GATE AG 2011

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1) The differential equation

$$2\frac{d^2z}{dx^2} + \frac{dz}{dx} + 3y = \sin x$$

is considered to be ordinary, as it has

a) one dependent variable b) one independent variable c) more than one dependent variable d) more than one independent variable

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2) A square matrix [A] will be lower triangular if and only if (a_{MN} represents an element of M^{th} row and N^{th} column of the matrix)

a) $a_{MN} = 0,\ N > M$

b) $a_{MN} = 0,\ M > N$

c) $a_{MN} \neq 0,\ M > N$

d) $a_{MN} \neq 0,\ N > M$

(GATE AG 2011)

3) The metering mechanism of a seed drill is driven by the ground wheels at a velocity ratio of 1:2. When forward speed of the seed drill is increased from 3.0 to 3.45 km h^{-1}, the seed rate would

a) increase by 15% b) decrease by 15% c) decrease by 13% d) remain the same

(GATE AG 2011)

4) A maize planter drops seeds at 0.20 m interval. The seed weight is 200 g per 1000 seeds. If the row to row spacing is 0.25 m, the seed rate in kg ha^{-1} is

a) 5 b) 10 c) 20 d) 40

(GATE AG 2011)

5) Which one of the following is **NOT** a towed wheel?

a) wheels of power tiller b) wheels of bullock cart c) front wheels of two wheel drive tractor d) wheels of trailer

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6) If the density of a fluid changes from point to point in a flow region, the flow is called

a) steady flow b) non-uniform flow c) unsteady flow d) compressible flow

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7) Capillary water is held in the soil due to

a) absorption force b) gravitational force c) surface tension force d) osmotic force

(GATE AG 2011)

8) The wedge storage in a river reach during the passage of a flood wave is

a) positive during rising phase

b) negative during rising phase

c) positive during falling phase

d) constant

(GATE AG 2011)

9) The viscosity of a Newtonian fluid depends primarily on X and to a lesser degree on Y. X and Y are

a) X = temperature, Y = flow velocity

b) X = flow velocity, Y = pressure

c) X = temperature, Y = pressure

d) X = roughness of the surface across which the fluid flows, Y = flow velocity

(GATE AG 2011)

10) Milk is agitated in a tank with a rotating impeller. For this system: Let

$$X = \frac{P}{\rho N^3 D^5}, \quad Y = \frac{D^2 N \rho}{\mu}, \quad Z = \frac{DN^2}{g}$$

where, P = power imparted by the impeller to the fluid, N = rate of rotation of the impeller, D = impeller diameter, g = acceleration due to gravity, ρ = fluid density, and μ = fluid viscosity. The X, Y, Z are

a) X = Grashof number, Y = Power number, Z = Reynolds number

b) X = Power number,Y = Reynolds number,Z = Froude number

c) X = Reynolds number,Y = Froude number,Z = Grashof number

d) X = Froude number,Y = Grashof number,Z = Power number

(GATE AG 2011)

11) The highest order of polynomial integrand for which Simpson's 1/3 rule of integration is exact is

a) first b) second c) third d) fourth

(GATE AG 2011)

12) The mean value of a function $f(x)$ from $x = a$ to $x = b$ is given by

a) $\frac{f(a)+f(b)}{2}$

b) $\frac{\int_a^b f(x)\,dx}{b-a}$

c) $\frac{f(a)+2f\left(\frac{a+b}{2}\right)+f(b)}{4}$

d) $\int_a^b f(x)\,dx$

(GATE AG 2011)

13) A statistical measure of the variability of a distribution around its mean is referred to as

a) coefficient of determination
b) coefficient of variation
c) standard error
d) standard deviation

(GATE AG 2011)

14) An engine is to be run in dual fuel mode using diesel and producer gas with diesel as pilot fuel. Operation NOT required while running the engine is

a) cooling of the producer gas
b) preheating of the producer gas
c) cleaning of the producer gas
d) mixing of producer gas with air

