



General Aptitude

Q.1 – Q.5 Carry ONE mark Each

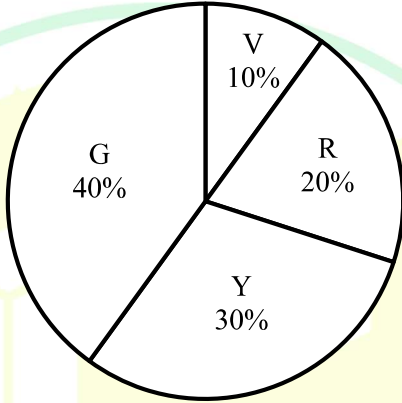
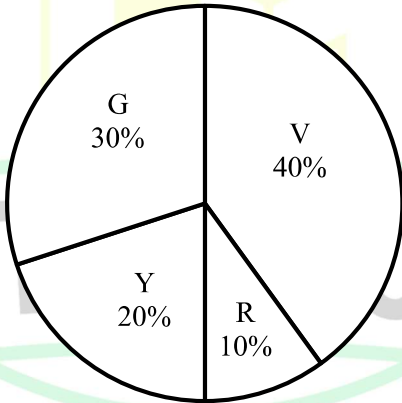
Q.1	Even though I had planned to go skiing with my friends, I had to _____ at the last moment because of an injury. Select the most appropriate option to complete the above sentence.
(A)	back up
(B)	back of
(C)	back on
(D)	back out
Q.2	The President, along with the Council of Ministers, _____ to visit India next week. Select the most appropriate option to complete the above sentence.
(A)	wish
(B)	wishes
(C)	will wish
(D)	is wishing

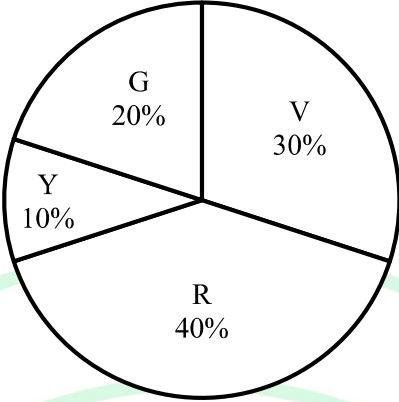
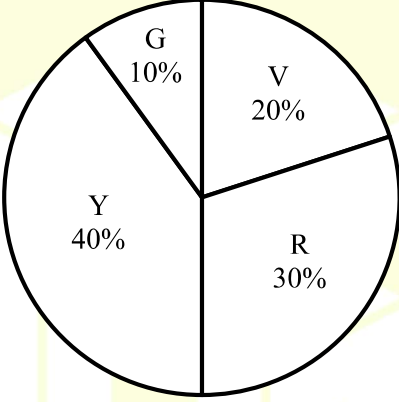


Q.3	An electricity utility company charges ₹ 7 per kWh (kilo watt-hour). If a 40-watt desk light is left on for 10 hours each night for 180 days, what would be the cost of energy consumption? If the desk light is on for 2 more hours each night for the 180 days, what would be the percentage-increase in the cost of energy consumption?
(A)	₹ 604.8; 10%
(B)	₹ 504; 20%
(C)	₹ 604.8; 12%
(D)	₹ 720; 15%

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Q.4	In the context of the given figure, which one of the following options correctly represents the entries in the blocks labelled (i), (ii), (iii), and (iv), respectively?																
	<table><tr><td>N</td><td>U</td><td>F</td><td>(i)</td></tr><tr><td>21</td><td>14</td><td>9</td><td>6</td></tr><tr><td>H</td><td>L</td><td>(ii)</td><td>O</td></tr><tr><td>12</td><td>(iv)</td><td>15</td><td>(iii)</td></tr></table>	N	U	F	(i)	21	14	9	6	H	L	(ii)	O	12	(iv)	15	(iii)
N	U	F	(i)														
21	14	9	6														
H	L	(ii)	O														
12	(iv)	15	(iii)														
(A)	Q, M, 12, and 8																
(B)	K, L, 10 and 14																
(C)	I, J, 10, and 8																
(D)	L, K, 12 and 8																

Q.5	<p>A bag contains Violet (V), Yellow (Y), Red (R), and Green (G) balls. On counting them, the following results are obtained:</p> <ul style="list-style-type: none"> (i) The sum of Yellow balls and twice the number of Violet balls is 50. (ii) The sum of Violet and Green balls is 50. (iii) The sum of Yellow and Red balls is 50. (iv) The sum of Violet and twice the number of Red balls is 50. <p>Which one of the following Pie charts correctly represents the balls in the bag?</p>										
(A)	 <table border="1"> <caption>Data for Pie Chart (A)</caption> <thead> <tr> <th>Color</th> <th>Percentage</th> </tr> </thead> <tbody> <tr> <td>Violet (V)</td> <td>10%</td> </tr> <tr> <td>Red (R)</td> <td>20%</td> </tr> <tr> <td>Yellow (Y)</td> <td>30%</td> </tr> <tr> <td>Green (G)</td> <td>40%</td> </tr> </tbody> </table>	Color	Percentage	Violet (V)	10%	Red (R)	20%	Yellow (Y)	30%	Green (G)	40%
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(B)	 <table border="1"> <caption>Data for Pie Chart (B)</caption> <thead> <tr> <th>Color</th> <th>Percentage</th> </tr> </thead> <tbody> <tr> <td>Violet (V)</td> <td>40%</td> </tr> <tr> <td>Red (R)</td> <td>10%</td> </tr> <tr> <td>Yellow (Y)</td> <td>20%</td> </tr> <tr> <td>Green (G)</td> <td>30%</td> </tr> </tbody> </table>	Color	Percentage	Violet (V)	40%	Red (R)	10%	Yellow (Y)	20%	Green (G)	30%
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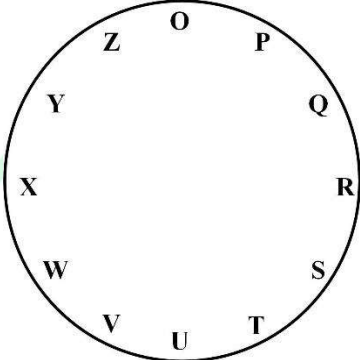
(C)	 <table border="1"> <thead> <tr> <th>Category</th> <th>Percentage</th> </tr> </thead> <tbody> <tr> <td>V</td> <td>30%</td> </tr> <tr> <td>R</td> <td>40%</td> </tr> <tr> <td>G</td> <td>20%</td> </tr> <tr> <td>Y</td> <td>10%</td> </tr> </tbody> </table>	Category	Percentage	V	30%	R	40%	G	20%	Y	10%
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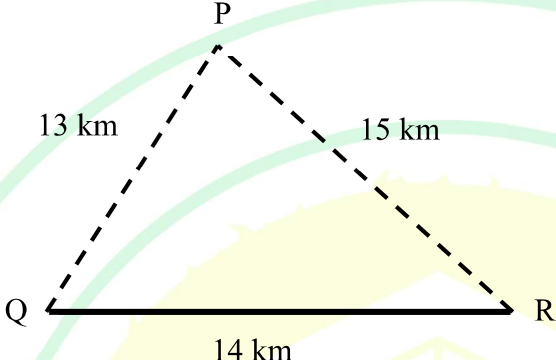
Q.6 – Q.10 Carry TWO marks Each

