ascending and involving the use of the brakes and sand in descending.

Capitalize the amounts obtained as above at rate of 6% per annum unless ohherwise instructed.

The above is based on an operating cost of $1.20 per train mile, and an average resistance of about 7½ lbs. per ton. Modify for different train mile costs and train resistance, increasing the additional cost of rise and fall as given above in direct proportion with <u>increase</u> in train mile cost and <u>decrease</u> in train resistance.

Note:- The cost of rise and fall is almost entirely due to increased fuel consumption. For Class B grades, this is about 80% of the total cost of rise and fall and on Class C about 70%, the balance being for wear and tear on rolling stock due to application of brakes etc. The cost of fuel for the larger roads in the United States averages, quite consistently, about 10% to 11% of the total operating cost, If there is reason to vary this item very much, the above values for rise and fall should be varied accordingly. The determination of the class to which a certain grade belongs depends upon a wide range of conditions. For ordinary purposes a rough classification may do, otherwise a more careful study from a profile of virtual grades and other data is necessary.

<u>PUSHER ENGINES.</u>

The cost of operating a pusher engine may be estimated at $15,000. to $20,000 per annum for ordinary engines. Where large engines of the mallet type are used it will be more than this. This will permit the expenditure of from $250.000 upwards (for each engine required to handle the traffic) to avoid the pusher grade. A table of balance grades for pusher engines is given at the end.

Use the following form for comparing the ultimate value of two or more lines:

	Data.		Capitalized Value	
	Line A	Line B	Line A	Line B