MN : MINING ENGINEERING A

Duration: Three Hours *Maximum Marks*: 100

Read the following instructions carefully.

1. This question paper contains 16 pages including blank pages for rough work. Please check all pages and report discrepancy, if any.

2. Write your registration number, your name and name of the examination centre at the specified locations on the right half of the Optical Response Sheet (ORS).

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

4. All questions in this paper are of objective type.

5. Questions must be answered on the **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. **For each question darken the bubble of the correct answer.** In case you wish to change an answer, erase the old answer completely. More than one answer bubbled against a question will be treated as an incorrect response.

6. There are a total of 65 questions carrying 100 marks.

7. Questions Q.1 – Q.25 will carry 1-mark each, and questions Q.26 – Q.55 will carry 2-marks each.

8. Questions Q.48 – Q.51 (2 pairs) are common data questions and question pairs (Q.52, Q.53) and (Q.54, Q.55) are linked answer questions. The answer to the second question of the linked answer questions depends on the answer to the first question of the pair. If the first question in the linked pair is wrongly answered or is un-attempted, then the answer to the second question in the pair will not be evaluated.

9. Questions Q.56 – Q.65 belong to General Aptitude (GA). Questions Q.56 – Q.60 will carry 1-mark each, and questions Q.61 – Q.65 will carry 2-marks each. The GA questions will begin on a fresh page starting from page 11.

10. Un-attempted questions will carry zero marks.

11. Wrong answers will carry **NEGATIVE** marks. For Q.1 – Q.25 and Q.56 – Q.60, ⅓ mark will be deducted for each wrong answer. For Q.26 – Q.51 and Q.61 – Q.65, ⅔ mark will be deducted for each wrong answer. The question pairs (Q.52, Q.53), and (Q.54, Q.55) are questions with linked answers. There will be negative marks only for wrong answer to the first question of the linked answer question pair i.e. for Q.52 and Q.54, ⅔ mark will be deducted for each wrong answer. There is no negative marking for Q.53 and Q.55.

12. Calculator (without data connectivity) is allowed in the examination hall.

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

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

SEAL

Q.1 – Q.25 carry one mark each.

Q.1 Ascensionally ventilated coal mine inclines ideally should have higher methane layering number when compared to descensionally ventilated inclines. The reason is

(A) in ascensionally ventilated incline density of air is higher

(B) ascenssionally ventilated incline creates conditions for improved turbulent mixing of methane layer

(C) methane drainage is not practiced in ascensionally ventilated incline

(D) descensionally ventilated incline creates conditions for improved turbulent mixing of methane layer

Q.2 A coolant is a desirable component in the design of a Self-Contained Breathing Apparatus since

(A) surroundings can be hot and humid during rescue

(B) a rescue worker generates large amount of metabolic heat

(C) exhaled air CO_2 absorption is an exothermic reaction

(D) exhaled air water vapour has to be condensed

Q.3 Determine the correctness or otherwise of the following **Assertion** [a] and the **Reason** [r]

Assertion : Both intake and return side stoppings must be closed simultaneously in the event of sealing off a coal mine panel with explosion hazard following a fire.

Reason : By continuously ventilating the area till simultaneous closure of the stoppings, the possibility of an explosion hazard due to gas build-up is avoided.

(A) [a] is true but [r] is false

(B) Both [a] and [r] are true and [r] is the correct reason for [a]

(C) Both [a] and [r] are true and [r] is not the correct reason for [a]

(D) Both [a] and [r] are false

Q.4 In a Cartesian coordinate system the vertices of a triangular plate are given by (–2, 1), (3, 4), and (–4, –8). The coordinates of the centre of gravity of the plate are

(A) 3, 4 (B) 7, 12 (C) –1, –1 (D) –3, –4

Q.5 An air quality parameter required to be monitored under the Indian National Ambient Air Quality Standards is

(A) As (B) Pb (C) Hg (D) Silica

Q.6 In an underground coal mine, a freshly exposed roof can be supported by a temporary support in the form of

(A) triangular chocks

(B) screw props

(C) safari supports

(D) hydraulic props

Q.7 At a surface mine office the independent Sound Pressure Levels (SPL) measured in dB(A) on account of 3 drill machines are 85, 88 and 85. If all the three machines work simultaneously, the combined SPL, in dB(A), is

(A) 91 (B) 90 (C) 92 (D) 94

Q.8 The backsight reading on a bench mark of RL 100.0 m is 1.45 m. If the inverse staff reading on a foresight is 2.23 m, the RL of the staff station in m is

(A) 105.13 (B) 103.68 (C) 100.78 (D) 98.55

Q.9 For a mine of production t per year, the total cost of production is given by $at^2 + b$. The revenue from sale is given by ct. If a, b and c, are constants, the breakeven value of t is

