

*SUBJECT 3.—Mine-gases, Spontaneous Combustion, and Ventilation.*

1. What gases are met with underground, and in what manner and to what extent are they dangerous in the air of mines? State how you would examine the air of a mine for the different gases.
2. Define "spontaneous combustion" and "gob-fires," in a mine? State how they are produced? Give a sketch of a gob-fire in the workings, and state how you would deal with it.
3. What is carbonic oxide? How is it produced in mines, and what effect has it on animal life?
4. A mine is ventilated by three splits of air, A, B, C: A passes 30,000 cub. ft. per minute, B 20,000 cub. ft. per minute, and C 15,000 cub. ft. per minute, out of a total of 65,000 cub. ft. If the total ventilation is increased to 120,000 cub. ft. per minute, what would each split take?
5. The barometer at the top of a shaft reads 30.4 in., the thermometer 63° Fahr., the depth of shaft is 1,300 ft., and at the shaft-bottom the thermometer reads 73° Fahr.: what will be the reading of the barometer at the shaft-bottom, and the difference in the pressure of the air at the top and bottom of the shaft?
6. Ventilate the plan on the following page, showing stoppings, air-currents, air-crossings, canvas doors, bratticing, doors, and regulators.
7. If the horse-power of a fan-engine is 60, and the water-gauge 3.25 in., what quantity of air should you obtain, with 60 per cent. useful effect of the fan?

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

1. In a mine with large areas of goaf, and limited ventilation, just sufficient for the active workings, what precautionary measures would you adopt with respect to the exhausted areas?
2. What experience have you had of underground fires, spontaneous or otherwise? Show by sketches how you would lay out a mine liable to spontaneous combustion. Give your reasons.
3. Mines may become dangerous from various causes: enumerate some of these, and state what measures you would adopt to render the mine safe.
4. State what you would do before firing shots in a dry and dusty place, what explosive you would use, and how you would fire it.
5. What is the principal cause of accidents in mines, and what are your suggestions relative to lessening such cause?

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

1. Enumerate the causes likely to lead to boiler-explosions, and what you would do to prevent same. Show by calculation how you would ascertain the safe working-pressure of a steam-boiler.
2. By endless rope it is proposed to haul 150 tons of coal per hour; the road is practically level; the loaded tubs to weigh 16 cwt., including a tare of 5 cwt.; the road is 2,640 yards long; speed of rope to be three miles per hour: what will be the pull on rope, horse-power and size of a pair of engines to do the work? Piston-speed, 240 ft. per minute; and boiler-pressure 120 lb. per square inch.
3. What is the horse-power developed by a pair of air-compressing engines, 36 in. cylinders, 6 ft. stroke, running 30 revolutions per minute, and compressing the air to 80 lb. per square inch above atmospheric pressure?

*SUBJECT 6.—Mine Drainage and Haulage, and Appliances for same.*

1. If there were three feeders of water flowing into the dip workings of your mine—A, 150 gals. per minute; B, 1,280 gals. per hour; and C, 288,000 gals. in 24 hours—give details and calculations showing size of pumps you would install to deal effectively with these feeders, the delivery column to be 40 chains long, rising 1 in 10.
2. Describe the mechanical and other appliances used in colliery winding. Give your recommendations respecting same, with a view to maximum safety.
3. In connection with an endless-rope system, branch ropes are worked: describe, and illustrate by sketches, how such a system is operated.
4. In connection with the haulage of coal by mechanical appliances and otherwise, various kinds of accidents occur: what precautionary measures can you suggest to lessen the number of such accidents?
5. What system of bringing the output to the surface would you adopt on an inclined plane 2,000 yards long, dipping 1 in 6, having in view the extension of the dip?
6. If required to make a new installation for which 1,000-horse-power steam plant is required, state class, size, working-pressure, and general specification of the boilers you would adopt, and give reasons for preference.