

MN:MINING ENGINEERING

Duration: Three Hours

Maximum Marks:100

Please read the following instructions carefully:

General Instructions:

1. Total duration of examination is 180 minutes (3 hours).
2. The clock will be set at the server. The countdown timer in the top right corner of screen will display the remaining time available for you to complete the examination. When the timer reaches zero, the examination will end by itself. You will not be required to end or submit your examination.
3. The Question Palette displayed on the right side of screen will show the status of each question using one of the following symbols:



You have not visited the question yet.



You have not answered the question.



You have answered the question.



You have NOT answered the question, but have marked the question for review.



You have answered the question, but marked it for review.

The Marked for Review status for a question simply indicates that you would like to look at that question again. ***If a question is answered and Marked for Review, your answer for that question will be considered in the evaluation.***

Navigating to a Question

4. To answer a question, do the following:
 - a. Click on the question number in the Question Palette to go to that question directly.
 - b. Select an answer for a multiple choice type question. Use the virtual numeric keypad to enter a number as answer for a numerical type question.
 - c. Click on **Save and Next** to save your answer for the current question and then go to the next question.
 - d. Click on **Mark for Review and Next** to save your answer for the current question, mark it for review, and then go to the next question.
 - e. **Caution: Note that your answer for the current question will not be saved, if you navigate to another question directly by clicking on its question number.**
5. You can view all the questions by clicking on the **Question Paper** button. Note that the options for multiple choice type questions will not be shown.

Answering a Question

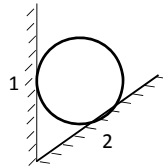
6. Procedure for answering a multiple choice type question:
 - a. To select your answer, click on the button of one of the options
 - b. To deselect your chosen answer, click on the button of the chosen option again or click on the **Clear Response** button
 - c. To change your chosen answer, click on the button of another option
 - d. To save your answer, you MUST click on the **Save and Next** button
 - e. To mark the question for review, click on the **Mark for Review and Next** button. *If an answer is selected for a question that is Marked for Review, that answer will be considered in the evaluation.*
7. Procedure for answering a numerical answer type question:
 - a. To enter a number as your answer, use the virtual numerical keypad
 - b. A fraction (eg., -0.3 or -.3) can be entered as an answer with or without '0' before the decimal point
 - c. To clear your answer, click on the **Clear Response** button
 - d. To save your answer, you MUST click on the **Save and Next** button
 - e. To mark the question for review, click on the **Mark for Review and Next** button. *If an answer is entered for a question that is Marked for Review, that answer will be considered in the evaluation.*
8. To change your answer to a question that has already been answered, first select that question for answering and then follow the procedure for answering that type of question.
9. Note that ONLY Questions for which answers are saved or marked for review after answering will be considered for evaluation.

Paper specific instructions:

1. There are a total of 65 questions carrying 100 marks. Questions are of multiple choice type or numerical answer type. A multiple choice type question will have four choices for the answer with only **one** correct choice. For numerical answer type questions, the answer is a number and no choices will be given. **A number as the answer should be entered** using the virtual keyboard on the monitor.
2. Questions Q.1 – Q.25 carry 1mark each. Questions Q.26 – Q.55 carry 2marks each. The 2marks 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 not attempted, then the answer to the second question in the pair will not be evaluated.
3. Questions Q.56 – Q.65 belong to General Aptitude (GA) section and carry a total of 15 marks. Questions Q.56 – Q.60 carry 1mark each, and questions Q.61 – Q.65 carry 2marks each.
4. Questions not attempted will result in zero mark. Wrong answers for multiple choice type questions will result in **NEGATIVE** marks. For all 1 mark questions, $\frac{1}{3}$ mark will be deducted for each wrong answer. For all 2 marks questions, $\frac{2}{3}$ 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. There is no negative marking for questions of numerical answer type.
5. Calculator is allowed. Charts, graph sheets or tables are **NOT** allowed in the examination hall.
6. Do the rough work in the Scribble Pad provided.