Q.6	<p>“His life was divided between the books, his friends, and long walks. A solitary man, he worked at all hours without much method, and probably courted his fatal illness in this way. To his own name there is not much to show; but such was his liberality that he was continually helping others, and fruits of his erudition are widely scattered, and have gone to increase many a comparative stranger’s reputation.”</p> <p>(From E.V. Lucas’s “A Funeral”)</p> <p>Based only on the information provided in the above passage, which one of the following statements is true?</p>
(A)	The solitary man described in the passage is dead.
(B)	Strangers helped create a grand reputation for the solitary man described in the passage.
(C)	The solitary man described in the passage found joy in scattering fruits.
(D)	The solitary man worked in a court where he fell ill.

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Q.7	<p>For the clock shown in the figure, if</p> <p>$O^* = O\ Q\ S\ Z\ P\ R\ T$, and</p> <p>$X^* = X\ Z\ P\ W\ Y\ O\ Q$,</p> <p>then which one among the given options is most appropriate for P^* ?</p>
	
(A)	P U W R T V X
(B)	P R T O Q S U
(C)	P T V Q S U W
(D)	P S U P R T V

Q.8	<p>Consider a five-digit number $PQRST$ that has distinct digits P, Q, R, S, and T, and satisfies the following conditions:</p> $P < Q$ $S > P > T$ $R < T$ <p>If integers 1 through 5 are used to construct such a number, the value of P is:</p>
(A)	1
(B)	2
(C)	3
(D)	4
Q.9	<p>A business person buys potatoes of two different varieties P and Q, mixes them in a certain ratio and sells them at ₹ 192 per kg.</p> <p>The cost of the variety P is ₹ 800 for 5 kg.</p> <p>The cost of the variety Q is ₹ 800 for 4 kg.</p> <p>If the person gets 8% profit, what is the $P:Q$ ratio (by weight)?</p>
(A)	5:4
(B)	3:4
(C)	3:2
(D)	1:1

Q.10	<p>Three villages P, Q, and R are located in such a way that the distance $PQ = 13$ km, $QR = 14$ km, and $RP = 15$ km, as shown in the figure. A straight road joins Q and R. It is proposed to connect P to this road QR by constructing another road. What is the minimum possible length (in km) of this connecting road?</p> <p>Note: The figure shown is representative.</p>
	
(A)	10.5
(B)	11.0
(C)	12.0
(D)	12.5
	<p style="text-align: center; font-size: 2em; opacity: 0.5;">GATE 2025</p> <p style="text-align: center; font-size: 1.5em; opacity: 0.5;">IIT Roorkee</p>



Q.11 – Q.35 Carry ONE mark Each

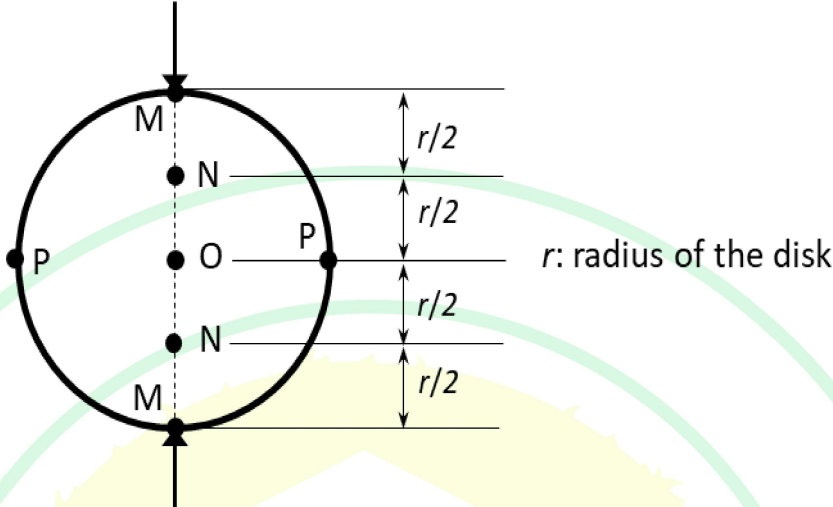
Q.11	A non-transit theodolite does NOT have
(A)	Vernier scale
(B)	face-left and face-right options
(C)	spirit level
(D)	cross-hair
Q.12	A steeply dipping metalliferous ore body is non-susceptible to spontaneous heating. The blasted ore is used as the platform to work in a stope. Appropriate mining method for this orebody is
(A)	room and pillar
(B)	sublevel stoping
(C)	block caving
(D)	shrinkage stoping

