GATE 2012 Online Examination
MN : MINING ENGINEERING

Duration: Three Hours | Maximum Marks: 100

Read the following instructions carefully.

1. The computer allotted to you at the examination center runs a specialized software that permits only one answer to be selected for multiple choice questions using a mouse. Your answers shall be updated and saved on a server periodically and at the end of the examination.
2. To login, enter your Registration Number and password provided in the envelope. Go through the symbols used in the test and understand the meaning before you start the examination. You can view all questions by clicking on the View All Questions button in the screen after the start of the examination.
3. To answer a question, select the question using the selection panel on the screen and choose the correct answer by clicking on the radio button next to the answer. To change the answer, just click on another option. If you wish to leave a previously answered question unanswered, click on the button next to the selected option.
4. The examination will automatically stop at the end of 3 hours.
5. There are a total of 65 questions carrying 100 marks. Except questions Q.26 – Q.30, all the other questions are of multiple choice type with only **one** correct answer. Questions Q.26 - Q.30 require a numerical answer, and a number should be entered using the virtual keyboard on the monitor.
6. Questions Q.1 – Q.25 carry 1 mark each. Questions Q.26 – Q.55 carry 2 marks each. The 2 marks questions include two pairs of common data questions and two pairs of 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 unattempted, then the answer to the second question in the pair will not be evaluated.
7. Questions Q.56 – Q.65 belong to General Aptitude (GA) section and carry a total of 15 marks. Questions Q.56 – Q.60 carry 1 mark each, and questions Q.61 – Q.65 carry 2 marks each.
8. Unattempted questions will result in zero mark and wrong answers will result in **NEGATIVE** marks. There is no negative marking for questions of numerical answer type, i.e., for Q.26 – Q.30. For all 1 mark questions, 1/3 mark will be deducted for each wrong answer. For all 2 marks questions, 2/3 mark will be deducted for each wrong answer. However, in the case of the linked answer question pair, there will be negative marks only for wrong answer to the first question and no negative marks for wrong answer to the second question.
9. Calculator is allowed. Charts, graph sheets or tables are **NOT** allowed in the examination hall. Do the rough work in the Scribble Pad provided.
10. You must sign this sheet and leave it with the invigilators at the end of the examination.

DECLARATION: I hereby declare that I have read and followed all the instructions given in this sheet.

Registration Number	**MN**								
Name									
Signature									

Verified that the above entries are correct. Invigilator's signature:	

Q. 1 – Q. 25 carry one mark each.

Q.1 A 30 m steel tape having an area of cross-section of 5 x 10^{-6} m^2 is standardized at 20^0C, supported under a tension of 5.45 N. It is used to measure a horizontal distance of 81.15 m under an applied tension of 9.09 N. The error, due to incorrect pulling arrangement in this observation, in m is (E_{steel} = 200 GPa)

(A) 0.148 (B) 0.295 (C) 1.820 (D) 3.640

Q.2 The coefficient of variation of a dataset is measured by

(A) $\frac{\text{mean}}{\text{standard deviation}}$ (B) $\frac{\text{mean}}{\text{variance}}$

(C) $\frac{\text{standard deviation}}{\text{mean}}$ (D) $\frac{\text{variance}}{\text{mean}}$

Q.3 The value of $\int_0^1 \sin^{-1}(\cos x)\,dx$ is

(A) $\frac{(\pi-1)}{2}$ (B) $\frac{(\pi+1)}{2}$ (C) $\frac{(2\pi+1)}{2}$ (D) $\frac{(2\pi-1)}{2}$

Q.4 Assuming $\sin(1) = 0.841$ and $\sin(3) = 0.141$, the Lagrangian linear interpolating polynomial, for the function $f(x) = \sin(x)$ defined on the interval [1, 3] and passing through the end points of the interval, is

(A) $-0.35x + 1.19$
(B) $-3.05x + 11.92$
(C) $-35.00x + 119.10$
(D) $-40.50x + 219.19$