Q. 1 – Q. 25 carry one mark each.

- Q.1 In the Coward flammability diagram, the respective percentages of methane and oxygen at the nose limit are
 (A) 14.2, 0.0 (B) 14.1, 18.2 (C) 5.8, 12.1 (D) 5.0, 19.2
- Q.2 If the transpose of a matrix is equal to its inverse, then the matrix is
 (A) symmetric (B) orthogonal (C) skew symmetric (D) singular
- Q.3 In the Moh's scale of hardness, the minerals in increasing sequence of hardness are
 (A) calcite, gypsum, topaz, diamond
 (B) topaz, gypsum, calcite, diamond
 (C) calcite, gypsum, diamond, topaz
 (D) gypsum, calcite, topaz, diamond
- Q.4 A ball of weight W is supported on smooth walls as shown in the following figure. R_1 and R_2 are reactions from the walls 1 and 2. The free body diagram of the ball is represented by

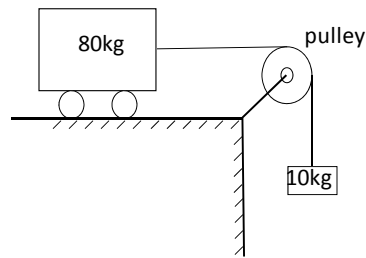


- (A)
- (B)
- (C)
- (D)

- Q.5 For a 25 mm diameter spherical charge, the maximum allowable charge length in cm is
 (A) 15.0 (B) 25.0 (C) 30.0 (D) 150.0
- Q.6 Long-hole drilling with crater blasting is used for the construction of
 (A) winze (B) shaft (C) raise (D) decline
- Q.7 Rill stoping method is a form of
 (A) block caving
 (B) artificially supported stoping
 (C) underhand stoping
 (D) overhand stoping
- Q.8 Transit theodolite is a
 (A) micro-optic theodolite
 (B) theodolite with face left and face right reading facilities
 (C) theodolite with stadia hairs
 (D) theodolite with two vertical circles

- Q.9 Incubation period is NOT related to
(A) crossing point temperature of coal
(B) panel size
(C) seam thickness
(D) explosibility of coal dust
- Q.10 The rotational speed and cutting velocity of a drill are 350 rpm and 71.50 m/min respectively. The diameter of the rotary drill bit in mm is
(A) 65 (B) 67 (C) 68 (D) 70
- Q.11 The pressure on a phreatic surface is
(A) less than atmospheric pressure
(B) greater than atmospheric pressure
(C) equal to atmospheric pressure
(D) independent of atmospheric pressure
- Q.12 Events A and B are independent but NOT mutually exclusive. If the probabilities $P(A)$ and $P(B)$ are 0.5 and 0.4 respectively, then $P(A \cup B)$ is
(A) 0.6 (B) 0.7 (C) 0.8 (D) 0.9
- Q.13 Among the following options, the specific energy for rock-drilling is lowest in
(A) rotary diamond drilling
(B) rotary roller drilling
(C) percussive drilling
(D) jet piercing
- Q.14 Identify the correct statement for a 'normal distribution'.
(A) Mean is greater than mode but less than median
(B) Mean is less than mode but greater than median
(C) Mean is greater than mode and median
(D) Mean, median and mode are equal
- Q.15 An emulsion explosive of specific gravity 1.25 is used for blasting in an iron ore formation having P-wave velocity of 3000 m/s and specific gravity of 3.20. For an explosive impedance to rock impedance ratio of 0.5, the desired velocity of detonation of the explosive in m/s is
(A) 3840 (B) 4000 (C) 4200 (D) 7680
- Q.16 The number of ways in which the letters in the word MINING can be arranged is
(A) 90 (B) 180 (C) 360 (D) 720
- Q.17 Under standard temperature and pressure conditions the theoretical maximum height in m to which water can be lifted using an air-lift pump is
(A) 10.33 (B) 9.61 (C) 7.45 (D) 6.05
- Q.18 In a belt conveyor system, function of the snub pulley is to
(A) clean the inner surface of the belt
(B) clean the outer surface of the belt
(C) increase the angle of contact of belt with drive drum
(D) decrease the belt tension

- Q.19 In the following figure, the coefficient of kinetic friction between the trolley and the surface is 0.04. When the block is released from rest, the acceleration of the trolley in m/s^2 becomes



