

UP Boiler Operation Engineers Examination – 2014

Boiler Engineering Paper – 2

Time: 3 Hours

Maximum Marks: 100

Q - 1: Choose the correct answer:

30 x 1 = 30 Marks

- (i) In water tube boiler
- a) Water passes through the tubes which are surrounded by flames and hot gases
 - b) The flames and hot gases pass through the tubes which are surrounded by water
 - c) Forced circulation takes place
 - d) None of the above
- (ii) The object of producing draught in a boiler is
- a) To provide the adequate supply of air for the fuel combustion
 - b) To exhaust the gases of combustion from the combustion chamber
 - c) To discharge the gases of combustion to the atmosphere through the chimney
 - d) All of the above
- (iii) In a glass tube type water indicator for a boiler, one end of the tube is connected to the water space and the other end is connected to
- a) Water space also
 - b) Chimney
 - c) Steam space
 - d) Superheater
- (iv) Which of the following statement is wrong?
- a) Locomotive boiler is a water tube boiler.
 - b) Water tube boilers are internally fired.
 - c) La-mont boiler is a low pressure water tube boiler.
 - d) All the above
- (v) The natural draught is produced by
- a) Steam jet
 - b) Centrifugal fan
 - c) Chimney
 - d) Both (a) & (b)
- (vi) A safety valve usually employed with stationary boilers is
- a) Lever safety valve
 - b) Dead weight safety valve
 - c) High steam and low water safety valve
 - d) All of these
- (vii) The chimney draught varies with
- a) Climatic conditions
 - b) Temperature of furnace gases
 - c) Height of chimney
 - d) All of the above
- (viii) The performance of boiler is measured by the
- a) Amount of water evaporated per hour
 - b) Steam produced in kg/h
 - c) Steam produced in kg/kg of fuel burnt
 - d) All of the above
- (ix) The maximum heat loss in a boiler occurs due to
- a) Moisture in fuel
 - b) Dry flue gases

- c) Steam formation
d) Unburnt carbon
- (x) Which of the following is not a boiler mounting?
a) Blow off cock
b) Feed check valve
c) Economiser
d) Fusible plug
- (xi) Which of the following are the boiler accessories?
a) Economiser
b) Superheater
c) Both (a) & (b)
d) None of these
- (xii) The ability of a material to resist softening at high temperature is known as
a) Creep
b) Hot tempering
c) Hot hardness
d) Fatigue
- (xiii) Killed steels are those steels
a) which are destroyed by burning
b) which after their destruction are recycled to produce fresh steel
c) which are de-oxidised in the ladle with silicon and aluminium
d) in which carbon is completely burnt
- (xiv) Corrosion resistance of steel is increased by the addition of
a) Chromium and nickel
b) Sulphur, phosphorus and lead
c) Vanadium and aluminium
d) Chromium, molybdenum, vanadium and tungsten
- (xv) Manganese in steel increases its
a) Tensile strength
b) Hardness
c) Ductility
d) malleability
- (xvi) Brinell hardness tester uses a steel ball of size
a) 5 mm
b) 10 mm
c) 15 mm
d) Both a & b
- (xvii) In arc welding, eyes need to be protected against
a) Intense glare
b) Sparks
c) Infra red rays
d) Infra-red and ultraviolet rays
- (xviii) The gases used in tungsten inert gas welding are
a) Hydrogen and oxygen
b) Hydrogen and CO₂
c) Argon and neon
d) Argon and helium
- (xix) In resistance welding, voltage used for heating is
a) 1 V
b) 10 V
c) 100 V
d) 440 V

