GENERAL APTITUDE

Q. No. 1 – 5 Carry One Mark Each

- 1. Hema's age is 5 years more than twice Hari's age. Suresh's age is 13 years less than 10 times Hari's age. If Suresh is 3 times as old as Hema, how old is Hema?
 - (A) 14 (B) 17 (C) 18 (D) 19

Answer: (D)

2. Tower A is 90m tall and tower B is 140 m tall. They are 100m apart. A horizontal skywalk connects the floors at 70m in both the towers. If a taut rope connects the top of tower A to the bottom of tower B, at what distance (in meters) from tower A will the rope intersect the skywalk?

Answer: (22.22)

3. The temperature T in a room varies as a function of the outside temperature T_0 and the number of persons in the room p, according to the relation $T=K(\Theta p+T_0)$, Where Θ and K are constants. What would be the value of Θ given the following data?

		T ₀	Р	Т						
		25	2	32.4						
		30	5	42.0						
	(A) 0.8	(B) 1.0		(C) 2.0	(D)	10.0				
A	nswer: (B)									
4	4. "The driver applied the as soon as she approached the hotel where she wanted to take a"									
	The words that hast fill the blanks in the shows contained are									
	The words that best I			nence are						
	(A) brake, break	(B) bre	ak, break	(C) brake, br	rake (D)	break, brake				
	(,,,	(=) 010	,	(-) 514110, 01	(2)					

Answer: (A)

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5.	"It is	no surprise that e	every so	ciety has had	d codes of be	haviour; howe	ever, the nat	ure of these	codes is often
	The v	word that best fills	the blai	nk in the abo	ve sentence i	s			
	(A)	unpredictable	(B)	simple	(C)	expected	(D)	strict	
Ans	wer:	(A)							

6. Each of the letters arranged as below represents a unique integer from 1 to 9. The letters are positioned in the figure such that (A×B×C), (B×G×E) and (D×E×F) are equal. Which integer among the following choices cannot be represented by the letters A, B, C, D, E, F or G?



7. Which of the following function (s) is an accurate description of the graph for the range (s) indicated?



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8. Consider a sequence of numbers a_1 , a_2 , a_3 ,..., a_n where $a_n = \frac{1}{n} - \frac{1}{n+2}$, for each integer n>0. What is the sum of the first 50 terms?

(A)	$\left(1+\frac{1}{2}\right)-\frac{1}{50}$	(B)	$\left(1+\frac{1}{2}\right)+\frac{1}{50}$
(C)	$\left(1+\frac{1}{2}\right) - \left(\frac{1}{51}+\frac{1}{52}\right)$	(D)	$1 - \left(\frac{1}{51} + \frac{1}{52}\right)$

Answer: (C)

9. The price of a wire made of superalloy material is proportional to the square of its length. The price of 10m length of the wire is Rs. 1600. What would be the total price (in RS.) of two wires of lengths 4m and 6m?

(A)	768	(B) 832	(C) 1440	(D) 1600
Answer:	(B)			

10. A fruit seller sold a basket of fruits at 12.5% loss. Had he sold it for Rs. 108 more, he would have made a 10% gain. What is the loss in Rupees incurred by the fruit seller?

	(A)	48	(B)	52		(C)	60	(D)	108	
A	nswer:	(C)								
					C D -					
					<u>CIVIL EN</u>	NGINE	ERING			
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1. The percent reduction in the bearing capacity of a strip footing resting on sand under flooding condition (water level at the base of the footing) when compared to the situation where the water level is at a depth much greater than the width of footing, is approximately

(A)	0	(B) 25	(C) 50	(D)	100
Answer:	(C)				

2. A column of height h with a rectangular cross section of size a ×2a has a buckling load of P. If the cross section is changed to 0.5a×3a and its height changed to 1.5h, the buckling load of the redesigned column will be

(A) P/12 (B) P/4 (C) P/2 (D) 3P/4

Answer: (A)

- 3. A steel column o ISHB 350 @ 72.4 kg/m is subjected to a factored axial compressive load of 2000kN. The load is transferred to a concrete pedestal of grade M20 through a square base plate. Consider bearing strength of concrete as 0.45f_{ck}, where f_{ck} is the characteristic strength of concrete. Using limit state method and neglecting the self weight of base plate and steel column, the length of a side of the base plate to be provided is
 - (A) 39cm (B) 42cm (C) 45cm (D) 48cm

Answer: (D)

4. A 1:50 model of a spillway is to be tested in the laboratory. The discharge in the prototype spillway is 1000m³/s. The corresponding discharge (in m³/s, up to two decimal places) to be maintained in the model, neglecting variation in acceleration due to gravity, is _____.