(GATE AG 2011)

15) The range of frequency of vertical vibration of tractor most harmful to the operator's body at a root mean square acceleration of 1.0 m s^{-2} in Hertz is

a) 0.4-0.8
b) 4.0-8.0
c) 400-800
d) 4000-8000

(GATE AG 2011)

16) The Sauter mean diameter of liquid droplets of a hydraulic spray is

a) median diameter of droplets
b) mean diameter of droplets
c) surface area of droplets
d) volume to surface area ratio of droplets

(GATE AG 2011)

17) A horizontal axis windmill having 8 blades is used for pumping water. Each blade has a tip radius of 1.0 m and a mean chord of 0.1 m. Assuming blade length equal to tip radius, solidity of the windmill is

a) 0.03
b) 0.10
c) 0.25
d) 0.80

(GATE AG 2011)

18) A completely saturated clay soil has particle density of 2600 kgm^{-3} and bulk density of 1400 kg $m^{-}3$. It has a moisture fraction of 40% on volume basis. The porosity of the soil is

a) 0.46
b) 0.54
c) 0.74
d) 0.86

(GATE AG 2011)

19) The magnetic bearing of a line at a station point is found to be 182°. The magnetic declination at the station is 3° E and the local attraction is −1° for correction. The true bearing of the line is

a) 186° b) 184° c) 180° d) 178°

(GATE AG 2011)

20) In wind erosion process, the rate of soil movement (S) depends on wind speed (v), threshold limit of wind speed required to move the soil (v_m) and average soil particle size (d). This interrelationship is expressed as

a) $S \propto (v - v_m)^2 d^{1/2}$ b) $S \propto (v - v_m)^3 d^{1/2}$ c) $S \propto (v - v_m)^2 d$ d) $S \propto (v - v_m)^3 d$

(GATE AG 2011)

21) For a catchment with an area of 400 km^2, the equivalent discharge of the S-curve obtained by summation of 4-h unit hydrograph in $m^3\ s^{-1}$ is

a) 100 b) 139 c) 200 d) 278

(GATE AG 2011)

22) A material having thermal conductivity k insulates a spherical object of diameter d. The heat transfer coefficient between the insulating material and the environment is h_0. The critical thickness of insulation for maximum heat transfer rate is

a) $\frac{k}{2h_0} - \frac{d}{2}$ b) $\frac{2k}{h_0} - \frac{d}{2}$ c) $\frac{k}{2h_0} - d$ d) $\frac{2k}{h_0} - d$

(GATE AG 2011)

23) For a mass of grain stored in a bin, the angle of internal friction of the grain is 30°. The ratio of normal pressure to the applied pressure within the bin is

a) 0.25 b) 0.33 c) 0.50 d) 1.00

(GATE AG 2011)

24) In a counter current concentric tube heat exchanger, the hot fluid enters at 360 K and leaves at 340 K. The cooling fluid enters at 300 K and leaves at 316 K. The logarithmic mean temperature difference in K is

a) 17.9 b) 39.2 c) 41.9 d) 57.3

(GATE AG 2011)

25) A constant heat flux of 500 W m^{-2} is supplied to one face of a food material having a plate-like structure with a thickness of 10 mm. The thermal conductivity of the food material is 1.5 $W\,m^{-1}\,°C^{-1}$. From the other face of the food material, heat is dissipated by convection into a fluid of 40°C temperature. The heat transfer coefficient of the fluid is 100 $W\,m^{-2}\,°C^{-1}$. The temperature in °C of the surface to which the heat flux is supplied will be

a) 43.3 b) 45.3 c) 48.3 d) 54.3

(GATE AG 2011)

26) The stationary points of $f(x, y) = \frac{1}{3}x^3 - xy^2 - 2y$ are

a) $(1, -1)$ and $(-1, 1)$ b) $(1, 1)$ and $(-1, -1)$ c) $(2, -2)$ and $(-2, 2)$ d) $(2, 2)$ and $(-2, -2)$

(GATE AG 2011)

