ENGINEERING MATHEMATICS
MOCK BOARD EXAMINATION (D)

1. The area of the triangle bounded by the coordinate axes and the tangent to the curve $y = x^2$ at the point (2, 4) is _____.
   a) 4
   b) 2
   c) 3
   d) 5

2. For what value of x will the curve $y = x^3 - 3x^2 + 4$ be concave upward?
   a) 3
   b) 4
   c) 2
   d) 6

3. If $x = t^2$ and $y = 2t$, find d^2y/ dx^2
   a) $-1/ t^2$
   b) $-1/2t^3$
   c) $-1/ 2t^2$
   d) $-l/ t^3$

4. Find the area bounded by the parabola $x^2 = 8y$ and its latus rectum.
   a) 16/3
   b) 32/3
   c) 22/3
   d) 11/3

5. The point where the sense of concavity of a curve changes is called the
   a) Maximum
   b) Minimum
   c) Inflection
   d) Intersection

6. If $y = \cos^2 x$, then y^1
   a) -2 Sin2x
   b) -Sin2x
   c) -Cos2x
   d) -2Cos2x

7. Find the approximate percentage error made in computing the surface area of a sphere if an error of 20% is made in measuring the radius of the sphere.
   a) 3%
   b) 2%
   c) 4%
   d) 5%

8. Find the equation of the tangent to $y = x^4 - x^2 + 2$ at the point (-1,2)
   a) x + 2y-3=0
   b) 2x+y=0
   c) 2x-y+3=0
   d) 2x-y=0

9. A set of elements that is taken without regard to the order in which the elements are arranged is called a _____.
   a) Sequence
   b) Progression
   c) Combination
   d) Probability

10. If the line through (-1,3) and (-3,-2) is perpendicular to the line through (-7,4) and (x,0). Find the value of x.
   a) 5
   b) 4
   c) 3
   d) 1

11. The graph of $3x^2 – y = y^2 + 6x$ is/an_____.
   a) Parabola
   b) Ellipse
   c) Hyperbola
   d) Circle

12. The radius of a circle is diminished by 20%, then its area will bepoint. diminished by _____.
   a) 46%
   b) 36%
   c) 26%
   d) 16%

13. The base of a right prism is a rectangle with edges 3 cm and 5 cm. If its lateral is 64 sq cm, find its altitude.
   a) 6cm
   b) 4cm
   c) 8cm
   d) 7cm

14. If 16 is 4 more than 3x, then 2x - 5 =?
   a) 2
   b) 3
   c) 4
   d) 1

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15. If the 1st and 4th terms of a harmonic progression are 1/3 and 1/9 respectively, find the 8^{th} term.
    a) 1/17
    b) 1/11
    c) 1/14
    d) 1/13

16. If y = x /2 + (sin2x) /4; find x for which dy/ dx = 0.
    a) π/4
    b) π/2
    c) π/3
    d) π/6

17. At what point of the curve $y = x^3 + 3x$ are the values of y' and y" equal?
    a) (-1, -4)
    b) (2,14)
    c) (1,4)
    d) (0,0)

18. If the 3rd derivative of a function in one variable is equal to zero, then the function is_____.
    a) Quadratic
    b) Cubic
    c) Linear
    d) Quartic

19. A number which can not he expressed as the quotient of two integers is _____.
    a) Rational
    b) irrational
    c) Natural
    d) Prime

20. The angle θ in the polar equation z = r(cosθ + isinθ) is called the_____.
    a) Argument
    b) Modulus
    c) Period
    d) Phase Angle

21. Find the area bounded by the parabola $x^2 = 16(y-1)$ and its latus rectum.
    a. 46.72
    b. 42.67
    c. 47.62
    d. 46.27

22. What is the value of x for which y = $2x^3 - 3x^2 - 36x + 25$ will have an inflection point?
    a. 1/ 3
    b. 1/4
    c. ½
    d. 1/5

23. Find the radius of curvature of $y = 2x^2$ at the point (1, 2).
    a. 17.25
    b. 17.52
    c. 15.72
    d. 15.27

24. The entrance arch of the municipality of San Pedro has the shape of a parabola with vertex at the top and axis vertical. It is 4m wide at the base and 8m high. How wide is its halfway?
    a) 2.83
    b) 3.82
    c) 2.38
    d) 3.28

