SUBJECT No. 4.—*On dealing with Old Workings and other Sources of Danger.*

1. Explain the precautions you would take, and show by sketches how you would operate, in approaching old workings to the rise, and known to be standing full of water.

2. Show by sketches how you would construct a dam underground in place 8 feet wide by 6 feet high to resist an ultimate head of 800 feet of water-pressure. Describe the nature and size of material, and show by calculation the pressure per square inch due to the head, and total pressure of water against the dam.

3. Give your ideas on the handling of explosives, also charging, tamping, and firing of shots. What is a blown-out shot, How is it caused, and what are the attendant dangers of such?

4. What do you consider the best explosive for use in—

(*a.*) Shaft-sinking;
(*b.*) Dry and dusty mines;
(*c.*) When firedamp is given off?

And state how you would carry out blasting under the several conditions above mentioned.

5. To what cause are the greatest number of accidents in coal-mines attributed? and what would you suggest should be done to minimise same?

6. Describe a safety-lamp, and give sketches in detail of a modern one, stating the principle of the lamp-gauze; and state what, in your opinion, is the best lamp for testing for firedamp.

SUBJECT No. 5.—*On Steam Boilers and Engines about Collieries.*

1. Describe the fittings of a Lancashire boiler; and, given such a boiler 30 feet long by 8 feet diameter, what should the thickness of plates be for a safe working-pressure of 120 lb. per square inch (show by calculation)? And give sketch showing how you would set such a boiler, giving dimensions of flues.

2. Give sketch of safety-valve, and state weight required to counterbalance a boiler-pressure of 90 lb. per square inch—length of lever between fulcrum and weight to be 34 inches; from fulcrum to centre of valve, $2\frac{1}{2}$ inches; diameter of valve, $2\frac{3}{4}$ inches; and weight of lever, 16 lb.

3. Draw a section through a steam-cylinder and valve-chest, showing position of glands and all steam-ports.

4. Explain the term "horse-power," and show by calculation the size of cylinder, length of stroke, and speed per minute of an engine required to develop 200-horse power with a boiler-pressure of 100 lb. per square inch; steam to be cut off at two-thirds of stroke.

5. Enumerate the causes which prevent the theoretical power of steam-engines being obtained in practice.

SUBJECT No. 6.—*On Mine Drainage and Haulage, and Appliances for same.*

1. Enumerate the different methods of mine-drainage, and the different types of pumping-engines; also explain why a siphon can deliver water over a point, say, 19 feet higher than the feed, and can deliver to a lower but not to a higher point than the feed.

2. Show by calculation the size of steam-cylinders you would apply to a direct-acting pump, using 60 lb. pressure per square inch, to deliver 90,000 gallons an hour to a vertical height of 700 feet, plunger-speed to be 150 feet per minute.

3. Assume you are required to haul 80 tons per hour by endless rope at a speed of 3 miles an hour over a road 1 mile long, grade being 1 in 9 against the load; each empty tub weighs 5 cwt., and carries 10 cwt. of coal; allowing $\frac{1}{25}$ for friction of tubs and 40 per cent. for other mechanical resistances; weight of rope, 12,000 lb.: find horse-power.

4. Enumerate the various systems of haulage in use for mines, and give particulars and sketches of any system of which you have practical knowledge.

5. Assume a boiler-pressure of 120 lb. per square inch, what size engines, length of stroke, and size of drum would be required to raise 1,000 tons in 8 hours from a depth of 1,600 ft.? Also give size, weight, and strength of rope, size and weight of tubs and cage, also kind and number of conductors you would adopt for guiding cages in shaft.

6. Describe the different kinds of safety appliances used in connection with winding from shafts.

SUBJECT No. 7.—*On Geology, Surveying, and Making of Plans.*

1. Describe the geology of any coalfield of which you have a knowledge. Show by sketches what is meant by "conformable strata," and say what is meant by the terms "igneous," "aqueous," and "metamorphic" as applied to rocks.

2. Show by sketches, and explain, how you would connect a surface with an underground survey, the shaft being 450 feet deep.

3. A triangular block the sides of which are 90 yards, 105 yards, and 125 yards respectively: give area in acres.

4. Describe the important features which should, in your opinion, be be delineated on colliery-plans.

5. Candidate to produce plan showing the workings of a colliery with the surface taken up for at least 20 acres in the vicinity of the shaft or adit, the workings to be shown in colours. The connection between the surface and underground must be shown and described in the event of there being only one shaft. The levels and main headings must have assumed traverse calculated in detail, and showing latitude and departure for each bearing. The plan to be candidate's own work, and to be accompanied by field-book.

6. Plot the following bearings with protractor and scale, and calculate the latitude and departure, and give course and length of 6th set to tie with the start of the first set.

1. N. 30° 15′ E., 500 links.
2. S. 40° 10′ E., 400 "
3. S. 10° 10′ W., 350 "
4. S. 65° 25′ W., 250 "
5. N. 50° 15′ W., 300 "

7. Describe system of levelling, and show how to keep a level-book and reduce levels.