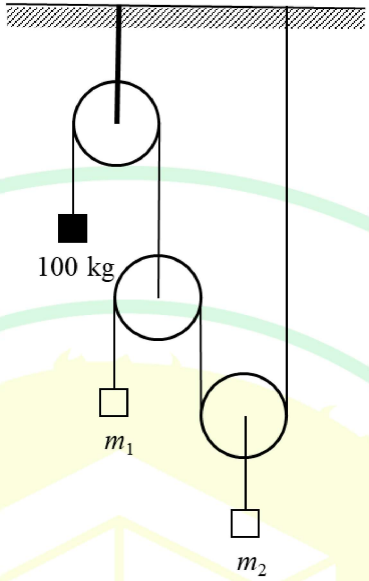
Q.13	If $y = x^x$, then $\frac{dy}{dx}$ is
(A)	$x^x(\ln x + 1)$
(B)	$x \times x^{x-1}$
(C)	$x \times (x - 1)$
(D)	$x \ln x$
Q.14	The rank of 3×3 matrix A is 2. The determinant of the matrix is
(A)	0
(B)	1
(C)	2
(D)	3



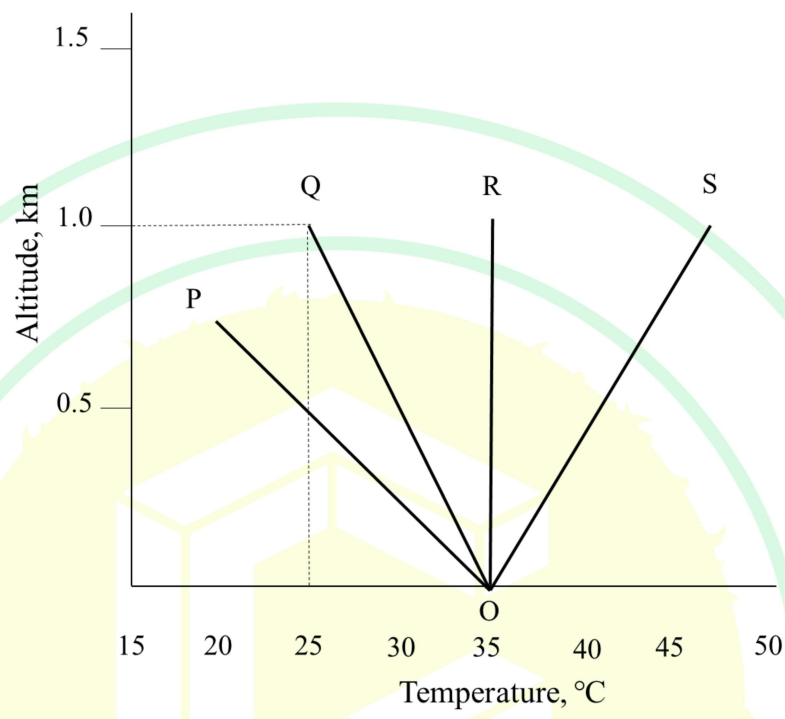
Q.15	The safety device used to arrest forward runaway tubs in rope haulage, is
(A)	monkey catch
(B)	drop warwick
(C)	stop-block
(D)	backstay
Q.16	The metal that belongs to Rare Earth Element category is
(A)	Cerium
(B)	Lithium
(C)	Titanium
(D)	Cobalt

Q.17	<p>The major (σ_1) and minor (σ_3) principal stresses and the maximum shear stress (τ_{max}) are related as $\tau_{max} = \sigma_1 = -\sigma_3$</p> <p>The magnitude of normal stress on the plane where τ_{max} acts is</p>
(A)	0
(B)	σ_1
(C)	σ_3
(D)	$(\sigma_1 - \sigma_3)/2$

Q.18	<p>In a Brazilian test, the front view of a homogeneous rock sample is shown in the figure. The failure initiates at the point</p> 
(A)	M
(B)	N
(C)	O
(D)	P

Q.19	<p>Three frictionless pulleys with rope attachment are in a static equilibrium as shown in the figure. The mass m_1 and m_2, in kg, respectively are</p> 
(A)	50, 100
(B)	50, 50
(C)	100, 50
(D)	50, 25
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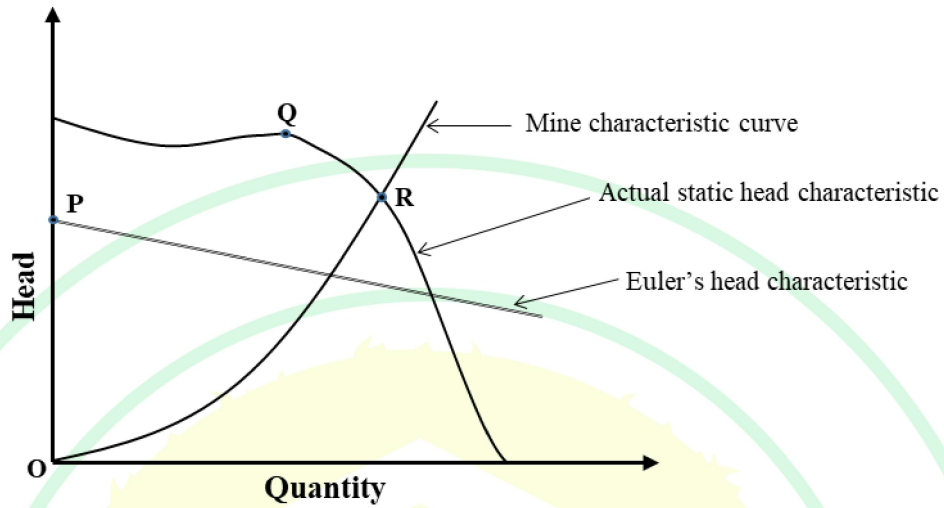
Q.20	<p>Match the source of error with the corresponding correction in surveying with steel tape.</p> <table border="1" data-bbox="318 380 1339 789"> <thead> <tr> <th>Source of error</th><th>Type of correction</th></tr> </thead> <tbody> <tr> <td>(P) Sag</td><td>(1) Only Positive (+)</td></tr> <tr> <td>(Q) Temperature</td><td>(2) Only Negative (–)</td></tr> <tr> <td>(R) Pull greater than standard pull</td><td>(3) Either positive or negative (+ or –)</td></tr> </tbody> </table>	Source of error	Type of correction	(P) Sag	(1) Only Positive (+)	(Q) Temperature	(2) Only Negative (–)	(R) Pull greater than standard pull	(3) Either positive or negative (+ or –)
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(A)	P→1, Q→2, R→3								
(B)	P→1, Q→3, R→2								
(C)	P→2, Q→3, R→1								
(D)	P→2, Q→1, R→3								

