PROBLEM SOLVING TECHNIQUES

PROBLEM 1

A WINCH IS TO BE DESIGNED FOR HAULING BOATS UP A RAMP SLOPING 30° TO THE HORIZONTAL

IF THE MAXIMUM POWER AVAILABLE IS 480 WATTS DETERMINE THE SPEED WITH WHICH THE BOAT CAN BE HAULED UP THE RAMP.

DATA:

MAX. BOAT WEIGHT = 135 KG

COEFFICIENT OF FRICTION = 0.22

STATE ANY ASSUMPTIONS YOU MAKE.

PROBLEM 2

THE CABIN OF AN AIRLINER HAS A VOLUME OF 5000 m^3. WHEN FLYING AT ITS CRUISING HEIGHT IT IS PRESSURISED TO 2/3 ATMOSPHERIC PRESSURE AND KEPT AT 21°C.
HOW MUCH AIR HAD TO BE RELEASED FROM THE CABIN DURING CLIMB IF THE AIR IN THE CABIN AT GROUND LEVEL WAS AT 101 kPa AND 17 °C?

DATA: THE GAS CONSTANT FOR AIR IS 0.287 kJ/kgK

HINT : USE THE GAS EQUATION $pV = mRT$

PROBLEM 3

A GAS EXPANDS IN A CYLINDER PISTON ASSEMBLY FROM AN INITIAL PRESSURE p_1 AND VOLUME V_1 TO A LOWER PRESSURE p_2 AND VOLUME V_2.

SHOW THAT THE WORK DONE BY THE EXPANDING GAS IS GIVEN BY:

$$\frac{p_2V_2 - p_1V_1}{1-n}$$

WHERE THE PRESSURE AND VOLUME ARE RELATED BY:

$$pV^n = \text{constant.}$$

A USEFUL APPROACH TO PROBLEM SOLVING

Draw a DIAGRAM or graph as a means of assembling your DATA:- This helps to clarify the nature of the problem and give a "feel" for it. Is any additional data required from tables, reference books etc? Use your practical knowledge and common sense to gain an understanding of the problem. In 'real life' what you expect the solution to be?

IDENTIFY the type of problem you are dealing with:- Static or dynamic? Design? Steady or unsteady? Open or closed? Stand back from the problem and ask yourself 'What is this about?' 'What do I have to find?' 'How might I set about it?' 'What assumptions are needed or implied?'

Write down the PRINCIPLES and/or formulae required:- eg Sum of Forces=0 & Sum of Moments=0; or SFEE; or Bernoulli's equation; or F=ma; or v = u + at etc. If necessary establish a sign convention for directions and angles.

APPLY the principles/formulae to effect a solution:- Your solution should be written as a 'story' which can be read and followed by another person without difficulty. Connect sections of calculation with appropriate words or phrases.

CONCLUDE with any necessary observations or COMMENTS: This may be as simple as underlining answers or collating results in the form of a chart, table or diagram. Comment on the significance of a result if appropriate.
Ask yourself whether the result is reasonable and realistic. If not, **CHECK** your units, method and calculations.

D I P A C

IMPORTANT NOTES

1. UNITS... must be consistent!
   Convert to fundamental SI, (J, kg, Pa, W, N etc.)
2. Ensure NUMERICAL ACCURACY!
   Practice using your calculator...
3. Keep it LEGIBLE and TIDY!
   Someone has to read it!
4. Mistakes.. cross out and mark off.
   Avoid TIPP-EX
5. STUCK part way?
   Assume a reasonable intermediate result and continue.

What makes life difficult is that the process of confronting and solving problems is a painful one. Problems, depending upon their nature, evoke in us frustration or grief or sadness or loneliness or guilt or anger or fear or anxiety or anguish or despair. These are uncomfortable feelings, often very uncomfortable, often as painful as any kind of physical pain. Indeed, it is because of the pain that events or conflicts engender in us that we call them problems. And since life poses an endless series of problems, life is always difficult and is full of pain as well as joy.

Yet it is in this whole process of meeting and solving problems that life has its meaning. Problems are the cutting edge that distinguish between success and failure. Problems call forth our courage and our wisdom; indeed, they create our courage and our wisdom. It is only because of problems that we grow mentally and spiritually. When we desire to encourage the growth of the human spirit, we challenge and encourage the human capacity to solve problems, just as in school we deliberately set problems for our children to solve. It is through the pain of confronting and resolving problems that we learn. As Benjamin Franklin said, "Those things that hurt, instruct." It is for this reason that wise people learn not to dread but actually to welcome problems and actually to welcome the pain of problems.

Dr M Scott-Peck -The Road Less Traveled