- (A) 9.65 (B) 1.23 (C) 1.09 (D) 0.74
- Q.20 Two meshing spur gear wheels of Module 6 have 24 and 42 teeth. The distance in mm between the centres of the gear wheels is
- (A) 1000 (B) 198 (C) 126 (D) 72
- Q.21 In an experiment to study coal dust explosibility, it is found that at least 3.0 g of limestone dust should be added to a sample of 2.0 g of coal dust to ensure that propagation of flame does not take place. The explosibility factor of coal dust is
- (A) 60.00 (B) 20.00 (C) 6.70 (D) 1.50
- Q.22 A 20 m steel tape used in a mine survey is found to be 20 cm short when compared with a standard tape. If the measured volume of a dump using the tape is 4000 m^3 , its actual volume in m^3 is
- (A) 3881 (B) 3902 (C) 3920 (D) 4121
- Q.23 A mine worker inhales normal air; whereas, the exhaled air contains 16.65% O_2 and 3.83% CO_2 . The respiratory quotient of breathing for the worker is
- (A) 0.23 (B) 0.89 (C) 0.99 (D) 1.13
- Q.24 Block economic values in Lakhs of Rupees for a section of a block economic model are shown below.

-1	-1	1	-1	0	-1
-1	0	0	0	-1	-2
-5	-3	-2	5	-2	-3

At a permissible slope angle of 1:1, the optimum pit value of the section in Lakhs of Rupees is

- (A) 0 (B) 1 (C) 2 (D) 3
- Q.25 The boundary of a mine is plotted on a scale of 1:2000. If a planimeter measures the plotted area as 58 cm^2 , the actual mine area in m^2 is
- (A) 5800 (B) 11600 (C) 23200 (D) 29000

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

- Q.26 For a shrinkage stope the following data values are given
- | | |
|--------------------------|-------------|
| Insitu tonnage | 9000 tonne |
| Insitu grade | 5.2 g/tonne |
| Average grade of waste | 1.4 g/tonne |
| Loss of ore in the stope | 10% |
| Dilution | 20% |

The grade at the mill-head in g/tonne is _____

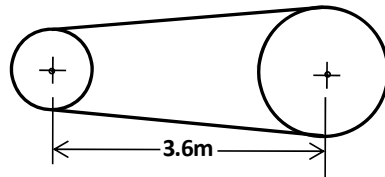
- Q.27 In an experiment to determine specific gravity of a soil sample, the following data is obtained:

Mass of empty pycnometer	20.4 g
Mass of pycnometer with soil sample	51.6 g
Mass of pycnometer with soil sample filled with water	88.6 g
Mass of pycnometer filled with water	70.4 g

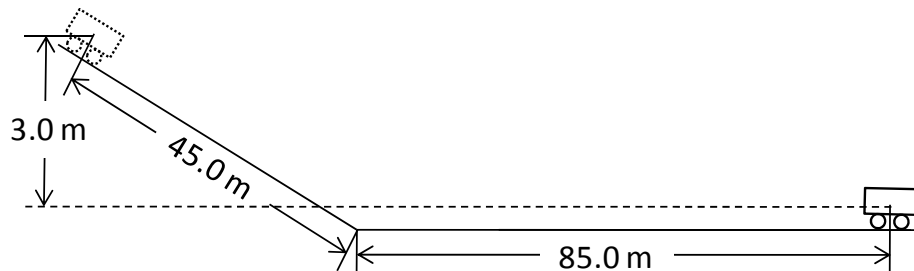
The specific gravity of the sample is _____

- Q.28 A cylindrical rock specimen of diameter 54 mm has Young's modulus of 68.97 GPa and Poisson's ratio of 0.35. The rock specimen fails in uniaxial compression at a lateral strain of 0.01%. The axial load at failure in kN is _____

- Q.29 An open belt drive connects two pulleys on parallel shafts that are 3.6 m apart as shown in the figure. The diameters of the pulleys are 2.4 m and 1.6 m. The angle of contact on the smaller pulley in degrees is _____



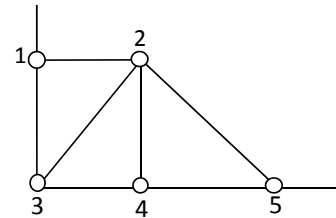
- Q.30 A two tonne mine car is released from the top of an incline at a height of 3 m as shown in the figure. The mine car travels 45 m along the inclined track and another 85 m along the horizontal track before coming to rest.



