MN:MINING ENGINEERING

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Q.1–Q.5 CARRY ONE MARK EACH

1) Choose the most appropriate word from the options given below to complete the following sentence.

A person suffering from Alzheimer disease _____ short-term memory loss.

(*GATE MN* 2014)

a) experienced b) has experienced c) is experiencing d) experiences

2) Choose the most appropriate word from the options given below to complete the following sentence

_____ he key to their happiness; they are satisfied with what they have

(*GATE MN* 2014)

a) Contentment b) Ambition c) Perseverance d) Hunger

3) Which of the following options is the closest in meaning to the sentence below? **As a woman, I have no country.**

(*GATE MN* 2014)

a) Women have no country.
b) Women are not citizens of any country.
c) Womens solidarity knows no national boundaries
d) Women of all countries have equal legal rights

4) In any given year, the probability of an earthquake greater than Magnitude 6 occurring in the Garhwal Himalayas is 0.04. The average time between successive occurrences of such earthquakes is _____ years.

(*GATE MN* 2014)

5) The population of a new city is 5 million and is growing at 20% annually. How many years would it take to double at this growth rate?

(*GATE MN* 2014)

a) 3-4 years b) 4-5 years c) 5-6 years d) 6-7 years

Q6 TO Q10 CARRIES 2 MARKS

6) In a group of four children, Som is younger to Riaz. Shiv is elder to Ansu. Ansu is youngest in the group. Which of the following statements is/are required to find the eldest child in the group?

Statements (*GATE MN* 2014)

1 Shiv is younger to Riaz.
2 Shiv is elder to Som.

a) Statement 1 by itself determines the eldest child.
b) Statement 2 by itself determines the eldest child.
c) Statements 1 and 2 are both required to determine the eldest child.

d) Statements 1 and 2 are not sufficient to determine the eldest child.

7) Moving into a world of big data will require us to change our thinking about the merits of exactitude. To apply the conventional mindset of measurement to the digital, connected world of the twenty-first century is to miss a crucial point. As mentioned earlier, the obsession with exactness is an artefact of the information-deprived analog era. When data was sparse, every data point was critical, and thus great care was taken to avoid letting any point bias the analysis. From BIG DATA Viktor Mayer-Schonberger and Kenneth Cukier The main point of the paragraph is :

(*GATE MN* 2014)

a) The twenty-first century is a digital world
b) Big data is obsessed with exactness
c) Exactitude is not critical in dealing with big data
d) Sparse data leads to a bias in the analysis

8) The total exports and revenues from the exports of a country are given in the two pie charts below. The pie chart for exports shows the quantity of each item as a percentage of the total quantity of exports. The pie chart for the revenues shows the percentage of the total revenue generated through export of each item. The total quantity of exports of all the items is 5 lakh tonnes and the total revenues are 250 crore rupees. What is the ratio of the revenue generated through export of Item 1 per kilogram to the revenue generated through export of Item 4 per kilogram?

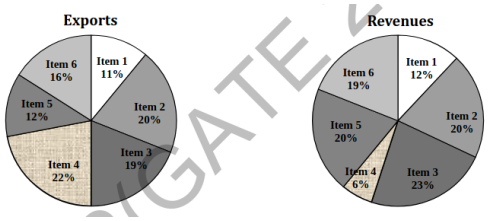

Fig. 1: EXPORT AND REVENUES

(*GATE MN* 2014)

a) 1 : 2 b) 2 : 1 c) 1 : 4 d) 4 : 1

9) X is 1 km northeast of Y. Y is 1 km southeast of Z. W is 1 km west of Z. P is 1 km south of W. Q is 1 km east of P. What is the distance between X and Q in km?

(*GATE MN* 2014)

a) 1 b) $\sqrt{2}$ c) $\sqrt{3}$ d) 2

10) 10% of the population in a town is *HIV*. A new diagnostic kit for HIV detection is available; this kit correctly identifies HIV^+ individuals 95% of the time, and HIV^- individuals 89% of the time. A particular patient is tested using this kit and is found to be positive. The probability that the individual is actually positive is _____.