- (xx) Seam welding is
- Multi-spot welding process
 - Continuous spot welding process
 - Used to form mesh
 - Used for welding cylindrical objects
- (xxi) Generally water pipe lines are designed with water velocity
- < 1 m/s
 - up to 2.0 m/s
 - > 2 m/s
 - None of the above
- (xxii) In indirect steam heating, the heat utilised for heating application
- Sensible heat
 - Latent heat
 - Specific heat
 - None of the above
- (xxiii) Orsat meter is used for
- gravimetric analysis of flue gas
 - volumetric analysis of flue gas
 - mass flow of the flue gas
 - measuring smoke density of flue gas
- (xxiv) Sulphur content of fuel is very important to the plant operator because it
- has high heating value
 - retards electric precipitation
 - promote complete combustion
 - has highly corrosive effect
- (xxv) Name the fan more suitable for high pressure application
- Propeller type fan
 - Tube axial fan
 - Backward curved centrifugal fan
 - None of the above
- (xxvi) Turndown Ratio of a burners is the ratio of
- Air to fuel
 - Maximum fuel input to actual fuel input
 - Maximum fuel input to minimum fuel input
 - Maximum air input to minimum air input
- (xxvii) ESP works on the principle of
- Corona Effect
 - Induction Effect
 - Skin Effect
 - None of the above
- (xxviii) A solution having 4 pH is more acidic than a solution of 7 pH
- 03 times
 - 30 times
 - 100 times
 - 1000 times
- (xxix) Demineralisation of water is the process to remove
- Dissolved oxygen
 - Dissolved salts
 - Carbon dioxide
 - chlorine
- (xxx) A rise in conductivity in boiler feed water indicate
- Drop in contamination of feed water
 - Greater purity of feed water

- c) Rise in contamination of feed water
- d) Has no relation with contamination of feed water

Q-2: Answer any 08 questions

8 x 2 = 16 Marks

- (i) What is excess air and why it is required for combustion in a boiler.
- (ii) Name the different external water treatment methods.
- (iii) Explain the Radiographic test for detecting material defects.
- (iv) Explain the principle of mechanical de-aeration (pressure type) of boiler feed water.
- (v) What is Caustic Embrittlement?
- (vi) Define draught. What is the function of draught in a boiler? Enumerate the different types of draught available for boiler.
- (vii) Explain reversible adiabatic expansion of steam.
- (viii) Explain over pressure & blow-down of a safety valve.
- (ix) Wet scrubber

Q-3: Answer any 4 Question

4 x 6 = 24 Marks

- (i) What is corrosion? Explain the electrochemical theory of corrosion. Explain importance of pH value to control the corrosion phenomenon.
- (ii) Describe the working of Demineralising water treatment plant system with neat sketch. List out its merits over other systems.
- (iii) Describe the function of Three Element Control in boiler operation.
- (iv) Write a short note on Combustion Control for boiler. Also describe the different types of combustion control.
- (v) Describe the main difference between an Impulse and a Reaction Turbine.
- (vi) A fan is operating at 900 RPM, develops a flow of 3000 Nm³/hr at a static pressure of 600 mmWC. What will be the flow and static pressure if the speed is reduced to 600 RPM?

Q-4: Answer any 02 question

2 x 15 = 30 Marks

- (i) Explain the working of Electrostatic Precipitator (ESP) with a neat diagram. List out its outstanding features over other collectors. Also explain the effect of the size of the particle and voltage supplied on the performance of ESP.
- (ii) What is fluidised bed combustion boiler? Explain features and operation of the boiler with neat sketch. Describe its merits and demerits of this boiler over pulverised fuel fired boiler.
- (iii) Calculate the minimum height of chimney required to produce a draft of 19 mm of water column if 18 kg of air is required per kg of fuel burnt on the grate. The mean temperature of the gas inside the chimney is 357 °C and that of atmospheric air 24 °C.
- (iv) Describe the Travelling Grate and Spreader Stoker Boilers.

UP Boiler Operation Engineers Examination – 2014

Boiler Engineering Paper – 1

Time: 3 Hours

Maximum Marks: 100

Q - 1: Choose the correct answer:

20 x 1 = 20 Marks

- (i) Hooke's law holds good up to
- Yield point
 - Limit of proportionality
 - Breaking point
 - Elastic limit
- (ii) If equal and opposite forces applied to a body tend to elongate it, the stress so produced is called
- Internal stress
 - Transverse stress
 - Tensile stress
 - Compressive stress
- (iii) Modulus of Rigidity is defined as the ratio of
- Longitudinal stress and longitudinal strain
 - Volumetric stress and volumetric strain
 - Lateral stress and lateral strain
 - Shear stress and shear strain
- (iv) The pressure at which the latent heat of vaporisation is zero is
- 225.65 kg / cm²
 - 273 kg / cm²
 - 100 kg / cm²
 - 1 kg / cm²
- (v) A thin shell of diameter d , thickness t and length l is subjected to an internal pressure p . The circumferential stress in the shell is
- $pd / 2t$
 - $pd / 4t$
 - $pd / 6t$
 - $pd / 8t$
- (vi) Super heating of steam is done at
- Constant volume
 - Constant temperature
 - Constant pressure
 - Constant enthalpy
- (vii) If the partial pressure of air and steam in a condenser be p_a and p_b respectively, then according to Dalton's law, the pressure in condenser is equal to
- $p_a - p_b$
 - $p_a + p_b$
 - $(p_a + p_b) / 2$
 - $\sqrt{p_a \times p_b}$
- (viii) Water at pressure 4 kg / cm² and 160 °C temperature, when exposed to atmosphere will
- Start boiling
 - Flash and get converted in to steam
 - Remain as it was
 - Cool down

$$P_c = P_a + P_b$$
$$P_c = P_a + P_b$$
$$P_c = P_a + P_b$$

$$P_c = P_a + P_b$$
$$P_c = P_a + P_b$$
$$P_c = P_a + P_b$$

Paper I

- (ix) Efficiency of a thermal cycle increases by
a) Regeneration
b) reheating of steam
c) both a & b
d) none of the above
- (x) For burning of 1 kg of carbon to CO as per chemically correct combustion, the amount of ~~oxygen~~ air required
a) 1 kg
b) 4/3 kg
c) 8/3 kg
d) 2 kg
- (xi) Ultimate analysis of fuel determine the percentage of
a) carbon, hydrogen, nitrogen, sulphur, moisture
b) fixed carbon, ash, volatile matter, moisture
c) higher calorific value
d) lower calorific value
- (xii) Incomplete combustion can be best judged by
a) smoke at chimney exit
b) excess air in flue gas
c) measuring carbon monoxide in flue gas
d) measuring temperature of flue gas at exit of furnace
- (xiii) In water wall furnace the heat is transferred to water wall by
a) Convection
b) Radiation
c) Conduction
d) Radiation & conduction
- (xiv) LMTD (log mean temperature difference) in case of counter flow compared to parallel flow heat exchanger is
a) Higher
b) Lower
c) Same
d) None of the above
- (xv) For industrial process heating the best quality of steam is
a) Dry saturated steam
b) Super heated steam
c) Wet steam
d) High pressure steam
- (xvi) Proper sizing of steam pipe lines helps in minimising
a) Steam requirement
b) Temperature drop
c) Boiler efficiency
d) Pressure drop
- (xvii) The parameter used by ASME to define fans, blowers and compressors
a) Fan ratio
b) Specific ratio
c) Blade ratio
d) Twist factor
- (xviii) The type of control gives maximum benefit for fan application for energy saving point of view is
a) Discharge damper control
b) Inlet guide vane control
c) Speed control
d) Variable pitch control



- (xix) What is the impact on flow and discharge pressure when the impeller of a pump is trimmed
- Flow decreases with increased pressure
 - Both flow and pressure increases
 - Both flow and pressure decreases
 - Flow increases with decreased pressure
- (xx) If the speed of a centrifugal pump is doubled, its power consumption will become
- Two times
 - Four times
 - Eight times
 - No change

Q-2: Write short note on any 06 of the following:

06 x 3 = 18 Marks

- Full lift safety Valve
- DR Steam pipe
- Hoop Stress
- Gross & Net calorific value of a fuel
- Thermodynamic steam trap
- Cavitation in a pumping system
- Types of centrifugal fans
- Reverse Osmosis