Answer: (0.0565)

- 5. A bitumen sample has been graded as VG30 as per IS : 73-2013. The '30' in the grade means that
 - (A) penetration of bitumen at 25°C is between 20 and 40
 - (B) viscosity of bitumen at 60°C is between 2400 and 3600 poise
 - (C) ductility of bitumen at 27°C is more than 30 cm
 - (D) elastic recovery of bitumen at 15°C is more than 30%

Answer: (B)

6. For the given orthogonal matrix Q

$$\mathbf{Q} = \begin{bmatrix} 3/7 & 2/7 & 6/7 \\ -6/7 & 3/7 & 2/7 \\ 2/7 & 6/7 & -3/7 \end{bmatrix}$$

The inverse is

(A)	$\begin{bmatrix} 3/7 & 2/7 \\ -6/7 & 3/7 \\ 2/7 & 6/7 \end{bmatrix}$	6/7 2/7 -3/7	(B)	$\begin{bmatrix} -3/7 \\ 6/7 \\ -2/7 \end{bmatrix}$	-2/7 -3/7 -6/7	-6/7 -2/7 3/7
(C)	$\begin{bmatrix} 3/7 & -6/7 \\ 2/7 & 3/7 \\ 6/7 & 2/7 \end{bmatrix}$		(D)	$\begin{bmatrix} -3/7 \\ -2/7 \\ -6/7 \end{bmatrix}$	6/7 -3/7 -2/7	$ \begin{bmatrix} -2/7 \\ -6/7 \\ 3/7 \end{bmatrix} $

Answer: (C)

$f(MD_{0})$	Number of specimens with					
I (MFa)	compressive strength equal to f					
23	4					
28	2					
22.5	5					
31	5					
29	4					

7. The frequency distribution of the compressive strength of 20 concrete cube specimens is given in the table.

If μ is the mean strength of the specimens and σ is the standard deviation, the number of specimens (out of 20) with compressive strength less than $\mu - 3\sigma$ is _____.

Answer: (0)

- 8. At the point x=0, the function $f(x) = x^3$ has
 - (A) local maximum
 - (B) local minimum
 - (C) both local maximum and minimum
 - (D) neither local maximum nor local minimum

9. There are 20,000 vehicles operating in a city with an average annual travel of 12,000 km per vehicle. The NO_x emission rate is 2.0 g/km per vehicle. The total annual release of NO_x will be

	(A)	4,80,000kg	(B) 4,800kg	(C) 480kg	(D)	48kg
Ar	nswer:	(A)				

10. A solid circular beam with radius of 0.25 m and length of 2m is subjected to a twisting moment of 20kNm about the z-axis at the free end, which is the only load acting as shown in the figure.



Answer: (D)

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	Tł	he s	hear stress compo	nent τ	at Point 'M' in	the cro	oss section of th	e beam at	a distan	ice of 1m from the
	fiz	xed	end is	xy						
	(A	A)	0.0MPa	(B)	0.51MPa	(C)	0.815MPa	(D)	2.0MP	a
An	iswer		(A)							
11.	. Tł	he s	peed density relation	onship fo	or a road section	is show	n in the figure.			
					•					
				Speed						
				Speed						
										