(*GATE MN* 2014)

Q. 1 TO Q. 25 CARRY ONE MARK EACH.

1) A block of weight 100 kN rests on a floor as shown in the figure. The coefficient of static friction between the block and the floor is 0.5. A force of 45 kN is applied horizontally on the block. The static frictional force in kN is

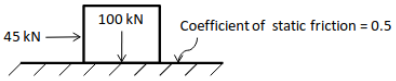

Fig. 2: spring block system

(*GATE MN* 2014)

a) 22.5 b) 50.0 c) 55.0 d) 100.0

2) A spring of constant stiffness k is stretched from point A to point B (displacement u in the figure) by a force F. The potential energy of the spring is expressed by

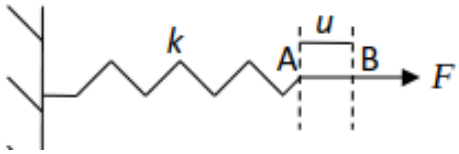

Fig. 3: spring block system

(*GATE MN* 2014)

a) $\frac{1}{2}ku^2 - Fu$
b) $\frac{1}{2}ku^2 + Fu$
c) $ku - F$
d) $ku + F$

3) If σ_s is the induced stress and σ_i is the in-situ stress at a point below ground, the stress concentration at that point is

(*GATE MN* 2014)

a) $\sqrt{\frac{\sigma_s}{\sigma_i}}$
b) $\sqrt{\frac{\sigma_i}{\sigma_s}}$
c) $\frac{\sigma_i}{\sigma_s}$
d) $\frac{\sigma_s}{\sigma_i}$

4) The components of state of stress at a point in x–y plane are given as $\sigma_{xx} = 5\,\text{MPa}$, $\sigma_{yy} = 10\,\text{MPa}$ and $\tau_{xy} = -2\,\text{MPa}$. The sum of the principal stresses acting on the x–y plane in MPa is _____.
(*GATE MN* 2014)

5) The angle $5°15'25''$ is expressed in hours, minutes, and seconds as

(*GATE MN* 2014)

a) $1^h20^{min}1.67^s$
b) $1^h20^{min}16.00^s$
c) $0^h21^{min}1.67^s$
d) $0^h21^{min}16.00^s$

6) A circular curve has a radius of 200 m and deflection angle of 65°.the length of the curve in m is
(*GATE MN* 2014)

a) 221 b) 227 c) 235 d) 262

7) The weight strength of ANFO of specific gravity 0.8 is 912 kcal/kg. The weight strength of an emulsion explosive of specific gravity 1.2 is 850 kcal/kg. Bulk strength of the emulsion explosive relative to ANFO in percentage is _____. (*GATE MN* 2014)

8) In a cut-and-fill stope, the main purpose of back filling is to

a) reduce ore dilution
b) prevent high stress concentrations in far field domain
c) prevent displacement due to dilation of fractured wall rock
d) improve ore rehandling

9) Bypass valve in a compressed oxygen type self-contained breathing apparatus is meant to (*GATE MN* 2014)
a) release accumulated nitrogen in the breathing bag
b) release excess pressure in the breathing bag
c) supply oxygen directly to wearer in case pressure reducing valve
d) flush out the apparatus with oxygen on opening the cylinder valve

10) Given S is the setting load and Y is the yield load of a hydraulic prop, the correct relationship is (*GATE MN* 2014)

a) $S \leq Y$ b) $S \geq Y$ c) $S = Y$ d) $S = Y^2$

11) Solution of the differential equation $\frac{dy}{dx} = ky$ follows exponential decay (where k is a constant) for x $\in [0, \infty)$ if

(*GATE MN* 2014)

a) $k \geq 0$ b) $k \leq 0$ c) $k = 0$ d) $k = e$

12) The value of k for which the vectors $\mathbf{a} = 2\mathbf{i} - 3\mathbf{j}$ and $\mathbf{b} = k\mathbf{i} + 4\mathbf{j}$ are orthogonal to each other is _____.

13) Which one of the following is the most likely mode of slope failure for waste dump (*GATE MN* 2014)

a) Circular
b) Wedge
c) Plane
d) Toppling

14) The occurrence of head in a single toss of an unbiased coin is given by a random variable X. The variance of X is _____.