(A) $[c \pm \sqrt{\{c^2 - 4ab\}}]/(2a)$ (B) $[\sqrt{\{c^2 - 4ab\}}]/(2a)$

(C) $[-c \pm \sqrt{\{c^2 - 4ab\}}]/(2a)$ (D) $[c \pm \sqrt{\{c^2 + 4ab\}}]/(2a)$

Q.10 The value of the $\lim_{x \to 1}\left[\frac{1 - x^{-1/3}}{1 - x^{-2/3}}\right]$ is

(A) ∞ (B) 1
(C) 0 (D) 1/2

Q.11 Two determinants of order n are multiplied. The order of the resultant determinant is

(A) n (B) $2n$ (C) n^2 (D) $n/2$

Q.12 The partial differential equation, $r\frac{\partial \theta}{\partial r} = \text{constant}$, is a solution for

(A) $\frac{\partial^2 \theta}{\partial r^2} - \frac{1}{r}\frac{\partial \theta}{\partial r} = 0$ (B) $\frac{\partial^2 \theta}{\partial r^2} + \frac{\partial \theta}{\partial r} = 0$

(C) $r^2\frac{\partial^2 \theta}{\partial r^2} + \frac{1}{r}\frac{\partial \theta}{\partial r} = 0$ (D) $\frac{\partial^2 \theta}{\partial r^2} + \frac{1}{r}\frac{\partial \theta}{\partial r} = 0$

Q.13 In Mohr-Coulomb failure criterion, the ratio of the uniaxial compressive strength to the tensile strength is

(A) $\frac{1+\sin\phi}{1-\sin\phi}$ (B) $\frac{1-\sin\phi}{1+\sin\phi}$

(C) $\frac{C(1+\sin\phi)}{(1-\sin\phi)}$ (D) $\frac{2C(1+\sin\phi)}{(1-\sin\phi)}$

Q.14 The average Young's modulus and Poisson's ratio values of a limestone sample are 60×10^3 MPa and 0.3 respectively. The shear modulus in MPa is

(A) 23.07 (B) 230.7 (C) 2307.0 (D) 23070.0

Q.15 The angle of draw in a trough subsidence helps in determining the

(A) maximum subsidence
(B) extent of surface subsidence
(C) plane of fracture
(D) critical width of the opening

Q.16 Recapping a winding rope is done to

(A) increase the flexural strength of the rope
(B) increase the flexibility of the rope
(C) remove a portion of the rope subjected to deterioration
(D) prevent the rope from excessive rusting

Q.17 Match the following for standard diamond drill rods.

Specification	Outer Diameter in mm
P. AW	p. 34.9
Q. BW	q. 44.4
R. EW	r. 54.0
S. NW	s. 66.7

(A) P-r; Q-q; R-s; S-p
(B) P-r; Q-p; R-s; S-q
(C) P-q; Q-r; R-p; S-s
(D) P-q; Q-r; R-s; S-p

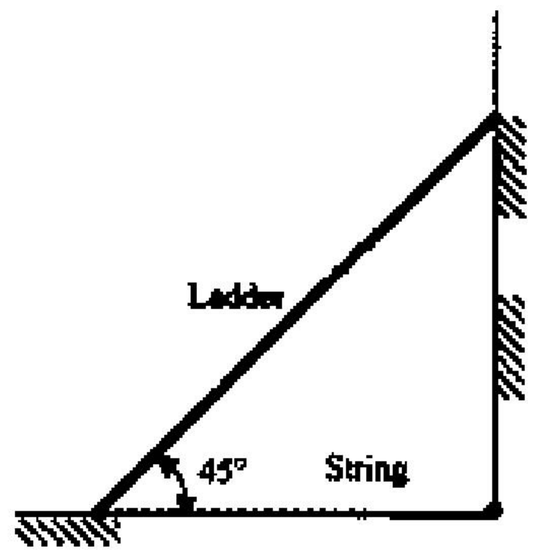
Q.18 Payback period is time required

(A) for the cash income from a project to get back the initial cash investment
(B) from the start of the project to the time to recover the total initial investment
(C) from the start of the project to the start of production
(D) to the period during which internal rate of return is generated

Q.19 For electric signaling systems in underground coal mines, the statement that is NOT true is

(A) all signaling equipment must be intrinsically safe
(B) the signaling circuit must be connected to ground
(C) the source of current should be an approved dry battery
(D) DC bells or relays when connected in parallel should be supplied from a single source of current

Q.20 A ladder of weight 50 N rests against a frictionless wall and floor as shown in the figure. A horizontal string ties the base of the ladder to the wall. The tension in the string in N is



(A) 100 (B) 50 (C) 72 (D) 25

Q.21 The mean and the standard deviation of the grade of iron ore in a deposit are 62% and 5% respectively. The coefficient of variation of the grade in % is