The specific rolling resistance of the car in N/tonne is _____

- Q.31 A surface miner with 2.0 m cutting drum width excavates coal in windrowing mode from a bench with effective face length 200 m. The cutting speed of the surface miner is 10 m/min and the cutting depth 25 cm. The density of coal is 1.4 tonne/m^3 . If the average turning time of the machine at the face end is 5 min, the rate of production in tonne/hour becomes _____
- Q.32 A core sample of a rock, having diameter 54 mm and length 108 mm, is subjected to axial loading. If the axial strain and Poisson's ratio are 2000×10^{-6} and 0.28 respectively, the value of volumetric strain, represented in micro-strain is _____
- Q.33 A flat bauxite deposit has thickness of 10 m with an average density of 2200 kg/m^3 . The grade values and the sample coordinates are as shown in the table. To carry out reserve estimation using triangular method, the triangles are constructed as shown in the figure.

Sample No	1	2	3	4	5
Alumina %	35	40	39	47	42
x coordinate, m	0	200	0	200	500
y coordinate, m	300	300	0	0	0



The alumina content in million tonnes, in the region comprising the three triangles is _____

- Q.34 If the following linear system of equations has non-trivial solutions

$$\begin{aligned} px + y + z &= 0 \\ 2x + y - 2z &= 0 \\ x + 2y - 3z &= 0 \end{aligned}$$

the value of p is

- (A) 1 (B) 0 (C) -1 (D) -7
- Q.35 A bucket wheel excavator with 20 buckets of capacity 0.5 m^3 each, rotates at 5 rev/min. The bucket fill factor is 80%. The excavator loads on to 1200 mm wide belt conveyor. The cross-section area (m^2) of the material on the belt is $0.1B^2$, where B is the belt width in m. The minimum speed of the belt in m/s to avoid spillage of material is
- (A) 7.23 (B) 5.79 (C) 4.63 (D) 3.70
- Q.36 A simplex tableau shown below is generated during the maximization of a linear programming problem using simplex method

Variable	Z	X_1	X_2	X_3	X_4	RHS
Z	1	-1	0	1	0	6
X_2	0	$1/3$	1	$1/3$	0	2
X_4	0	$7/3$	0	$-2/3$	1	2

After one iteration, the value of the objective function becomes

- (A) $\frac{48}{7}$ (B) $\frac{11}{3}$ (C) $\frac{22}{7}$ (D) $\frac{2}{3}$

Q.37 The value of $\int_0^{\pi/2} \log(\cos x) dx$ is

- (A) $-\frac{\pi}{2} \log 2$ (B) $-\frac{\pi}{4} \log 2$ (C) $\frac{\pi}{2} \log 2$ (D) $\frac{\pi}{4} \log 2$

Q.38 Given the following,

Machine

- P. Dint header
Q. Coal plough
R. Road header
S. Shearer

Component

1. Cowl
2. Cutting chain
3. Loading apron
4. Static set of bits

the correct match is

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

Q.39 Given the following,

Rescue apparatus

- P. Draeger BG-4
Q. MSA IW-65
R. Draeger Pulmotor
S. Oxyboks

Characteristic

1. Open circuit chemical oxygen self-rescuer
2. Filter type self-rescuer
3. Self-contained breathing apparatus
4. Resuscitation apparatus

the correct match is

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

Q.40 Given the following,

Equation/formula/law

- P. Bernoulli equation
Q. Poiseuille equation
R. Bromilow's formula
S. Stokes law

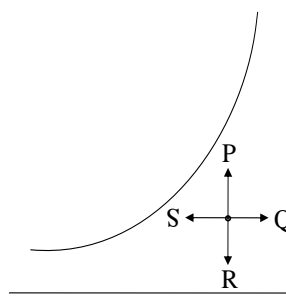
Application

1. Pressure loss in laminar flow of fluid
2. Drag loss due to regular obstructions in fluid flow
3. Energy conservation in ideal fluid flow
4. Terminal settling velocity of fine particles in fluid

the correct match is

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

Q.41 Four psychrometric processes P, Q, R and S are shown in the psychrometric chart below.



These processes respectively represent

- (A) dehumidification, humidification, sensible heating, sensible cooling
- (B) sensible heating, humidification, dehumidification, sensible cooling
- (C) dehumidification, sensible heating, sensible cooling, humidification
- (D) humidification, sensible heating, dehumidification, sensible cooling

Q.42 Given the following differential equation

$$\frac{d^2y}{dx^2} + 7\frac{dy}{dx} + 12y = 0$$

the general solution is

- (A) $y = Ae^{4x} + Be^{-3x}$
- (B) $y = Ae^{-4x} + Be^{-3x}$
- (C) $y = Ae^{3x} + Be^{-4x}$
- (D) $y = Ae^{4x} + Be^{3x}$