(*GATE MN* 2014)

15) The divergence of the vector $\mathbf{v} = (x + y)(-y\mathbf{i} + x\mathbf{j})$ is

(*GATE MN* 2014)

a) $y - x$ b) $x - y$ c) $x^2 - y^2$ d) $y^2 - x^2$

16) The $\lim_{x \to 0} \frac{|x|}{x}$ is

(*GATE MN* 2014)

a) -1 b) 0 c) 1 d) non-existent

17) For Indian coal mines, the maximum allowable concentration of respirable dust containing 7.5% free silica in mg/m^3 is

(*GATE MN* 2014)

a) 2.0 b) 2.2 c) 2.5 d) 2.7

18) Given k is the thermal conductivity, ρ is density and c is specific heat of a rock sample, the thermal diffusivity of the rock sample is

(*GATE MN* 2014)

a) $\frac{k\rho}{c}$ b) $\frac{\rho c}{k}$ c) $\frac{kc}{\rho}$ d) $\frac{k}{\rho c}$

19) Cyclone, bag filter and scrubber can be used for control of

(*GATE MN* 2014)

a) water pollution b) air pollution c) soil pollution d) noise pollution

20) A mine waste dump of pH 5.2 can be neutralized by adding

(*GATE MN* 2014)

a) urea b) calcium carbonate c) sulphuric acid d) sodium chloride

21) A flat coal seam of thickness (t) = 3 m is excavated and broken roof rock has completely filled the space created due to extraction as shown in the figure. If the bulking factor of roof rock is 1.2, the caving height (H) in m is

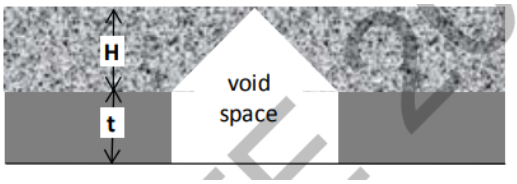

Fig. 4: Opencast Mine

(*GATE MN* 2014)

22) A piece of coal sample weighs 10 kg in air and 2 kg when immersed in water. The specific gravity of the coal sample is

(*GATE MN* 2014)

23) In a borehole log of 1.2 m in length, recovery of rock cores in cm is given below 20, 8, 15, 8, 8, 4, 3, 9, 10, 1, 5, 10 the RQD in percentage is

(*GATE MN* 2014)

a) 29.2 b) 31.8 c) 45.8 d) 50.0

24) An underground coal mine panel produces 520 tonnes per day deploying 220, 200 and 192 persons in three shifts. As per CMR 1957, the minimum quantity of air in m^3/min to be delivered at the last ventilation connection of the panel is

(*GATE MN* 2014)

25) In A PERT Network the activities on the critical path are a, b and c. The standard deviations of the durations of these activities are 2, 2 and 1 respectively. The variance of the project duration is

(*GATE MN* 2014)

a) 3 b) 5 c) 9 d) 12

26) A particle P is in equilibrium as shown in the figure. The magnitude in kN and the orientation θ in degrees of the force **F** respectively are

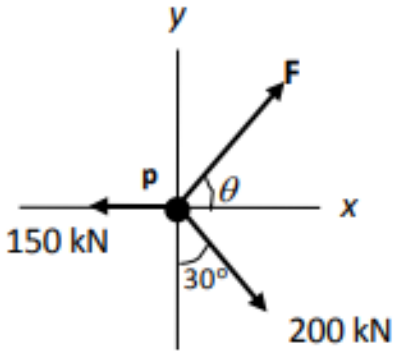

Fig. 5: diagram

(*GATE MN* 2014)

a) 5952.1,16.1 b) 221.2, 23.2 c) 102.3, 53.4 d) 180.3, 73.9

27) A distributed load of 4 kN/m acts on a beam of 6m length supported by a hinge and a roller as shown in the figure. The distance in m of the point of zero shear in the beam from the point A is

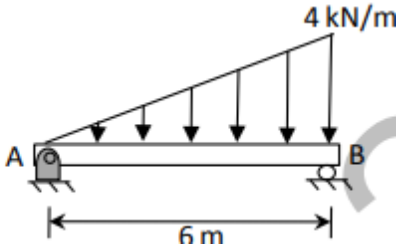

Fig. 6: Load

(*GATE MN* 2014)

