MOCK BOARD EXAMINATION IN
ENGINEERING MATHEMATICS

June 3, 2009

1. A man is three times as old as his son. Five years ago. He was five times old as his son was at that time. How old is the son.
   a. The son is 10 years old.
   b. The son is 12 years old.
   c. The son 9 years old.
   d. The son is 15 years old.

2. Two years ago, a boy is 2/3 as old as his sister. In two years, the boy will be ¾ as old as she. How old are they?
   a. The boy is 10 yrs. old and his sister is 14 years old.
   b. The boy is 12 years old
   c. The sister of the boy is older than him.
   d. The boy is 13 yrs. old and his sister is 14 yrs. old.

3. Mary is twice as old as Ana was when Mary was as old as Ana is now.
How old is Ana?
   a. Ana is 16 yrs. old.
   b. Ana is 15 years old.
   c. Ana is 17 years old.
   d. Ana is 13 years old.

4.The sum of the parents' ages is twice the sum of their children's ages. Five years ago, the sum of the parents' ages is four times the sum their children's ages.
In 15 years, the sum of the parents' ages will be equal to the sum of their children's ages.
How many children are there?
   a. There are 4 children
   b. There are 6 children
   c. There are 5 children
   d. There are 2 children

5. A and B can do a piece of work in 20 days, B and C in 30 days, C & A in 40 days. How long can each worker do the work alone?
   a. $t_A = 1/A = 240/5 = 48$ days; $t_B = 1/B = 240/7 = 34.3$ days; $t_C = 1/C = 240/1 = 240$ days
   b. $t_A = 1/A = 240/4 = 60$ days; $t_B = 1/B = 240/6 = 40$ days; $t_C = 1/C = 240/2 = 120$ days
   c. $t_A = 1/A = 240/6 = 40$ days; $t_B = 1/B = 240/7 = 34.3$ days; $t_C = 1/C = 240/1 = 240$ days
   d. $t_A = 1/A = 240/3 = 80$ days; $t_B = 1/B = 240/1 = 240$ days; $t_C = 1/C = 240/4 = 60$ days

6. Ding can finish a job in 8 hours. Tito can do it in 5 hrs. If Ding worked ahead for 3 hours and then Tito was asked to help him finish it, how long will Tito have to work with Ding?
   a. t = 1.90 hrs.
   b. t = 1.00 hr
   c. t = 1.92 hrs.
   d. t = 1.94 hrs.

7. A pipe can fill up the tank with the drain open in 3 hrs. If the pipe runs with the drain open for 1 hr. and then the drain is closed, it will take 45 more minutes for the pipe to fill up the tank. If the drain will be closed right at the start of filling, how long will the pipe be able to fill up the tank?
   a. 1.30 hr.
   b. 1.40 hr
   c. 1.25 hr
   d. 1.00 hr

8. How much tin and how much lead can be added to 700 kg of an alloy containing 50% tin and 25% lead to make an alloy which is 60% tin and 20% lead?
   a. Add 175 kg of lead and no lead.
   b. Add 170 kg of tin with lead
   c. Add 175 kg of lead and tin
   d. Add 175 kg of tin and no lead

9. A man bought 20 pcs of assorted calculators for P20, 000. These calculators are three types, namely:
   a) Programmable at P3000/pc.
   b) Scientific at P1500/pc.
   c) Household type at P500/pc.
How many of each type did he buy?
   a. 3 pcs programmable type; 4 pcs scientific type; 10 pcs household type
   b. 2 pcs programmable; 5 pcs scientific; 13 pcs household
   c. 5 pcs scientific; 2 pcs programmable; 12 pcs household
   d. 2 pcs programmable; 4 pcs scientific; 13 households

10. Find the smallest number which when: you divide by 2, the remainder is 1; you divide by 3, the remainder is 2; you divide by 4, the remainder is 3; you divide by 5, the remainder is 4; and when you divide by 6, the remainder is 5.
   a. x = 59
   b. x = 49
   c. x = 35
   d. x = 65

11. The sum of the digits of a 3 – digit number is 17. The hundred's digit is twice the unit's digit. If 396 were subtracted from

the number, the order of the digits will be reversed. Find the number.