(A) 24.8 (B) 12.4 (C) 8.0 (D) 4.0

Q.22 The variance of failure time (time to failures) of an electric motor in shovel is 1600 hr^2. If the failure time follows an exponential distribution, the expected failure time in hr is

(A) 40 (B) 80 (C) 800 (D) 1600

Q.23 Match the following

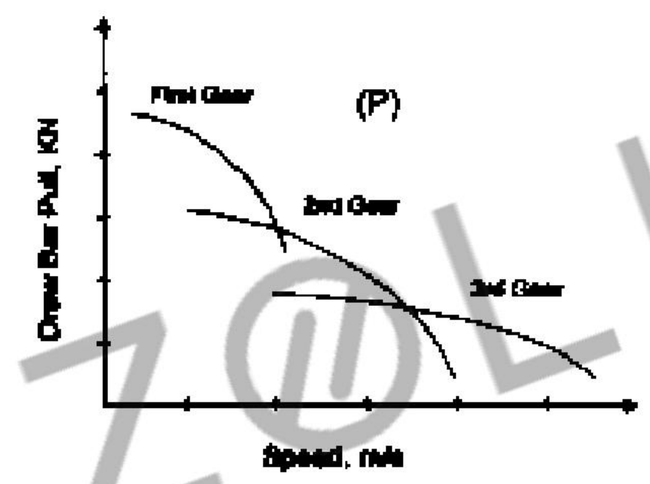
	Instrument		Purpose / Measurement
1	Abney's level	a	horizontal and vertical angles
2	Pentograph	b	area of plotted figure
3	Planimeter	c	enlargement and reduction of plotted maps
4	Box Sextant	d	angle of inclination

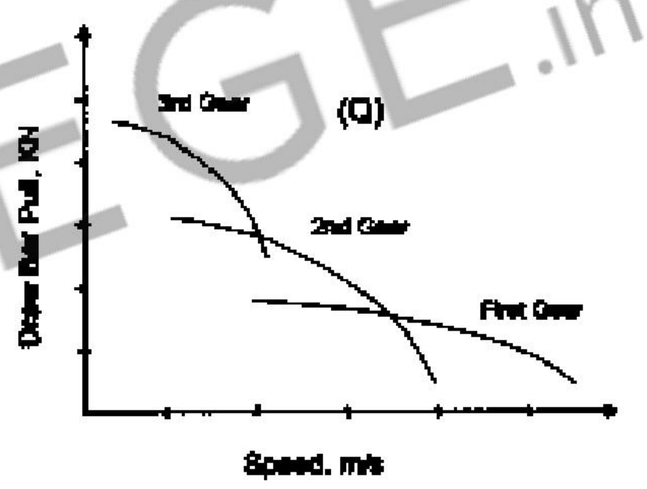
(A) 1-a; 2-c; 3-d; 4-b (B) 1-c; 2-b; 3-d; 4-a
(C) 1-d; 2-a; 3-d; 4-c (D) 1-d; 2-c; 3-b; 4-a

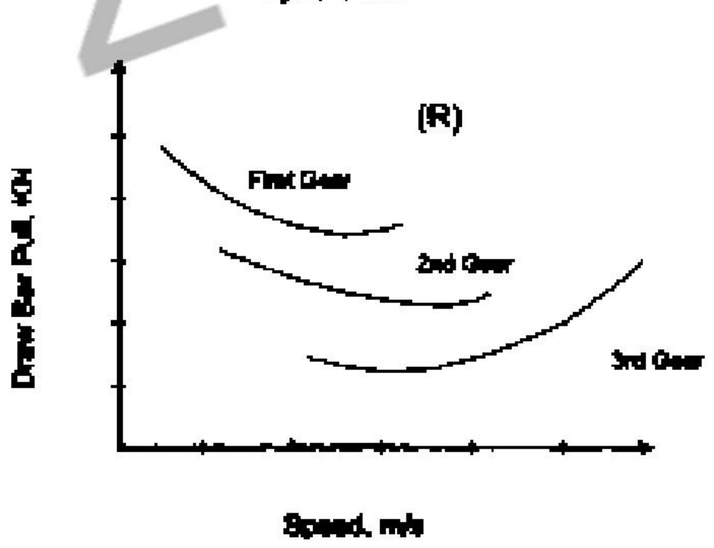
Q.24 A cage weighing 12000 kg is raised by four chains each making an angle of 30° with the vertical. The tension in each chain in kN is