Q.5 If Poisson's ratio of a rock sample is 0.25, then the relationship among the modulus of elasticity (E), modulus of rigidity (G) and bulk modulus (K) is

(A) E = K = G (B) E > G > K (C) E = G > K (D) E > K > G

Q.6 The 2nd order differential equation having a solution $y = (A/x) + B$, where A and B are constants, is

(A) $\frac{d^2y}{dydx} + \frac{2}{x}\frac{dy}{dx} = 0$

(B) $\frac{d^2y}{dx^2} + \frac{2}{x}\frac{dy}{dx} = 0$

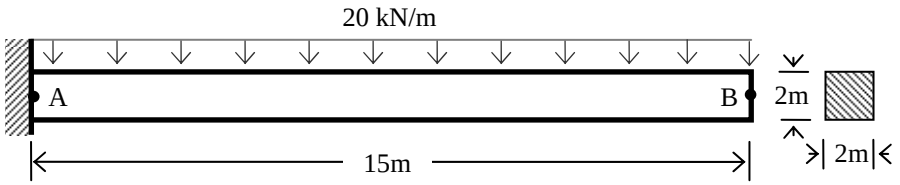
(C) $\left(\frac{d^2y}{dx^2}\right)^2 + \frac{2}{x}\frac{dy}{dx} = 0$

(D) $\frac{d^2y}{dydx} + \frac{d^2y}{dx^2} + \frac{dy}{dx} = 0$

Q.7 A cylindrical rock specimen is uniaxially loaded under compression and fails at 50 MPa. The fracture plane is inclined at an angle of 45^0 with the axial direction. The normal and shear stresses respectively on the failure plane in MPa are

(A) 50, 50 (B) 0, 50 (C) 50, 0 (D) 25, 25

Q.8 A uniformly distributed load of 20 kN/m is acting on a 15 m long cantilever beam AB of area of cross section 2 m x 2 m, as shown in the figure. The beam is fixed at point A. The modulus of elasticity of the material is 1.0 GPa.



The maximum vertical displacement of the beam in m is

(A) 0.004 (B) 0.020 (C) 0.071 (D) 0.190

Q.9 In a surface mine, sound pressure level at a location generated by operation of a dozer and a drill respectively are 80 dBA and 60 dBA, when operated independently. The sound pressure generated by the dozer compared to the drill is higher by a factor of

(A) 10 (B) 20 (C) 100 (D) 200

Q.10 As per the Indian Electricity Rules 1956, the maximum permissible length of a flexible cable used with an electric rope shovel in m is

(A) 100 (B) 200 (C) 300 (D) 500

Q.11 The equipment that is NOT used in hard rock metal mining drivage is

(A) road header (B) drill jumbo
(C) jack hammer (D) dint header

Q.12 The roof bolt that follows the principle of point anchorage is

(A) expansion shell bolt (B) full column grouted bolt
(C) split set bolt (D) swellex bolt

Q.13 Equipment used in mining of placer deposits is

(A) auger (B) wagon drill (C) rope saw (D) riffle box

Q.14 A dump truck powered by 350 kW engine is running at a speed of 35 km/h. Considering the transmission efficiency of the truck as 85%, the rim pull of the truck in kN is

(A) 21 (B) 31 (C) 41 (D) 51

Q.15 Nystagmus is a miner's disease associated with

(A) lever (B) lung (C) eye (D) stomach

Q.16 Apart from mining of coal, the longwall mining method has been practiced for mining the deposits of

(A) copper (B) lead and zinc (C) manganese (D) pyrite and phosphate

Q.17 The three segments, whose synchronous functioning is essential for GPS operations, are

(A) space, control and user (B) signal, control and user
(C) space, control and geo-registration (D) signal, control and geo-registration

Q.18 When a double ended ranging drum shearer cuts coal in a longwall face,

(A) both the drums rotate in the same direction keeping the front drum up and the rear drum down
(B) both the drums rotate in the opposite direction keeping the front drum up and the rear drum down
(C) both the drums rotate in the opposite direction keeping the front drum down and the rear drum up
(D) both the drums rotate in the same direction keeping the front drum down and the rear drum up