a. 845
b. 584
c. 854
d. 458

12. The sum of the digit of a 3 – digit number is 17. The hundred's digit is twice the unit's digit. Find the number.

a. 683 and 584
b. 386 and 854
c. 683 and 854
d. 863 and 854

13. At what time after 3'oclock will the hands of the clock be together?

a. 3:16.36
b. 3:10.00
c. 3:20.30
d. 3:60.36

14. Expand $(x^2-2y)^6$

a. $Q = x^{12} – 12x^{10}y + 60x^8y^2 – 160x^6y^3 + 240x^4y^4 – 192x^2y^5 – 64y^5$
b. $Q = x^{14} – 12x^{12}y + 60x^{10}y^2 – 160x^8y^3 + 240x^6y^4 – 192x^2y^5 – 64y^5$
c. $Q = x^{12} – 12x^{10}y^2 + 60x^8y^3 – 160x^6y^4 + 240x^4y^5 – 192x^2y^6 – 64y^7$
d. $Q = y – 12x^{10}y^2 + 60x^8y^4 – 160x^6y^6 + 240x^4y^8 – 192x^2y^{10} – 64y^{12}$

15. Find the middle term in the expansion of $(x2-2y)^{10}$

a. $8064x^{10}y^5$
b. $–8064x^{10}y^5$
c. $6084x^{10}y^5$
d. $–6084x^{10}y^5$

16. In the expansion of $(x^2-2y)^{10}$, find the term involving a) y^3 ; b) x^{12}

a. 5^{th} term, 5^{th} term
b. 2^{th} term, 5^{th} term
c. 3th term, 5^{th} term
d. 4th term, 5^{th} term

17. In the expansion of $(x^2- 1/x^3)^{30}$, find the term (or term free of x).

a. 13^{th} term
b. 14^{th} term
c. 15^{th} term
d. 16^{th} term

18. The midpoint of the sides of a 2m x 2m square are interconnected to form a smaller square. The midpoints of the sides of the square formed are again interconnected to form another smaller square. If the process will be repeated indefinitely, find the sum of the areas of all the squares formed including that of the original square.

a. $S_\infty = 6$ sq.m.
b. $S_\infty = 7$ sq.m
c. $S_\infty = 8$ sq.m
d. $S_\infty = 5$ sq.m

19. At what time after 3'oclock will the hands of the clock be bisected by the second hand?

a. 3:00:07.57
b. 3:59:02.50
c. 3:00.07.57
d. 3:45.57

20. A and B can do a piece of work in 20 days, B and C in 30 days, C & A in 40 days. If the three work together, how long will they be able to finish the job?

a. t = 240/12 days
b. t = 240/13 days
c. t = 240/14 days
d. t = 240/10 days

21. Solve for x, y & z in the following simultaneous equation:
$x^y x^z = 100\ 000 \rightarrow$ equation 1;
$x^y/x^z = 10 \rightarrow$ equation 2;
$(x^y)^z = 1\ 000\ 000 \rightarrow$equation 3.

a. x = 10, y = 3, z = 1
b. x = 10, y = 3, z = 2
c. x = 10, y = 4, z = 2
d. x = 10, y = 2, z = 3

22. Solve for x in: $\log_2 \log_3 \log_x 2 = 1$

a. $x = \sqrt[6]{2}$
b. $x = \sqrt[4]{2}$
c. $x = \sqrt[8]{2}$
d. $x = \sqrt[9]{2}$

23. Solve for x, $\log x^2 – \log 5x = \log 20$

a. 200
b. 250
c. 100
d. 75

24. When you divide $(x^4 - ax^3 - 2x^2 - 3+ b)$ by (x - 1), the remainder is +2. When you divide it by x + 2, the remainder is –1. Find a & b.

a. a = – 7/3, b = 11/3
b. a = 7/3, b = -11/3
c. a = -7/3, b = -11/3
d. a = 7/3, b = 11/3

25. Derive the Pythagorean Theorem

a. $a^2 + b^2 = c^2$
b. $a^3 + b^3 = c^3$
c. $a + b = c$
d. $a^4 + b^4 = c^4$

26. At what time after 3'oclock will the hands of the clock be opposite each other?

a. 3:49.09
b. 3:30.02
c. 3:00.00
d. 3.45.60

27. Solve for the interior angles of the pentagram.

a. 60^0

b. 180^0
c. 90^0
d. 360^0

28. Find the area of hex decagon of trimester 32 units.
a. 80.44 sq. units
b. 90.44 sq. units
c. 50.55 sq. units
d. 50.44 sq. units

29. At a certain instance, the captain of a ship observed that the angle of elevation of the top of a lighthouse 50 meters above the water level is $60^{0.}$ After traveling directly away from the lighthouse for 5 minutes, the same captain noticed that the angle of elevation is now just 30^0. If the telescope is 6 meters above the water line, find the velocity of the ship.
a. 11.16m/min
b. 10.16m/min
c. 15.16m/min
d. 16.10m/min