					Den	sity				
	Tł	he s	hape of the flow-de	ensity re	lationship is					
	(A	A)	piecewise linear			(B)	parabolic			
	(C	C)	initially linear that	n parabo	olic	(D)	initially parab	olicthen lii	near	
An	iswer	:	(C)							
12.	. Tł	he v	width of a square for	ooting a	nd the diameter of	of circu	lar footing are	equal. If b	oth the f	ootings are placed
	or fo	n the	e surface of sandy	soil, the	e ratio of the ult	mate b	earing capacity	of circula	r footing	g to that of square
	ίΔ	4)	A/3	(B)	1	(\mathbf{C})	3/4	(D)	2/3	
An	(r: Iswer:	•	(C)	(D)	1	(0)	5/1	(D)	215	
		•								
13	. A	wel	l designed signaliz	ed inters	section is one in	which t	he			
	(A	A)	crossing conflicts	are incre	eased					
	(B	3)	total delay is mini	mized						
	(C	C)	cycle time is equa	l to the s	sum of red and g	een tin	nes in all phases			
	(E))	cycle time is equa	l to the s	sum of red and ye	ellow ti	mes in all phase	;		
An	iswer	:	(B)		·		-			

14. A flow field is given by $u=y^2$, v=-xy, w=0. Value of the z – component of the angular velocity (in radians per unit time, up to two decimal places) at the point (0,-1, 1) is _____.

Answer: (1.5)

15. In a shrinkage limit test, the volume and mass of a dry soil pat are found to be 50cm³ and 88g, respectively. The specific gravity of the soil solids is 2.71 and the density of water is 1 g/cc. The shrinkage limit (in %, up to two decimal places) is _____.

Answer: (19.92)

16. A 10m wide rectangular channel carries a discharge of $20m^3$ /s under critical condition. Using g=9.81m/s², the specific energy (in m, up to two decimal places) is _____.

Answer: (1.11)

- **17.** The Le Chatelier apparatus is used to determine
 - (A) Compressive strength of cement
- (B) fineness of cement

(C) setting time of cement

(D) soundness of cement

Answer: (D)

18. A city generates 40×10^6 kg of municipal solid waste (MSW) per year, out of which only 10% is recovered / recycled and the rest goes to landfill. The landfill has a single lift of 3m height and is compacted to a density of 550 kg/m³. If 80% of the landfill is assumed to be MSW, the landfill area (in m², up to one decimal place) required would be_____.

Answer: (27272.1)

19. In a fillet weld, the direct shear stress and bending tensile stress are 50MPa and 150MPa, respectively. As per IS 800:2007, the equivalent stress (in MPa up to two decimal places) will be _____.

Answer: (173.205)

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20. A core cutter of 130mm height has inner an outer diameters of 100 mm and 106mm, respectively. The area ratio of the core cutter (in % up to two decimal places) is _____.

Answer: (12.36)

- **21.** Two rectangular under-reinforced concrete beam sections X and Y are similar in all aspects except that the longitudinal compression reinforcement in section Y is 10% more. Which one of the following is the correct statement?
 - (A) Section X has less flexural strength and is less ductile than section Y
 - (B) Section X has less flexural strength but is more ductile than section Y
 - (C) Section X and Y have equal flexural strength but different ductility
 - (D) Section X and Y have equal flexural strength and ductility

Answer: (A)

22. For routing of flood in a given channel using the Muskingum method, two of the routing coefficients are estimated as C_0 =-0.25 and C_1 =0.55. The value of the third coefficient C_2 would be _____.

A	nswer:		(0.7)							
2	3. Th	e d	eformation in concr	ete due	to sustained load	ing is				
	(A))	creep	(B) h	hydration	(C)	segregation	(D)	shrinkage	
A	nswer:		(A)							
2	4. Be	m	oulli's equation is ap	oplicable	e for					
	(A))	viscous and compr	essible f	fluid flow					
	(B)		Inviscid and comp	raccibla	fluid flow					
	(D)		inviscit and comp		India IIOw					
	(C))	Inviscid and incom	pressibl	le fluid flow					
	(D)	viscous and incom	pressible	e fluid flow.					
				-						

Answer: (C)