Q-3: Answer any 04 questions

04 x 8 = 32 Marks

- (i) A steel rod 25 mm in diameter and 2 metre long is subjected to an axial pull of 45 KN. Find
- Intensity of stress $\sigma = \frac{P}{A}$
 - The strain $E = \frac{\text{Stress}}{\text{Strain}}$
 - Elongation, Take $E = 2 \times 10^5 \text{ N/mm}^2 = 2 \times 10^5$
- (ii) The temperature of a 2 meter long rod is raised from 10 °C to 80 °C. Find the expansion of the rod. If the expansion of the rod is prevented, find stress developed in the material. Take $E = 1 \times 10^5 \text{ N/mm}^2$, $\alpha = 0.000012 / ^\circ\text{C}$.
- (iii) Find the power that can be transmitted by a shaft 60 mm diameter at 180 rpm. The permissible shear stress is 85 N / mm². $\tau = \frac{2T}{r}$ $P = \frac{2\pi NT}{60}$
- (iv) Calculate the blow down rate (kg/hr) for a boiler with an evaporation rate 20 TPH, if the maximum permissible TDS in boiler water is 2000 ppm and with 10 % make-up water addition. The feed water TDS is 100 ppm. $\% \text{ Blowdown} = \frac{\text{TDS}_{\text{sat}} - \text{TDS}_{\text{feed}}}{\text{TDS}_{\text{sat}} - \text{TDS}_{\text{makeup}}}$
- (v) A process requires 6 TPH of dry saturated steam at 7 kg / cm² (g). Determine the size of pipe line. Specific volume of steam at 7 kg / cm² (g) is 0.24 m³ / kg. (Take velocity of steam as 30 m/sec). $\text{Flow} = \text{Area} \times \text{Vel}$
- (vi) A pump is delivering 50 M³/hr of water with a discharge pressure of 3.5 kg / cm². The water is drawn from a sump where water level is 5 meter below the pump centre line. The power drawn by the motor is 9.5 KW at 90 % motor efficiency. Find out the efficiency of the pump.

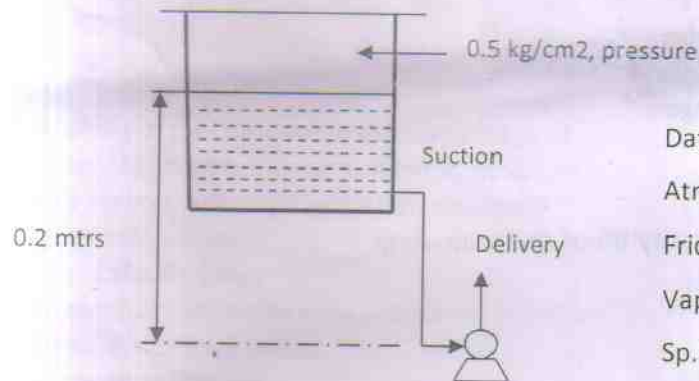
Paper II

0Q - 4:
Marks

Answer any 02 questions

2 x 15 = 30

- (i) Explain the available and the required NPSH in a pumping system. Calculate the available NPSH for the system shown in figure:



Data Given:

Atm. Pr. at installation = 0.9 kg/cm^2

Friction Loss = 1.5 mtrs

Vapour pressure of liquid = 0.45 kg/cm^2

Sp. Gravity of liquid = 0.8

- (ii) The percentage composition of a sample of a liquid fuel by weight is, Carbon - 84.8 % and Hydrogen - 15.2 %. Calculate

- (a) The weight of air required for the combustion of 1 kg of fuel. $\frac{100}{23} [3 \times 7C + 8H + 5O]$
- (b) The volumetric composition of the product of combustion if 15 % excess air is supplied. $13.13, 5.27, 7.34, 73.7C$

- (iii) (a) Define boiler efficiency. Describe the indirect method of calculating the boiler efficiency.

- (b) Find out the efficiency and evaporation ratio of a coal fired boiler by direct method with the data given below:

Quantity of steam (dry saturated) generated	8 TPH
Steam pressure / temperature	$10 \text{ kg/cm}^2 \text{ (g)} / 180^\circ \text{C}$
Qty of coal consumed	1.8 TPH
Feed water temperature	85°C
GCV of coal	3200 Kcal / kg
Enthalpy of steam at 10 kg/cm^2 pressure	665 Kcal / kg

UP Boiler Operation Engineers Examination – 2014

ENGINEERING DRAWING

Time: 04 Hours

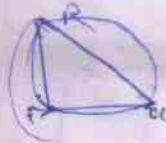
Maximum Marks: 100

Q. 1: Details of spring loaded safety valve are shown in Fig. 1 of attached sheet. Draw the assembled front elevation with valve in closed position. (50 Marks)

