3. The temperature of the air in the downcast and upcast shafts of a colliery is 50° and 80° Fahr. respectively: what volume of air in the upcast amounts to the same weight as 1 cubic foot in the downcast at same depth?

4. Show how you would ventilate the workings on annexed plan, having due regard to the requirements for haulage.

5. If a drift 30 yards long, 6 ft. wide, and 4 ft. high is filled with a mixture of firedamp and air at the most explosive point, what quantity of air would be required to dilute it so as to be non-explosive?

SUBJECT No. 6.—*On the Nature and Composition of Explosives and Dangerous Gases met with in Coal-mines, and on Spontaneous Combustion.*

1. Give the chemical composition of any of the high-explosive compounds of which you have a knowledge.

2. What gases are most common in coal-mines? State composition, under what conditions and where most frequently found.

3. Which is the most likely part of a working-place to find firedamp accumulating in? What is the most explosive mixture of firedamp and air? What effect has firedamp unmixed with air upon the flame in a lamp?

4. What in your opinion is the best means of avoiding dust-explosions in underground workings?

5. Explain what you understand by the term "spontaneous combustion," and what steps should be taken to prevent same in coal-mining.

SUBJECT No. 7.—*On the Drainage of Mines, and Pumping-appliances.*

1. What is the principle which governs the working of pumps generally?

2. What diameter of pump would be required to replace two pumps of 8 in. and 12 in. diameter respectively, assuming stroke same in each pump?

3. Give sketches of working-parts of—

(*a.*) Bucket lift,

(*b.*) Ram pump,

and show how placed in shaft.

4. Assuming feeder of water, 500 gallons per minute, to be pumped from a depth of 1,000 ft., what pumps would you apply, and what horse-power will be required to do the work?

5. State principle controlling the working of a siphon, and how same can be applied to drainage of mines.

SUBJECT No. 8.—*The Haulage of Coal on Underground Planes and Shafts, also Different Systems of such.*

1. What is meant by "self-acting inclines," and what is the least grade at which such inclines will act?

2. Describe with sketches any systems of haulage with which you are conversant, and state system you prefer, and why.

3. Describe with sketches how you would fit a shaft with necessary guides for cages to work in a shaft 1,000 ft. deep, and state kind of guide you prefer. Give reasons.

4. Assume shaft 800 ft. deep, quantity of coal to be raised 600 tons per day of eight hours, and show how you would arrive at size of engines, diameter of drum, and rope required.

5. State requirements of the Act as to inspection of machinery.

SUBJECT No. 9.—*The Theoretical and Effective Power of Steam-engines and Boilers, also Strength of Hauling Rope, Chains, &c.*

1. Find the horse-power of an engine whose mean steam-pressure is 75 lb., diameter of cylinder 18 in., length of stroke 36 in., and steam cut off at two-thirds of the stroke, number of revolutions being 50 per minute.

2. Sketch a Lancashire boiler, showing the position of fittings required, with name of each.

3. A loaded tub weighing 10 cwt. standing on a level takes a pull of 25 lb. to start it: what pull will be required to move it on an incline of 1 in 20?

4. Show by calculations how you would ascertain breaking-strain and safe working-loads of chains and ropes.

5. What size hauling-engine would be required to raise 100 tons per hour up an incline 1,000 yards long, grade 1 in 10, and assuming speed of five miles an hour?

SUBJECT No. 10.—*The Incrustation of Steam-boilers, Causes of same, and Remedies.*

1. Under what conditions does the formation of scale occur in steam-boilers, and what are the dangers likely to arise from such forming?

2. Describe any system with which you are acquainted for the prevention of incrustation in boilers.

3. What system for the heating of feed-water do you consider the best, and what are the advantages of using hot feed?

4. Under what conditions would it, in your opinion, be dangerous to put the feed on to a boiler; and under such conditions, what would you do?

SUBJECT No. 11.—*Tapping Water in Mines, and Mode of constructing Dams underground.*

1. What circumstances would guide you in selecting the position for an underground dam to resist heavy pressure? How would you construct such a dam, and what special precautions would you take during progress of work? Give sketches and dimensions, and state material to be used, and generally what would be required to make secure.