27) The divergence of the vector $\mathbf{F} = \sin(xy)\,\mathbf{i} + y\cos(z)\,\mathbf{j} + xz\cos(z)\,\mathbf{k}$ (i, j, and k represent unit vectors along the three orthogonal axes) at $x = y = 0$ is

a) $\sin(z)$ b) $\cos(z)$ c) $-\sin(z)$ d) $-\cos(z)$

(GATE AG 2011)

28) A plane contains the following three points: P$(2, 1, 5)$, Q$(-1, 3, 4)$ and R$(3, 0, 6)$. The vector perpendicular to the above plane can be represented as

a) 2i - j + k b) i + 2j + 2k c) 2i + 3j + k d) i + 2j + k

(GATE AG 2011)

29) The solution of

$$x\frac{dy}{dx} = x^2 + 3y$$

for $x > 0$ and $y(1) = 2$ is

a) $y = x^3 + 3x^2$ b) $y = x^2 + 3x^3$ c) $y = -x^2 + 3x^3$ d) $y = -x^2 - 3x^3$

(GATE AG 2011)

30) A two cylinder four stroke diesel engine develops 15 kW power at 2400 rpm. Its brake specific fuel consumption is 0.268 kg kW^{-1} h^{-1}. If the specific gravity of fuel is 0.85, quantity of fuel injected per cylinder per cycle in m^3 is

a) 0.028×10^{-6} b) 0.033×10^{-6} c) 0.056×10^{-6} d) 0.065×10^{-6}

(GATE AG 2011)

31) A hydraulic spray nozzle has a discharge of 450 ml min^{-1} at a pressure of 280 kPa. If the pressure is increased by 10%, the discharge will be

a) increased by 4.9% b) increased by 10.0% c) increased by 21.0% d) decreased by 4.6%

(GATE AG 2011)

32) In a cutter bar mower, the cutter bar drive consists of an offset slider crank mechanism with a crank of radius 36 mm and a pitman of length 360 mm. If offset of the crank is 72 mm, the stroke length in mm would be

a) 36.0 b) 72.0 c) 73.5 d) 80.5

(GATE AG 2011)

33) The cost of a tractor is Rs. 340000. Its service life is 10 years and the salvage value is 10% of initial cost. Its depreciation in 2^{nd} year, following constant rate method, in rupees would be

a) 30600 b) 34000 c) 50070 d) 55550

(GATE AG 2011)

34) The resultant soil reaction force acting on a single bottom mould board plough has a component of 1200 N acting at an angle of 31° downwards in a vertical plane. This plane is along the direction of travel. Weight of the plough is 620 N. Neglecting the side forces, the magnitude of pull in N would be

a) 618 b) 1028 c) 1350 d) 1609

(GATE AG 2011)

35) A concrete-lined non-circular tunnel has a semi-circle at the top and a rectangular section at the bottom. The semi-circle has a diameter of 6 m whereas the rectangular section is 6 m wide and 3 m high. The tunnel carries a discharge of 128 $m^3\ s^{-1}$. If the friction factor f=0.017, then the head loss in 1 km length of the tunnel in m will be

a) 0.57 b) 1.15 c) 2.29 d) 4.58

(GATE AG 2011)

36) In a falling head permeameter test, the initial head is 0.30 m The head drops to 0.01 m in 40 min. The permeability of a soil sample, 0.06 m high and 50×10^{-4} m^2 in cross-sectional area, is found to be 1.0×10^{-6} m s^{-1}. The size of the stand pipe in m^2 is

a) 1.82 b) 1.82×10^{1} c) 1.82×10^{-2} d) 1.82×10^{-4}

(GATE AG 2011)

