2007
MN: Mining Engineering

Duration : Three Hours   Maximum Marks :150

Read the following instructions carefully.

1. This question paper contains 85 objective type questions. Q.1 to Q.20 carry **one** mark each and Q.21 to Q.85 carry **two** marks each.

2. Attempt all the questions.

3. Questions must be answered on Objective Response Sheet (ORS) by darkening the appropriate bubble (marked A, B, C, D) using HB pencil against the question number on the left hand side of the ORS. **Each question has only one correct answer.** In case you wish to change an answer, erase the old answer completely.

4. Wrong answers will carry NEGATIVE marks. In Q.1 to Q.20, **0.25** mark will be deducted for each wrong answer. In Q.21 to Q.76, Q.78, Q.80, Q.82 and in Q.84, **0.5** mark will be deducted for each wrong answer. However, there is no negative marking in Q.77, Q.79, Q.81, Q.83 and in Q.85. More than one answer bubbled against a question will be taken as an incorrect response. Unattempted questions will not carry any marks.

5. Write your registration number, your name and name of the examination centre at the specified locations on the right half of the ORS.

6. Using HB pencil, darken the appropriate bubble under each digit of your registration number and the letters corresponding to your paper code.

7. Calculator is allowed in the examination hall.

8. Charts, graph sheets or tables are NOT allowed in the examination hall.

9. Rough work can be done on the question paper itself. Additionally blank pages are given at the end of the question paper for rough work.

10. This question paper contains **20** printed pages including pages for rough work. Please check all pages and report, if there is any discrepancy.

S/121 Food/06–MN–1A

Q. 1 – Q. 20 carry one mark each.

Q.1 If the slope of a diagonal of a rectangle is m the slope of the other diagonal

(A) $\dfrac{1}{2m}$ (B) $-\dfrac{1}{2m}$ (C) $\dfrac{1}{m}$ (D) $-\dfrac{1}{m}$

Q.2 If the rank of a matrix $\mathbf{A}$ is r, the rank of the matrix $\mathbf{A^T}$ is

(A) r, if and only if $\mathbf{A^T = A}$ (B) r, for all $\mathbf{A}$
(C) p, where $p \neq r$ (D) $r-1$, where $r \geq 1$

Q.3 Bulk modulus of rock is defined as

(A) $\dfrac{\text{shear stress}}{\text{volumetric strain}}$ (B) $\dfrac{\text{hydrostatic pressure}}{\text{shear strain}}$

(C) $\dfrac{\text{hydrostatic pressure}}{\text{volumetric strain}}$ (D) $\dfrac{\text{shear stress}}{\text{shear strain}}$

Q.4 The magnitude of the resultant moment about point O in Nm of the two forces acting on the rod shown below is
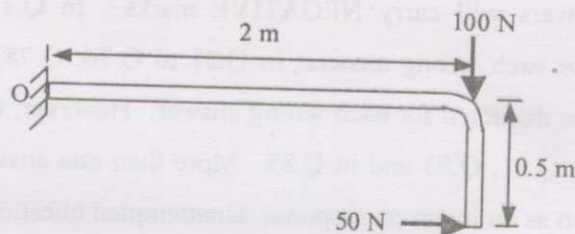
(A) 25   (B) 125   (C) 175   (D) 225

Q.5 Radial stress on the excavation boundary of a circular tunnel is

(A) always zero
(B) always positive
(C) always negative
(D) positive in some area and negative in some area

Q.6 The critical diameter of an explosive is defined as the diameter below which it

(A) develops the optimum velocity of detonation
(B) does not involve in chemical reaction
(C) develops the maximum velocity of detonation
(D) deflagrates

Q.7 Which one of the following supports does NOT require a power pack for its operation

(A) chock shield support   (B) open circuit hydraulic prop
(C) close circuit hydraulic prop   (D) Alpine breaker line support

Q.8   In a centrifugal flow fan the conversion of velocity pressure to static pressure is
       accomplished with the help of

       (A) impeller   (B) curved blades   (C) hub   (D) casing

Q.9   A 3.3 kV, 3-phase AC motor having a PF of 0.85 draws current at 95 A. The motor
       input power in kW is

       (A) 266.5   (B) 461.5   (C) 543.0   (D) 799.5

Q.10   The amount of total stone dust required in kg for a secondary/heavy type stone dust
       barrier in a roadway of size 4.0 m × 3.0 m is

       (A) 1320   (B) 4680   (C) 5200   (D) 6600

Q.11   In the Gaussian plume model, the dispersion coefficients are function of

       (A) distance from source and stability class
       (B) stack height and distance from source
       (C) stability class and source coordinates
       (D) source coordinates and distance from source