Q.21	The figure below shows four profiles of the environmental lapse rate. Given the dry adiabatic lapse rate = $-10^{\circ}\text{C}/\text{km}$, the atmosphere is highly unstable for the profile
	
(A)	OP
(B)	OQ
(C)	OR
(D)	OS

Q.22	In a depillaring face of an underground coal mine, both wet and dry bulb temperatures are 30 °C. The relative humidity of the face environment, in percentage, is
(A)	0
(B)	30
(C)	60
(D)	100
Q.23	The chemicals used in a foam type fire extinguisher are
(A)	NaHCO_3 and Na_2SO_4
(B)	$\text{Al}_2(\text{SO}_4)_3$ and Na_2SO_4
(C)	$\text{Al}_2(\text{SO}_4)_3$ and $\text{Al}(\text{OH})_3$
(D)	NaHCO_3 and $\text{Al}_2(\text{SO}_4)_3$

Q.24

Pressure head characteristic of a mine fan and a mine characteristic curves are shown in figure below:



Point	Nomenclature
P	1: Stall point
Q	2: Operating point
R	3: Theoretical shut-off head

Match the points with their corresponding nomenclatures

(A)

P→1, Q→2, R→3

(B)

P→2, Q→3, R→1

(C)

P→3, Q→1, R→2

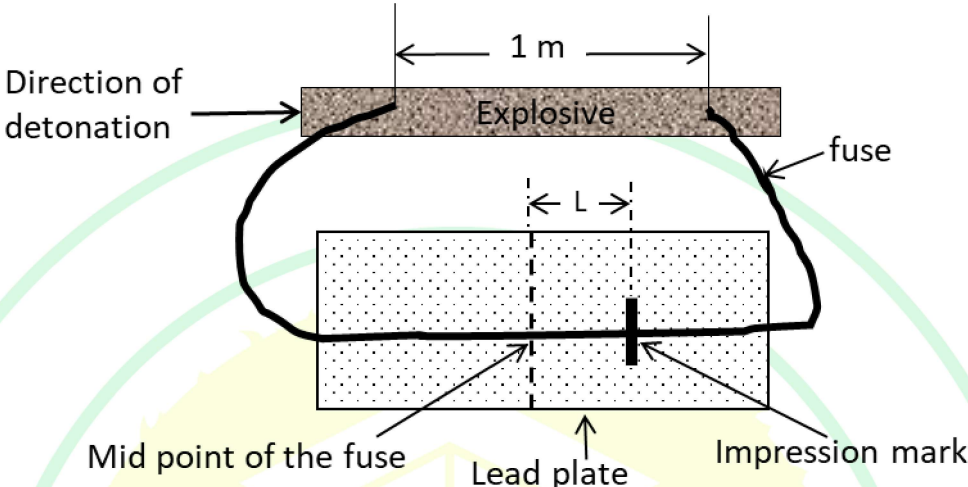
(D)

P→1, Q→3, R→2



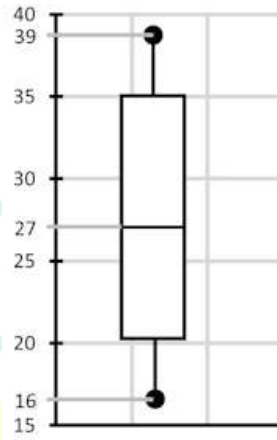
Q.25	As per CMR 2017, haulage ropes shall be recapped once at least in every
(A)	6 months
(B)	12 months
(C)	18 months
(D)	24 months
Q.26	In a shovel dumper combination, the loading time of a dumper is 3 minutes. The shovel serves 8 dumpers. If the cycle time of a dumper including its loading time is 22 minutes, the waiting time of a dumper, in minute, is ____ (<i>in integer</i>)

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Q.27	<p>An HMX explosive having Velocity of Detonation (VOD) of 10500 m/s is tested by D'Autriche method with a detonating fuse of VOD 7000 m/s, as shown in the figure. The impression mark on lead plate will be obtained at a distance (L), in m, from the midpoint of the fuse, is ____ (rounded off to two decimal places)</p> 
Q.28	<p>Hydraulic fracturing method is used to determine the major principal stress (σ_1) in an underground rock strata having tensile strength of 6 MPa. The minor principal stress (σ_3) in the strata is 8 MPa. If fluid pressure of 10 MPa is required to fracture the vertical borehole in that strata, the magnitude of σ_1, in MPa, is ____ (rounded off to 2 decimal places)</p>
Q.29	<p>The value of $\lim_{x \rightarrow 0} \left(\frac{\tan 11x}{\tan 5x} \right)$ is, ____ (rounded off to 1 decimal place)</p>

Q.30

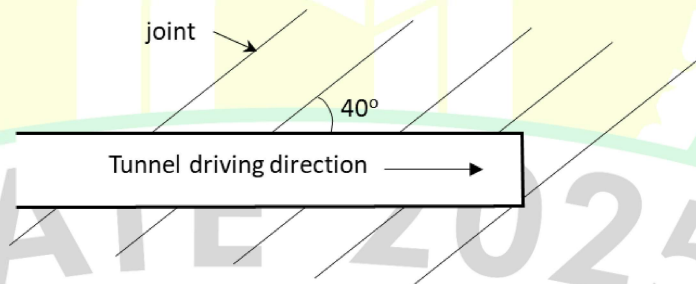
The box plot of a data set is shown below



The interquartile range of the data set is ____ (in integer)

Q.31

The unadjusted RMR of a tunnel roof is 64. A single joint set exists in the roof as shown in the figure.



