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Abstract: Since the year 1872 all underground managers of mines are required, by the English mining law, to appear before a board of examiners and receive a certificate of competency, previous to assuming charge of mines. This article presents the required qualifications of the applicants.

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CERTIFICATED ENGLISH MANAGERS.

Since the year 1872 all underground managers of mines are required, by the English mining law, to appear before a board of examiners and receive a certificate of competency, previous to assuming charge of mines.

The following qualifications are required on the part of applicants presenting themselves for examination, viz. :

Applicants must be above 21 years of age, and must have had either—

1. Two year's experience, underground, in any capacity; or,
2. Have served three years in a mining engineer's office, and have been engaged in the active survey of pits and making plans; or,
3. Have been employed as a mechanic at a mining establishment for two years, and have been, during the eight months immediately preceding their application, employed under ground acquiring a knowledge of mineral workings.

The subjects of examination are the following, viz. :

Written examination, applicants required to count on:

1. Mines Regulation Act, 1872, general knowledge of.....	20
2. Ventilation, theory and practice.....	80
3. Sinking, fitting and pumping.....	40
4. Winding and haulage.....	40
5. Modes of working coal, iron, stone, or rather mineral, having refer- ence to the nature of roofs and pavements, and setting of the workings of a new pit.....	80
6. Surveying and drawing.....	60
7. Arithmetic up to vulgar fractions, including calculation of areas and velocities.....	40
Maximum number of marks.....	360

There need not be *viva voce* examinations; 120 marks to pass, but every candidate must obtain at least 30 marks in each of No. 2 and No. 5, and must obtain at least 60 marks out of at least two of the other subjects.

Candidates for examination for a certificate of competency, are required to sign an undertaking to keep the information contained in the examination papers strictly private and confidential; and, also, to engage not to take copy of such paper, or to publish the same in any way.

The following are some of the questions, selected at random, which have been prepared by examining boards:

Explain the ordinary conditions for adopting the long-wall and pillar and room-working.

Draw a free-hand sketch, or describe the mode you would adopt in laying out the workings of a colliery from the pit bottom, giving the dimensions and showing ventilation by arrows.

Explain difference between pillar and room and long-wall workings, more especially as relates to the ventilation, timbering and production of coal.

What is ventilation, and why is it required in mines?

Describe the method of measuring the air of mines by means of powder smoke and by an anemometer.

What is the cause of friction of air in mines?

How does friction increase or decrease?

How does splitting the air effect the quantity passing through a mine?

What is the meaning of the pressure of the air?

How does the pressure of the atmosphere affect the velocity of the mine currents?

State the rule for finding the weight of a column of air.

What is fire-damp, and what are its competent parts?

What other gases, besides fire-damp, are met in coal mines? Give an account of the nature and properties of the various gases of coal mines.

Explain the principles of a safety lamp?

Explain the uses of the barometer and thermometer in mines.

What is a water-gauge, and for what purpose is it used in mines?

Describe the best method of timbering, walling and tubing a shaft.

Describe the best method of sinking the quicksand.

Explain the action of a syphon, and its use and application in draining mines.

State the various methods of pumping water out of mines.

Write a short essay on the daily operations of a colliery in full operation.

FULL LIST OF QUESTIONS

put to applicants for certificates of competency as mining boss or underground manager, by the examining board in Endinburg, Scotland, in November, 1873:

When underground workings are approaching old wastes of which no plans have been kept, what special dangers are the workmen exposed to, and how would you provide against them?

State shortly the general rules as to the use of gunpowder and other explosive material in mines where inflammable gas has been noticed.

What is the requirement of the act as to the number of shafts in use at each mine, and state shortly the exceptions to it that may be allowed.

In mines where there is inflammable gas, what special precautions are to be observed by the workmen, and by those in charge of the mine?

Give a short statement of the requirements of the act regarding man-holes, or places of refuge on underground roads.

What limitations does the act impose in the employment in mines of young persons between 12 and 16 years of age?

Explain why artificial ventilation is more reliable than natural. Describe the different modes of producing artificial ventilation.

For an extensive but shallow working, would you adopt a fan or a furnace? And give your reasons.

How do you measure the velocity of an air current, and at what velocity would you have air traveling through the workings?

Give your reasons for making air courses as large as possible. Explain the advantages of splitting the air.

Describe the barometer, and explain how it indicates the atmospheric pressure. What is a water gauge, and of what use is it?

Sketch what you consider a good furnace for a pit 60 fathoms deep, with 100 men, giving its dimensions and relative position to the shaft.