Q.12   The rachet-and-pawl arrangement in percussive drill machine helps in

       (A) providing required rotational speed
       (B) indexing at the bit rock interface
       (C) regulating air flow in forward and return strokes of the piston
       (D) engaging the bit with the rock between the blows

Q.13   The measurement of distances from a position on the earth to artificial satellites is
       known as

       (A) astronomical ranging   (B) pseudo ranging
       (C) satellite ranging   (D) celestial ranging

Q.14   In opencast mining, the width which is extracted from the working bench is termed as

       (A) cut   (B) bench width   (C) bank width   (D) bench face

Q.15   Zener barriers are associated with

       (A) increased safety apparatus
       (B) statistically safe apparatus
       (C) flame proof apparatus
       (D) intrinsic safety apparatus

Q.16   The most recent model of self-contained compressed-oxygen breathing apparatus is

       (A) Proto-IV   (B) BG-174   (C) BG-4   (D) BG-174A

Q.17   The measures of dispersion are

(A) range, variance, and standard deviation
(B) mean, median, and variance
(C) mean, mode, and skewness
(D) mean, range, and variance

Q.18   In a single server queueing model with constant arrival rate, which one of the following probability distributions is followed by the inter-arrival times of the customers at the service facility?

(A) binomial   (B) Poisson   (C) Weibull   (D) exponential

Q.19   A company invested Rs. 4 lakh in a machine with an expected useful life of 12 years. The net income expected from the operation of the machine is Rs. 80,000 per annum. The payback period for the machine in years is

(A) 4   (B) 5   (C) 6   (D) 7

Q.20   The angular (horizontal/vertical) observation made by a transit theodolite with the face of the vertical circle on the right of the observer is called

(A) face right observation   (B) face left observation
(C) normal observation   (D) reciprocal observation

Q. 21 to Q. 75 carry two marks each.

Q.21   Two sides of a triangle are represented by vectors $\mathbf{a} = \hat{i} + \hat{j} + \hat{k}$ and $\mathbf{b} = -\hat{i} - \hat{j} + \hat{k}$. The area (magnitude) of the triangle is

(A) $1/\sqrt{2}$ (B) 1   (C) $\sqrt{2}$ (D) $2\sqrt{2}$

Q.22   The cost of diesel is Rs. $\left(25 + \dfrac{x}{90}\right)$ per km to drive a dump truck at a speed of x km/hour. The maintenance cost of the truck is Rs. 10 per hour. To minimize the cost per km, the truck speed in km/hour is

(A) 5   (B) 20   (C) 25   (D) 30

Q.23   The functions $f(x)$ and $g(x)$ satisfy $f(x = 0) = 3$, $f'(x = 0) = -5$, $g(x = 0) = 2$ and $g'(x = 0) = -10$. The value of $\dfrac{d}{dx}\left(\dfrac{f(x)}{g(x)}\right)_{x=0}$ is

(A) −35.0   (B) −5.0   (C) 0.5   (D) 5.0

Q.24 A wooden block of 50 kg rests on the floor (shown in figure below) for which coefficient of static friction is 0.5. The smallest magnitude of the force **P** in kg that will cause impending motion of the block is
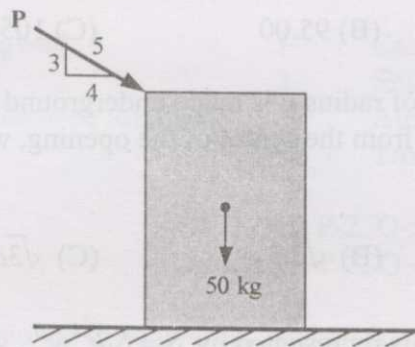
(A) 50   (B) 40   (C) 30   (D) 25

Q.25 The solution of $ye^x dx + (4y + e^x)dy = 0$ for $y(0) = -1$ is

(A) $ye^x + 2y^2 - 1 = 0$ (B) $e^x + y^2 x - 2 = 0$

(C) $ye^x - y^2 = 0$ (D) $xe^x + y^2 - 1 = 0$

Q.26 A point P (10, 3) MPa on the Mohr's circle represents normal and shear stresses. If the centre of the Mohr's circle is C (6, 0) MPa, the normal and shear stresses in MPa on the point diametrically opposite to P are