28) A dry rock sample of diameter 50 mm and length 100 mm weighs 300 g. After saturating in brine solution of specific gravity 1.05, its weight increased to 330 g. The porosity of the rock sample in percentage is

(*GATE MN* 2014)

29) A joint plane of length L and dip δ intersects the toe of a slope as shown in the figure. The weight of the shaded block is W. Uniform water pressure P acts normal to the joint plane. If the cohesion and angle of internal friction of the joint surface are c and ϕ respectively, then the expression for 'safety factor' of the shaded block is

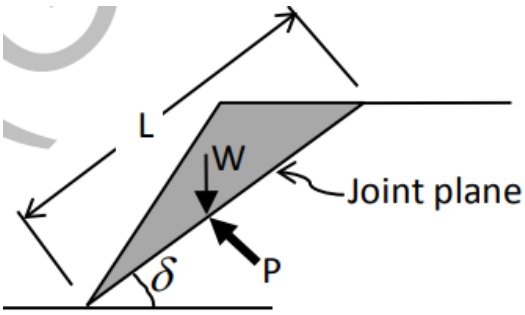

Fig. 7: dia

(*GATE MN* 2014)

a) $\dfrac{Lc + (W \sin\delta - LP)\tan\phi}{W\cos\delta}$

b) $\dfrac{Lc + (W \cos\delta + LP)\tan\phi}{W\sin\delta}$

c) $\dfrac{Lc + (W \cos\delta - LP)\tan\phi}{W\sin\delta}$

d) $\dfrac{Lc + (W \sin\delta + LP)\tan\phi}{W\cos\delta}$

30) The lengths and standard errors of three sections AB, BC, and CD of a straight line AD are given below $AB = 125.85 \pm 0.021$ m; $BC = 205.72 \pm 0.029$ m; $CD = 246.21 \pm 0.025$ m

(*GATE MN* 2014)

a) ±0.0436 b) ±0.0350 c) ±0.0250 d) ±0.0019

31) The bearing of side AB of a regular hexagon $ABCDEF$ is $S\ 50°10'\ E$. If the station C is easterly from the station B, the whole circle bearing of the side BC is

(*GATE MN* 2014)

a) 65°15′25″ b) 69°50′25″ c) 69°15′25″ d) 69°50′0″

32) In a room-and-pillar stope, bench blasting is conducted using ANFO having density of $800 kg/m^3$The specific gravity of rock is 2.5, hole diameter is 100 mm and spacing to burden ratio is 1.3.The charge length of each blast hole is 80% of the hole length. For a desired powder factor of 0.48 kg/tonne, the spacing and burden of the blast pattern in m respectively are

(*GATE MN* 2014)

a) −5 b) +5 c) −2 d) +2

33) Match the following for ore handling operations in an underground metal mine

TABLE I: Match The Following

Arrangement		**Description**	
(P)	Drawpoint	**(I)**	arrangement that prevents oversized rock to pass
(Q)	Ore pass	**(II)**	a system of vertical or near vertical openings for transferring ore from a stope to a single delivery point
(R)	Grizzly	**(III)**	a place where ore can be loaded and removed
(S)	Finger raise	**(IV)**	a vertical or inclined opening used for transferring ore

a) P-IV, Q-III, R-II, S-I
b) P-III, Q-IV, R-I, S-II
c) P-II, Q-IV, R-I, S-III
d) P-III, Q-I, R-II, S-IV

34) The following characteristic curves (P, Q, R, S) pertain to rotary drilling in rock.

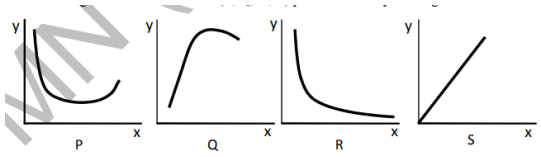

Fig. 8: graph

a) Torque versus RPM
b) Rate of penetration versus uniaxial compressive strength of rock
c) Rate of penetration versus weight on bit
d) Specific energy versus weight on bit

(*GATE MN* 2014)

a) P-III, Q-IV, R-II, S-I
b) P-II, Q-IV, R-I, S-III
c) P-IV, Q-III, R-II, S-I
d) P-I, Q-III, R-II, S-IV

35) The height H of a drawpoint in a sublevel caving stope is 3.0 m. If the angle of repose (φ) of broken ore is 35°, the digging depth y of the loader as shown in the figure in m is _____.