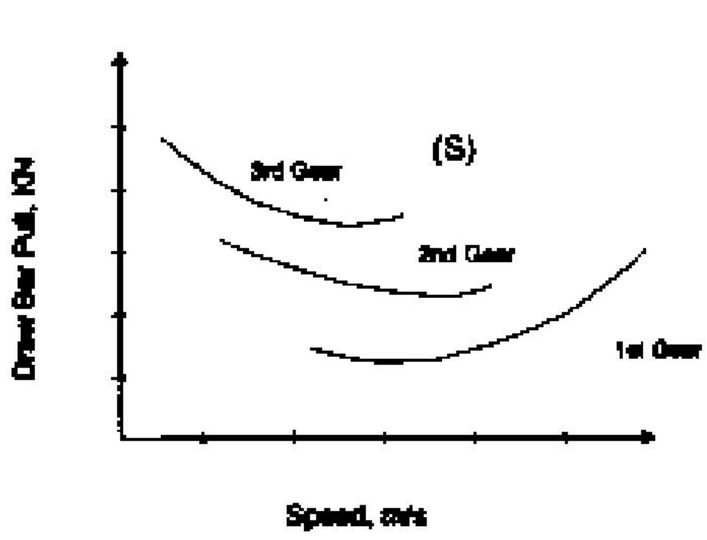
(A) 41 (B) 34 (C) 25 (D) 20

Q.25 The relationship between the drawbar pull and the speed for different gears of a self propelling vehicle is represented by









(A) Q (B) S (C) R (D) P

Q.26 – Q.55 carry two marks each.

Q.26 A flammable mixture has 70% CH_4 and 30% CO. The lower flammability limits for these gases are 5% and 13% respectively. For the mixture, the lower flammability limit in % is

(A) 6.13 (B) 8.72 (C) 10.25 (D) 12.16

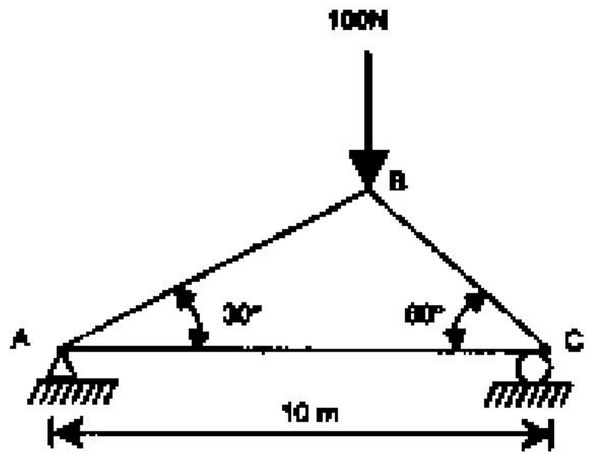
Q.27 The volume of tetrahedron with vertices at (0,0,0), (1,0,0), (0,1,0) and (0,0,1) is

(A) 1/2 (B) 1/4 (C) 1/6 (D) 1/8

Q.28 A balanced winder raises 3000 tonnes per day from a depth of 500 m. The payload of the winding cage is 7 tonnes. The energy consumed per day in kWh at 70% winder efficiency is

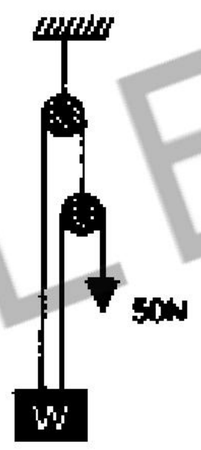
(A) 6030 (B) 5840 (C) 5750 (D) 5630

Q.29 A truss is loaded as shown in the figure. The force in the member AC is



(A) tension 75.9 N
(B) compression 43.3 N
(C) tension 43.3 N
(D) compression 75.9 N

Q.30 In the frictionless pulley system shown in the figure, each pulley weighs 20 N. The weight W, in N, that can be lifted by the system under the conditions shown is



(A) 200 (B) 170 (C) 150 (D) 100

Q.31 A force of $50\hat{i} - 50\hat{j}$ N is moved from the origin to a coordinate $(4.0m, 2.0m)$. The work done in the process in J is

(A) 75.6
(B) 85.5
(C) 90.2
(D) 100.0

Q.32 The queue of trucks at a crusher plant hopper is known to be M/M/1 queue. The probability that there is no truck to unload is 0.3.
Due to rains the mean service time at the hopper is increased by 30%. As a consequence, the expected number of trucks in the queuing system (including the one possibly unloading) becomes

(A) 10 (B) 12 (C) 14 (D) 16

Q.33 Pull from an underground tunnel blasting is normally distributed with a mean of 100 tonnes and variance 100 (tonnes)^2. The probability that the tonnage value from a blast exceeds 110 is

(A) 0.60 (B) 0.80 (C) 0.16 (D) 0.32

Q.34 The feasibility region of an LP problem in variables x and y is given by the following constraints, in addition to the non-negativity constraints.

$y \leq 60;\ x \leq 90;\ x + y \leq 70$.