Under ordinary conditions as regards gas, what quantity of air would you have circulating in a pit with one hundred men, and what is the least dimensions you would have the air courses? Give observations regarding the necessity of having the air course uniformly large.

Explain the ordinary conditions for adopting the long wall, and the stoop and room working.

In a seam having a dip and rise of 1 in 6, and the direction of the plane of the coal being to the full rise, sketch what you consider a good form of long wall working for it, having regard to the ventilation, direction of the drawing roads, etc.

Under the same conditions, give us a sketch of a stoop and room working by which the greatest percentage of the seam can be got out.

In a four-foot seam of coal 80 fathoms deep, what size would you make the pillars, having regard to the ultimate extraction of the greatest quantity of coal, combined with safety to the workmen.

Give a rough section showing the different seams of coal in your district.

Under ordinary conditions as regards roof and pavement, give your observations on the cost of working a four foot seam of coal by stoop and room, and a two foot seam by long-wall, embracing the oncost necessary in each.

Sketch what you consider the best form of a shaft one hundred fathoms deep, for an out-put of three hundred tons a day, including ordinary provisions for pumps, and showing arrangement of slides and cages with dimensions.

Explain how you would prevent water met with near the surface from getting into the shaft.

How many gallons are there in 1,200 tons of water, and describe the general arrangement and size of pipes for lifting that quantity daily from a pit 80 fathoms deep.

Describe the class of engine best adapted for the above work, size of cylinder, stroke and strokes per minute.

Explain fully the advantages in a deep shaft of having a series of lifts instead of one long lift to the surface.

Explain the action of a syphon and its use and application in draining mines.

State the various methods you know of pumping water out of a dip working.

Describe the best kind of a boiler for the safe and economical production of steam.

Explain the forces acting on a self-acting inclined plane.

Compare the friction of ordinary tubs on tram-rails with the friction on a well made railway.

Under the usual conditions of tram-rails and tubs, what is the flattest gradient for a self-acting inclined plane 300 fathoms long, to pass 100 tons in 8 hours. Sketch the best arrangement of it at the top.

Explain the best modes of drawing coal along a level road, or one not dipping sufficiently to take away the rope.

Explain why conical drums are necessary in deep shafts.

Whether are chains, wire ropes, or hemp ropes preferable and give your reasons. Given the breaking strains of a rope, what is a safe working load for it?

State from your experience what is the cost of haulage underground per ton per mile. How does it compare with the cost of a mineral railway above ground? Give your observations on the different modes of hauling known to you, and how you think they might be improved.

Accidents frequently happen at headings where the loaded tubs are taken down with snibbles, by the full tub running into the one before it, or an empty one coming up; how would you remedy this and still retain the use of snibbles?

In speaking of machinery, what is meant by horse power?

Sketch on paper as near as you can the following bearings of a survey: 82° N. E. 68 links, 51° S. E. 95 links, 63° N. E. 79 links, 20° N. E. links, 85° N. W. 87 links, 87° N. W. 140 links, 52° S. W. 140 links, and 48° S. E 85 links.

Describe the compass and explain the circumstances under which it is unreliable.

Explain what is meant by the scale of half an inch to a chain.

Describe the process of surveying underground.

Describe how you would plot the same survey on paper, and name the instruments you would require to use.

Why is it necessary to make deductions from the measurements to the rise and dip in steep working, and how would you find the correct measurements?

Suppose you were driving toward an old waste which is shown only in a plan twenty years old, explain the precautions to be taken as regards the meridian.

Add together 507 tons, 13 cwts., 2 qrs., 12 lbs.; 1670 tons, 15 cwts., 1 qr., 8 lbs.; 47 tons, 14 cwts., 3 qrs., 14 lbs.; and 408 tons, 9 cwts., 2 qrs., 7 lbs.

How much would be required to pay 75 men a fortnight's wages at the rate of 27s. $4\frac{1}{2}$ d. each week?

How many cubic feet of air will pass per minute through an airway 5 by 7 feet when the air current is traveling at the rate of 20 yards in 15 seconds.

What weight of material will have to be raised in sinking a shaft 15 by $5\frac{1}{2}$ feet and 40 fathoms deep, supposing it averages 150 lbs per cubic foot?

How many gallons of water will be pumped in an hour by an engine making 8 strokes of 7 feet each minute, the diameter of the pump being 15 inches?

How much power would it require to send 10,000 cubic feet of air per minute through an air course having an area of 40 square feet, and how much would the power require to be increased to do it if the area was only 20 square feet?

