Part I

Answer 30 questions from this part. Each correct answer will receive 2 credits. No partial credit will be allowed. Write your answers on a separate sheet. Where applicable, answers may be left in terms of π or in radical form.

1 Express the sum of $\sqrt{-49}$ and $2\sqrt{-16}$ as a monomial in terms of i.

2 Find the value of $\sum_{n=1}^{3} (2n - 1)$.

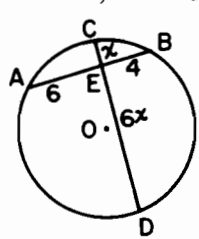
3 Express $\dfrac{1}{3 - \sqrt{3}}$ as an equivalent fraction with a rational denominator.

4 Perform the indicated operations and express in simplest form:

$$\left(\frac{x + y}{x}\right)\left(\frac{xy}{x^2 + 2xy + y^2}\right)$$

5 Solve for y: $\dfrac{3}{y} = 2 + \dfrac{5}{y}$

6 In the diagram below, chords $\overline{AB}$ and $\overline{CD}$ of circle O intersect in E. If $AE = 6$, $EB = 4$, $CE = x$, and $ED = 6x$, find CE.



7 Given the set of functions: $\{\sin x, \cos x, \tan x\}$. What is the probability that a function chosen at random from this set is positive in both Quadrants I and III?

8 If $\log n = 0.5459$, find n to the *nearest thousandth.*

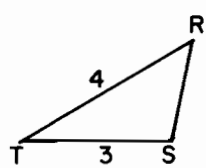
9 Find the numerical value of $\sin(-270°)$.

10 If $\tan A = \frac{1}{3}$, find the value of $\tan 2A$.

11 A diagonal is drawn in a rectangle whose dimensions are 10 cm by 50 cm. Find the tangent of the angle formed by the diagonal and the longer side.

12 Express the product $5i(3i - 2)$ as a complex number in $a + bi$ form.

13 In the accompanying diagram of $\triangle RST$, $ST = 3$ and $RT = 4$. If $m\angle T = 30$, find the area of $\triangle RST$.



14 If $\cos x = \frac{1}{8}$ where x is an acute angle, find the value of $\cos \frac{x}{2}$.

15 Solve the equation $\sqrt{2 \sin x + 7} = 3$ for the smallest positive value of x.

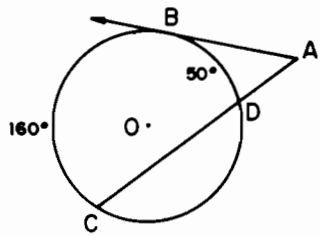
16 If $3^{x+2} = 9^x$, what is the value of x?

17 If $f(x) = 3 \cos \frac{x}{3}$, find $f(\pi)$.

18 In $\triangle ABC$, $a = 4$, $b = 5$, and $\cos C = \frac{1}{8}$. Find the length of side c.

19 In the accompanying diagram, $\overrightarrow{AB}$ is tangent to circle O at B and $\overline{ADC}$ is a secant.

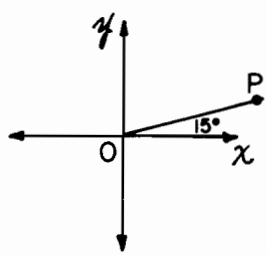
If $m\overset{\frown}{BD} = 50$ and $m\overset{\frown}{BC} = 160$, find $m\angle A$.



Directions (20–35): For *each* question chosen, write on the separate answer sheet the *numeral* preceding the word or expression that best completes the statement or answers the question.

20 In the accompanying diagram, $\overline{OP}$ forms an angle of 15° with the x-axis. The reflection of $\overline{OP}$ in the y-axis is $\overline{OP'}$. What is the measure of $\angle POP'$?

(1) 30
(2) 75
(3) 135
(4) 150



21 A set of measures that follows a bell curve has a mean of 50 and standard deviation of 5. Approximately what percent of the measures fall between 45 and 55?

(1) 34
(2) 68
(3) 95
(4) 98

22 The expression $\sin\theta(\csc\theta - \sin\theta)$ is equivalent to

(1) 1
(2) $\cos\theta$
(3) $\tan\theta - 1$
(4) $\cos^2\theta$

23 Which relation is *not* a function?

(1) $\{(x,y)|y = \sin x\}$ (3) $\{(x,y)|y = 4\}$

(2) $\{(x,y)|y = -x\}$ (4) $\{(x,y)|x = 4\}$

24 The graph of the equation $y = x^2 + 2x - 8$ intersects the x-axis at

(1) 2 and -4 (3) -2 and -4

(2) -2 and 4 (4) 2 and 4

25 The expression $\log 3x$ is equivalent to

(1) $(\log 3)(\log x)$ (3) $\log 3 + \log x$

(2) $3 \log x$ (4) $\log (3 + x)$

26 A fair die is tossed three times. The probability of obtaining exactly 2 fives is

(1) $\frac{1}{72}$ (3) $\frac{25}{72}$

(2) $\frac{5}{72}$ (4) $\frac{67}{72}$

27 The roots of the equation $-x^2 + x + 6 = 0$ are

(1) real, rational, and unequal

(2) real, irrational, and unequal

(3) real, rational, and equal

(4) imaginary

28 If $y = \cos(\text{Arc sin } \frac{\sqrt{3}}{2})$, then y is equal to

(1) $\frac{\sqrt{3}}{2}$ (3) 30°

(2) $\frac{1}{2}$ (4) 60°

29 A circle has a radius of 6 centimeters. What is the number of radians in a central angle which has an arc of length 12 centimeters?