The number of corner point feasible solutions for this problem are

(A) 3 (B) 4 (C) 5 (D) 6

Q.35 The unit cost matrix of a balanced transportation problem is shown below

Destination		D1	D2	D3	Supply
Source	S1	7	3	6	60
	S2	5	4	9	60
	S3	8	6	7	80
Demand		50	120	30	

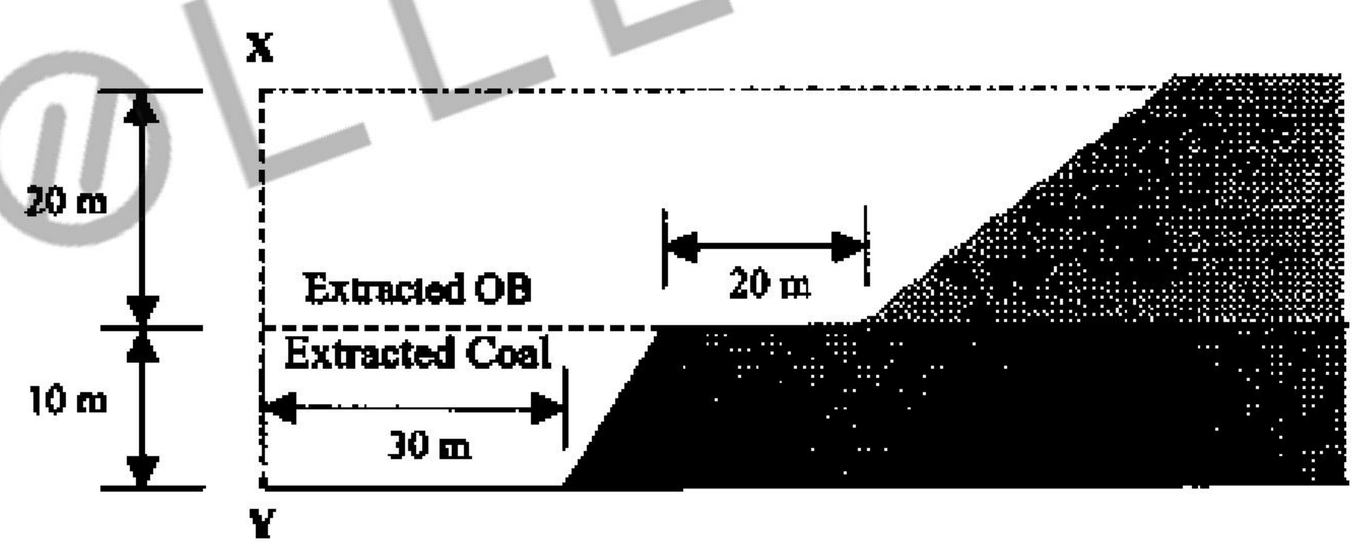
The transportation cost of the initial basic feasible solution obtained by the North-West corner rule is

(A) 1025 (B) 1075 (C) 1130 (D) 1226

Q.36 A high volume air sampler is operated for 8 hours in a mine with the flow rate of air varying from 1.5 m^3/min to 1.3 m^3/min. The empty weight of the filter paper is 2.30 g and the final weight is 2.65 g. The mean concentration of the Suspended Particulate Matter (SPM) during the study period in $\mu g/m^3$ is

(A) 591 (B) 550 (C) 545 (D) 521

Q.37 In an opencast mine shown in the figure below the coal has a density of 1.4 tonne/m^3. Assuming mining operation started from plane XY, the operating stripping ratio under the given conditions in m^3/tonne is



(A) 2.32 (B) 2.47 (C) 2.56 (D) 2.64

Q.38 A developed panel for a coal seam having incubation period of 6 months has 32 square pillars under extraction having size 25 m, and height 3.0 m. Density of coal is 1.4 tonne/m^3. Extraction ratio during depillaring is expected to be 75%. To depillar the panel within the incubation period, assuming 25 working days in a month, the production from the panel in tonne/day is

(A) 420 (B) 480 (C) 560 (D) 680

Q.39 A closed traverse ABCDE of perimeter 425 m has a total error $+0.25m$ in latitude and $-0.44m$ in departure. The precision of traverse is

(A) 1 in 556 (B) 1 in 785 (C) 1 in 833 (D) 1 in 1024

Q.40 The value of the given integral is

$$\int_{\frac{\pi}{5}}^{\frac{3\pi}{10}} \frac{\sin x}{(\sin x + \cos x)}\, dx$$

(A) $\frac{\sin \pi/8}{10}$ (B) $\frac{\pi}{10}$ (C) $\frac{\sin \pi/5}{10}$ (D) $\frac{3\pi}{10}$