37) A 100 ha reservoir receives 2500 mm of rainfall during a period of 2 years. During this period the mean inflow to the stream is 1.0 $m^3\ s^{-1}$, the mean outflow from the stream is 0.8 $m^3\ s^{-1}$, and the increase in the storage is 500 ha m. Assuming that there is no seepage loss, the total evaporation during the period in m is

a) 1.011 b) 10.11 c) 101.1 d) 1011

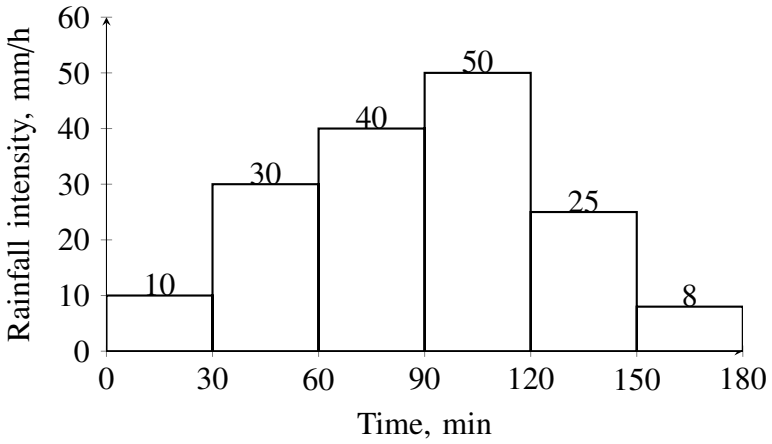
(GATE AG 2011)

38) The following figure presents the hyetograph for a 3-hour storm. The surface runoff for the event is estimated to be 38 mm. The phi-index for the event in $mmh^{-}1$ is

a) 11.50 b) 14.25 c) 15.80 d) 17.25

(GATE AG 2011)

39) A crop grown over an area of 50 ha can tolerate 5 decisiemens m^{-1} of electrical conductivity in the drainage water. The consumptive use of the crop is 1.0 m, 30% of which is obtained from the rainfall and the remainder is met from the irrigation water having electrical conductivity of 2 decisiemens m^{-1}. For efficient crop production, the leaching requirement and the quantity of water that must be drained from the area are



a) 40% and 0.23 Mm^3
b) 60% and 0.23 Mm^3
c) 40% and 0.21 Mm^3
d) 60% and 0.21 Mm^3

(GATE AG 2011)

40) A fully penetrating tubewell of 0.2 m diameter is operational in a confined aquifer of 20 m thickness. The hydraulic conductivity of the formation (K) is 20 m per day and the radius of influence is 1000 m. Water table is 50 m above the bottom of screen and the maximum drawdown is 10 m. Subsequently two more tubewells of the same size are installed in such a way that the three tubewells form an equilateral triangle of side 300 m. All three tubewells have equal discharge when operated independently. If all tubewells are operated simultaneously, the percent loss in the discharge of the first well is

a) 20.73 b) 35.75 c) 48.85 d) 61.90

(GATE AG 2011)

41) For the eastern Himalayan region having hill slope of 16%, a bench terrace system is to be designed. It is found that the depth of cut for constructing the bench terrace cannot be more than 0.40 m due to the limitation of the soil depth. If a batter slope of $\frac{1}{2}$: 1 is proposed, the maximum possible width of the terrace and the required earthwork per hectare (assuming cut equal to fill) will be

a) 3.4 m, 680 m^3 b) 4.8 m, 960 m^3 c) 4.6 m, 920 m^3 d) 5.0 m, 1000 m^3

(GATE AG 2011)

42) The sieve analysis of a finely ground rice powder is represented by a straight line from zero percent mass at 1 μm particle size to 100 percent mass at 101 μm particle size. The volume-surface mean diameter in μm is

a) 14.6 b) 19.2 c) 21.7 d) 25.3

(GATE AG 2011)

43) A plate shaped frozen food has a thickness of 20 mm, average thermal conductivity of 2.58 W m^{-1} Â°C^{-1}, density of 1080 kg m^{-3}, specific heat of 3550 J kg^{-1} Â°C^{-1}, and a uniform temperature of