Q.43 Given the following,

Mining method	Technique
P Thick seam extraction	1 Double unit face
Q Bord and pillar extraction	2 Jet cutting
R Longwall face development	3 Inclined slicing
S Hydraulic mining	4 Half moon method

the correct match is

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

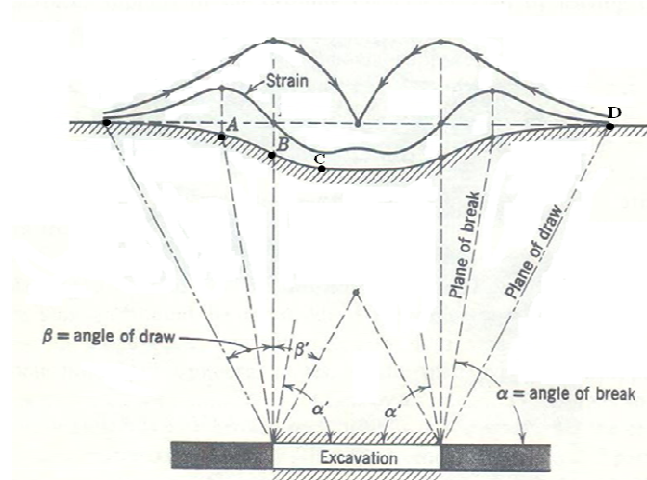
Q.44 Given the following,

Excavating/loading machine	Transportation scheme
P Bucket Wheel Excavator	1 Mine tub
Q Continuous Miner	2 Armoured flexible chain conveyor
R Shearer	3 Shiftable Conveyor
S Load Haul Dumper	4 Shuttle car

the correct match is

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

- Q.45 A sub-critical subsidence profile is shown in the figure below. The points A, B, C, and D represent respectively the points of



- (A) zero vertical displacement, maximum tension, inflexion, maximum compression
 (B) inflexion, maximum tension, maximum compression, zero vertical displacement
 (C) maximum tension, inflexion, maximum compression, zero vertical displacement
 (D) maximum compression, maximum tension, inflexion, zero vertical displacement
- Q.46 The uniaxial compressive strength of a limestone sample is 80 MPa. The sample is confined at a pressure of 20 MPa in a triaxial compressive strength test. Based on Hoek-Brown failure criteria the maximum principal stress at failure in MPa is (consider rock constants as $m = 7.88$, $s = 1.0$ and $a = 0.5$)
- (A) 117.9 (B) 132.3 (C) 137.9 (D) 157.9
- Q.47 A wire of length L is cut into two pieces to construct a circle and an equilateral triangle such that the combined area is minimum. The length of the wire used to construct the circle is
- (A) $\frac{\sqrt{3}\pi L}{9+\sqrt{3}\pi}$ (B) $\frac{9L}{9+\sqrt{3}\pi}$ (C) $\frac{L}{2}$ (D) $\frac{18L}{9-\sqrt{3}\pi}$

Common Data Questions

Common Data for Questions 48 and 49:

Pressure characteristic of a mine fan is given by, $P = -0.06Q^2 + 400$, where P is the pressure in Pa and Q the quantity in m^3/s . The resistance of the mine is $0.19 \text{ N s}^2/\text{m}^8$.

- Q.48 The mine quantity in m^3/s is
- (A) 160.0 (B) 53.5 (C) 45.9 (D) 40.0
- Q.49 An identical fan is installed in the mine to operate in series with the existing fan. The new mine quantity in m^3/s is
- (A) 75.6 (B) 56.7 (C) 50.8 (D) 30.2

Common Data for Questions 50 and 51:

The following observations are taken during a closed traverse.

Side	Length (m)	WCB
AB	100	90°
BC	173	180°
CA	200	330°

Q.50 The closing error of the traverse in mm is

- (A) 205 (B) 20.5 (C) 2.05 (D) 0.205

Q.51 The reduced bearing of the closing error in degrees is

- (A) 87.21 (B) 64.03 (C) 14.04 (D) 0

Linked Answer Questions

Statement for Linked Answer Questions 52 and 53:

Economic analysis of an iron ore deposit reveals that the net value of the ore is related to the grade mined as shown in the table.