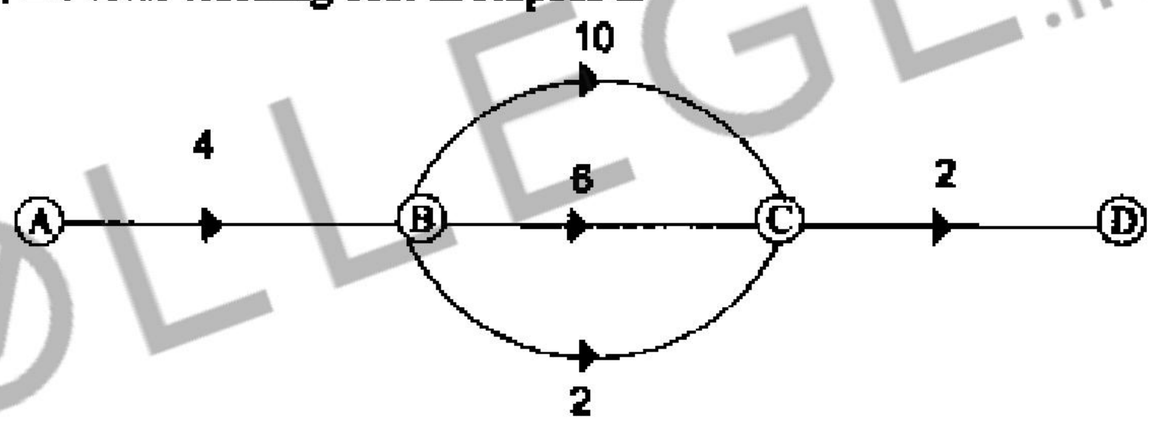
Q.41 The probabilities of hitting a target by A and B are 1/3 and 2/5 respectively. A shoots at the target once, followed by B shooting at the target once. The probability of hitting the target is

(A) 2/15 (B) 5/15 (C) 8/15 (D) 9/15

Q.42 The value of k for which the points $(5,5),(k,1),(10,7)$ lie on a straight line is

(A) –5 (B) +5 (C) –2 (D) +2

Q.43 A project network comprises five activities as shown below. The activity durations, in days, are as indicated. Crashing of any activity costs Rs. 1000 per day. If the project is crashed to the shortest possible duration, the total crashing cost in Rupees is

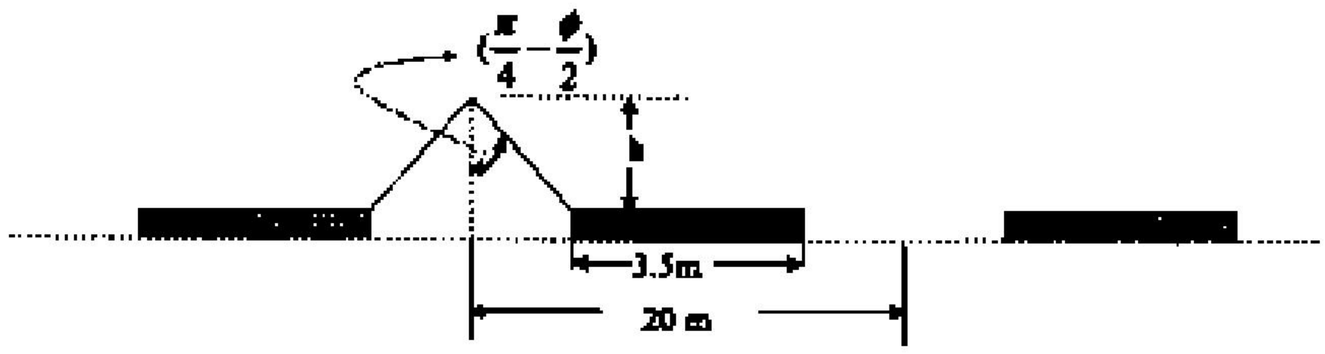


(A) 15000 (B) 14000 (C) 13000 (D) 12000

Q.44 A steel wire rope of 25 mm diameter weighing 37 N/m has 6 strands of 7 wires each. The diameter and tensile strength of each wire are 2.5 mm and 1800 MPa, respectively. The factor of safety for raising a cage of weight 60 kN from a depth of 200 m is

(A) 5.60 (B) 4.50 (C) 4.25 (D) 4.15

Q.45 In block caving operation the draw points are placed at 20 m center to center, with the pillar width 3.5 m as shown in the figure below. The muck is assumed to have zero cohesion and 35° friction angle. The height of draw cone (h) in m is