(A) 2, −3   (B) 4, −3   (C) 2, 3   (D) 4, 3

Q.27 A rock sample with a horizontal joint is subjected to 10 MPa of normal pressure as shown in the figure. The elastic modulus and Poisson's ratio of the rock are 5.0 GPa and 0 respectively. If the normal stiffness (k_{nn}) of the joint is 50 GPa/m, normal displacement at the top of the sample (AA' line) in mm is
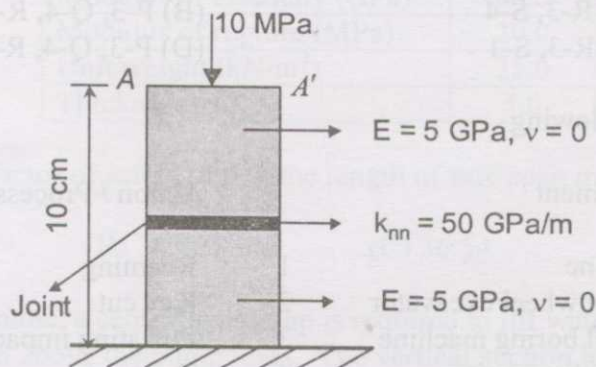
(A) 0.2   (B) 0.4   (C) 0.6   (D) 0.8

Q.28 The state of stress ($\sigma_{xx}, \sigma_{yy}, \tau_{xy}$) at a point below ground is found to be (5, 15, −3) MPa. The angle measured in the counter clockwise direction between the x-axis and the major principal axis in degree is

(A) 9.52   (B) 15.48   (C) 150.48   (D) 164.52

Q.29 The unconfined compressive strength of a cylindrical rock sample ___ The angle of internal friction of the rock is 30°. If a confining pressure o__ ___plied radially to the rock sample, the confined compressive strength in MPa __

(A) 92.88　　　　(B) 95.00　　　　(C) 105.00　　　　(D) 110.0_

Q.30 A circular opening of radius a is made underground in hydrostatic stress condition_ The radial distance from the centre of the opening, where the tangential stress is twi__ the radial stress, is

(A) a　　　　(B) $\sqrt{2}a$　　　　(C) $\sqrt{3}a$　　　　(D) $2\sqrt{3}a$

Q.31 Coal pillar strength is represented by $S = S_1 h^\alpha w^\beta$, where S_1= insitu strength of the pillar, h = mining height, and w = pillar width. Two bord and pillar panels are developed in the similar geological conditions at depths D_1 and D_2 with mining heights h_1 and h_2 respectively. If the gallery width and the pillar width in both the panels remain the same, the ratio of pillar safety factors, SF_1/ SF_2 is

(A) $\left(\dfrac{h_2}{h_1}\right)^\alpha \dfrac{D_1}{D_2}$　　　(B) $\left(\dfrac{h_2}{h_1}\right)^\alpha \dfrac{D_2}{D_1}$　　　(C) $\left(\dfrac{h_1}{h_2}\right)^\alpha \dfrac{D_1}{D_2}$　　　(D) $\left(\dfrac{h_1}{h_2}\right)^\alpha \dfrac{D_2}{D_1}$

Q.32 Match the following

	Belt conveyor component		Function
P	Pull cord	1	Cleaning device
Q	Snub pulley	2	Discharging material on the side of the conveyor
R	Tripper	3	Safety stopping device
S	Rotary brush	4	Increasing the angle of wrap

(A) P-1, Q-2, R-3, S-4　　　　(B) P-3, Q-4, R-1, S-2
(C) P-4, Q-2, R-3, S-1　　　　(D) P-3, Q-4, R-2, S-1

Q.33 Match the following

	Equipment		Action / Process
P	Dragline	1	Reaming
Q	Bucket wheel excavator	2	Key cut
R	Tunnel boring machine	3	Pulsating impact
S	Hydraulic monitor	4	Terracing

(A) P-1, Q-2, R-3, S-4　　　　(B) P-2, Q-4, R-1, S-3
(C) P-2, Q-4, R-3, S-1　　　　(D) P-3, Q-4, R-2, S-1

Q.34 Match the following

	Mining method		Face supporting system
P	Mechanised longwall	1	Cable bolting
Q	Blasting gallery	2	Shield type powered supports
R	Steep seam mechanised longwall	3	Alpine breaker line supports
S	Wangawilli	4	Troika shield supports

(A) P-1, Q-2, R-3, S-4   (B) P-2, Q-1, R-4, S-3

(C) P-3, Q-4, R-2, S-1   (D) P-2, Q-4, R-1, S-3

Q.35 A 15 yd^3 dragline is deployed in an overburden bench of an opencast mine. It works for 40 days at the rate of 6 hours per shift and 3 shifts a day. The cycle time, bucket fill factor, and operating efficiency of the dragline are respectively 50 s, 0.8, and 75%. The total volume of overburden in m^3 handled by the dragline is
(1 yd^3 = 0.765 m^3)