Grade (%Fe)	Net value of ore (Rs/tonne)
64.5	3200
60.2	1800

Q.52 Assuming linear relationship between the net value and grade, the break-even cut-off grade in % Fe is

- (A) 52.2 (B) 54.7 (C) 58.0 (D) 62.2

Q.53 Assuming that the grade follows normal distribution with mean 62.7%, and standard deviation 10.0% (A portion of the standard normal distribution table is given below),

z	0.00	0.01	0.02	0.03	0.04
0.6	0.72575	0.72907	0.73237	0.73565	0.73891
0.7	0.75803	0.76115	0.76424	0.76730	0.77035
0.8	0.78814	0.79103	0.79389	0.79673	0.79954
0.9	0.81594	0.81859	0.82121	0.82381	0.82639
1.0	0.84134	0.84375	0.84613	0.84849	0.85083

the percentage of waste in the deposit based on the break-even cut-off grade is

- (A) 78.8 (B) 71.2 (C) 28.8 (D) 21.2

Statement for Linked Answer Questions 54 and 55:

A 4.6 m wide vein dipping at 80° is mined by horizontal cut-and-fill stoping method. The fill is to be placed in the stope along the length of 46 m and to a height of 3.0 m. If the specific weight of the fill material is 15.86 kN/m^3 and the porosity is 35%, under fully saturated conditions

Q.54 the volume of water in the fill in m^3 is

- (A) 222.18 (B) 332.40 (C) 336.44 (D) 634.80

Q.55 the mass of solids in saturated fill in tonnes is

- (A) 820.00 (B) 804.10 (C) 799.30 (D) 788.80

General Aptitude (GA) Questions

Q. 56 – Q. 60 carry one mark each.

Q.56 If $3 \leq X \leq 5$ and $8 \leq Y \leq 11$ then which of the following options is TRUE?

- (A) $\frac{3}{5} \leq \frac{X}{Y} \leq \frac{8}{5}$
 (B) $\frac{3}{11} \leq \frac{X}{Y} \leq \frac{5}{8}$
 (C) $\frac{3}{11} \leq \frac{X}{Y} \leq \frac{8}{5}$
 (D) $\frac{3}{5} \leq \frac{X}{Y} \leq \frac{8}{11}$

Q.57 The Headmaster _____ to speak to you.

Which of the following options is incorrect to complete the above sentence?

- (A) is wanting
 (B) wants
 (C) want
 (D) was wanting

Q.58 Mahatama Gandhi was known for his humility as

- (A) he played an important role in humiliating exit of British from India.
 (B) he worked for humanitarian causes.
 (C) he displayed modesty in his interactions.
 (D) he was a fine human being.

Q.59 All engineering students should learn mechanics, mathematics and how to do computation.

I

II

III

IV

Which of the above underlined parts of the sentence is not appropriate?

(A) I

(B) II

(C) III

(D) IV

Q.60 Select the pair that best expresses a relationship similar to that expressed in the pair:
water: pipe::

(A) cart: road

(B) electricity: wire

(C) sea: beach

(D) music: instrument

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

Q.61 Velocity of an object fired directly in upward direction is given by $V = 80 - 32t$, where t (time) is in seconds. When will the velocity be between 32 m/sec and 64 m/sec?

(A) (1, 3/2)

(B) (1/2, 1)

(C) (1/2, 3/2)

(D) (1, 3)

Q.62 In a factory, two machines M1 and M2 manufacture 60% and 40% of the autocomponents respectively. Out of the total production, 2% of M1 and 3% of M2 are found to be defective. If a randomly drawn autocomponent from the combined lot is found defective, what is the probability that it was manufactured by M2?

(A) 0.35

(B) 0.45

(C) 0.5

(D) 0.4

Q.63 Following table gives data on tourists from different countries visiting India in the year 2011.

Country	Number of Tourists
USA	2000
England	3500
Germany	1200
Italy	1100
Japan	2400
Australia	2300
France	1000

Which two countries contributed to the one third of the total number of tourists who visited India in 2011?

(A) USA and Japan

(B) USA and Australia

(C) England and France

(D) Japan and Australia

Q.64 If $|-2X + 9| = 3$ then the possible value of $|-X| - X^2$ would be:

- (A) 30 (B) -30 (C) -42 (D) 42

Q.65 All professors are researchers
Some scientists are professors

Which of the given conclusions is logically valid and is inferred from the above arguments:

- (A) All scientists are researchers
(B) All professors are scientists
(C) Some researchers are scientists
(D) No conclusion follows

END OF THE QUESTION PAPER