 marks for definition, 02 marks for any two causes**

	d	**Classify the Dies. List their application** Dies are Classified based on cutting and shearing action • Blanking dies • Piercing dies • Perforating dies • Lancing • Notching • Trimming • Shaving • Nibbling dies Dies are Classified based on method of operation • Simple dies • compound dies • combination dies • progressive dies • transfer dies • multiple dies **Applications:** 1. Aircraft/Aerospace industry 2. Boiler manufacturing 3. Pressure vessel, tank manufacturing 4. Chassis, door, cabinets in Automobile Industry 5. Chemical processing equipment and Jewelry 6. Food & beverage – grain dryers, sorting machines, fruit and vegetable juice presses, cheese molds, baking trays, coffee screens. 7. Tube notching is in the manufacture of bicycle frames	**02 marks for classification, 02 marks for any 04 applications**

	e	In shearing operation punch has to enter in die. Hence a dimension of punch has to be smaller than that of die. The difference in their dimensions results in clearance. Clearance has lot of importance in shearing. Excessive clearance – It produces greater roll over radius, angular blank and long burr. The plastic deformation (penetration) is more which causes material to be drawn rather shearing. Insufficient clearance – This causes fracture to miss cutting edges of punch and die do not meet each other as shown in figure. This results in two burnishing edges. Correct clearance – This produces moderate roll over which is followed by single burnishing edge. This results in correct break. The fracture meets each other. **In blanking operation** where the slug or blank is the desired part and has to be held to size the die opening size equals the blank size and the punch size is obtained by subtracting the clearance from the die opening size as shown in fig. **Die size = blank size** **Punch size = blank size – 2 x clearance**  **Blanking clearance.** The amount of clearance depends on the stock thickness the kind of material etc. the usual clearance per side of the die for various metals are as follow **S No. Material** **Clearance** 1. For soft aluminium < 1 mm C=3% of t >1 mm C=5% of t 2. For hard aluminium C = 5% - 8% of t 3. For hard steel C=5% of t 4. For stainless steel C = 5% - 8% of t The clearance may also be determined with the help of following relation $$c = 0.0032\ t \cdot \sqrt{\tau_s}, \text{mm}$$ where τ_s is the shear strength of the material in N/mm^2.	**02 marks for importance 02 marks for explanation (fig not essential if drawn give advantage)**

4		**Attempt any TWO**	**2 x 6 =12**
	a	 F = Frictional force N = Normal to frictional force Fs = Shear force Fn = Normal to shear force Fc = Cutting force or tangential component of force Ft =Thrust force or feed force Fc and Ft are along and normal to the direction of velocity. Ø = Shear angle	**04 marks for sketch, 02 marks to list forces**
	b	**Sharpening of Single Point Cutting Tool on Grinding machine** **1) Hand** Grinding **Method:** Hand grinding is the most common rough method of sharpening used in machine shops. the tool is sharpened (grind) on the grinding machine. The operator has to hold the tool against the rotating wheel. In this method the skilled operator is required to provide the appropriate geometry by judgment. 2) **Sharpening of Single Point Cutting Tool on Grinding machine using attachment:** Tool grinding attachment can be used for sharpening a variety of tools and cutters. Using this method the sharpener is fast, safe, precise and easy. It provides the facility to set the tool at any required angle.	**03 marks each**

	c	**Degrees of Freedom :** A workpiece free in space can move in an infinite number of directions. For analysis, this motion can be broken down into twelve directional movements, also called as degrees of freedom. Any rectangular body has selected three axes along *x*-axis, *y*-axis and *z*-axis. It can move along any of these axes or any of its movement can be released to these three axes. As the double-headed arrows indicate, the translational and rotational positions six axial & six radial can vary in either direction with respect to each of the three axes. These twelve coordinates are known as the twelve degrees of freedom of a three-dimensional object. **Importance of Locating:** 1] A desired relationship between the workpiece and the jigs or fixture correctness of location directly influences the accuracy of the finished product. 2] Any locator is to reference the workpiece and to ensure repeatability/Interchangeability. 3] Restrict the undesired movement and rotation of workpiece. 4] Determine the position of the workpiece with respect to cutting tool. **Importance of clamping device**: (a) It should **rigidly hold** the workpiece. (b) The workpiece being clamped should not be damaged due to application of clamping pressure by the clamping unit. (c) The clamping pressure is enough to overcome the **Operating pressure/Cutting Force** applied on the workpiece as both pressure acts on the workpiece in opposite directions. (d) Clamping device is capable to be unaffected by the vibrations generated during an operation. (e) It should also be user friendly, like its clamping and releasing should be easy and less time consuming. Its maintenance will also be easy. f) Clamping pressure is directed towards the support surfaces or support points to prevent undesired lifting of workpiece from its supports. (g) Clamping faces is hardened by proper treatments to minimize their wearing out. (h) To handle the workpieces made of fragile material the faces of clamping unit is equipped with fiber pads to avoid any damage to workpiece.	**03 marks for explanation, 03 marks for importance**