Q.2: Draw the following views of the object shown pictorially in Fig. 2 of attached sheet according to the first angle projection method: (15 Marks)

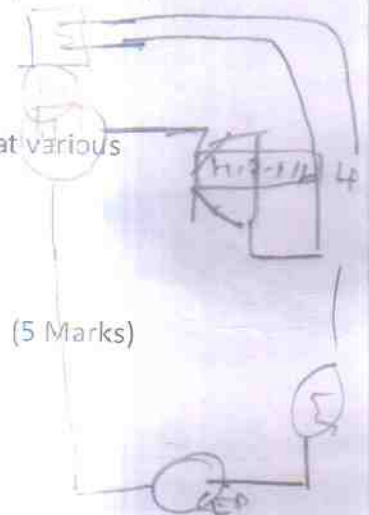
- a) Front View
- b) Top View
- c) Side view from the right

Q. 3: Construct a right angle PQR. Describe a circle of 20mm radius touching the side PQ and QR. (10 Marks)



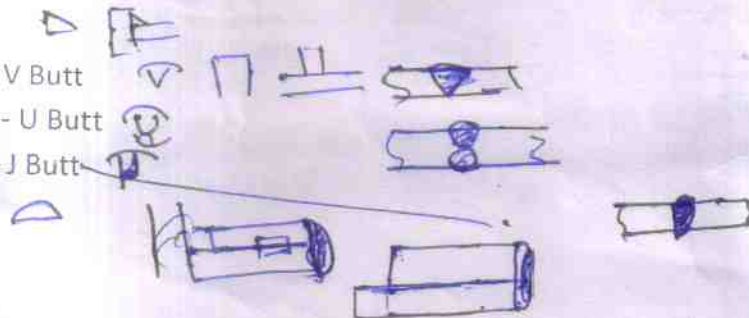
Q. 4: Draw neat proportionate sketch of any two of the following: (20 Marks)

- a) Steam pressure reducing and de-superheating station
- b) Bucket type steam trap
- c) Regenerative feed cycle and show the process of heating the feed water at various stages on T – S diagram.



Q. 5: Draw free hand drawing along with symbol of the following form of weld: (5 Marks)

- a) Fillet
- b) Single - V Butt
- c) Double - U Butt
- d) Single - J Butt
- e) Edge



