SUBJECT NO. 3.—*Gases of Mines, Spontaneous Combustion, and Ventilation.*

1. Describe the properties of oxygen and nitrogen gases, give the specific gravity of each, and state what effect nitrogen has on the oxygen of the atmosphere.

2. Enumerate the gases met with in mining and the causes of their generation, give their specific gravities, and state what means you would adopt to remove such gases.

3. What are the causes of spontaneous combustion, and what are the principal dangers resulting from underground fires, and what steps would you take to obviate such?

4. If a large accumulation of explosive gas should be met with in a mine where furnace ventilation is applied without a dumb drift, what would you do to remove the gas?

5. A steam-jet and fan acting together on an upcast shaft produce 80,000 cubic feet of air per minute. When the fan is stopped the jet produces 16,000 cubic feet. What quantity would the fan running alone give?

6. Ventilate the annexed plan, showing stoppings, air-currents, air-crossings, canvas doors, bratticing, doors, and regulators.

7. There are two airways: the first is 10 ft. square, the second 8 ft. by 5 ft. The same quantity of air has to be passed in each airway. The water-gauge in the first is 0·8. What will be the water-gauge in the second airway?

SUBJECT 4.—*Dealing with Old Workings and other Sources of Danger.*

1. In reopening a large area of old workings, one section to the dip and one to the rise, which have been standing sealed off for some time, what measures would you adopt?

2. How would you deal with a spontaneous outbreak of fire in a heavily fallen goaf adjacent to active workings?

3. The greatest percentage of accidents in mining occur from falls of roof and sides: what are your views with regard to still further minimising such accidents?

4. What is a "missed shot" and a "blown-out shot," and what accidents are liable to arise from the use of explosives?

5. Describe what measures you would adopt for general safety in working seams of coal under tidal waters?

SUBJECT 5.—*Steam Boilers and Engines used about Mines.*

1. Describe the purposes of the following steam-boiler appliances: viz., steam-gauge, water-gauge, safety-valve, blow-off tap, manhole, damper; also, explain the principle of the Bourdon steam-gauge.

2. Enumerate the necessary precautions to be observed in operating steam boilers and engines, to avoid accidents; and state what steps you would take to have them effectively carried out.

3. The air-cylinder of a compressor is 36 in. diameter and 6 ft. stroke, double-acting, and working at 30 strokes per minute the air is compressed to 60 lb. per square inch above the atmosphere: how many cubic feet of air should be delivered per hour, assuming the atmospheric pressure at 15 lb. per square inch?

SUBJECT 6.—*On Mine-drainage, Haulage, and Appliances for same.*

1. What size steam-cylinders, also pump-rams, double-acting, would be required to deliver 1,000 gallons per minute against a head of 100 fathoms? Effective steam-pressure 60 lb. per square inch, and speed of rams 180 ft. per minute.

2. From a main haulage-way there are two haulage-roads branching off right and left. Describe, and show by sketches, how you would arrange the junction for dealing with a large output. Endless rope is the method of haulage.

3. A pair of winding-engines have cylinders 40 in. diameter and 6 ft. stroke; steam-pressure, 100 lb. per square inch. How many revolutions per minute will they be running when developing 1,200 horse-power?

4. In a mine with shafts 600 ft. deep it is proposed to instal endless-rope haulage: describe in detail and illustrate by sketches how you would carry out the work.

5. Describe the various systems of underground haulage, and point out the distinctive features of each; also sketch in detail the appliances of a balance jig in a steep seam.

6. Show by sketch how you would fix a 10 in. column of pipes in a shaft 500 ft. deep.

7. Enumerate what precautions and appliances you would adopt to reduce machinery accidents in shafts to a minimum.