(A) 356918   (B) 634521   (C) 557685   (D) 991440

Q.36 The phenomenon of fretting (necking) of pillars in room-and-pillar stoping is common in the pillars formed in

(A) massive rock with very high pillar height to width ratio
(B) regularly jointed rock with high pillar height to width ratio
(C) massive rock with low pillar height to width ratio
(D) transversely jointed rock with low pillar height to width ratio

Q.37 In an underground opening, the immediate roof strata consists of two rock layers with the following properties:

Property	Layer-1	Layer-2
Modulus of elasticity (GPa)	60.0	40.0
Modulus of rupture (MPa)	20.0	10.0
Unit weight (kN/m^3)	25.0	20.0
Thickness (m)	5.0	2.5

Considering a factor of safety of 4.0, the length of safe span in m is

(A) 27.82   (B) 34.06   (C) 36.54   (D) 39.34

Q.38 In an opencast mine, a centrifugal pump is required to lift water at the rate of 60 l/s to a height of 80 m above the pump level. The vertical suction head is 4 m. The total friction head including shock and energy loss is 10 m. If the pump runs at an efficiency of 80%, the brake power of the motor in kW is

(A) 70.50   (B) 67.50   (C) 63.00   (D) 57.55

Q.39   Match the following

	Support system		Support principle
P	Shotcrete	1	reinforces rock mass by binding them together
Q	Backfill	2	acts as link between two layers of rock to transfer load between them
R	Bolt	3	imposes kinematic constraints on key pieces in a stope boundary
S	Prop	4	prevents spatially progressive disintegration of near field rock mass

(A) P-3, Q-4, R-2, S-1   (B) P-2, Q-1, R-4, S-2
(C) P-4, Q-3, R-1, S-2   (D) P-3, Q-4, R-1, S-2

Q.40   Match the following

	Stope		Drill machine		Method of drilling
P	Shrinkage	I	Drill jumbo	1	Fan drilling
Q	Room-and-pillar	J	Down-the-hole hammer	2	Overhand drilling
R	Sublevel	K	Hand held stopper	3	Parallel drilling
S	Sublevel caving	L	Mechanised fan drill	4	Frontal/vertical/downward benching

(A) P-I-2, Q-K-4, R-L-3, S-J-1   (B) P-K-4, Q-I-3, R-J-2, S-L-1
(C) P-K-2, Q-I-4, R-J-3, S-L-1   (D) P-I-3, Q-K-4, R-J-1, S-L-2

Q.41   A coal seam of 12 m thickness is worked out by mechanized top coal caving system. The thickness of the bottom slice is 3 m, length of the solid coal face is 120 m and the average depth of cut by the shearer (web) is 70 cm. The density of coal is 1300 kg/m^3 with the percentage of extraction in the slice at 95 and in the top coal at 70. The production of coal per cycle in tonne is

(A) 1008   (B) 999   (C) 688   (D) 311

Q.42   Two reservoirs are connected by two equal length parallel pipelines with diameters d and $2d$. Assuming similar resistance coefficients, if the discharge through the smaller diameter pipeline is 0.04 m^3/s, the discharge through the other pipeline in m^3/s is
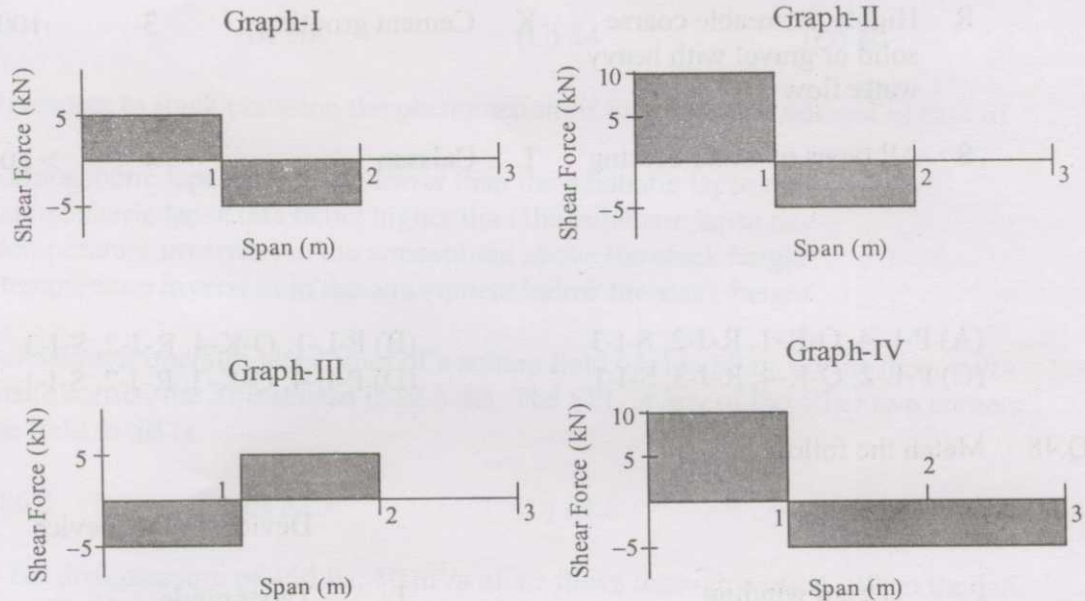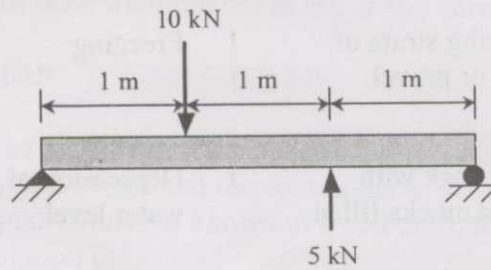
(A) 0.226   (B) 0.426   (C) 1.130   (D) 1.280