Q.19 The match the following

	Mine gas		**Principal constituent**
P	Stink damp	1	CO
Q	White damp	2	H_2S
R	Black damp	3	CH_4
S	Fire damp	4	CO_2

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

Q.20 Continuous miner and shuttle car combination is NOT applicable in mining with

(A) rib pillar extraction technique
(B) Wangawilli system
(C) room and pillar method
(D) longwall method

Q.21 Contours in a topographic map

(A) are not closed upon themselves although the earth is a continuous surface
(B) are not perpendicular to the direction of maximum slope
(C) provide an indication of presence of valley or ridge in the area
(D) are the lines joining the points of same declination at different elevations

Q.22 A Dragger Gas Mask DOES NOT filter

(A) water vapour
(B) nitrous fumes
(C) carbon monoxide
(D) carbon dioxide

Q.23 A system consists of four elements A, B, C and D which are connected functionally in a parallel configuration. The individual reliability of the elements is 0.80, 0.82, 0.85 and 0.90 respectively. The reliability of the system is

(A) 0.498 (B) 0.602 (C) 0.750 (D) 0.999

Q.24 The blasting technique used for controlled throw of overburden is known as

(A) cast blasting
(B) coyote blasting
(C) plaster shooting
(D) pop shooting

Q.25 The stoping method, where a large part of blasted ore is allowed to accumulate in the stope to serve the purpose of providing working platform for stoping as well as to support the wall-rock, is known as

(A) shrinkage stoping
(B) cut and fill stoping
(C) square-set stoping
(D) sublevel stoping

Q. 26 to Q. 55 carry two marks each.

Q.26 The injury rates of mine workers in an underground coal mine based on age group are given below:

Age group of mine workers	Age-specific injury rate (per 1000 persons)	Age-specific population in the mine
18 – 32	1.8	1000
33 – 46	2.5	500
47 – 60	4.5	300

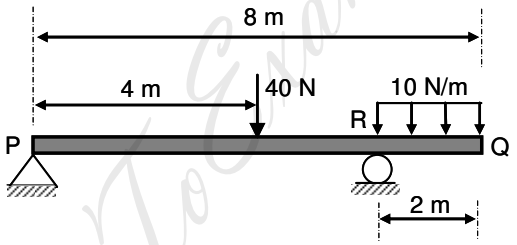
The injury rate per 1000 persons employed in the mine for the total population is

(A) 0.24 (B) 2.44 (C) 8.80 (D) 24.40

Q.27 A shearer is deployed in a mine where the specific energy consumption for cutting coal is 800 kJ/m^3. The specific gravity of coal is 1.2. If the machine produces 700 te/h, the electrical power consumption in kW of the shearer at 65% motor efficiency is

(A) 149.4 (B) 199.4 (C) 219.4 (D) 239.4

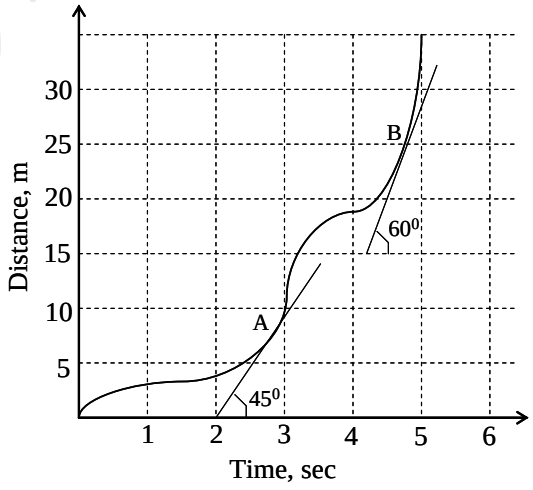
Q.28 The figure shows a weightless beam PQ of length 8 m resting on a hinge support at P and on a roller support at R. A vertical force of 40 N is acting at a distance of 4 m from P. A uniformly distributed load of 10 N/m is acting on a length of 2 m of the beam from Q.