Dip of the joint: $20^\circ - 45^\circ$

Drive with dip: Rating = -2

Drive against dip: Rating = -10

Using the abridged RMR table for adjustment orientation, the RMR is ____ (in integer)

Q.32	In a ventilation network, three airways with resistances of $4.0 \text{ N s}^2 \text{ m}^{-8}$, $6.25 \text{ N s}^2 \text{ m}^{-8}$ and $9.0 \text{ N s}^2 \text{ m}^{-8}$ are connected in parallel. The equivalent resistance of the network in $\text{N s}^2 \text{ m}^{-8}$ is _____ (rounded off to 2 decimal places)
Q.33	<p>In a bord and pillar panel, the following data are obtained</p> <p>Number of blasting rounds per shift : 8</p> <p>Face dimension (m × m) : 4.2×2.5</p> <p>Average pull (m) : 1.2</p> <p>Specific gravity of coal : 1.4</p> <p>Manpower per shift : 100</p> <p>The OMS (output per manshift) of the panel, in tonne, is _____ (rounded off to 2 decimal places)</p>
Q.34	If the in-situ density of coal is 1320 kg/m^3 and the density of blasted coal is 952 kg/m^3 , the swell factor is _____ (rounded off to 3 decimal places)



Q.35	<p>The relevant information on metal extraction from a copper mine are given below</p> <p>Selling price of copper (Rs./kg) = 900</p> <p>Mining cost (Rs./tonne of ore) = 500</p> <p>Processing cost (Rs./tonne of ore) = 2000</p> <p>Overall recovery of copper metal (%) = 70</p> <p>Ignoring all other costs, the breakeven cutoff grade of copper, in %, is _____ (rounded off to 2 decimal places)</p>

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Q.36 – Q.65 Carry TWO marks Each

Q.36	<p>Match the type of deposit with the corresponding process of formation</p> <table border="1" data-bbox="321 472 1341 913"> <thead> <tr> <th>Deposit type</th><th>Process of formation</th></tr> </thead> <tbody> <tr> <td>P. Hydrothermal deposit</td><td>I. Alteration arising in rocks due to hot igneous solutions</td></tr> <tr> <td>Q. Metasomatic deposit</td><td>II. Leaching away of soluble minerals leaving behind valuable minerals at or near the surface</td></tr> <tr> <td>R. Placer deposit</td><td>III. Formed from highly fluid solution of magma</td></tr> <tr> <td>S. Lateritic deposit</td><td>IV. Transported and subsequent concentration of broken materials from parent rock</td></tr> </tbody> </table>	Deposit type	Process of formation	P. Hydrothermal deposit	I. Alteration arising in rocks due to hot igneous solutions	Q. Metasomatic deposit	II. Leaching away of soluble minerals leaving behind valuable minerals at or near the surface	R. Placer deposit	III. Formed from highly fluid solution of magma	S. Lateritic deposit	IV. Transported and subsequent concentration of broken materials from parent rock
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(A)	P-III, Q-I, R-IV, S-II										
(B)	P-II, Q-IV, R-I, S-III										
(C)	P-III, Q-II, R-I, S-IV										
(D)	P-IV, Q-III, R-II, S-I										

Q.37	Following information are given for three mines of a company receiving explosives from three suppliers.																																			
	<table><tr><th colspan="2" rowspan="2"></th><th colspan="3">Explosive transportation cost (Rs./tonne)</th><th rowspan="2">Supply capacity (tonne)</th></tr><tr><th>Mine-1</th><th>Mine-2</th><th>Mine-3</th></tr><tr><td rowspan="3">Explosive suppliers</td><td>Supplier - S</td><td>10</td><td>15</td><td>50</td><td>2500</td></tr><tr><td>Supplier - O</td><td>5</td><td>2</td><td>100</td><td>2500</td></tr><tr><td>Supplier - I</td><td>30</td><td>40</td><td>20</td><td>3000</td></tr><tr><td colspan="2">Explosive demand (tonne)</td><td>1000</td><td>2000</td><td>5000</td><td></td></tr></table> <p>Considering the initial basic feasible solution of this transportation problem, using North-West corner method, the transportation cost of explosives supplied to the company, in Rs., is</p>							Explosive transportation cost (Rs./tonne)			Supply capacity (tonne)	Mine-1	Mine-2	Mine-3	Explosive suppliers	Supplier - S	10	15	50	2500	Supplier - O	5	2	100	2500	Supplier - I	30	40	20	3000	Explosive demand (tonne)		1000	2000	5000	
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(B)	109000																																			
(C)	293500																																			
(D)	385000																																			



Q.38	A triaxial test on a sandstone sample is conducted at a confining pressure of 10 MPa. The elastic axial and volumetric strains at axial stress of 50 MPa are recorded to be 4.2×10^{-3} and 2.0×10^{-3} respectively. The modulus of elasticity, in GPa, and Poisson's ratio of the sample, respectively are closest to
(A)	5.11, 0.35
(B)	10.22, 0.35
(C)	5.11, 0.17
(D)	10.22, 0.17

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Q.39

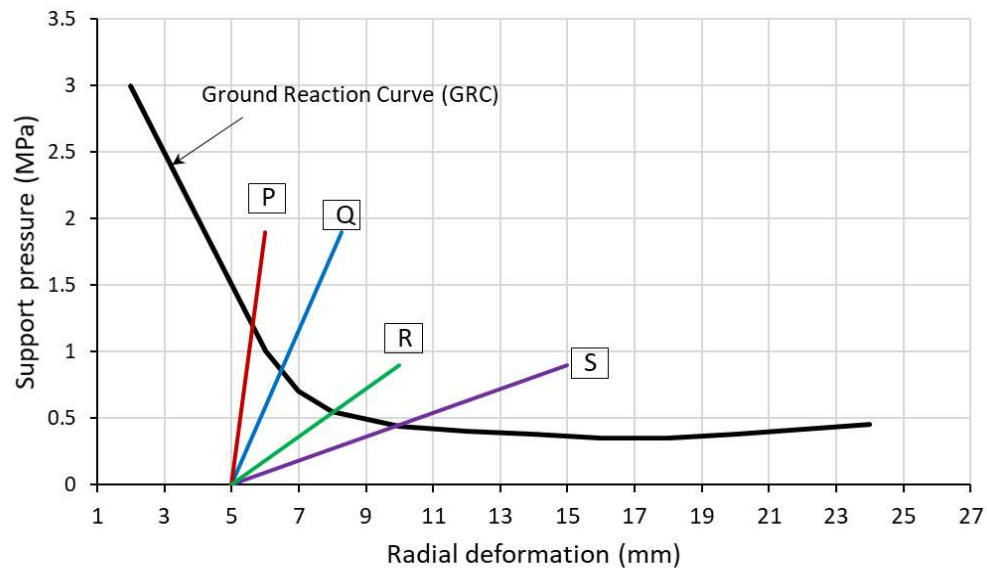
A ground reaction curve (GRC) of a 3 m radius unlined circular tunnel is shown in the figure. The tunnel is supported by 300 mm thick shotcrete lining. The uniaxial compressive strength (σ_c), modulus of elasticity (E_c) and Poisson's ratio (ν) of shotcrete material are 20 MPa, 15 GPa and 0.25 respectively. The maximum capacity (p_{max}) of the lining and its stiffness (k) are given as