−20 Â°C. The food material is suddenly immersed in a well stirred hot water maintained at a constant temperature of 90 Â°C. The heat transfer coefficient between the food material and hot water is 25 W m^{-2} Â°C^{-1}. The time required for the centre temperature of the food material to reach 30 Â°C in minutes is

a) 3.9 b) 7.9 c) 15.5 d) 31.0

(GATE AG 2011)

44) 300 kg of parboiled and wet paddy having an initial moisture content of 28% (dry basis) was dried in a batch type dryer. During drying operation, grain sample was drawn at regular time intervals to measure its moisture content (dry basis). It was found that the moisture content of the grain bore linear relationship with drying time till 30 minutes of drying operation at which moisture content was 22.3%. The drying rate (kg h^{-1}) during this interval was

a) 28.3 b) 37.5 c) 41.7 d) 48.1

(GATE AG 2011)

45) A mixture of microorganisms, P, Q, R, and S are to be inactivated by autoclaving. Number of spores of the above organisms is 6×10^5, 4×10^6, 2×10^4, and 9×10^5 respectively. Further, their decimal reduction time (D) values in minute are 2.2, 1.8, 0.8, and 1.6 respectively. It is desired to microbiologically inactivate the mixture at 121°C to obtain a probability of spoilage of 10^{-5}. The microorganisms that will be inactivated first and that at the last are respectively

a) P and Q b) R and P c) P and S d) P and R

(GATE AG 2011)

46) The average interstitial velocity in a packed bed is 2.5 m s^{-1} and the superficial velocity under minimum fluidized condition based on the cross-section of the empty container is 1 m s^{-1}. Solid particles having density of 1200 kg m^{-3} and size of 0.15 mm are to be fluidized using air at 3 atm absolute pressure and 30°C temperature having a density of 3.5 kg m^{-3}. The empty bed cross section is 0.4 m^2 and the bed contains 400 kg of solid. Pressure drop at minimum fluidized condition in Pa is

a) 3.5×10^3 b) 6.5×10^3 c) 9.7×10^3 d) 17.1×10^3

(GATE AG 2011)

47) Sphericity of a particle is defined as: (surface to volume ratio for a sphere having identical volume as that of the particle) / (the surface to volume ratio of the particle). The measure of sphericity of a cube shaped sugar crystal is

a) $\left(\frac{\pi}{6}\right)^{\frac{1}{3}}$ b) $\left(\frac{\pi}{6}\right)^{\frac{2}{3}}$ c) $\left(\frac{\pi}{4}\right)^{\frac{1}{3}}$ d) $\left(\frac{\pi}{4}\right)^{\frac{2}{3}}$

(GATE AG 2011)

Common Data Questions Common Data for Questions 48 and 49:

A 5 ha field under wheat crop is irrigated at 40% depletion of available moisture content. The field capacity, wilting point and bulk density of the soil in the field are 32% (on weight basis), 20% (on

weight basis) and 1400 kg m^{-3} respectively. To irrigate the field in a day of 10 hours, a pump is used which lifts 270 m^3 of water per hour against a total head of 20 m.

48) If the root zone depth is 0.8 m, the volume of water required to irrigate the field in m^3 will be

a) 2700 b) 3150 c) 3600 d) 4050

(GATE AG 2011)

49) The pump is driven by an electric motor. If the pump, drive and motor efficiencies are 80%, 82% and 90% respectively, the required size of electric motor in horse-power will be

a) 20.0 b) 24.5 c) 30.0 d) 33.5

(GATE AG 2011)

Common Data for Questions 50 and 51:

A vertical hydraulic cylinder having an inside diameter of 100 mm is used in a hoist for lifting load. A constant flow rate pump capable of delivering 12 litre per minute at a maximum pressure of 18 MPa is used for supplying the fluid. Volumetric and mechanical efficiencies of the pump are 91% and 85% respectively.

