

Energy Systems Engineering
M.Tech Admission Test
20th May 2001 Time : 1 hour

Please answer all questions in the paper itself. Show all working.

Name :

Gate Registration:

Percentile:

1. Solve the following differential equation:

$$d^2y/dx^2 + 4y = 0$$

with the following initial conditions $y(0) = 1$, $y'(0) = 0$ [3]

2. Consider the following system of equations:

$$11x + 14y + 9z = 13$$

$$12x + 4z = 9$$

$$23x + 14y + 13z = 20$$

a) Does this system have a solution?

b) If yes, find it. If no, explain why not.[3]

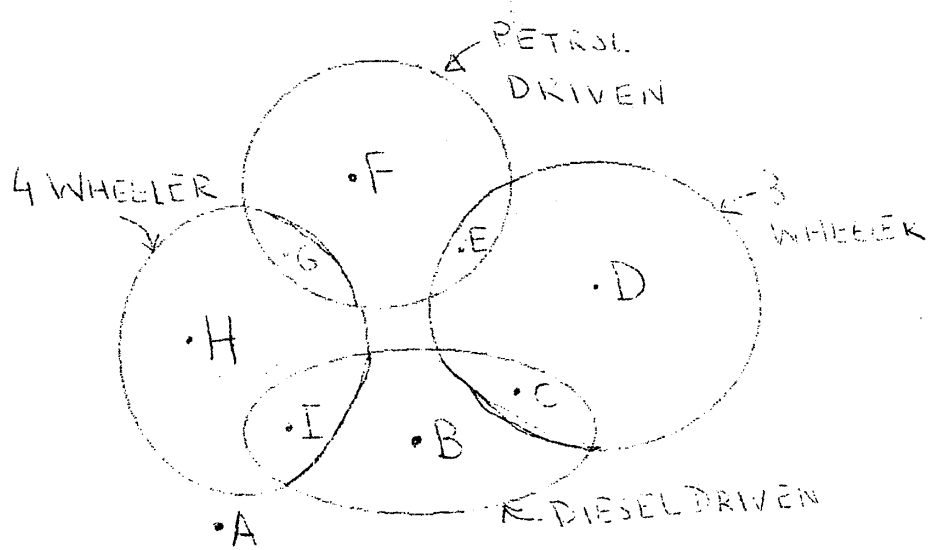
3. $x^2 - 3x^2 + 4x + 1 = 0$

a) Does this equation have a real solution between -1 and 0 ? Explain why.

b) How many solutions will this equation have? Why? .. [2+1]

4. Evaluate a) $\int x e^{ax} dx$ where a is a constant

b) $\int \ln bx dx$ where b is a constant .. [2+2]



5. Study the Venn diagram shown above and answer the following questions:

Points A to I represent vehicles of various kinds.

- a) List all vehicles which are petrol driven. _____
- b) List all three wheeled vehicles which are diesel driven _____
- c) List the four wheeled vehicles which are not petrol driven. _____
- d) What sort of vehicle is B?
- e) What sort of vehicle is A?

.....[5]

6. A city is supplied electricity by three power plants.

A- 50 MW, Probability of outage 0.3

B- 100 MW, Probability of outage 0.2

C-200 MW, Probability of outage 0.1

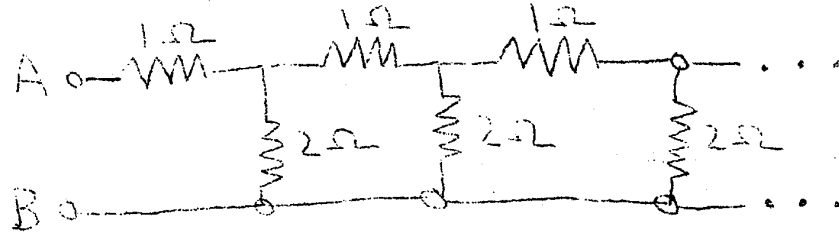
a) What is the probability that the city receives no power at all?

b) What is the probability that the city receives at least 150 MW of power?

....[2+3]

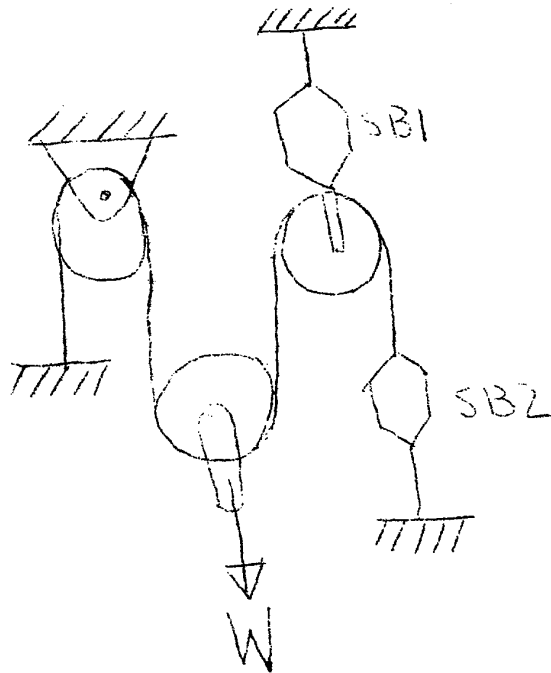
7. A power plant consumes 10 kg/s of coal of calorific value 20 MJ/kg. The net efficiency of the plant is 30%, and the power consumed by pumps and auxiliaries in the plant is 10 MW. Determine a) gross output of the plant and b) rate of heat rejection to the environment. [2+3]

8. Evaluate the equivalent resistance R_{eq} between points A and B:

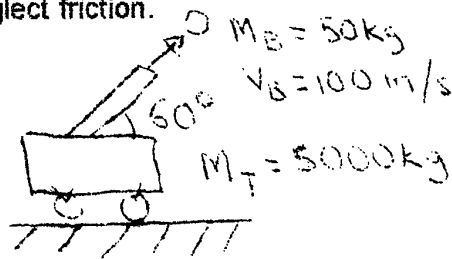


.....[5]

9. Determine the ratings on spring balances SB1 and SB2.[3]



10. A cannon ball is fired from a cannon fixed on a trolley, which is initially at rest, as shown. Determine the velocity (speed, direction) of the trolley after the ball is fired. Neglect friction.[4]



11. The nameplate rating of a single phase induction motor is 200 V, 50 A, $\text{pf} = 0.8$, $\text{RPM} = 1440$.

- Determine the rated power output and reactive power.
- If a capacitor of rating 3 kVAr is connected in parallel to the motor, determine the new values of reactive power and power factor.

.....[5]