25. Evaluate $\int_0^1 1- x/ 1 -\sqrt{x}\ dx$
    a) 1.5
    b) 1.8
    c) 1.7
    d) 1.9

26. The graph of $x^3 + y^3 - 3axy = 0$ is called the_____
    a. Cissoid of Diodes
    b. Strophoid
    c. Folium of Descartes
    d. Cycloid

27. At the maximum point, the value of y" is____.
    a. Positive
    b. Negative
    c. Zero
    d. Infinity

28. If 8=0, then the line Ax +By + C = 0 is ___.
    a. Parallel to x-axis
    b. Coincident with y-axis
    c. Parallel to y-axis
    d. Slanting upward

29. Which of the following equations has a graph called the Spiral of Archimedes?

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a. $r\theta = a$
b. $r = a\theta$
c. $r=e^{a\theta}$
d. $\theta=Ln\ (r)$

30. Every point on a parabola is equidistant from a fixed point and a fixed line. The fixed line is called the _____
    a. Asymptote
    b. Latus Rectum
    c. Directrix
    d. Axis

31. If $kx^3 - (k + 3)\ x^2 + 13$ is divided by $x - 4$ and the remainder is 157, then the value of k is
    a. 6
    b. 3
    c. 5
    d. 4

32. If sin A = 4/5. A in quadrant II, sin B = 7/25, B in quadrant I, find sin (A + B).
    a. 4/5
    b. 3/5
    c. 2/5
    d. 3/4

33. If the perimeter of a regular octagon is 160, find the length of its apothem.
    a. 24.41
    b. 21.41
    c. 24.14
    d. 21.14

34. Find the value of x if $(2)\log_2 x = 5$.
    a. 3
    b. 4
    c. 5
    d. 6

35. What is the probability of obtaining at least 4 heads when a coin is tossed 5 times ?
    a. 0.1857
    b. 0.1758
    c. 0.1785
    d. 0.1875

36. Express $-4 - 4\sqrt{3}\ i$ in trigonometric form.
    a. $8\ cis\ 60^o$
    b. $8\ cis\ 120^o$
    c. $8\ cis\ 240^o$
    d. $8\ cis\ 300^o$

37. If $\log_x (1/144) = -2$, and $x > 0$, then x equals
    a. -12
    b. 12
    c. -4
    d. 10

38. If the complement of an angle θ is 2/5 of its supplement, then θ equals
    a) 20^o
    b) 30^o
    c) 40^o
    d) 50^o

39. In how many ways can 8 students at Cambridge University be divided into groups of 2?
    a. 2520
    b. 5040
    c. 2250
    d. 4500

40. If Tan A = 1/3 and Cot B = 4, then, Tan (A + B) is equal to ____
    a. 11/7
    b. 7/11
    c. 7/12
    d. 12/7

41. Simplify sin2A / (1+ cosA)
    a. Cot A
    b. Tan A
    c. Sec A
    d. Sin A

42. The hypotenuse of a right triangle is 34 m and one leg is 14 cm longer than the other. The lengths of the two legs are _____ and _____ cm.
    a. 12 and 30
    b. 14 and 30
    c. 16 and 30
    d. 16 and 12

43. The distance between points (-2, 9) and (4, -7) is
    a. 18
    b. 17.09
    c. 19.07
    d. 19

ENGINEERING MATHEMATICS
MOCK BOARD EXAMINATION (D)

44. How many permutations can be made from the letters A, B, C if all letters are taken at a time?
    a. 5
    b. 4
    c. 6*
    d. 7

45. How many 3 digit numbers may be formed from the digits 0, 1, 2, 3, 4 &5 if no digit may be repeated in a given number?
    a. 100
    b. 200
    c. 300
    d. 400

46. How many 3 digit numbers may be formed from the digits 0, 1, 2, 3, 4 &5 if digits may be repeated in a given number?
    a. 180
    b. 170
    c. 190
    d. 150