50) The rate of lifting of load in m s^{-1} and maximum amount of load that can be lifted in kN are

a) 0.020, 180 b) 0.025, 141 c) 0.064, 45 d) 0.080, 565

(GATE AG 2011)

51) The size of motor required for operating the pump in kW is

a) 3.60 b) 3.96 c) 4.24 d) 4.65

(GATE AG 2011)

Linked Answer Questions

Statement for Linked Answer Questions 52 and 53:

A towed pneumatic wheel (width to diameter ratio of 0.3) is to be rolled on a leveled concrete surface. Total wheel load is 2000 N.

52) The force in N required to roll the wheel on the horizontal concrete surface would be

a) 80 b) 91 c) 800 d) 912

(GATE AG 2011)

53) The minimum slope in degrees of the concrete surface with respect to the horizontal at which the wheel itself will start rolling downward is

a) 2.29 b) 5.28 c) 23.58 d) 27.13

(GATE AG 2011)

Statement for Linked Answer Questions 54 and 55:

A vegetable with 70% moisture (wet basis) is to be dried in a countercurrent dryer to give a product with 5% moisture (wet basis). The feed rate to the dryer is 0.15 kg s^{-1}. The drying medium consists of air at 100°C containing water vapour with a partial pressure of 1.0 kPa. The air leaves the dryer at 40°C and is 70% saturated. The system works under a total pressure of 101.3 kPa. The vapour pressure of water that saturates air at 40°C is 7.4 kPa. Molecular weight of water and air may be taken as 18 and 29 respectively.

54) The humidity (kg of water vapour / kg of dry air) of the outlet air is

a) 0.0027 b) 0.0172 c) 0.0335 d) 0.0483

(GATE AG 2011)

55) The flow rate (kg s^{-1}) of inlet air required is

a) 0.161 b) 0.817 c) 1.634 d) 3.783

(GATE AG 2011)

General Aptitude (GA) Questions

Q. 56 – Q. 60 carry one mark each

56) Choose the most appropriate word from the options given below to complete the following sentence: Under ethical guidelines recently adopted by the Indian Medical Association, human genes are to be manipulated only to correct diseases for which _____ treatments are unsatisfactory.

a) similar

b) most

c) uncommon

d) available

(GATE AG 2011)

57) Choose the word from the options given below that is most nearly opposite in meaning to the given word:Frequency

a) periodicity

b) rarity

c) gradualness

d) persistency

(GATE AG 2011)

58) Choose the most appropriate word from the options given below to complete the following sentence: It was her view that the country's problems had been _____ by foreign technocrats, so that to invite them to come back would be counter-productive.

a) identified b) ascertained c) exacerbated d) analysed

(GATE AG 2011)

59) There are two candidates P and Q in an election. During the campaign, 40% of the voters promised to vote for P, and rest for Q. However, on the day of election 15% of the voters went back on their promise to vote for P and instead voted for Q. 25% of the voters went back on their promise to vote for Q and instead voted for P. Suppose, P lost by 2 votes, then what was the total number of voters?

a) 100 b) 110 c) 90 d) 95

(GATE AG 2011)

60) 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: Gladiator : Arena

a) dancer : stage

b) commuter : train

c) teacher : classroom

d) lawyer : courtroom

(GATE AG 2011)

Q. 61 – Q. 65 carry two marks each

61) The sum of n terms of the series $4 + 44 + 444 + \ldots$ is

a) $\frac{4}{81}\left[10^{n+1} - 9n - 1\right]$

b) $\frac{4}{81}\left[10^{n+1} - 9n - 1\right]$

c) $\frac{4}{81}\left[10^{n+1} - 9n - 10\right]$

d) $\frac{4}{81}\left[10^{n} - 9n - 10\right]$

(GATE AG 2011)