(*GATE MN* 2014)

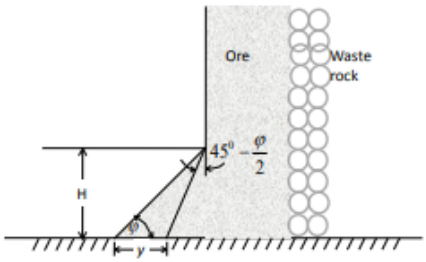

Fig. 9: illustration

36) The area enclosed by the curves $y = x^2$ and $y = x^3$ for $x \in [0, \infty)$ is

(*GATE MN* 2014)

a) 1/12 b) 1/6 c) 1/2 d) 1

37) For an explosives company, the probability of producing a defective detonator is 0.02. The probability that a lot of 50 detonators produced by the company contains at most 2 defective detonators is (*GATE MN* 2014)

38) The area enclosed by the curves $y = x^2$ and $y = x^3$ for $x \in [0, \infty)$ is

(*GATE MN* 2014)

a) $\frac{1}{12}$ b) $\frac{1}{6}$ c) $\frac{1}{2}$ d) 1

39) The value of a, for which the function below is continuous at $x = 1$ is

$$f(x) = \begin{cases} 2x + ax^2, & x \leq 1 \\ 4x + 3, & x > 1 \end{cases}$$

(*GATE MN* 2014)

a) 13.09 b) 12.50 c) 11.74 d) 10.87

40) The sum of the infinite series $a + ar + ar^2 + ar^3 + \cdots + ar^{n-1} + \cdots$ for $|r| < 1$ is (*GATE MN* 2014)

a) $a(1 + r)$ b) $a(1 - r)$ c) $\frac{a}{1+r}$ d) $\frac{a}{1-r}$

41) A centrifugal pump has a discharge rate of 2000 L of water per min against a total head of 200 m. If the pump efficiency is 75%, the input power to the pump in kW is

(*GATE MN* 2014)

a) 87.20 b) 49.05 c) 13.33 d) 7.50

42) A dragline is required to remove $3,00,000\ m^3$ of rock per month on the bank volume basis. Consider the following data for the dragline operation.
Effective working hours per month = 450, Bucket fill factor = 0.8, Cycle time = 65 s, Swell factor of the rock = 1.25, The minimum bucket capacity of the dragline in m^3 is

(*GATE MN* 2014)

a) 7.70 b) 9.63 c) 12.04 d) 18.80

43) A direct rope haulage pulls 8 tubs loaded with coal through an incline of length 500 m having an inclination of 1 in 6. Consider the following additional data. Capacity of tub = 1.0 tonne Tare weight of tub = 500 kg Hauling speed = 9 km per hour Coefficient of friction between wheel and rail = 1/60 Coefficient of friction between rope and drum = 1/10 Mass of rope per meter = 1.5 kg The minimum power required to haul the tubs in kW is

(*GATE MN* 2014)

a) 345.50 b) 348.60 c) 350.10 d) 365.50

44) A coal mine receives two bids for purchase of a new dragline. The first bid quotes Rs. 150 crore as a price to be paid in full on delivery. The second bid quotes Rs. 180 crore as a price payable at the end of the third year after delivery. If the discount rate is 12%, the difference in NPV between the first and second bids in crore of rupees is

(*GATE MN* 2014)

45) Match the following in the context of underground mine environment:

TABLE II: Match The Following

Instrument	**Measuring parameter**
P. Haldane apparatus	*I*. Humidity
Q. Godbert-Greenwald apparatus	*II*. Air velocity
R. Hygrometer	*III*. Mine air composition
S. Anemometer	*IV*. Ignition point temperature

(*GATE MN* 2014)

a) P-II, Q-I, R-III, S-IV
b) P-III, Q-IV, R-I, S-II
c) P-IV, Q-II, R-III, S-I
d) P-I, Q-III, R-IV, S-II

46) A mine airway having cross-section of $2.2\,\text{m} \times 2.2\,\text{m}$ and length 500 m contains a bend. Given that the airway friction factor is $0.01\,\text{Ns}^2/\text{m}^4$, shock loss factor for the bend is 0.07, and density of air is $1.2\,\text{kg}/\text{m}^3$, the equivalent length of the airway in m is

(*GATE MN* 2014)

47) In order to estimate the NVP in a mine,measurements are made at the main fan as shown below.