The magnitude of reaction force at R in N is

(A) 20 (B) 30 (C) 40 (D) 50

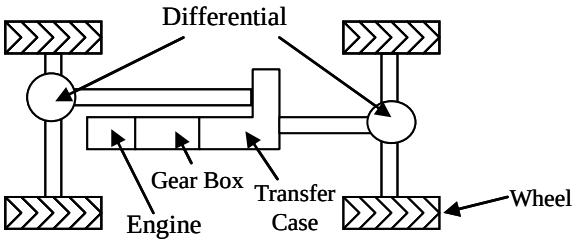
Q.29 The figure shows the distance vs time graph of a moving particle. The tangents to the curve at A and B make angles of 45^0 and 60^0 respectively with the time axis.



The ratio of the speeds of the particle at B and at A is

(A) 0.72 (B) 1.38 (C) 1.58 (D) 1.75

Q.30 The gear ratios of the first gear, transfer case and differential of a four wheel drive vehicle are 3.81:1, 2.72:1 and 4.11:1 respectively. If the engine is rotating at 1000 rpm and the wheel diameter is 1.2 m, the speed of the vehicle in first gear in km/h is



(A) 5.31 (B) 3.68 (C) 2.42 (D) 1.68

Q.31 An iron ore mine recorded an average of 3 accidents per month. The number of accidents is distributed according to Poisson distribution. The probability that there will be exactly 2 accidents per month is

(A) 0.22 (B) 0.30 (C) 0.43 (D) 0.67

Q.32 Match the following:

	Equipment		**Component**
P	Scraper	1	Dribble belt
Q	Dragline	2	Dipper stick
R	Bucket wheel excavator	3	Fair lead
S	Rope shovel	4	Bowl

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

Q.33 The torque in N-m of a winder motor is described by the relationship $T = 1450 - 3.2\omega$, where, ω is the angular speed of the motor in rad/s. If the shaft is rotating at a speed of 1450 rpm, the power of the motor in kW is

(A) 112.4 (B) 146.4 (C) 184.4 (D) 212.4

Q.34 An investment of Rs. 10,000, compounded annually, is estimated to return Rs. 20,000 after 6 years from the date of investment. The expected rate of return on this investment in percentage is

(A) 8.75 (B) 10.50 (C) 12.25 (D) 16.6

Q.35 A spherical droplet of water, with density 1000 kg/m^3 and diameter of 1 µm, is falling in air. The viscosity of air is 1.85 x 10 $^{-5}$ kg/m·s. Neglecting air density and assuming that the settling of droplet in air follows Stokes' Law, the settling velocity in m/s is

(A) 0.98 x 10 $^{-5}$ (B) 2.95 x 10 $^{-5}$ (C) 8.04 x 10 $^{-5}$ (D) 53.03 x 10 $^{-5}$

Q.36 A mining company has three mines (M1, M2 and M3) that supply coal to three power plants (P1, P2 and P3). The three mines produce 900, 1000 and 1200 te of coal per day respectively. The power plant requirements from these three mines are 1200, 1000 and 900 te per day respectively. The unit cost of transporting coal from the three mines to the three power plants in Rs. is given below

		Power plants		
		P1	P2	P3
Mines	M1	8	10	12
	M2	12	13	12
	M3	14	10	11

Based on the initial basic feasible solution, using Vogel's approximation method, the total transportation cost in Rs. is

(A) 31200 (B) 31400 (C) 32800 (D) 40000

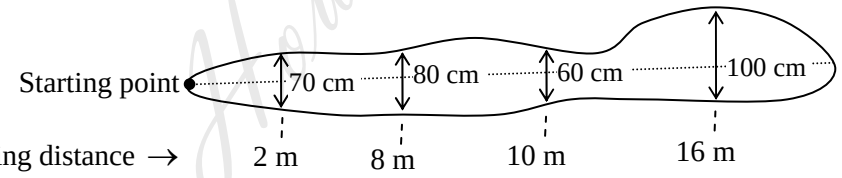
Q.37 The angle between the tangents to the curve $\vec{R} = t^2\hat{i} + 2t\hat{j}$ at the point $t = \pm 1$ is