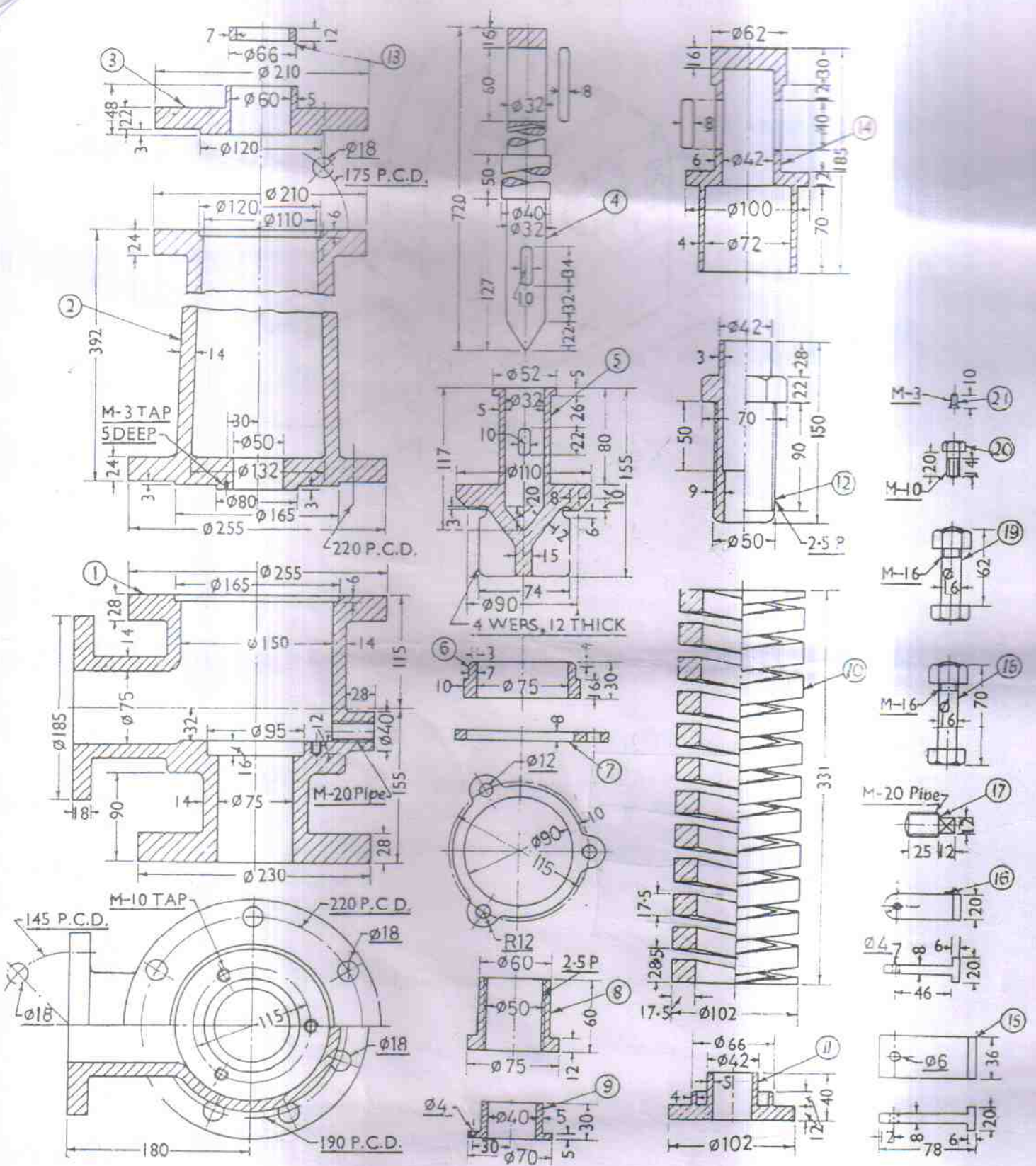


FIG. 1 - SPRING LOADED SAFETY VALVE

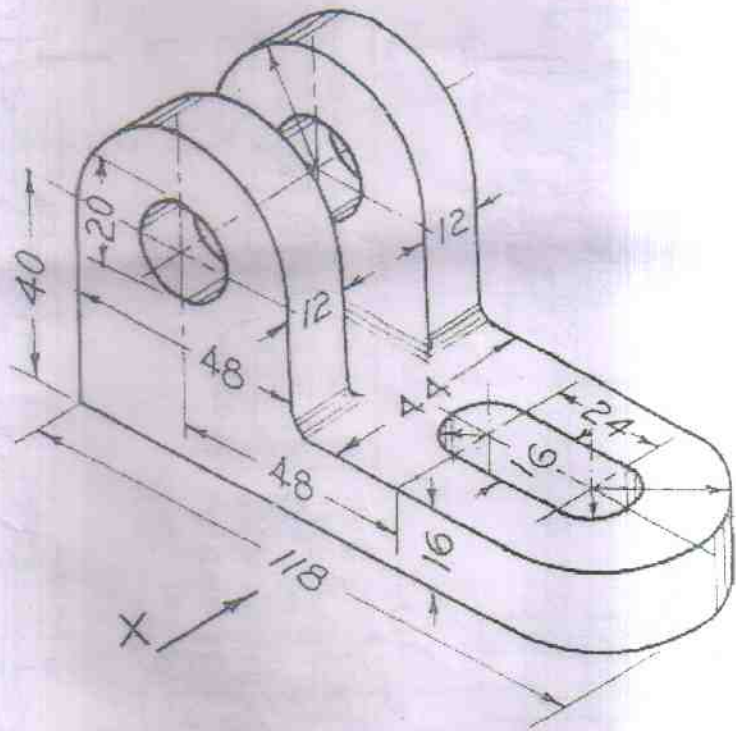


FIG. 2