$$p_{max} = \frac{1}{2} \sigma_c \left(1 - \frac{(a-t)^2}{a^2} \right)$$

$$k = \frac{E_c (a^2 - (a-t)^2)}{(1+\nu)[(1-2\nu)a^2 + (a-t)^2]}$$

where a = radius of the unlined tunnel and t = thickness of the lining.

If the lining is constructed after 5 mm radial deformation, the support reaction is best represented by the line



(A)

P

(B)

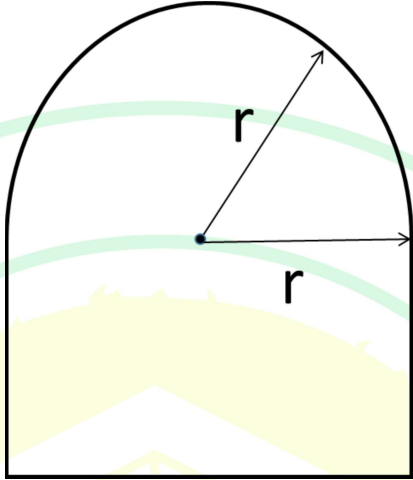
Q

(C)

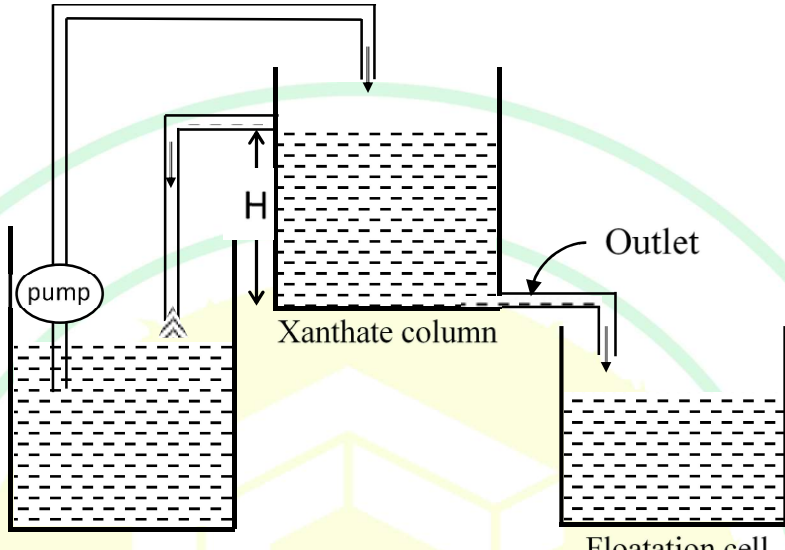
R

(D)

S

Q.40	<p>A fixed quantity of air needs to be sent through a cross section, as shown in the figure. The perimeter of the cross section is 20 m. The radius (r) of the semicircle, in m, to minimize the air velocity through the section is</p> 
(A)	$20/(4 + \pi)$
(B)	$40/(4 + \pi)$
(C)	$20/(4 - \pi)$
(D)	$40/(4 - \pi)$
	GATE 2025
	IIT Roorkee

Q.41	<p>Based on the theodolite survey for a closed traverse PQRS, the following bearings are observed for the sides of the traverse.</p> <table border="1" data-bbox="664 403 1015 684"> <thead> <tr> <th>Line</th><th>Fore bearing</th></tr> </thead> <tbody> <tr> <td>PQ</td><td>60°30'</td></tr> <tr> <td>QR</td><td>105°30'</td></tr> <tr> <td>RS</td><td>220°30'</td></tr> <tr> <td>SP</td><td>310°30'</td></tr> </tbody> </table> <p>The interior angles at P and R respectively are</p>	Line	Fore bearing	PQ	60°30'	QR	105°30'	RS	220°30'	SP	310°30'
Line	Fore bearing										
PQ	60°30'										
QR	105°30'										
RS	220°30'										
SP	310°30'										
(A)	45°00', 115°00'										
(B)	70°00', 65°00'										
(C)	135°00', 90°00'										
(D)	250°00', 115°00'										
Q.42	The CORRECT statement(s) of dragline operation is/are -										
(A)	The initial cut is called “Key” cut.										
(B)	Tandem method of operation requires at least two draglines.										
(C)	Dragline excavates material above the working bench.										
(D)	Dragline can move with walking pad.										