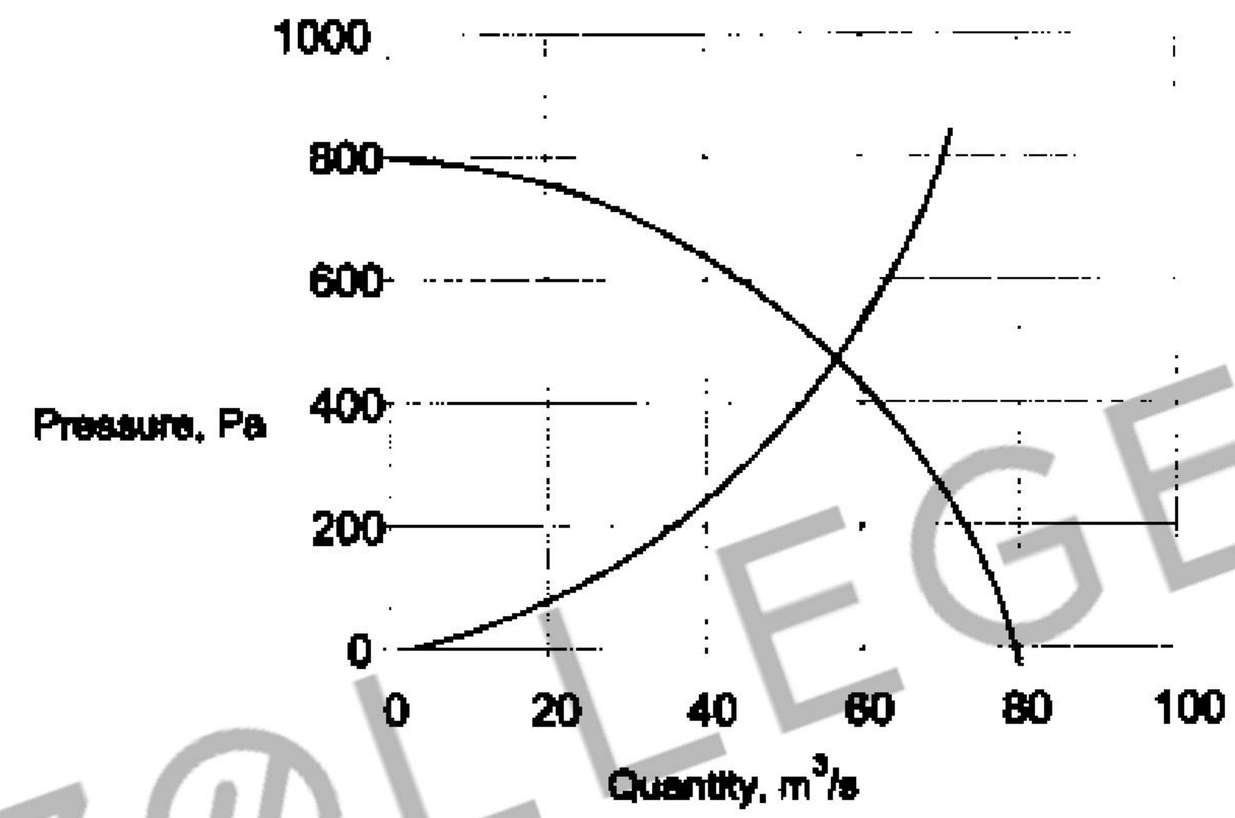


(A) 12.5 (B) 14.6 (C) 15.8 (D) 16.5

Q.46 The stroke length and pitch of the rifle bar of a percussive drill machine are 60 mm and 1/760 respectively. If the drill operates at 2000 blows/minute, the rotational speed in rpm of the drill steel is

(A) 145 (B) 158 (C) 162 (D) 175

Q.47 The main fan operating point of a ventilation system is shown in the figure below. If an NPV of 200 Pa assists the ventilation system, the resultant pressure (Pa) and quantity (m^3) generated by the fan respectively are

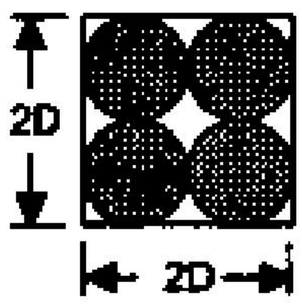


(A) 500,68 (B) 600,63 (C) 640,55 (D) 400,63

Common Data Questions

Common Data for Questions 48 and 49:

The granular media in an ore bin is assumed to be of regular spherical shape represented by the geometry as shown in the figure. The unit weight of solids is 25 kN/m^3.



Q.48 The void ratio is

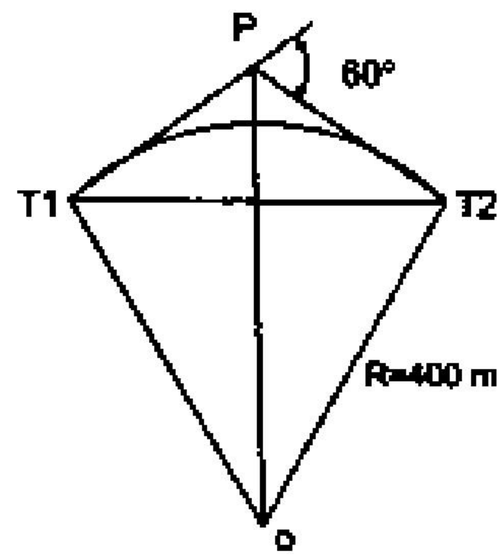
(A) 0.91 (B) 0.84 (C) 0.78 (D) 0.69

Q.49 The dry density in kN/m^3 is

(A) 13.09 (B) 12.50 (C) 11.74 (D) 10.87

Common Data for Questions 50 and 51:

Match the elements of a simple curve as given in the figure below.