5		**Attempt any TWO**	**2 x 6 =12**
	a	Q.5 (a) Given Data :- outside diameter of washer = 45 mm inside diameter of washer = 20 mm Sheet thickness = 1.7 mm Clearance is taken as 5% of stock thickness $\therefore c = 5\%$ of $t = 0.05 \times 1.7$ -- 1M $\therefore c = 0.085$ mm ---- 1 M Punching punch dia = 20 mm ---- 1 M Punching die dia. = 20 + 0.085 ---- 1 M = 20.085 mm Blanking die dia = 45 mm ---- 1 M Blanking punch dia = 45 - 0.085 --- 1 M = 44.915 mm	

	b	**Design of Fixtures for Milling Machine:** **Component:** Drawing of the component to be studied carefully. Ensure work is performed in a proper sequence. Maximum operations should be performed on a machine in single setting. **Capacity of the machine:** Careful consideration to be performed on type and capacity of machine. **Production requirements:** Design to be made on basis of actual production requirements. Then comes decision on manual and automatic tooling arrangements. **Location:** Location should ensure equal distribution of forces throughout all sequence of operation. Location should be hard resistant, wear resistant and high degree of accuracy. Movement of work piece should be restricted. We should be fool proofed to avoid improper locations of the work piece. We should facilitate easy and quick loading of work piece. Redundant locators should be avoided. Sharp corners must be avoided. At least one datum surface should be established. **Loading and unloading arrangements:** There should be adequate clearance for loading and unloading. Hence process becomes quick and easy. Size variation must be accepted. It should be hardened material and non-sticky. **Clamping arrangements:** Quick acting clamps must be used as far as possible. The clamping should not cause any deformation to the work piece. It should always be arranged directly above points supporting the work. Power driven clamps are favored as they are quick acting, controllable, reliable and operated without causing any fatigue to the operators. **Base and Body construction:** Methods used: Machining, Forging and machining, Casting, Fabricating, Welding. Tool guiding and cutter setting: By adjusting the machine or using cutter setting block, the cutter is set relative to the work in a fixture. The drill bushes fitted on jig plates guides the tools. **Rigidity and vibration:** fixture must possess enough rigidity and robustness. Should not vibrate as it may lead to unwanted movement of work piece and tools. **Safety:** Operation should be assured full safety. **Cost:** Cost incurred should be optimum.	**01 mark each any six points**