(A) $\frac{\pi}{2}$ (B) $\frac{\pi}{3}$

(C) $\frac{\pi}{4}$ (D) $\frac{\pi}{6}$

Q.38 The chip sampling data, spaced irregularly for a gold vein deposit, are shown in figure. The sample points have equal influence on both the sides.

Distance of sample from starting point (m)	2	8	10	16
Width (cm)	70	80	60	100
Assay (g/te)	5	7	6	4



The mean assay value in g/te is

(A) 6.52 (B) 5.50 (C) 5.19 (D) 4.50

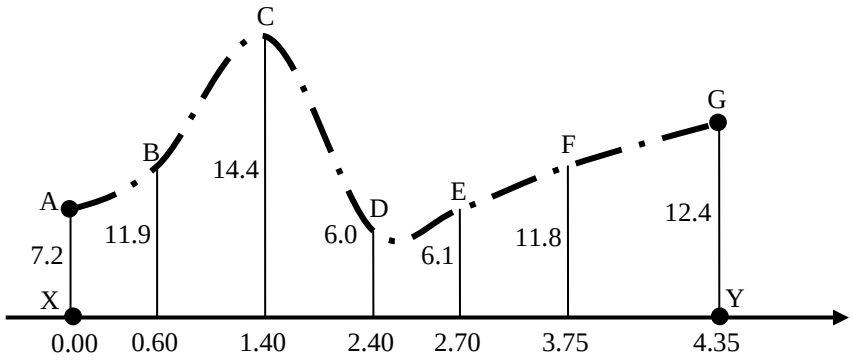
Q.39 A series of triaxial tests of sandstone samples reveal the cohesion and the angle of internal friction as 21.65 MPa and 30° respectively. Based on the assumption that the sandstone samples follow the Mohr-Coulomb's failure criteria, the tensile strength in MPa is

(A) 12.50 (B) 18.75 (C) 21.65 (D) 25.00

Q.40 The adjusted values of departure and latitude for a traverse line AB obtained in a field survey of a mine are 225.520 m and 388.835 m respectively. The length in m and azimuth of line AB are

(A) 449.50, 30.11° (B) 614.36, 30.11°
(C) 614.36, 45.11° (D) 449.50, 45.11°

Q.41 The figure shows the values of seven perpendicular offsets and the respective locations along the line XY as observed while carrying out a traverse survey. The area of the plot XABCDEFGY in m^2 is



(All measurements are in meters)

(A) 26.10 (B) 43.38 (C) 44.92 (D) 62.50

Q.42 In a longwall panel, the main gate road is 1000 m long, 4.5 m wide and 2 m high. The gate road is to be used for airflow at the rate of 17 m^3/s. Considering a coefficient of resistance of airways of 0.01, the pressure in Pa required to maintain the airflow in the gate road is

(A) 51.83 (B) 463.84 (C) 875.98 (D) 7885.32

Q.43 The cofactor matrix of $P = \begin{bmatrix} 3 & 1 & 2 \\ 2 & 3 & 1 \\ 1 & 2 & 3 \end{bmatrix}$ is