30. Find the diameter of the circumscribing semi-circle.
a. 7.056 units
b. 6.056 units
c. 5.056 units
d. 8.056 units

31. Find the radius of the small circle
a. 23
b. 24
c. 25
d. 30

32. Find the area of the shaded region.
a. 25π sq. units
b. 23π sq. units
c. 22π sq. units
d. 20π sq. units

33. Find the area of the shaded region.
a. 2π sq. units
b. 3π sq. units
c. 4π sq. units
d. 5π sq. units

34. Find the area of the shaded region.
a. 3.97 sq. units
b. 3.87 sq. units
c. 3.67 sq. units
d. 3.57 sq. units

35. An equilateral triangle with inscribed circle is drawn inside a circle whose radius is 2m.
Another equilateral triangle with inscribed circle is drawn inside the smaller circle, and so on and so forth. Find the sum of perimeters of all triangles drawn.
a. S = 12√1m.
b. S = 15√3m.
c. S = 13√ 3m.
d. S = 12√3m.

36. Four grapefruits (considered spheres) 6cm in diameter were placed in a square box whose inside base dimensions are 12cm by 12 cm. In the space between the first four grapefruit, a fifth of the same diameter was then placed on top of them. How deep must the box be so that the top will just touch the fifth grapefruit?
a. h = 10.24cm
b. h = 15.24cm
c. h = 11.24cm
d. h = 12.24cm

37. A spherical ball of radius 3 cm was drooped into a conical vessel of depth 8 cm and radius of base 6 cm. what is the area of the portion of the sphere which lies above the circle of contact with the cone?
a. A = 90.48.
b. A = 80.48
c. A = 90.38
d. A = 80.38

38. Find the volume of the solid common to two cylinders intersecting at 90^0 angle if radius of cylinders are both 3m.
a. $133cm^3$
b. $122cm^3$
c. $144cm^3$
d. $111cm^3$

39. Find the volume of a right conoid whose radius of base is 1m and every cross section is an isosceles of altitude 2m.
a. π sq. unit
b. π cu. sq. unit
c. π km unit
d. π cu. Unit

40. Find the location of the center of the circle defined by the equation, $X^2 + y^2 + 4x – 6y – 12 = 0$
a. center at (2, 3)
b. center at (-2, 3)
c. center at (3, 2)
d. center at (-3, 2)

41. Find the equation of a parabola whose latus rectum is joined by points (2, 1) & (-4, 1).
a. $(x + 1)^4 = 6 (y- 5/2)$
b. $(x +1)^2 = 6 (y +5/2)$
c. $(x – 1)^2 = -6(y –5/2)$
d. $(x + 1)^2 = -6(y-5/2)$

42. A car headlight reflector is cut by a plane along its axis. The section is a parabola having the light center at the focus. If the distance of focus from vertex is ¾ cm, and if the diameter of reflector is 10cm, find its depth.
a. 25/3 cm

b. 24/2 cm
c. 25/2 cm
d. 24/3 cm

43. Find the equation of an ellipse with axis parallel to X-axis, center at (0, 0), eccentricity is 1/3, and distance between foci is 2.
a. $x^2/9 + y^2/8 = 1$
b. $x/9 + y/8 = 1$
c. $x^3/9 + y^3/8 = 1$
d. $x/8 + y/9 = 1$

44. Find the equation of the locus of a point that moves so that difference of its distance form points (-4, 0) and (4, 0) is 6.
a. $(x–2)^2/9 – (y–k)^2 = 1$
b. $((x+0)^2/9 – (y-k)^2 = 1$
c. $(x-0)^2/9 – (y-k)^2 = 1$
d. $(x-0)^2/9 + (y- k)^2$

45. The altitude and radius of a cone were measured and found to be 2m and 1m respectively. If the maximum possible errors in measurement are 3cm and 2cm respectively, find the maximum possible error in calculating the volume.
a. 0.109 cu. meter
b. 0.115 cu. meter
c. 0.125 cu. meter
d. 0.151 cu. Meter

46. A 6 ft. tall man walks away from a 20 ft. high lamppost at the rate of 3 ft/sec. Find:
a) How fast is the tip of his shadow moving?
b) How fast is the length of his shadow changing?
a. 6/14 ft/sec
b. 3/7 ft/sec
c. 6/7 ft/sec
d. 9/7 ft/sec

47. A dive-bomber is losing altitude at the rate of 600 km/hr. How fast is the visible surface of the earth decreasing when the bomber is 1km high? Assume that the radius of the earth is equal to 6400 km.
a. The visible area is decreasing at 20.12×10^6 km^2/hr
b. The visible area is decreasing at 23.12×10^6 km^2/hr
c. The visible area is decreasing at 20.12×10^6 km^2/hr
d. The visible area is decreasing at 24.12×10^6 km^2/hr