47. How many in no.45 are odd?
    a. 38
    b. 28
    c. 48
    d. 58

48. How many in no. 45 are even?
    a. 42
    b. 32
    c. 22
    d. 52

49. How many in no. 46 are even?
    a. 80
    b. 90
    c. 70
    d. 60

50. How many in no. 45 are less than 330?
    a. 42
    b. 52
    c. 32
    d. 22

ENGINEERING MATHEMATICS
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ANSWERS TO PRE-BOARD EXAMINATION

1	A	11	C	21	B	31	D	41	B
2	C	12	B	22	C	32	B	42	C
3	B	13	B	23	B	33	C	43	B
4	B	14	B	24	A	34	C	44	C
5	C	15	A	25	C	35	D	45	A
6	B	16	B	26	C	36	C	46	A
7	C	17	A	27	B	37	B	47	C
8	B	18	A	28	C	38	B	48	D
9	C	19	B	29	B	39	A	49	B
10	C	20	B	30	C	40	B	50	B

1. Equation of Tangent: to find the equation of tangent: y' = 2x = 4 at (2,4); then; y=4=4 (x-2) and the x and y intercepts are at points (0.4) and (1.0). The area of the triangle is A = (1/2) (b) (h) = ½ (4) (2) A=4

2. Take the first derivative of y: $y' = 3x^2 - 6x = 0$;
Then, factoring: $3x(x-2) = 0$; Extracting roots: $x_1 = 0$, $x_2 = 2$

3. $x = t^2 \rightarrow t = \pm\sqrt{x}$ and $y = 2t = \pm 2\sqrt{x}$
$y' = (2)(1/2\sqrt{x}) = 1/\sqrt{x}$; Finally: $y'' = -1/2(x)^{3/2} = -1/2t^3$

4. 4a=8 or a=2=h; b=LR=8
Area = (2/3) (b)(h) = 213 (2) (8) = 32/3

6. y' = 2 (cosx) d/dx cosx = 2cosx (-sinx) = -2sinx cosx = -sin2x

7. $A = 4\pi r^2$ $dA = 4\pi [r^2 - (0.8r)^2] 4.5r^2 \rightarrow \%$
$E = (4.52r^2) / (4\pi r^2) = 0.36 \times 100\% = 36\%$

8. $y' = 4x^3 - 2x$ at P (-1, 2) → y' — 4 $(-1)^3$ - 2 (1) = -2 = slope;
By point-slope formula *The equation of tangent is: y -2= -2 (x+1) or 2x+y= 0

10. m_1 = [3- (-2)1/ [-1 - (-3)= 5/2; in., = -2/5 = (0 -4)/[x - (-7)] or 2(x+7) =20; x=(20-14)/2=3

12. $A_1 = \pi r^2$; $A_2 = \pi(0.8r)^2 = 0.647\pi r^2$ —> $\Delta A = \pi r^2(1 - 0.64) = 0.36\pi r^2$

13. 2(3 + 5)h = 64 → h = 64/16 = 4 cm

14. 3x+4= 16—>x= 12/3 = 4;2x-5=2(4)-5=3

15. The sequence is Given By : { 1/3, 1/5, 1/7 1/9. 1/11, 1/13, 1/15, 1/17 }

16. dy/dx = 1/2 + (2/4) (cos 2x) ; cos 2x = -1, Cos^{-1} (-1) = 2x = π, then x = π /2.

17. $3x^2 + 3 = 6x$; then: $x^2 - 2x + 1 = 0$ or x =1 and y =4 or at point (1, 4).

21. The parabola's vertex is at V(0,1); it opens up; The length of latus rectum is LR=4a= 16:a=4
Area = (2/3) (b) (h) = (2/3) (16) (4) = 42.67

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22. $y'=6x^2 -6x-36 \rightarrow y''=12x-6 \rightarrow 4y' \neq 0$; set $y''=0$
$12x - 6 = 0$, Therefore: $x = ½$

23. $R = \dfrac{[1 + (y')^2)]^{3/2}}{y'}$
$y=2x^2 \rightarrow y'= 4x$ at (1,2)
$y'= 4(1) = 4$, Substituting:

$$R = \frac{[1 + (4)^2]^{3/2}}{4} = 17.52$$

25. $\int_0^1 1 - x/1- \sqrt{x}\, dx = x + 2/3\ (x)\ 3/2 \Big|_0^1 = 1+2/3 =5/3 \approx 1.666$