Q.43 The shear force diagram for the shaft shown below resembles which of the following graphs?

10 kN

1 m   1 m   1 m

5 kN

Graph-I

Shear Force (kN)

5

-5

1   2   3

Span (m)

Graph-II

Shear Force (kN)

10

5

-5

1   2   3

Span (m)

Graph-III

Shear Force (kN)

5

-5

1   2   3

Span (m)

Graph-IV

Shear Force (kN)

10

5

-5

1   2   3

Span (m)

(A) Graph-I   (B) Graph-II   (C) Graph-III   (D) Graph-IV

Q.44 A 12 tonne diesel locomotive of 60 kW is plying in an underground haulage roadway. The coefficient of adhesion is 0.25 and the maximum gear efficiency is 80%. The speed in m/s at which it will haul a train at its full power is

(A) 2.548   (B) 2.448   (C) 2.038   (D) 1.630

Q.45 An air receiver of volume 0.2 m^3 has an initial temperature of 27°C and pressure 1800 kPa. After use, the air pressure falls to 1200 kPa at a temperature of 17°C. The volume of air consumed in m^3 corresponding to an air pressure of 101.3 kPa and temperature of 0°C is

(A) 0.693   (B) 0.895   (C) 1.002   (D) 1.251

Q.46 Four benches are being worked by the opencast mining system. Height, width and face angle for each bench are 15 m, 50 m and 70° respectively. The overall slope angle of the benches in degrees is

(A) 15.45   (B) 19.25   (C) 32.65   (D) 36.25

Q.47 Match the following

	Rock mass condition		Shaft sinking method		Limiting depth (m)
P	Water bearing strata of loose sand or gravel	I	Freezing	1	40
Q	Competent rock with fissures and cracks filled with water	J	Depression of ground water level	2	150
R	Highly permeable coarse solid or gravel with heavy water flow	K	Cement grouting	3	1000
S	All types of water bearing rocks	L	Caissan	4	> 600

(A) P-L-4, Q-K-1, R-J-2, S-I-3   (B) P-L-1, Q-K-4, R-J-2, S-I-3
(C) P-L-2, Q-K-4, R-J-3, S-I-1   (D) P-L-4, Q-K-3, R-J-2, S-I-1

Q.48 Match the following

	System		Device/ Safety device
P	Drum winding	1	Taper guide
Q	Koepe winding	2	Detaching safety hook
R	Inclined Haulage	3	Rider
S	Winding in sinking shaft	4	Back catch

(A) P-1, Q-2, R-3, S-4   (B) P-4, Q-3, R-1, S-2
(C) P-2, Q-1, R-3, S-4   (D) P-2, Q-1, R-4, S-3

Q.49 A closed container with 10 kg of air at ambient pressure and specific heat 1020 kJ/kg $^{\circ}$C is cooled from 35°C. If the removal of 200 kJ of heat resulted in the saturation of air, the corresponding dew point temperature in $^{\circ}$C is

(A) 33.0   (B) 27.3   (C) 15.4   (D) 12.9

Q.50 Identify the INCORRECT statement

(A) Evasee is meant to minimise exit shock losses
(B) Evasee efficiency is primarily a function of divergence angle and area ratio
(C) Evasee produces an inevitable increase in friction losses
(D) Evasee installation leads to reduction in the fan total pressure