Q.43	<p>A constant feed of 400 mL/s is maintained by a Xanthate column of height H as shown in the figure. The outlet cross section area is $1.0 \times 10^{-4} \text{ m}^2$. The acceleration due to gravity is 10 m/s^2. Neglecting friction and other losses, the value of H, in cm, is ____ (rounded off to 2 decimal places)</p> 
Q.44	<p>A continuous miner serves two shuttle cars of 12 tonne capacity each. Shuttle cars I and II operate with a total cycle time of 12 minutes and 15 minutes respectively, which includes loading time of 8 minutes for each car. The production rate of the continuous miner, in tonne/hour, is ____ (rounded off to 2 decimal places)</p>
Q.45	<p>In a sublevel stope, a ringhole blast round is designed for winning 2500 tonne of ore with 8.0 % metal content. The blast results into breakage of 90.0 % of the design blast round. Overbreak of 250 tonne wallrock with 0.5 % metal content dilutes the blasted ore. The total metal content, in tonne, considering 95 % recovery of the blasted muck from the stope, is ____ (rounded off to 2 decimal places)</p>

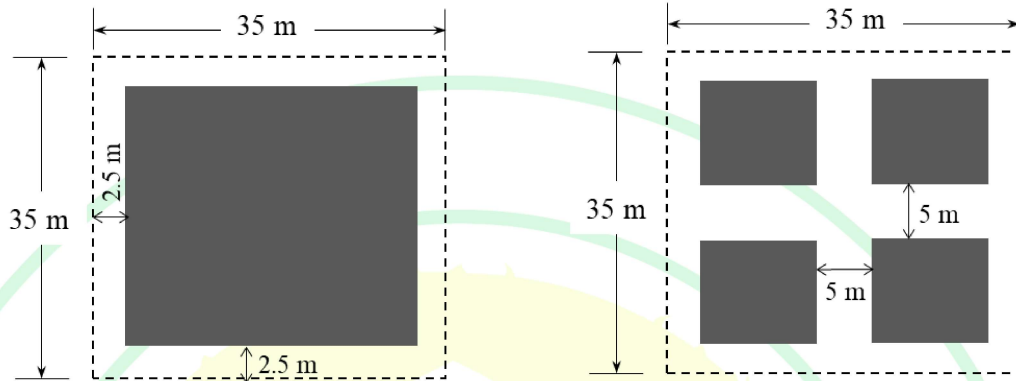
Q.46	<p>In a surface mine, blasting is carried out using electronic detonator and cartridge emulsion explosive with following details:</p> <p>Burden = 3.5 m</p> <p>Spacing = 4.5 m</p> <p>Bench height = 10.0 m</p> <p>Subgrade drilling = 1.0 m</p> <p>Stemming = 4.0 m</p> <p>Linear charge concentration = 16 kg/m</p> <p>Cost of one detonator = Rs. 800</p> <p>Cost of explosive = Rs. 30/kg</p> <p>The cost of blasting material per cubic meter of blasted rock, in Rs., is _____ (rounded off to 2 decimal places)</p>
Q.47	<p>A pit slope has the following information:</p> <p>Number of benches = 5</p> <p>Height of each bench = 8 m</p> <p>Bench slope angle = 70 degree</p> <p>If width of one bench is 24 m and that of other four benches is 10 m each, the overall pit slope angle, in degree, is _____ (rounded off to 2 decimal places)</p>

Q.48	<p>A direct rope haulage has the following details</p> <p>Output = 24 tonne/hour</p> <p>Length of trip = 610 m</p> <p>Gradient = 1 in 12</p> <p>Capacity of mine car = 1.0 tonne</p> <p>Tare weight of mine car = 0.5 tonne</p> <p>Average rope speed = 1.694 m/s</p> <p>Change over time of cars = 3 minute</p> <p>Acceleration due to gravity = 10.0 m/s^2</p> <p>Neglecting all frictional resistance and mass of the rope, the minimum power required, in kW, to raise the loaded mine cars is _____ (rounded off to 3 decimal places)</p>
Q.49	<p>A mine void of dimension $100.0 \text{ m} \times 2.0 \text{ m} \times 1.2 \text{ m}$ is to be filled in 3 hours by hydraulic stowing. The sand to slurry ratio is 0.4. If the hydraulic fill factor is 0.9, the hourly consumption of water for the operation, in m^3, is _____ (rounded off to 2 decimal places)</p>
Q.50	<p>A 2.5 tonne diesel locomotive hauls 5 mine cars upslope having a gradient of 1 in 20. The constant tractive force of the locomotive is 1800 kN. The gross weight of a car is 3 tonne. Acceleration due to gravity is 10.0 m/s^2. If the acceleration of the system is 0.5 m/s^2, the rolling resistance in kN/tonne is _____ (rounded off to 3 decimal places)</p>

Q.51	<p>A longwall panel is to be developed in a flat seam at a depth of H m. The surface subsidence profile (s) of the area with the horizontal distance x is estimated as</p> $s = \frac{S_{max}}{2} \left[1.002 - \tanh \left(\frac{4.8x}{H} \right) \right]$ <p>where, S_{max} is the maximum subsidence at the centre of the panel, x is measured from the inflection point. The value of x is negative towards the panel centre and positive towards the panel boundary.</p> <p>The ratio between the critical width of the panel and the depth is _____ (rounded off to 2 decimal places)</p>					
Q.52	<p>The percent Fe content of a random sample consisting of five observations is shown.</p> <table><tr><td>62</td><td>64</td><td>63</td><td>60</td><td>61</td></tr></table> <p>If mean grade of the stockpile is estimated using the above data, the standard error of mean grade, in %, is _____ (rounded off to 3 decimal places)</p>	62	64	63	60	61
62	64	63	60	61		

Q.53

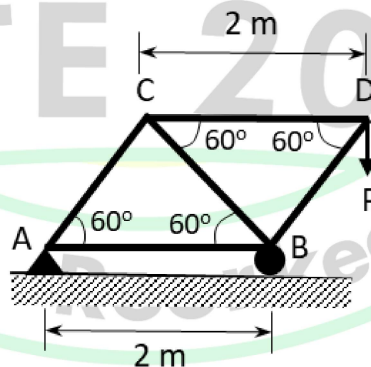
In a bord and pillar panel, a square pillar of size 35 m × 35 m (centre to centre) is extracted to form four equal square-shaped stooks as shown. The width of each gallery and crosscut is 5 m. The height of the working seam is 3 m. The reduction in safety factor after pillar splitting by using Bieniawski's pillar strength formula, in %, is _____ (rounded off to 2 decimal places)



Bieniawski's pillar strength formula, $S_p = S_1 \left(0.64 + 0.36 \frac{w}{h} \right)$; where, S_1 = strength of 0.9 m^3 of coal block, w = pillar width and h = mining height