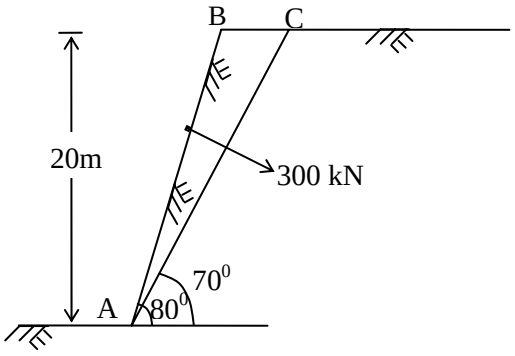
(A) $\begin{bmatrix} 21 & -5 & 2 \\ 2 & 21 & -5 \\ -5 & 2 & 21 \end{bmatrix}$ (B) $\begin{bmatrix} 21 & 2 & -5 \\ 2 & 7 & 15 \\ -5 & 21 & 2 \end{bmatrix}$ (C) $\begin{bmatrix} -5 & 2 & 21 \\ 15 & 7 & 2 \\ -2 & 21 & -5 \end{bmatrix}$ (D) $\begin{bmatrix} 15 & 7 & 2 \\ -5 & 2 & 21 \\ -2 & 21 & -5 \end{bmatrix}$

Q.44 Match the following:

	Mining system		**Face supports**
P	Mechanized longwall in flat seam	1	Cable bolting
Q	Blasting gallery method	2	Shield support
R	Mechanized longwall in steep seam	3	Alpine breaker line support
S	Wangawilli method for 3 m thick coal seam	4	Troika shield support

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

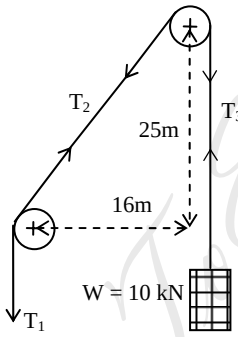
Q.45 An opencast mine bench has a potential failure plane AC as indicated in figure. Bolts are installed to stabilize the failure plane providing a resultant bolting force of 300 kN. The area of sliding block ABC is 37.45 m^2. The unit weight, cohesion and angle of internal friction of rock are 25 kN/m^3, 20 kPa and 40^0 respectively.



The factor of safety of slope when bolts are installed perpendicular to the failure plane is

(A) 0.79 (B) 1.08 (C) 1.78 (D) 3.46

Q.46 Figure shows a two pulley system for hoisting a load of 10 kN. The coefficient of friction between each pulley and the rope is 0.2. The vertical and horizontal distances between the centers of the pulleys are 25 m and 16 m respectively.



The tensions T_1 and T_2 respectively in kN are

(A) 6.00, 5.38 (B) 12.37, 11.06 (C) 18.74, 16.73 (D) 25.11, 22.41

Q.47 A circular tunnel of 1.85 m radius is driven in rock in a hydrostatic stress field of 20 MPa. The tunnel lining is provided before occurrence of any rock deformation. The shear modulus of rock is 2 GPa and the modulus of elasticity of lining material is 3 GPa. Assuming both rock and lining behave elastically, the radial pressure on the rock and lining interface in MPa is

(A) 8.19 (B) 9.91 (C) 11.62 (D) 13.33

Common Data Questions

Common Data for Questions 48 and 49:
A 2.5 m thick coal seam lying at an average depth of 100 m has been developed by bord and pillar method. The width of the square pillars is 30 m (centre to centre) and the gallery width is 4 m. The average density of the overlying strata is 26 kN/m^3 and the pillar strength is 4500 kN/m^2.

Q.48 Extraction ratio during the development of the pillar is

(A) 0.129 (B) 0.148 (C) 0.218 (D) 0.249

Q.49 The safety factor of the pillar is

(A) 1.1 (B) 1.3 (C) 1.5 (D) 1.7

Common Data for Questions 50 and 51:
The following data are provided for a surface mine to be excavated by a shovel:

Production target	: 10000 te/shift
Available hours per shift	: 6 hrs
Shovel loading cycles per hour	: 106
Bank density of the material mined	: 2400 kg/m^3
Swing factor at 120^0 swing	: 0.91
Bucket fill factor	: 0.64
Utilization of available time	: 83%
No of working days in a year	: 300
No of shifts per day	: 3

Q.50 The annual production target in Mte is
(A) 5.76 (B) 7.00 (C) 8.19 (D) 9.00

Q.51 The size of bucket of the shovel in m^3 is
(A) 5.55 (B) 9.33 (C) 11.22 (D) 13.55