Q.50 The tangent length in m is
(A) 215.5 (B)220.4 (C) 228.4 (D) 230.9

Q.51 The length of the long chord in m is
(A) 375 (B) 400.0 (C) 415 (D) 450

Linked Answer Questions

Statement for Linked Answer Questions 52 and 53:

A longwall panel with a face height of 3.0 m and face length of 150.0 m is worked in 3 shifts per day employing 40 men per shift. The depth of the web of the shearer cutting coal is 0.5 m. The unit weight of the coal is 1.4 tonne/m^3. Two full face cuts are executed per shift.

Q.52 The daily production from the panel in tonnes is
(A) 945 (B) 1240 (C) 1890 (D) 2530

Q.53 The panel OMS in tonnes is
(A) 12.75 (B) 15.75 (C) 8.75 (D) 5.25

Statement for Linked Answer Questions 54 and 55:

Air at a density of 1.2 kg/m^3 flows in a straight duct such that the velocity at the centre is 12.5 m/s. The method factor for the velocity profile is known to be 0.80.

Q.54 The velocity pressure value in the duct in Pa is
(A) 31 (B) 47 (C) 60 (D) 83

Q.55 The air flow encounters a symmetric expansion such that the cross-sectional area of the duct becomes double. The static pressure value at the inlet and outlet of the expansion are 60 Pa and 90 Pa, respectively. Neglecting friction, the shock pressure loss on account of expansion in Pa is
(A) 15 (B) 22 (C) 38 (D) 46

General Aptitude (GA) Questions

Q.56 – Q.60 carry one mark each.

Q.56 *Which of the following options is the closest in meaning to the word below:*
Exhort

(A) urge
(B) condemn
(C) restrain
(D) scold

Q.57 *The question below consists of a pair of related words followed by four pairs of words. Select the pair that best expresses the relation in the original pair.*
Preamble : Constitution

(A) amendment : law
(B) prologue : play
(C) episode : serial
(D) plot : story

Q.58 *Choose the most appropriate word from the options given below to complete the following sentence:*
The committee wrote a _____ report, extolling only the strengths of the proposal.

(A) reasonable
(B) supportive
(C) biased
(D) fragmented

Q.59 *Choose the most appropriate word from the options given below to complete the following sentence:*
If the country has to achieve real prosperity, it is _____ that the fruits of progress reach all, and in equal measure.

(A) inevitable
(B) contingent
(C) oblivious
(D) imperative

Q.60 A person invests Rs.1000 at 10% annual compound interest for 2 years. At the end of two years the whole amount is invested at an annual simple interest of 12% for 5 years. The total value of the investment finally is:

(A) 1776 (B) 1760 (C) 1920 (D) 1936

Q.61 – Q.65 carry two marks each.

Q.61 **The ban on smoking in designated public places can save a large number of people from the well known effects of environmental tobacco smoke. Passive smoking seriously impairs respiratory health. The ban rightly seeks to protect non-smokers from its ill effects.**

Which of the following statements best sums up the meaning of the above passage:

(A) Effects of environmental tobacco are well known.
(B) The ban on smoking in public places protects the non smokers.
(C) Passive smoking is bad for health.
(D) The ban on smoking in public places excludes passive smoking.

Q.62 Given the sequence A, B, B, C, C, C, D, D, D, D, ... etc., that is one A, two Bs, three Cs, four Ds, five Es and so on, the 240th letter in the sequence will be:

(A) V (B) U (C) T (D) W

Q.63 Consider the set of integers {1, 2, 3, ..., 5000}. The number of integers that is divisible by neither 3 nor 4 is:

(A) 1668 (B) 2084 (C) 2500 (D) 2916

Q.64 A positive integer m in base 10 when represented in base 2 has the representation p and in base 3 has the representation q. We get $p - q = 990$ where the subtraction is done in base 10. Which of the following is necessarily true:

(A) $m \geq 14$ (B) $9 \leq m \leq 13$ (C) $6 \leq m \leq 8$ (D) $m < 6$

Q.65 Given the following four functions $f_1(n) = n^{100}$, $f_2(n) = (1.2)^n$, $f_3(n) = 2^{n/2}$, $f_4(n) = 3^{n/3}$ which function will have the largest value for sufficiently large values of n (i.e. $n \to \infty$)?

(A) f_4 (B) f_3 (C) f_2 (D) f_1

END OF THE QUESTION PAPER

Space for Rough Work

Space for Rough Work

Space for Rough Work

Space for Rough Work

SEAL