TABLE III: Match The Following

Fan speed (RPM)	**Fan drift pressure (Pa)**	**Fan quantity (m^3/s)**
800	655	82.2
950	730	85.5

(*GATE MN* 2014)

48) The NVP is : The resistances of two splits A and B are $0.35\,\text{Ns}^2\text{m}^{-8}$ and $0.05\,\text{Ns}^2\text{m}^{-8}$ respectively. The combined resistance of the shafts and trunk airways is $0.4\,\text{Ns}^2\text{m}^{-8}$. A booster fan is planned

to be installed in split A to increase the quantity flowing through it. Assuming that the surface fan continues to operate at a constant pressure of 1000 Pa, the critical pressure of the booster fan in Pa is :

(*GATE MN* 2014)

49) A pitot tube is inserted in a ventilation duct with the nose facing the air flow. A vertical U-tube manometer filled with alcohol (specific gravity 0.8) has been used for pressure measurements such that 10.2 mm is read as the total pressure and 8.8 mm as the static pressure. Given the density of air to be 1.2 kg/m^3 , the air velocity at the nose of the pitot tube in m/s is :

(*GATE MN* 2014)

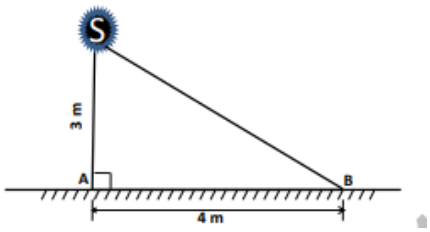

Fig. 10: Illustration for Q49

50) An illumination source S shown in the figure emits light equally in all directions. At a point A on the floor, the illuminance is 5.0 lux. The illuminance at point B on the floor in lux is

(*GATE MN* 2014)

51) Two machines A and B while operating simultaneously produce a sound pressure level of 85 dBA at a point. When the machine A stops, the sound pressure level at that point reduces to 80 dBA. The sound pressure level at the same point due to machine A operating alone in dBA is

(*GATE MN* 2014)

a) 70.0 b) 75.0 c) 80.0 d) 83.3

52) A waste water effluent has BOD5 of 80 mg/L and the reaction rate constant is 0.16 per day. The ultimate BOD in mg/L is (*GATE MN* 2014)

a) 85 b) 100 c) 120 d) 145

53) A series of tri-axial compression tests conducted on sandstone samples reveal the following relationship between major and minor principal stresses:

$$\sigma_1 = 50 + 3\sigma_3 \quad \text{[stresses are in MPa]}$$

The cohesion in MPa and angle of internal friction in degrees of sandstone respectively are :

(*GATE MN* 2014)

a) 14.43, 30.0 b) 14.43, 60.0 c) 0.21, 73.9 d) 0.21, 16.1

54) Six detonators each having resistance of 1.5 ohm are connected in parallel. A 15 V exploder is connected to the detonators by two single-core cables of resistance 3 ohm each. The current in the circuit in Ampere is :

(*GATE MN* 2014)

55) The failure and repair rates of a shovel are 0.06 hr^{-1} and 0.04 hr^{-1} respectively.

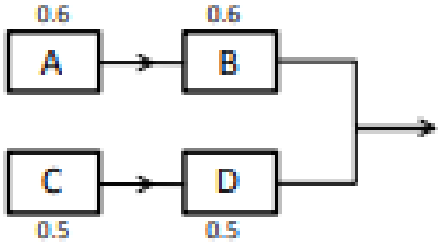

Fig. 11: Flowchart

The individual reliability values of four sub-systems are given in the figure below. The reliability of the system is

END OF THE QUESTION PAPER