The following questions were prepared by the examining board of the bituminous coal fields, on the passage of the mining law,

April 18, 1877, for the examination of applicants for the office of Inspector of mines:

What is your age?

Are you a citizen of the United States?

What is your present occupation; how long have you been thus engaged?

Have you had five years experience in the workings of the bituminous coal mines of Pennsylvania?

State particularly what opportunities you have had for obtaining a practical knowledge of the workings of mines.

Have you had any experience in mines where fire-damp or any noxious gases have been evolved to any great extent?

How would you lay out a mine to conform with the provisions of the "ventilation act."

What are the most frequent causes of accidents in coal mines?

Where should the largest pillars be left, in swamps or on summits?

In the use of powder, where there is fire-damp, what plan do you consider the safest?

What effect if any, does gob heaped against the side of a pillar, have on its strength?

Which requires the largest pillars, thick or thin seams of coal—all other conditions being equal?

How would you test the safety of the roof in entries and rooms?

What kind of wood, in practical mining, do you consider the best for pit posts?

Name the different gases found in coal mines.

What is the composition and relative weight of carbonic acid gas (black damp), as found in coal mines; how can its presence be detected?

What percentage of carbonic acid gas, in the air of a mine, will extinguish the flame of a lamp; and what percentage is dangerous to life?

Mention some of the causes which produce carbonic acid gas in mines.

What is the composition and relative weight of carburetted hydrogen gas (fire-damp), as found in coal mines; and how can its presence be detected?

How is this gas produced, and where is it found in mines?

What is the appearance of the flame of the lamp or candle, when the mixture of this gas and air is near the explosive point?

Will this gas explode unmixed with air?

After explosion is this gas dangerous to life; and is it heavier or lighter than air?

What is it called after explosion?

What are the component parts of atmospheric air, and the proportions?

What is the weight or pressure, of the atmosphere at the earth's surface, nearly.

What safety lamps do you consider the best?

Give a general description of each of these lamps, and how used.

How many holes to the square inch, in the gauze surrounding a lamp is considered safe?

What is the reason that the gas, when ignited in the lamp, does not pass through the gauze and ignite the gas outside the lamp?

What velocity of air current will drive the flame through the gauze?

If you were examining a mine, and the gas in your safety lamp should ignite, what would be your method of procedure?

Mention the different modes in use for the ventilation of mines.

Can natural ventilation be relied on at all times?

If so, by what plan? If not, why?

Name some of the best modes of artificial ventilation.

Explain the principles of furnace ventilation.

Does the capacity of a furnace depend upon the depth of the shaft, to secure the same ventilation?

Where would you locate a furnace, to be the most effective?

Where would you locate the upcast, in low or elevated positions?

What advantage, if any, is there in building a chimney on the surface, at the upcast shaft?

What is the best form of shaft, or chimney for ventilating purposes.

Can you with safety, use a furnace to ventilate mines, where explosive gases are generated? If so, describe the kind you would use?

How would you kindle a furnace, situated at the highest opening,

when the exterior air is at the temperature of 90° and that of the mine at 50° , and the current moving in the direction of lowest opening, to prevent filling the mine with smoke?

How does the steam jet compare with the furnace, as a means of ventilation and how should it be applied?

Describe the different modes of using the fan in ventilating mines, which mode would you prefer; and why?

If you wish to double the velocity of the air-current in the mine, in what proportion would you increase the capacity of the furnace, fan, or other motive power?

If you consider it any advantage to split the air-current in mines, state your reasons, and the method of doing the same.

What will the volume of air, per minute, passing through an opening 6 feet 9 inches by 5 feet, when the anemometer shows a velocity of 105 feet per minute.

What instruments should an inspector have to enable him to discharge his duties under the ventilation act; and what is the particular use of each instrument?

How does a barometer indicate danger in a mine?

What means may be employed to ascertain the velocity of air-currents in mines other than by the anemometer?

What is the cubical contents of a circular shaft whose diameter is 5 feet and height 60 feet.

Give a description of an approved safety catch and its action.

What test would you give to wire ropes and chain cables used in shafts and slopes?

In a mine having two divisions, from the downcast to the upcast, one division being 3,000 yards long, on which is placed a regulator, 3 feet high and 4 feet wide, what should be the width of a regulator, of the same height, placed in the other division, which is 4,000 yards long, so that the same quantity of air may pass through both openings, other conditions being the same in both divisions? What is the dimensions of a square regulator, on the latter division, to allow the same quantity of air to pass.