25. Which one of the following matrices is singular?

(\mathbf{A})	$\begin{bmatrix} 2 & 5 \end{bmatrix}$	(D)	$\begin{bmatrix} 3 & 2 \end{bmatrix}$	(\mathbf{C})	2 4	(D)	4	3]
(A)	1 3	(В)	2 3	(C)	3 6	(D)	6	2

Answer: (C)

Q. No. 26 - 55 Carry Two Marks Each

[2018, Paper-I]

26. Variation of water depth (y) in a gradually varied open channel flow is given by the first order differential equation

 $\frac{dy}{dx} = \frac{1 - e^{-\frac{10}{3}\ln(y)}}{250 - 45e^{-3\ln(y)}}$

Given initial condition: y(x=0) = 0.8m. The depth (in m, up to three decimal places) of flow at a downstream section at x=1m from one calculation step of Single step Euler Method is ______.

Answer: (0.793)

27. An aircraft approaches the threshold of a runway strip at a speed of 200km/h. The pilot decelerates the aircraft at a rate of 1.697m/s^2 and takes 18s to exit the runway strip. If the deceleration after exiting the runway is 1 m/s^2 , then the distance (in m, up to one decimal place) of the gate position from the location of exit on the runway is _____.

Answer: (313)

28. A water sample analysis data is given below:

Ion	Concentration, mg/L	Atomic Weight
Ca ²⁺	60	40
Mg ²⁺	30	24.31
HCO ₃ ⁻	400	61

The carbonate hardness (expressed as mg/L of CaCO₃, up to one decimal place) for the water sample is

Answer: (273.406)



29. A cylinder of radius 250mm and weight, W=10kN is rolled up an obstacle of height 50mm by applying a horizontal force P at its centre as shown in the figure.



All interfaces are assumed frictionless. The minimum value of P is



30. An RCC beam of rectangular cross section has factored shear of 200kN at its critical section. Its width b is 250 mm and effective depth d is 350mm. Assume design shear strength τ_c of concrete as 0.62 N/mm² and maximum allowable shear stress $\tau_{c.max}$ in concrete as 2.8 N/mm². If two legged 10mm diameter vertical stirrups of Fe250 grade steel are used, then the required spacing (in cm, up to one decimal place) as per limit state method will be______.

Answer: (8.2)

31. A $0.5m\times0.5m$ square concrete pile is to be driven in a homogeneous clayey soil having undrained shear strength, $c_u = 50$ kPa and unit weight, $\gamma = 18.0$ kN/m³. The design capacity of the pile is 500kN. The adhesion factor α is given as 0.75. The length of the pile required for the above design load with a factor of 2.0 is

(A) 5	.2m	(B)	5.8m	(C)	11.8m	(D)	12.5m
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Answer: (C)

32. At a construction site, a contractor plans to make an excavation as shown in the figure.



The water level in the adjacent river is at an elevation of +20.0m. Unit weight of water is 10kN/m³. The factor of safety (up to two decimal places) against sand boiling for the proposed excavation is ______.

Answer: (1)

33. A conventional drained triaxial compression test was conducted on a normally consolidated clay sample under an effective confining pressure of 200kPa. The deviator stress at failure was found to be 400kPa. An identical specimen of the same clay sample is isotropically consolidated to a confining pressure of 200kPa and subjected to standard undrained triaxial compression test. If the deviator stress at failure is 150kPa, the pore pressure developed (in kPa, up to one decimal place) is ______.

Answer: (125)

34. The solution (up to three decimal places) at x=1 of the differential equation $\frac{d^2y}{dx^2} + 2\frac{dy}{dx} + y = 0$ subject to

boundary conditions y(0) = 1 and $\frac{dy}{dx}(0) = -1$ is _____.

Answer: (0.368)

35. Rainfall depth over a watershed is monitored through six number of well distributed rain gauges. Gauged data are given below.

Rain Gauge Number	1	2	3	4	5	6
Rainfall Depth(mm)	470	465	435	525	480	510
Area of Thiessen Polygon ($\times 10^4 \text{ m}^2$) 95	100	98	80	85	92

The Thiessen mean value (in mm, up to one decimal place) of the rainfall is _____

Answer: (479.1)

36. The dimensions of a symmetrical welded I-section

are shown in the figure.