26. Note: Cissoid of Diodes : $y^2 = x^3/ (2a-x)$; Strophoid : $y^2 = x^2(a+x)/(a-x)$; Cycloid: $x = a (\theta \sin \theta)$ and $y =a (1-\cos\theta)$

29. NOTE: $r\theta = a$ is a reciprocal hyperbolic spiral; $r = e^{ao}$ and $\theta = \text{Ln}r$ are both logarithmic spirals

31. According to the Remainder theorem - "For any constant r, if a polynomial is divided by the binomial x - r until the remainder R is free of x, then R = f(r)." Then, Let:

$f(x)=kx^3-(k+3)x^2+13; x-4 \leftrightarrow x-r \rightarrow r = 4$ and $l57= f(4)$
$\rightarrow k (4)^3 - (k + 3) (4)^2 + 13 = 157;$
Expanding: $64k - 16k - 48 + 13 - 157 = 0$ or
$48k = 192,$
Finally, $k = 192/48 = 4$

32. Sin A = 4/5 ; A in QII Sin B = 7/25 B in QI; By trigonometric Identities:
Sin (A+B) = Sin A cosB + cosA + 5mB; and substituting values:
Sin (A + B) = (4/5) (24/25) + (-3/5) (7/25) = 3 / 5

33. P = Perimeter of Polygon; P = 160; n = 8; P = nb; or 160 = 8b; Therefore: b = 20;
a = apothem of polygon ; n = number of sides of polygon;
and : $\theta = 360 / 8 = 45^0$
$P = 2(a)(n) [\text{Tan} (180^o/ n)]$; $160 = 2a(8)\tan (180/8)$;
If $\cot(\theta/2) = a / (b/2)$; then: $a = b/2 \cot (\theta/2)$; $a = 20/2\cot (45^o/2)$ or $a = 24.14$

34. $(2)^{\log_2 x} = 5$; $\log_2 (2)\log_x^x = \log_2 5$; $\log_2^x \log_2 5$; $\log_2 x = \log 5$; then: $x = 5$

35. Pr ($x \geq 4H$) at n = S times; Pr ($x \geq 4$) = Pr ($x = 4H$) + Pr ($x = 5H$)
Pr ($x \geq 4$) = ${}_5C_4(1/2)^4\ (1/2)^1 + {}_5C_5(1/2)^5\ (1/2)^0 = 0.1875$

NOTE: The sample space and corresponding probabilities are:

{HHHHH) + $(1/2)^5 = 0.03125$ and {HHHHT, HHHTH, HHTHH, HTHHH, THHHH} Pr ($x = 4$) = $5(1/2)^4\ (1/2) =0.15625$
$\sum$ Pr (X) = 0.03125 + 0.15625 = 0.1875

37. $\log_x (1/144) = -2$; $x> 0$; $1/144 = x^{-2}$; $1/ (12)^2 = x^{-2}$; $(12)^{-2} = x^{-2}$ $x = 12$

38. $2/5 (180 - \theta) = (90^0 - \theta)$ or $\theta = 90^0/3 = 30^0$

39. $N = ({}_8C_2)({}_6C_2)({}_4C_2)({}_2C_2) = 2520$

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40. Tan A = 1/3 ; If Cot B = 4, then, Tan B = 1/4. By trigonometric identities:
Tan (A + B) = $\frac{\text{Tan A + Tan B}}{[1 - (\text{Tan A})(\text{Tan B})]}$ = $\frac{(1/3) + 1/4)}{1 - (l/3)(1/4)}$; Finally: Tan (A + B) = 7/11

41. [2 (Sin A)] / (2 Cos^2A) = Sin A / Cos A = Tan A

42. Let x = 1 side; y = longer side; then, by Pythagorean Theorem : $(34)^2 = x^2 + (x + 14)^2$ or $2x^2 + 28x - 960 = 0$

Extracting roots; x = 16: y = 16 + 14 = 30

43. By Pythagorean Theorem,

$D^2=([(4) - (4)]^2 + [(-7) - (9)]^2 = (6)^2 + (16)^2 = 292$; therefore: Distance = 17.088 linear units