48. Find the angle that the parabola $x^2 = y + 2$ makes with the x – axis.
a. $\theta = 71.53^0$
b. $\theta = 70.53^0$
c. $\theta = 69.53^0$
d. $\theta = 72.53^0$

49. Divide 90 into 3 parts so that their product is in its maximum.
a. the numbers are 30, 40 and 20
b. the numbers are 30, 30 and 30
c. the numbers are 30, 35, and 25
d. the numbers are 40, 25 and 25

50. Find the minimum possible sum for three positive numbers whose product is 27.
a. 9
b. 8
c. 5
d. 4

ANSWERS: MOCK BOARD IN ENGINEERING MATHEMATICS (C)

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

SOLUTION:

1.

	5yrs	is	Will be
man	5y	3x	
son	y	X	

Key equation:

5(x-y = 5) →equation 1

(3x-5y=5) →equation 2

(-)5x-5y = 25

- 2x = -20

y = 10

Therefore: The son is 10 years old.

2.

	(2 yrs ago) was	(now) is	(2 yrs from now will be
Boy	2/3 x	2/3 x + 2	3/4y
sister	x	x +2	y

y – x = 4 →equation 1

¾ y – 2/3 x = 4 →equation 2

consider time elapsed from was to will be:

9 (y – x = 4)

12 (3/4 y – 2/3 x = 4)

9y – 8x = 48

9y – 9x = 36

x = 12

x + 2 = 14

2/3x+2 = 10

Therefore:

The boy is 10 yrs. old and his sister is 14 yrs. old.

3.

	was	is	Will be
Mary	2x	24	
Ana	X	2x	

Key equation:
2x – x = 24 – 2x
x = 8
2x = 16
Therefore:
Ana is 16 years old
Note: this solution is based on the interpretation that the time condition, 'when Mary was old as Ana is now' refers entirely to the statement, 'Mary is twice as old as Ana was' and not only to the phrase, 'Ana was'. This being the case, the solution and answer will be the same even as we change the problem into:

Mary is 24 years old.
Mary was twice as old as Ana was when Mary was old as Ana is now.
How old is Ana?

4. Let: n = no. of children
A = average age of children at present
A – 5 = average age of children 5 years ago
A + 5 = average age of children in 15 yrs.
SUM OF AGES:

	was	is	Will be
Parents	4n(A-5)	2nA	N(a+15)
Children	N(A-5)	nA	N(A+15)

Consider the time elapsed from was to is for parents:
2nA-4n(A-5) = 10
-2nA+20n = 10 →divide by 2
-nA+10n = 5 → equation 1
consider time elapsed(is to will be)
n(A+15) –2nA = 30
-nA + 15n = 30→equation 2
-nA + 10n = 5 →equation 1
5n =25
n = 5
Therefore:
There are 5 children

5. Let a) A = Rate of workman "A"; b)B = rate of workman "B"; c)C = rate of workman "C"
CONDITION 1:
A(20)+B(20) = 1 →equation 1
CONDITION 2:
B(30)+c(30) = 1 →equation 2
CONDITION 3:
A(40)+C(40) = 1 →equation 3
Solving the 3 equations simultaneously:
A = 5/240

B = 7/240
C = 1/240
Therefore:
$^{t}A = 1/A = 240/5 = 48$ days
$^{t}B = 1/B = 240/7 = 34.3$ days
$^{t}C = 1/C = 240/1 = 240$ days

6. let t = time Tito worked with Ding to finish the job.
CONDITION 1: $t_D = 8$
$D = 1/t_D = 1/8$
CONDITION 2: $t_T = 5$
$T = 1/t_T = 1/5$
CONDITION 3: D(3)+T(t)+(t) = 1
1/8(3)+1/5 t + 1/8 t = 1
t = 1.92 hrs.

7. CONDITION 1: A(3)-B(3hrs)=1 →equation 1
CONDITION 2: A(1)-B(1hr)+A(0.75hr)=1
Multiply by 3
5.25A-3B=3→subtr. eqtn. 1 (-)3A-3B = 1 →equation 1

2.25A = 2
A = 2/2.25
$t_A = 1/A = 2.25/2 = 1.25$hr

8.