C

Q.5 (c) Given Data

Bend length = L = 30cm = 300mm

$\sigma_{ut} = 1500 N/mm^2$

$t = 3 mm$

$K = 1.33$

$w = 8 \times t$ — 1m

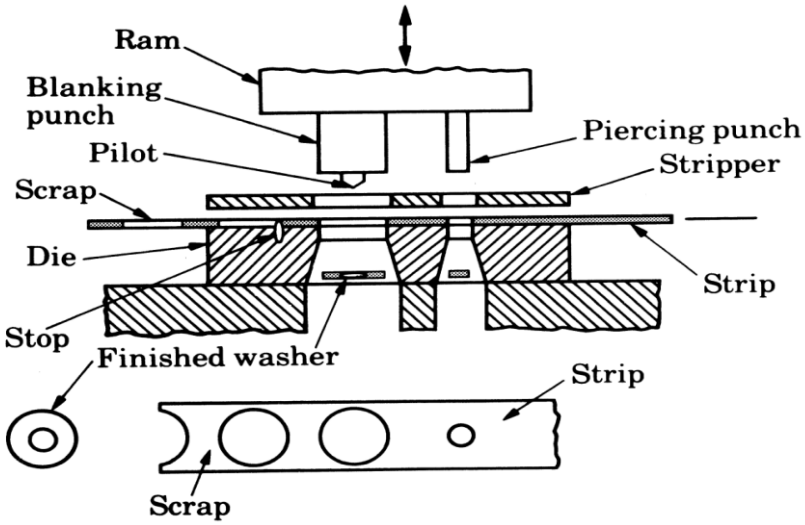
$w = 24 mm$ — 1m

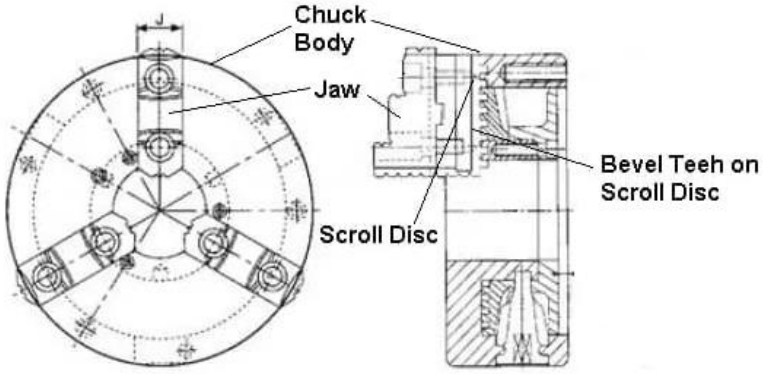
Bending force, F

$$F = \frac{K \times L \times \sigma_{ut} \times t^2}{w}$$ — 1m

$$= \frac{1.33 \times 300 \times 1500 \times (3)^2}{24}$$ — 1m

$$\boxed{F = 224.437 \times 10^3 N}$$ — 2m

6		**Attempt any TWO**	**2 x 6 =12**
	a	**Progressive die:** In progressive die, two or more operations are performed simultaneously at a single stroke of the press by mounting separate sets of dies and punches at two or more different stations. The metal is progressed from one station to the other till the complete part is obtained. The sheet metal is fed in to the first die where a hole is pierced by the piercing die set in the first cutting stroke of the ram. Plate is then advanced in the next station and the correct spacing is obtained by the stop. In the second cutting stroke of the ram, pilot enters in to the pierced hole and correctly locates it. While the blanking punch descends and shears the plate to form a washer. By the time the blanking operation is performed, the hole for the next washer is also pierced at the first station. Thus although two strokes are required to complete a washer, each piece of washer is discharged on every strokes of the ram due to the continuity on operation.  	**03 marks for sketch, 03 marks for explanation**

	b	**Three-jaw universal chuck:** Three-jaw universal chuck is used to hold round and hexagonal work. It grasps the work quickly and within a few hundredths of a millimeters or thousandths of an inch of accuracy, because the three jaws move simultaneously when adjusted by the chuck wrench. This simultaneous motion is cause by a scroll plate into which all here jaws fit. Three jaws chucks are made in various sizes from 1/8-16 inch in diameter. They are usually provided with two sets of jaws, one for outside chucking and the other for inside chucking.  **NOTE:** *Widely used lathe fixtures are Universal self-centering two, three, four jaw chucks, and face plate ect. Consider any one.*	**03 marks for sketch, 03 marks for explanation**

C

Q.6(c) Given Data :-

$h = 48$ mm
$d = 48$ mm
$r = 2$ mm
$t = 1$ mm

The ratio $\frac{d}{r} = \frac{48}{2} = 24$

As the ratio $\frac{d}{r} > 20$ ------ 1M

$\therefore$ D = Blank diameter

$$D = \sqrt{d^2 + 4dh}$$

$$= \sqrt{(48)^2 + (4 \times 48 \times 48)}$$

$D = 107.33$ mm ------ 1M

According to the general rule adding 0.05 mm to the blank diameter for each 10 mm of the cup diameter.

$\therefore$ $0.005 \times 107.33 = 0.536$ mm

$\therefore$ $D = 107.33 + 0.536$

$\therefore$ $D = 107.866$ mm

$\therefore$ $D = 108$ mm ------ 1M

* Number of draws :-

$$\frac{h}{d} = \frac{48}{48} = 1.0$$ ------ 1M

From table No. of draws = 2 ------ 1M

* Radius on punch and die.

For first draw $= 4 \times t = 4 \times 1 = 4$ mm

For second draw radius should be 4 to 10 times stock thickness

$\therefore$ radius = 4 to 10 mm ------ 1M