The plastic section modulus about the weaker axis

(in cm³, up to one decimal place) is _____.

Answer: (89.9)



(All dimensions are in mm)

37. A rigid smooth retaining wall of height 7m with vertical backface retains saturated clay as backfill. The saturated unit weight and undrained cohesion of the backfill are 17.2kN/m³ and 20kPa, respectively. The difference in the active lateral forces on the wall (in kN per meter length of wall, up to two decimal places), before and after the occurrence of tension cracks is _____.

Answer: (46.52)

38. A waste activated sludge (WAS) is to be blended with green waste (GW). The carbon (C) and nitrogen (N) contents. per kg of WAS and GW, on dry basis are given in the table.

Parameter	WAS	GW
Carbon (g)	54	360
Nitrogen (g)	10	6

The ratio of WAS to GW required (up to two decimal places) to achieve a blended C:N ratio of 20:1 on dry basis is _____

Answer: (1.643)

39. The infiltration rate f in a basin under ponding condition is given by $f=30+10e^{-2t}$, where, f is in mm/h and t is time in hour. Total depth of infiltration (in mm, up to one decimal place) during the last 20 minutes of a storm of 30 minutes duration is _____.

Answer: (11.74)

40. In laboratory, a flow experiment is performed over a hydraulic structure. The measured values of discharge and velocity are $0.05m^3$ /s and 0.25m/s, respectively. If the full scale structure (30 times bigger) is subjected to a discharge of $270m^3$ /s, then the time scale (model to full scale) value (up to two decimal places) is

Answer: (0.2)

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- 41. A plate in equilibrium is subjected to uniform stresses along its edges with magnitude $\sigma_{xx} = 30$ MPa and $\sigma_{yy} = 50$ MPa as shown in the figure.



The Young's modulus of the material is $2 \times 10^{11} N/m^2$ and the Poisson's ratio is 0.3 if σ_{zz} is negligibly small and assumed to be zero. Then the strain ε_{zz} is

(A) -120×10^{-6} (B) -60×10^{-6} (C) 0.0 (D) 120×10^{-6}

Answer: (A)

42. An RCC short column (with lateral ties) of rectangular cross section of 250mm×300mm is reinforced with four numbers of 16mm diameter longitudinal bars. The grades of steel and concrete are Fe415 and M20, respectively.

Neglect eccentricity effect. Considering limit state of collapse in compression (IS 456:2000), the axial load carrying capacity of the column (in kN, up to one decimal place), is _____.

Answer: (918.83)

43. Consider the deformable pin-jointed truss with loading, geometry and section properties as shown in the figure.

Given that $E=2\times10^{11}$ N/m², A=10mm², L =1 m and P =1 kN. The horizontal displacement of joint C (in mm, up to one decimal place) is _____. Answer: (2.707) **G** Engineering Success

44. The figure shows a simply supported beam PQ of uniform flexural rigidity EI carrying two moments M and 2M.



	The	slope at P	will be										
	(A)	0		(B)	ML/(9E	I)	(C)	ML/(6EI))	(D)	ML/(3H	EI)	
Ansv	ver:	(C)		1									
45.	The u(0)	solution $a = 3x$ and	at x=1, t= $\frac{\partial u}{\partial t}(0) = 3$	1 of ti is	he partial	different	ial equ	ation $\frac{\partial^2 \mathbf{u}}{\partial \mathbf{x}^2}$	$=25\frac{\partial^2 \mathbf{u}}{\partial t^2}$	subje	ect to in	itial cond	litions of
	(A)	1		(B)	2		(C)	4		(D)	6		
Ansv	ver:	(D)											
46.	A sq aeria lengt	uare area l photogr h of the c	(on the su aph. The amera lens	rface o topogi s is 15	of the eart aphic ma 0mm, the	h) with s p shows height fro	ide 100 that a om whi	m and unit contour of ch the aeria	form heig f 650m p al photog	ht, app basses raph w	pears as through vas taker	1 cm ² on the area n, is	a vertical . If focal
Ansv	(A) ver:	800m (C)		(B)	1500m		(C)	2150m		(D)	3150m		
47.	A ca The	ntilever bover the second s	eam of len isplaceme	gth 2n nt at 1	n with a so the free e	quare sec nd is 5m	tion of m. The	side length e beam is	0.1 m is made of	loade steel	d vertica with Yo	ally at the oung's mo	free end.