Q.54

A five-member truss system is shown in the figure. The maximum vertical force P in kN that can be applied so that loads on the member CD and BC do **NOT** exceed 50 kN and 30 kN, respectively is _____ (rounded off to 2 decimal places)



Q.55	<p>The characteristic polynomial of a third order matrix, \mathbf{A}, is given by</p> $f(x) = x^3 - 6x^2 + 11x - 6$ <p>If one of the eigen values of \mathbf{A} is 1, then sum of the other two eigen values is _____ (in integer)</p>
Q.56	<p>The directional derivative of a function $f(x, y, z) = 4x^2 + 8y^2 + 9z^2$ at the point P (3, 4, 5) in the direction vector $\vec{b} = 2\hat{i} - 3\hat{j} + 4\hat{k}$ is _____ (rounded off to 1 decimal place)</p>
Q.57	<p>Average noise level at a working place is 80 dB(A) for the first 10 minutes and 60 dB(A) for the next 30 minutes. The energy equivalent continuous noise level at the place for the entire period of 40 minutes, in dB(A), is _____ (rounded off to 2 decimal places)</p>
Q.58	<p>The area bounded by the curves, $y = \sqrt{x}$, and $y = 8x^2$ is _____ (rounded off to 3 decimal places)</p>

Q.59	<p>Data from a borehole log with collar elevation at 590 mRL are given below. Composite grade is calculated using cores of 5 m above and below the reference bench at 580 mRL. The composite grade, in %, is ____ (rounded off to 1 decimal place)</p> <table><tr><th>Sequence of cores (top to bottom)</th><th>Core length (m)</th><th>Grade (%)</th></tr><tr><td>1</td><td>3.0</td><td>40</td></tr><tr><td>2</td><td>3.0</td><td>42</td></tr><tr><td>3</td><td>2.0</td><td>41</td></tr><tr><td>4</td><td>3.0</td><td>43</td></tr><tr><td>5</td><td>2.0</td><td>42</td></tr><tr><td>6</td><td>3.0</td><td>41</td></tr><tr><td>7</td><td>3.0</td><td>44</td></tr></table>	Sequence of cores (top to bottom)	Core length (m)	Grade (%)	1	3.0	40	2	3.0	42	3	2.0	41	4	3.0	43	5	2.0	42	6	3.0	41	7	3.0	44
Sequence of cores (top to bottom)	Core length (m)	Grade (%)																							
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5	2.0	42																							
6	3.0	41																							
7	3.0	44																							
Q.60	<p>The information of a mining project for a life of three years is given below:</p> <table><tr><th>Year</th><th>0</th><th>1</th><th>2</th><th>3</th></tr><tr><td>Revenue (Crore Rupees)</td><td></td><td>200</td><td>300</td><td>400</td></tr><tr><td>Capital cost (Crore Rupees)</td><td>300</td><td></td><td></td><td></td></tr><tr><td>Operating cost (Crore Rupees)</td><td></td><td>30</td><td>40</td><td>35</td></tr></table> <p>Applicable tax rate = 30 % Discount rate = 10 %</p> <p>If straight line depreciation with zero salvage value is applicable, the NPV, in Crore Rupees, is ____ (rounded off to 2 decimal places)</p>	Year	0	1	2	3	Revenue (Crore Rupees)		200	300	400	Capital cost (Crore Rupees)	300				Operating cost (Crore Rupees)		30	40	35				
Year	0	1	2	3																					
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Q.61	In a longwall panel, air flows at a velocity of 1.2 m/s through a 900 m long gate road of 2.5 m height and 3 m width. The coefficient of friction is $0.022 \text{ N s}^2 \text{ m}^{-4}$. The frictional pressure drop, in Pa, between two ends of the gate road is _____ (rounded off to 3 decimal places)											
Q.62	SO_2 is emitted at a rate of 20 kg/s from a $10 \text{ km} \times 10 \text{ km}$ airshed in an industrial area. Wind blows at a speed of 4 m/s from one direction in that area. Radiation inversion restricts the mixing height to 1200 m. Neglect SO_2 concentration in the incoming air. Assuming emitted SO_2 to be conservative, the steady state SO_2 concentration in the airshed, in $\mu\text{g}/\text{m}^3$, is _____ (rounded off to 2 decimal places)											
Q.63	<p>Reciprocal levelling is performed for points P and Q by placing the same levelling instrument at A and B. The observations of staff readings are tabulated as below.</p> <table><tr><th rowspan="2">Instrument location</th><th colspan="2">Staff intercept readings (in m)</th></tr><tr><th>Station P</th><th>Station Q</th></tr><tr><td>A (near P)</td><td>1.512</td><td>2.100</td></tr><tr><td>B (near Q)</td><td>0.680</td><td>1.302</td></tr></table> <p>If the Reduced Level (RL) of P is 115.246 m, then the true RL of Q, in m, is _____ (rounded off to 3 decimal places)</p>	Instrument location	Staff intercept readings (in m)		Station P	Station Q	A (near P)	1.512	2.100	B (near Q)	0.680	1.302
Instrument location	Staff intercept readings (in m)											
	Station P	Station Q										
A (near P)	1.512	2.100										
B (near Q)	0.680	1.302										
Q.64	A wastewater sample has an ultimate BOD of 300 mg/L. BOD reaction rate constant is 0.22 per day at 20°C . If the temperature coefficient is 1.05, the 5-day BOD at 25°C , in mg/L, is _____ (rounded off to 2 decimal places)											

Q.65	<p>A double ended ranging drum (DERD) shearer uni-directionally cuts coal in a longwall panel having the following details</p> <p>Shearer drum diameter = 1.4 m</p> <p>Panel dimension = 1200 m \times 200 m \times 2.4 m</p> <p>Web depth = 0.6 m</p> <p>Average cutting speed = 5 m/minute</p> <p>Average retreating speed = 10 m/minute</p> <p>Average operational delay between cuts is 2 hour. There are two production shifts, each of 8 hour duration. The number of days required for complete extraction of the panel is _____ (in integer)</p>
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