Q.51 A single lamp placed centrally at the roof provides 40 lux illumination ver͟ below, at the floor of an underground workshop. The workshop is of dimensi͟ 20.0 m × 20.0 m with height 4.0 m. Assuming uniform spherical dispersion of luminous intensity, the floor level illumination in lux at any corner of the workshop

(A) 23.2   (B) 10.9   (C) 3.0   (D) 0.8

Q.52 An effluent sample is diluted with fresh water to make up a solution of 300 ml. The DO of the solution initially is 8.0 mg/l and the value falls to 3.0 mg/l after 5 days. If the 5-day BOD of the original effluent is known to be 50 mg/l, the amount of fresh water added in ml to the solution is

(A) 270   (B) 160   (C) 54   (D) 30

Q.53 With respect to stack emission the phenomenon of fumigation is noticed in case of

(A) atmospheric lapse rate being lower than the adiabatic lapse rate
(B) atmospheric lapse rate being higher than the adiabatic lapse rate
(C) temperature inversion in the atmosphere above the stack height
(D) temperature inversion in the atmosphere below the stack height

Q.54 A jackhammer operates at a corner of a square field of side 50 m. At the diagonally opposite corner, the SPL sensed is 82.3 dB. The SPL at any of the other two corners of the field in dB is

(A) 86.3   (B) 85.3   (C) 83.6   (D) 81.2

Q.55 At a fan drift pressure of 450 Pa, 50 m^3/s of air flows through a mine. When the fan stops, 10 m^3/s of air still flows in the same direction. The mine resistance in Ns^2/m^8 is

(A) 0.1731   (B) 0.1800   (C) 0.1875   (D) 0.2372

Q.56 In an experiment to determine rock thermal conductivity a disc of rock specimen is placed between two solid brass cylinders and one dimensional heat flow is created as shown. The readings of the thermocouple sensors with respect to zero potential are shown in the figure. Brass thermal conductivity is 90 W/m °C, and the thermocouple constant is 40 μV/°C. The rock thermal conductivity in W/m °C and the heat flux in W/m^2 respectively are

2000 µV   1920 µV   1520 µV

Brass   Brass

10 cm   1 cm   Rock
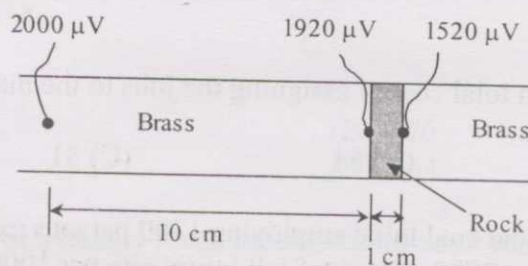
(A) 1.8, 1800   (B) 0.6, 1020   (C) 3.2, 540   (D) 2.1, 670

Q.57 Consider the following data for the grade of iron ore from a working ... past 5 weeks

Week	1	2	3	4	5
Grade (% Fe)	62.1	61.0	60.5	62.5	62.0

The 3-week moving average forecast for the grade, in % Fe, in the 6th week is

(A) 61.66   (B) 61.90   (C) 62.20   (D) 62.50

Q.58 The random variable X has the following probability mass function

$$P(4) = \frac{1}{4}, \quad P(8) = \frac{1}{4}, \quad P(12) = \frac{1}{4}, \quad P(16) = \frac{1}{4}.$$

The expected value of X is

(A) 1   (B) 3   (C) 10   (D) 12

Q.59 The time between successive failures (in hours) of a side discharge loader operating in a mechanised underground coal mine are as follows:

62, 58, 54, 50, 52, 60, 58, 57, 50, 53

If the failure data follow an exponential distribution, then reliability of the equipment for a period of 50 hours is

(A) 0.25   (B) 0.40   (C) 0.60   (D) 1.00

Q.60 Three jobs A, B, and C are to be assigned to three machines X, Y and Z. The processing costs are given below:

		Machine		
		X	Y	Z
Job	A	19	28	31
	B	11	17	16
	C	12	15	13

The minimum total cost of assigning the jobs to the machines is

(A) 60   (B) 54   (C) 51   (D) 49

Q.61 An underground coal mine employing 1200 persons experienced 12 roof fall injuries during the year 2005. The roof fall injury rate per 1000 persons employed during the period 2005, as per the DGMS norms, is

(A) 6   (B) 8   (C) 10   (D) 12

Q.62 Consider the following linear programming problem:

Maximize $Z = 6X_1 + 4X_2$
Subject to
$2X_1 \leq 8$
$2X_2 \leq 12$
$3X_1 + 2X_2 \leq 18$
$X_1 \geq 0, X_2 \geq 0$

The multiple optimal solutions lie on the line joining the corner points

(A) (0, 0), (0, 6)   (B) (0, 6), (2, 6)   (C) (2, 6), (4, 3)   (D) (4, 3), (4, 0)

Q.63 Match the following

	Problem		Technique
P	Queueing	1	Time series models
Q	Project scheduling and monitoring	2	Linear programming models
R	Transportation	3	Waiting line models
S	Forecasting of production	4	PERT and CPM

(A) P-3, Q-4, R-2, S-1   (B) P-2, Q-3, R-4, S-1
(C) P-3, Q-4, R-1, S-2   (D) P-2, Q-4, R-3, S-1

Q.64 The net present value in Rs. of a 3 -year annuity of Rs. 10,000 discounted at 10% is

(A) 9,091   (B) 17,355   (C) 24,869   (D) 26,446

Q.65 For a track gauge of 1.05 m and a speed of 10 km/hour, the super-elevation in cm from the following figure is
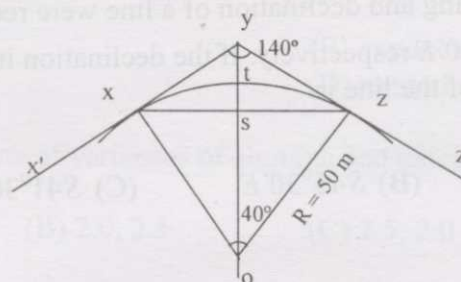
(A) 1.65   (B) 2.76
(C) 5.54   (D) 6.64

Q.66 In the bubble tube of a dumpy level, the bubble moves 5 mm for a change of inclination of 40″. The sensitivity in mm and the radius of the bubble tube in m are
(1 radian = 206265″)

(A) 0.125, 12.89   (B) 0.063, 26.78   (C) 0.125, 25.78   (D) 0.063, 12.89

Q.67 The value of $\mathbf{A \cdot B}$, if $\mathbf{A + B} = \begin{bmatrix} 1 & -1 \\ 3 & 0 \end{bmatrix}$ and $\mathbf{A - B} = \begin{bmatrix} 3 & 1 \\ 1 & 4 \end{bmatrix}$, is

(A) $-4\begin{bmatrix} 1 & 1 \\ 0 & 3 \end{bmatrix}$

(B) $-2\begin{bmatrix} 1 & 1 \\ 0 & 3 \end{bmatrix}$

(C) $\begin{bmatrix} 1 & 1 \\ 0 & 3 \end{bmatrix}$

(D) $-\dfrac{1}{2}\begin{bmatrix} 1 & 1 \\ 0 & 3 \end{bmatrix}$

Q.68 The values of $f(x)$ at x_0, x_1 and x_2 are 9.0, 12.0 and 15.0 respectively. Using the Simpson's $\dfrac{1}{3}$ rule, the value of $\displaystyle\int_{x_0}^{x_2} f(x)$, considering an interval of 0.1 is

(A) 1.2 (B) 2.4 (C) 1.6 (D) 1.8

Q.69 From the following page of a levelling field book, the missing values in F.S. and B.S. respectively are

Station	B.S.	I.S.	F.S.	Rise	Fall	Remarks
1	4.550					Starting Point
2	2.125		?		0.750	Change point
3		2.225				
4	?		1.975			Change point
5		2.445		1.500		

(A) 3.804, 0.945   (B) 3.804, 3.945
(C) 5.300, 0.945   (D) 5.300, 3.945

Q.70 The magnetic bearing and declination of a line were recorded in the year 1906 as $S43^\circ30'E$ and $2^\circ00'E$ respectively. If the declination in the year 2006 is $3^\circ00'W$, the magnetic bearing of the line is

(A) $S48^\circ30'E$ (B) $S45^\circ30'E$ (C) $S41^\circ30'E$ (D) $S38^\circ30'E$

Common Data Questions

Common Data for Questions 71,72,73: In a straight duct of length 200 m a fan 50 m away from the inlet such that the mean air velocity in the duct is 8.0 m/s at a de 1.1 kg/m³. The friction pressure loss per m length of the duct is 3.0 Pa and the entry sho factor is 1.2. Answer the following in terms of guage pressure values in Pa.

