NORMAL SCHOOL FOR UPPER CANADA.

THIRTY-FIFTH SESSION, JUNE, 1866.

Examiners in Department of Mathematics, Chemistry, and Natural Philosophy:

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NATURAL PHILOSOPHY.—BOTH DIVISIONS.

Time—Three Hours.

1. Describe the *barometer*—explaining the cause of its regular and irregular oscillations and the circumstances upon which its reliability as a scientific instrument depends.

2. Explain the effect of *friction* in machinery—the different expedients employed for overcoming it, and state Coulomb's laws in regard to both sliding and rolling friction.

3. Describe the production of sound—the circumstances upon which its pitch and intensity depend, state the rapidity with which sounds travel and the circumstances determining the distances to which they may be heard.

4. Describe the different modes of determining the specific gravity of liquids.

5. Briefly describe the human ear and explain the function of each part. In what manner does the organ of hearing become modified in the lower classes of animals.

6. Describe the common pump and the fire engine, and give the theory of their action.

7. State the leading ideas that enter into the construction of the different parts of the condensing steam engine.

8. Describe the production of echoes—explaining clearly how the number of syllables repeated is determined.

9. The flood-gate of a canal is 12 feet wide, and is immersed in water perpendicularly to the depth of $9\frac{1}{2}$ feet— the water being just level with its upper edge:—Required the pressure:

      I. On one side of the whole gate.
      II. On the lowest three-sevenths of the gate.
      III. On the uppermost two-fifths of the gate.
      IV. On the middle seven-ninths of the gate.

10. What power will sustain a weight of 40000 lbs. by means of a differential wheel and axle, the radii of the axles being $2\frac{1}{5}$ and $3\frac{2}{7}$ inches, and the radius of the wheel 25 inches.

11. In what time will a locomotive of 90 horse powers carry a train whose weight is 55 tons, from Toronto to Kingston, a distance of 180 miles—the first-fourth of the journey being up an incline of 7 in 2000—the last three-fourths down an incline of 3 in 10000—the rate of the train for the first-fourth being 20 miles per hour, and the average atmospheric resistence for the last three-fourths being 300 lbs.—friction as usual?

12. The mercury in a barometer at the summit of a mountain stands at the height of 12 inches, while that in another barometer at its base stands at the height of 29 inches. Required the height of the mountain.

13. Assuming that 100 cubic inches of atmospheric air at the surface of the sea weigh 32 grains, what would be the weight of 100 cubic inches taken from a height of say 27 miles above the surface of the earth?

14. A high pressure steam engine, whose piston has an area of 280 square inches, and makes 20 strokes per minute—the boiler evaporating $\frac{4}{5}$ of a cubic foot of water per minute into 180 cubic feet of steam, under a pressure of 65 lbs. to the square inch—pumps 40 cubic feet of water per hour from a mine 150 feet deep. The residue of the work of the engine is consumed in working a circular saw 10 feet in diameter, against oak timber 2 feet in thickness. Now, assuming that the peripheral resistance is directly proportional to the thickness of the timber, that in pine it is 20 lbs. to the linear inch, and that the resistence of oak is to that of pine as 20 to 17, how many revolutions will the saw make per minute?