Given alloy	tin	lead	Resulting alloy
50% tin	100% tin	0% tin	60% tin
25% lead	0% lead	100% lead	20% lead
700kg +	x	+ y	=700+x+y

Consider tin content: 50%(700)+100%x+0%y = 60%(700+x+y)
350+x = 420+0.6x+0.6y
0.4x – 0.6y = 70 →equation 1
consider lead content:
25%(700)+0%x+100%y = 20%(700)+x+y)
175+y = 140+0.2x+0.2y
0.2x+0.8y=-35→multiply by 2
0.4x+1.6y = 70→subtr. eqn. 1
(-)0.4x-0.6y = 70→equation 1

y = 0 →substitute to equation 1
0.4x-0.6(0) = 70
x = 70/0.4 = 175kg
thus: Add 175kg of tin and no lead.

9.

Progra-mmable	Sci entific	Hous ehold	Assort-ment
P3000 /pc	P1500 /pc	P500 /pc	
X + y + Z = 20 pcs			

3000x 1500y 500z 20000

Key equation:
X+y+z = 20
3000x+1500y+500z= 20000→divide by 500
6x+3y+z = 40→equation 2
x+y+z = 20 → equation1
subtract equation 1 form equation 2
6x+3y+z = 40→equation 2
(-)x+y+z = 20→ equation 1

5x + 2y = 20
y = 20-5x/2

Note: only two available equations can be derived. Although there are 3 unknowns, the problem can b solved because x, y, and z are positive whole numbers.
By trial and error:
When:
X = 1 y = 7.5 n.a
X = 2 y = 5 ok!
X= 3 y = 2.5 n.a
Thus x = 2, y = 5
From equation 1:
Z = 20-x-y = 13
Thus: the man bought 2 pcs of programmable, 5 pcs of scientific and 13 pcs of household type of calculator.

10. Let x = the number
CONDITION 1:
x/2 = A+1/2
CONDITION 2:
x/3 = B +2/3
CONDITION 3
x/4 = C +3/4
CONDITION 4:
x/5 = D+4/5
CONDITION 5:
x/5 = E+5/6
A, B, C, D, E, and X are whole numbers
From condition 1:
x must be odd
From condition 4:
X must be a number divisible by 5+the remainder 4
If it ends with 0+4 = 4→ even
If it ends with 5+4 = 9→ odd
Thus, x must end with 9

By trial and error:
When:
x=9, B= (9-2)/3=7/3→not ok
x=49, B=47/3→ not ok
x=59, B=57/3=19→ok
C=(59-3)/4=56/4=14ok
E=(59-5)/6=9→ ok
Thus:
X = 59

11. CONDITION 1:
x+y+z = 17→ equation1
CONDITION 2:
X = 2z →equation 2
CONDITION 3:
(100x+10y+z) –396=100z+10y+x
99x-99z=396 →divide by 99
x-z = 4 →substitute eqn. 2
2z-z = 4
z = 4
From equation 2:
X = 2z
X = 8
From equation 1:
Y=17-x-z
Y=5
Thus:
The number is 854

12.
x+y+z = 17 →equation 1
x = 2z →equation 2
when:
z=1 x=2 y=14 → not ok
z=2 x=4 y=11→not ok
z=3 x=6 y=8 →ok
z=4 x=8 y=5 →ok
z=5 x=10 → not ok
thus:
The numbers are 683 and 854.

13. key equation
15 mins+M/12 = M
M=16.36 mins.
Thus:
The time is 3.16.36
Another solution:
By Padilla's formula:
M=2/11(∠referene±reqd)
M=2/11($90^0 \pm 0^0$)
M=16.36 mins

14. no. of terms=n+1=6+1=7

Let:
$Q=(x^2-2y)^6$
$Q=1(x^2)^6(2y)^0- \ 6(x^2)^5(2y)^1+15(x^20^4(2y)^2$
$-20(x^2)^3(2y)^3+15(x^2)^2(2y)^4$
$-60(x^2)^1(2y)^5+1(x^2)^0(2y)^6$
$Q=x^{12}\ 12x^{10}y+60x^8y^2-160x^6y^3+240x^4y^4-192x^2y^5+64y^6$

19. key equation:
15mins+M/12=M+2Θ → equation 1
but
θ = 60M-M
θ =50M →substitute to eqn. 1
thus:
15+M/12=M+2(59M)
15=118.9167M
M=0.126 min
M=7.57 seconds
Required time is 3:00:07.57

20. let t = time for A, B, and C to finish the job by working together.

$At+Bt+Ct = 1$

$(A+B+C)t = 1$

$$t = \frac{1}{A + B + C}$$

$$t = \frac{1}{5/240+7/240+1/240}$$

t = 240/13 days

26. **key equation:**

45 mins+M/12 = M

M=49.09 mins

Thus:

The time is 3:49.09

ANOTHER SOLUTION:

By Padilla's formula:

M=2/11

$M=2/11(90^0+180^0)$

M=49.09mins