(1) $\frac{1}{2}$ (3) 18

(2) 2 (4) 72

30 What is the solution set of the equation $|3x + 2| = 5$?

(1) $\{1\}$
(2) $\{\frac{7}{3}\}$
(3) $\{1, -\frac{7}{3}\}$
(4) $\{-1, \frac{7}{3}\}$

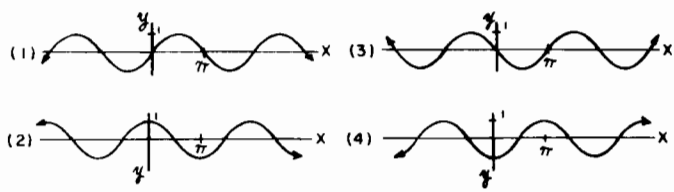
31 Which is the fourth term in the expansion of $(x + 3)^5$?

(1) $270x^2$
(2) $135x^2$
(3) $+405x$
(4) $+135x$

32 The value of $\frac{1}{2^{-3}}$ is

(1) $\frac{1}{8}$
(2) $\frac{1}{6}$
(3) 6
(4) 8

33 Which graph represents the reflection over the x-axis of the curve $y = \sin x$?

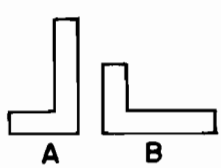


34 As angle θ increases from 0 to π, the value of $\cos \theta$ will

(1) decrease, only
(2) increase, only
(3) decrease then increase
(4) increase then decrease

35 Figure B is the image of figure A under which single transformation?

(1) line reflection
(2) translation
(3) rotation
(4) glide-reflection



Part II

Answer four questions from this part. Show all work unless otherwise directed.

36 *a* On the same set of axes, sketch and label the graphs of $y = \sin x$ and $y = 2 \cos x$ in the interval $-\pi \leq x \leq \pi$. [8]

b For how many values in the interval $-\pi \leq x \leq \pi$ does $\sin x = 2 \cos x$? [2]

37 A class of students obtained the following results on a test:

4 students received 90%
5 students received 80%
8 students received 70%
3 students received 60%

For these scores, find the:

a mean [3]

b standard deviation to the *nearest tenth* [7]

38 *a* Solve the equation $x^2 + 2x + 10 = 0$ and express the roots in $a + bi$ form. [4]

b Prove the identity:

$$\sin 2x = \frac{2 \tan x}{1 + \tan^2 x} \quad [6]$$

39 *a* Given the function $f = \{(x,y) | y = \log_2 x\}$.

(1) Sketch the graph of f. [4]

(2) Write an equation for f^{-1}, the inverse of f. [2]

b Using logarithms, find $\sqrt[3]{432}$ to the *nearest hundredth*. [4]

40 Given points $A(0,0)$, $B(8,6)$, and $C(8,0)$.

a Graph $\triangle ABC$. [1]

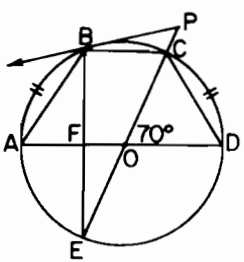
b Graph and state the coordinates of $\triangle A'B'C'$, the image of $\triangle ABC$ after the transformation $D:(x,y) \rightarrow (\frac{3}{2}x, \frac{3}{2}y)$. [3]

c Graph and state the coordinates of $\triangle A''B''C''$, the image of $\triangle ABC$ after a reflection in the line $x = 2$. [3]

d Graph and state the coordinates of $\triangle A'''B'''C'''$, the image of $\triangle ABC$ under the transformation $G:(x,y) \rightarrow (x+3, y-7)$. [3]

41 In $\triangle ABC$, $m\angle B = 38°$, $m\angle C = 56° 20'$, and $a = 12$. Find the length of side c to the *nearest integer*. [10]

42 In the accompanying diagram, $ABCD$ is inscribed in circle O, $m\angle COD = 70$, $\overline{AOD}$ is a diameter, $\overrightarrow{PB}$ is tangent to circle O at B, $\overline{PCOE}$ is a secant, and $m\overset{\frown}{BA} = m\overset{\frown}{CD}$.



Find:

a $m\overset{\frown}{BC}$ [2]

b $m\angle PBC$ [2]

c $m\angle A$ [2]

d $m\angle BPE$ [2]

e $m\angle AFE$ [2]