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HARRISON COLLEGE

FOURTH FORM MATHEMATICS

INTERNAL PROMOTION EXAMINATION 2015 - 2016

DURATION: 2 hour and 15 minutes

GENERAL INSTRUCTIONS TO CANDIDATES

1. This question paper consists of SIX printed pages.
2. Write your name clearly on **EACH** sheet of paper used.
3. All 15 questions in SECTION A and all 5 questions in SECTION B are to be attempted.
4. All working for SECTION B must be clearly shown.
5. Number your responses carefully and identically (including any associated parts) as they appear on the question paper.
   Do **NOT** write ANY responses beside each other.
6. Calculators are allowed.
7. If a numerical answer cannot be given **exactly**, and the accuracy required is not specified in the question, then in the case of an angle it must be given correct to **one (1)** decimal place, in other cases it **must** be given correct to **three (3)** significant figures.
8. The maximum mark for this examination is 75.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

LIST OF FORMULAE

Volume of a prism

$V = Ah$ where A is the area of a cross-section and h is the perpendicular length.

Volume of cylinder

$V = \pi r^2 h$ where r is the radius of the base and h is the perpendicular height.

Volume of a right pyramid

$V = \frac{1}{3}Ah$ where A is the area of the base and h is the perpendicular height.

Circumference

$C = 2\pi r$ where r is the radius of the circle.

Arc length

$S = \frac{\theta}{360} \times 2\pi r$ where θ is the angle subtended by the arc, measured in degrees.

Area of a circle

$A = \pi r^2$ where r is the radius of the circle.

Area of a sector

$A = \frac{\theta}{360} \times \pi r^2$ where θ is the angle of the sector, measured in degrees.

Area of trapezium

$A = \frac{1}{2}(a + b)h$ where a and b are the lengths of the parallel sides and h is the perpendicular distance between the parallel sides.

Roots of quadratic equations

If $ax^2 + bx + c = 0$,

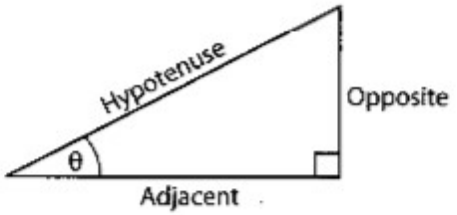
then $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Trigonometric ratios

$\sin\theta = \frac{\text{opposite side}}{\text{hypotenuse}}$

$\cos\theta = \frac{\text{adjacent side}}{\text{hypotenuse}}$

$\tan\theta = \frac{\text{opposite side}}{\text{adjacent side}}$



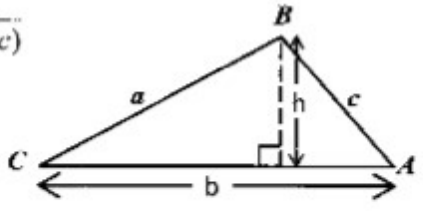
Area of triangle

Area of $\Delta = \frac{1}{2}bh$ where b is the length of the base and h is the perpendicular height.

Area of $\Delta ABC = \frac{1}{2}ab\sin C$

Area of $\Delta ABC = \sqrt{s(s-a)(s-b)(s-c)}$

where $s = \frac{a + b + c}{2}$



Sine rule

$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

Cosine rule

$a^2 = b^2 + c^2 - 2bc\cos A$

GO ON TO THE NEXT PAGE

SECTION A

Write the letter which corresponds to your answer on the foolscap provided.

1. $(a+2)(a-2) =$

   (A) a^2+4 (B) a^2+4a+4 (C) a^2-4a+4 (D) a^2-4

2. $(x+3)^2 =$

   (A) x^2+6x+9 (B) x^2-6x+9 (C) x^2+6 (D) x^2+9

3. If $x^2+kx+15=(x+t)(x+5)$ for all values of x and if k and t are constants, what is the value of k?

   (A) 8 (B) 9 (C) 10 (D) 12

4. The solution(s) of the equation $x^2-1=0$ is/are

   (A) $x=1$ (B) $x=-1$ (C) $x=2$ (D) $x=\pm 1$

   Questions 5 – 7 refer to the function given below

$$f(x)=x^2-2x+3$$

5. If x^2-2x+3 is written in the form $(x+h)^2+k$, the values of h and k respectively are

   (A) -1 and 3 (B) 1 and 3 (C) -1 and 2 (D) 1 and 2

6. The minimum value of $f(x)$ is

   (A) 2 (B) -2 (C) -3 (D) 3

7. The value of x for which the minimum value of $f(x)$ occurs is

   (A) -1 (B) 1 (C) 3 (D) -3

8. Given that $f(x)=x^2-7$, the value of $f(-2)=$

   (A) -3 (B) -5 (C) -11 (D) 3

9. Given that $g(x)=2x-1$ then $g^{-1}(3)=$

   (A) 5 (B) 2 (C) 1 (D) 7

10. Given that $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$
$A = \{2, 3, 5, 7\}$ and $B = \{2, 4, 6, 8\}$ are subsets of U then $(A \cup B)'$.
(A) $\{2, 3, 4, 5, 6, 7, 8\}$ (B) $\{1, 9, 10\}$ (C) $\{2\}$ (D) $\{9, 10\}$