62) Given that $f(y) = |y|/y$, and q is any non-zero real number, the value of $[f(q) - f(-q)]$ is

a) 0 b) -1 c) 1 d) 2

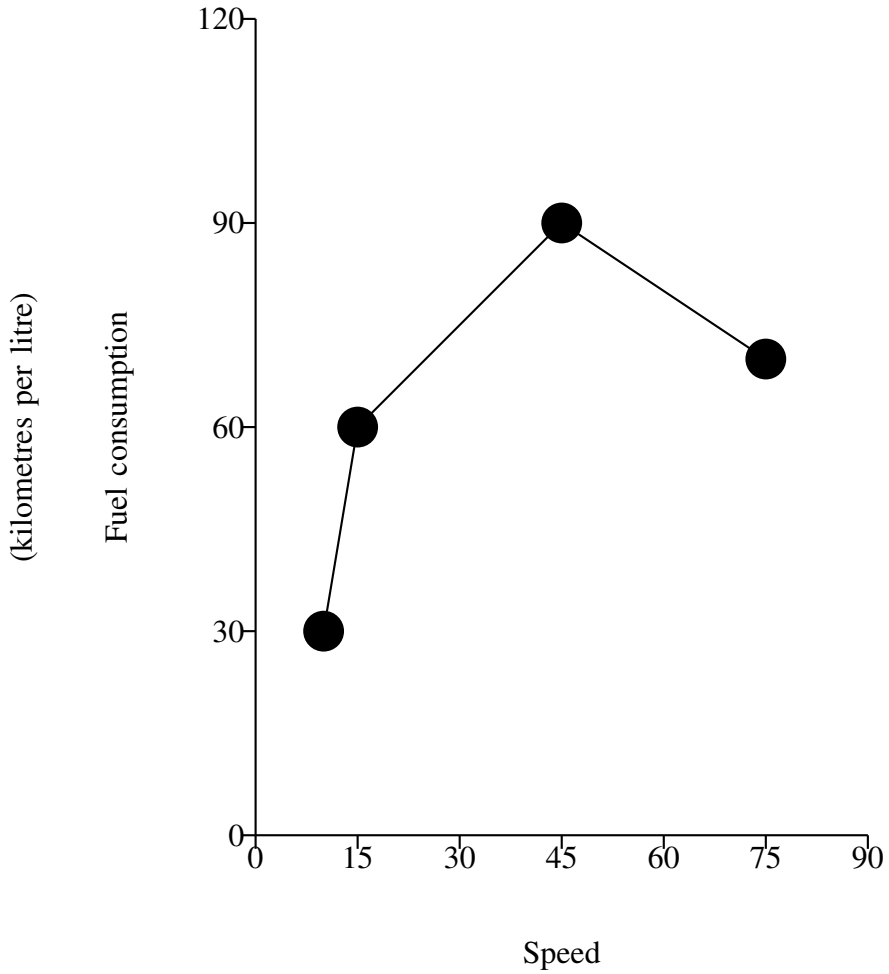
(GATE AG 2011)

63) Three friends, R, S and T shared toffee from a bowl. R took $\frac{1}{3}$ of the toffees, but returned four to the bowl. S took $\frac{1}{4}$ of what was left but returned three toffees to the bowl. T took half of the remainder but returned two back into the bowl. If the bowl had 17 toffees left, how many toffees were originally there in the bowl?

a) 38 b) 31 c) 48 d) 41

(GATE AG 2011)

64) The fuel consumed by a motorcycle during a journey while traveling at various speeds is indicated in the graph below.



65) The distances covered during four laps of the journey are listed in the table below:

Lap	Distance (kilometres)	Average speed (kilometres per hour)
P	15	15
Q	75	45
R	40	75
S	10	10

From the given data, we can conclude that the fuel consumed per kilometre was least during the lap:

a) P

b) Q

c) R

d) S

(GATE AG 2011)

66) The horse has played a little known but very important role in the field of medicine. Horses were injected with toxins of diseases until their blood built up immunities. Then a serum was made from their blood. Serums to fight with diphtheria and tetanus were developed this way.

It can be inferred from the passage, that horses were:

a) given immunity to diseases

b) generally quite immune to diseases

c) given medicines to fight toxins

d) given diphtheria and tetanus serums

(GATE AG 2011)

END OF THE QUESTION PAPER