Linked Answer Questions

Statement for Linked Answer Questions 52 and 53:
A mining project is composed of five activities whose three time estimates in months are given below:

Activity	Estimated duration (months)		
	Optimistic time	Most likely time	Permissible time
1-2	1	1	7
1-3	2	5	8
2-4	1	1	7
3-4	2	5	14
4-5	3	6	15

Q.52 The expected duration of the mining project in months is
(A) 5 (B) 16 (C) 18 (D) 29

Q.53 The standard deviation of the project length in months is
(A) 2 (B) 3 (C) 6 (D) 9

Statement for Linked Answer Questions 54 and 55:
In a mine between upcast shaft and downcast shaft, two airways are connected in parallel and their resistances are 100 and 120 N s^{-2} m^{-8} respectively. The resistance of upcast shaft, downcast shaft and the fan drifts are 10, 20 and 5 N s^{-2} m^{-8} respectively. The fan drift air pressure is 15 MN/m^2.

Q.54 The rate of airflow through the mine in m^3/s is
(A) 4.16 (B) 18.26 (C) 240.35 (D) 333.33

Q.55 The rate of airflow through the split airway having resistance of 100 N s^{-2} m^{-8} in m^3/s is
(A) 0.42 (B) 0.79 (C) 2.19 (D) 7.90

General Aptitude (GA) Questions

Q. 56 – Q. 60 carry one mark each.

Q.56 Choose the most appropriate alternative from the options given below to complete the following sentence:

I ___ to have bought a diamond ring.

(A) have a liking
(B) should have liked
(C) would like
(D) may like

Q.57 Choose the most appropriate alternative from the options given below to complete the following sentence:

Food prices ___ again this month.

(A) have raised
(B) have been raising
(C) have been rising
(D) have arose

Q.58 Choose the most appropriate alternative from the options given below to complete the following sentence:

The administrators went on to implement yet another unreasonable measure, arguing that the measures were already ___ and one more would hardly make a difference.

(A) reflective (B) utopian (C) luxuriant (D) unpopular

Q.59 Choose the most appropriate alternative from the options given below to complete the following sentence:

To those of us who had always thought him timid, his ___ came as a surprise.

(A) intrepidity (B) inevitability (C) inability (D) inertness

Q.60 The arithmetic mean of five different natural numbers is 12. The largest possible value among the numbers is

(A) 12 (B) 40 (C) 50 (D) 60

Q. 61 - Q. 65 carry two marks each.

Q.61 Two policemen, A and B, fire once each at the same time at an escaping convict. The probability that A hits the convict is three times the probability that B hits the convict. If the probability of the convict not getting injured is 0.5, the probability that B hits the convict is

(A) 0.14 (B) 0.22 (C) 0.33 (D) 0.40

Q.62 The total runs scored by four cricketers P, Q, R, and S in years 2009 and 2010 are given in the following table:

Player	**2009**	**2010**
P	802	1008
Q	765	912
R	429	619
S	501	701

The player with the lowest percentage increase in total runs is

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

Q.63 If a prime number on division by 4 gives a remainder of 1, then that number can be expressed as

(A) sum of squares of two natural numbers
(B) sum of cubes of two natural numbers
(C) sum of square roots of two natural numbers
(D) sum of cube roots of two natural numbers

Q.64 Two points (4, p) and (0, q) lie on a straight line having a slope of 3/4. The value of ($p - q$) is

(A) -3 (B) 0 (C) 3 (D) 4

Q.65 **In the early nineteenth century, theories of social evolution were inspired less by Biology than by the conviction of social scientists that there was a growing improvement in social institutions. Progress was taken for granted and social scientists attempted to discover its laws and phases.**

Which one of the following inferences may be drawn with the greatest accuracy from the above passage?

Social scientists

(A) did not question that progress was a fact.
(B) did not approve of Biology.
(C) framed the laws of progress.
(D) emphasized Biology over Social Sciences.

END OF THE QUESTION PAPER