11. In an assortment of cereals, 23 types contain oats and 25 types contain rice. Some of these cereals contain both oats and rice. If 16 cereals in this assortment contain oats but not rice, how many cereals contain rice but not oats?
(A) 18 (B) 7 (C) 9 (D) 16

Questions 12 – 13 refer to the vectors below

$$\overrightarrow{OA} = \begin{pmatrix} -3 \\ 2 \end{pmatrix} \text{ and } \overrightarrow{OB} = \begin{pmatrix} 5 \\ -1 \end{pmatrix}$$

12. $\overrightarrow{AB} =$
(A) $\begin{pmatrix} 2 \\ 1 \end{pmatrix}$ (B) $\begin{pmatrix} -8 \\ 3 \end{pmatrix}$ (C) $\begin{pmatrix} 8 \\ -3 \end{pmatrix}$ (D) $\begin{pmatrix} 8 \\ -3 \end{pmatrix}$

13. The length of the vector $\overrightarrow{AB}$ is
(A) $\sqrt{55}$ (B) $\sqrt{73}$ (C) $\sqrt{5}$ (D) $\sqrt{11}$

14. Which of the following pair of vectors is parallel?
(A) $u = \begin{pmatrix} 2 \\ 1 \end{pmatrix}$ and $v = \begin{pmatrix} -4 \\ 2 \end{pmatrix}$
(B) $u = \begin{pmatrix} 2 \\ 1 \end{pmatrix}$ and $v = \begin{pmatrix} -4 \\ -2 \end{pmatrix}$
(C) $u = \begin{pmatrix} 1 \\ 2 \end{pmatrix}$ and $v = \begin{pmatrix} 2 \\ -4 \end{pmatrix}$
(D) $u = \begin{pmatrix} 1 \\ 2 \end{pmatrix}$ and $v = \begin{pmatrix} -2 \\ 4 \end{pmatrix}$

15. In triangle ABC, $AB = 8$ cm, $AC = 10$ cm and angle $BAC = 30°$. The area of the triangle is
(A) 40 cm^2 (B) 80 cm^2 (C) 60 cm^2 (D) 20 cm^2

[15]

SECTION B

ANSWER ALL QUESTIONS

1. In a survey of 48 students it was discovered that 28 of them own an I – pad and 19 own an I – phone and 9 students own neither.

   (i) Given that x students own both and I-pad and an I-phone, draw a Venn diagram to represent this information. [4]

   (ii) Determine the value of x. [3]

2. Given that $f(x) = \frac{x-3}{x+2}$ and $g(x) = 3x + 1$, determine

   (i) the value of x for which $f(x)$ is undefined [1]

   (ii) $g^{-1}(x)$ [3]

   (iii) $g^{-1}(4)$ [2]

   (iv) an expression for $fg(x)$ in its simplest terms. [3]

3. Factorise, completely, each of the following

   (i) $6x - 10$ [1]

   (ii) $4x^2 - 81$ [2]

   (iii) $2ax - 2bx + 3ay - 3by$ [3]

   (iv) $3x^2 - 5x - 2$ [3]

4. (a) Solve each of the following equations

   (i) $x^2 + 5x = 0$ [3]

   (ii) $(x + 5)(x - 3) = 0$ [2]

   (iii) $a^2 + 4 = 13$ [3]

   (iv) $x^2 - 7x + 3 = -3$ [4]

   (v) $2x^2 - 3x - 6 = 0$ correct to 2 decimal places. [5]

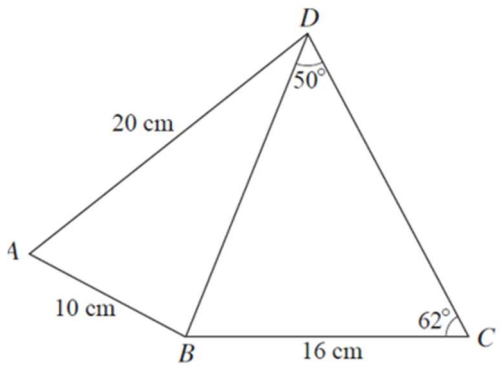
(b) Solve the pair of simultaneous equations

$$2y^2 - 3x = -6$$

$$x - 2y = 2$$

[7]

5. In the diagram, angle $BDC = 50°$ and angle $BCD = 62°$. It is given that $AB = 10$ cm, $AD = 20$ cm and $BC = 16$ cm.



(i) Find the length of BD. [4]

(ii) Find angle BAD. [3]

(iii) Find the area of quadrilateral $ABCD$. [4]

END OF EXAMINATION