 2.0×10^{11} N/m². The maximum bending stress at the fixed end of the cantilever is

(A)	20.0MPa	(B)	37.5MPa	(C)	60.0MPa	(D)	75.0MPa

Answer: (B)

(D)

 π^2

48.	The v	value of the integral	$\int_0^{\pi} \mathbf{x} \mathbf{c}$	$\cos^2 x dx$ is		
	(A)	$\pi^2/8$	(B)	$\pi^2/4$	(C)	$\pi^2/2$

Answer: (B)

49. The void ratio of a soil is 0.55 at an effective normal stress of 140kPa. The compression index of the soil is 0.25. In order to reduce the void ratio to 0.4, an increase in the magnitude of effective normal stress (in kPa, up to one decimal place) should be ______.

Answer: (417.35)

50. A closed tank contains 0.5m thick layer of mercury (specific gravity=13.6) at the bottom. A 2.0m thick layer of water lies above the mercury layer. A 3.0 m thick layer of oil (specific gravity=0.6) lies above the water layer. The space above the oil layer contains air under pressure. The gauge pressure at the bottom of the tank is 196.2 kN/m². The density of water is 1000kg/m³ and the acceleration due to gravity is 9.81m/s². The value of pressure in the air space is

(D)

- (A) 92.214 kN/m²
- (C) 98.922kN/m²

(B) 95.644kN/m²

99.321kN/m²

Answer: (A)

51. The following details refer to a closed traverse:

	Consecutive Coordinate								
Line	Northing (m)Southing (m)Easting (m)		Easting (m)	Westing (m)					
PQ		437	173						
QR	101		558						
RS	419			96					
SP		83		634					

The length and direction (Whole circle bearing) of closure, respectively are

2m and 90°

(B)

(A) 1 m and 90°

(C) 1 m and 270°

(D) $2m \text{ and } 270^{\circ}$

Answer: (A)

52. Given the following data: design life n=15 years, lane distribution factor D=0.75. Annual rate of growth of commercial vehicles r=6%. Vehicle damage factor F=4 and initial traffic in the year of completion of construction =3000 commercial Vehicles Per Day (CVPD). As per IRC:37-2012, the design traffic in terms of cumulative number of standard axles (in million standard axles, up to two decimal places) is

Answer: (76.46)

53. A priority intersection has a single lane one way traffic road crossing an undivided two lane two way traffic road. The traffic stream speed on the single lane road is 20kmph and speed on the two lane road is 50kmph. The perception-reaction time is 2.5s, coefficient of longitudinal friction is 0.38 and acceleration due to gravity is 9.81m/s². A clear sight triangle has to be ensured at this intersection. The minimum lengths of the sides of the sight triangle along the two lane road and the single lane road, respectively will be

(A) 50m and 20m

(B) 61m and 18m

(C) 111m and 15m

incubation at 27°C for this wastewater will be ____

· · ·

(B)

Answer:

54.

- (D) 122m and 36m
- The ultimate BOD (L0) of a wastewater sample is estimated as 87% of COD. The COD of this wastewater is 300mg/L. Considering first order BOD reaction rate constant k (use natural Log) = 0.23 per day and temperature coefficient $\theta = 1.047$, the BOD value (in mg/L, up to one decimal place) after three days of

Answer: (160.22)

- **55.** A rapid sand filter comprising a number of filter beds is required to produce 99MLD of potable water. Consider water loss during backwashing as 5%, rate of filtration as 6.0m/h and length to width ratio of filter bed as 1.35. The width of each filter bed is to be kept equal to 5.2m. One additional filter bed is to be provided to take care of break-down, repair and maintenance. The total number of filter beds required will be
 - (A) 19 (B) 20 (C) 21 (D) 22

Answer: (C)