Q.71 The total pressure at the outlet of the duct is

(A) –35.2   (B) 35.2   (C) 192.2   (D) 635.2

Q.72 The total pressure at the inlet side of the fan is

(A) –192.2   (B) –150.0   (C) 150.0   (D) 192.2

Q.73 The total pressure generated by the fan is

(A) 600.0   (B) 635.2   (C) 677.4   (D) 682.2

Common Data for Questions 74, 75: A bauxite deposit has been intersected by 5 drill holes. The values of alumina (% by weight) and silica (% by weight) in these drill holes are as follows:

Drill hole number	Alumina (%)	Silica (%)
1	46	1
2	42	5
3	45	2
4	43	4
5	44	3

Q.74 The relationship between alumina and silica is

(A) positive linear   (B) exponential
(C) negative linear   (D) random

Q.75 The unbiased estimate of variances of alumina and silica in (%)² respectively are

(A) 2.5, 2.5   (B) 2.0, 2.5   (C) 2.5, 2.0   (D) 2.0, 2.0

Linked Answer Questions: Q.76 to Q.85 carry two marks

Statement for Linked Answer Questions 76 & 77: Porosity of a coarse grain sandstone sample is 15%. The specific gravity of sandstone is 2.8.

Q.76 What is the void ratio in the sandstone sample?

(A) 0.150   (B) 0.176   (C) 0.850   (D) 1.176

Q.77 If the sandstone sample is fully saturated in water, the saturated density of the sample in kg/m^3 is

(A) 1590   (B) 2234   (C) 2438   (D) 2531

Statement for Linked Answer Questions 78 & 79: A double outboard chain stranded conveyor is installed in an underground coal mine to transport coal. The mass of the chain and associated flight is 40 kg/m, the coefficients of kinematic friction are 0.33 between chain and the pan and 0.5 between conveyed coal and the pan. The motor efficiency is 80%. Coal is to be conveyed at the rate of 120 t/hour over a length of 120 m at a chain speed of 0.9 m/s. The bulk density of coal is $900 \ kg/m^3$.

Q.78 The power requirement of the motor of the chain conveyor in kW is

(A) 33.16   (B) 37.53   (C) 42.00   (D) 45.94

Q.79 The power requirement of the motor of the chain conveyor in kW, if it moves in the uphill direction at a gradient of 1 in 10, is

(A) 46.91   (B) 42.00   (C) 38.53   (D) 30.16

Statement for Linked Answer Questions 80 & 81: The observed total time of drilling a face in an underground coal mine is 18 min. The rating of the drill crew performance, expressed in percentage, is 90. Following allowances are recommended by the mine management
   i)   personal needs allowance: 5% of the basic time
   ii)   fatigue allowance: 4% of basic time
   iii)   contingency delay allowance: 1% of basic time

Q.80 The basic time required for the drilling job by the crew in min is

(A) 16.2   (B) 17.4   (C) 18.0   (D) 20.0

Q.81 The standard time required for the same drilling job by the crew in min is

(A) 15.50   (B) 17.01   (C) 17.82   (D) 18.90

Statement for Linked Answer Questions 82 & 83: The results of a th̶̶̶̶ey are given below

Points	North Coordinate, in m	East Coordinate, in m
A	400.5	620.2
B	750.5	320.5

Q.82 The length of the line AB in m is

(A) 460.78   (B) 349.70   (C) 106.60   (D) 50.30

Q.83 The bearing of the line AB in degrees is

(A) −23.17NE   (B) 23.17NW   (C) 40.57NW   (D) 40.57NE

Statement for Linked Answer Questions 84 & 85: The following figure provides the grade information.

% Cu = 0.56

% Cu = 0.64

8 m

16 m

A
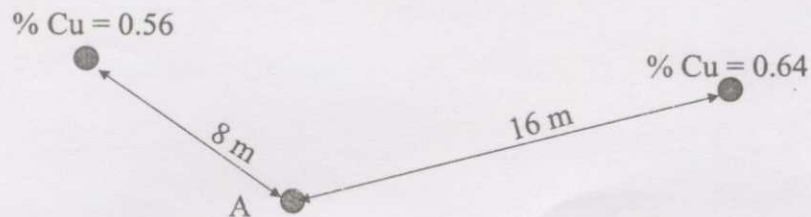
Q.84 The grade of copper (%) at point A using the inverse distance weighting method is

(A) 0.47   (B) 0.58   (C) 0.61   (D) 1.20

Q.85 Assume the grade at A to be the average grade of copper, mill recovery to be 85% and the smelting & refining losses to be 1.0 kg of copper per tonne of ore. The amount of saleable copper in kg/tonne of ore is

(A) 2.93   (B) 3.93   (C) 4.93   (D) 5.93

END OF THE QUESTION PAPER