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HARRISON COLLEGE

FOURTH FORM MATHEMATICS

INTERNAL PROMOTION EXAMINATION 2014 - 2015

DURATION: 2 hours

GENERAL INSTRUCTIONS TO CANDIDATES:

1) This question paper consists of FIVE printed pages including the cover page.

2) Write your name clearly on **EACH** sheet of paper used.

3) All twenty- one questions are to be attempted.

(a) For your responses to questions in section A, circle the letter that matches your response to each question on the answer sheet provided.

(b) For your responses to questions 16 - 21 in Section B, number your responses carefully and identically (including any associated parts) as they appear on the question paper. Do **NOT** write ANY of your responses beside each other.

4) Calculators are allowed.

5) 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.

6) The maximum mark for this examination is 60.

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

LIST OF FORMULAE

Roots of quadratic equations If $ax^2 + bx + c = 0$

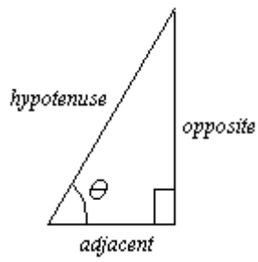
then $x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$

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.

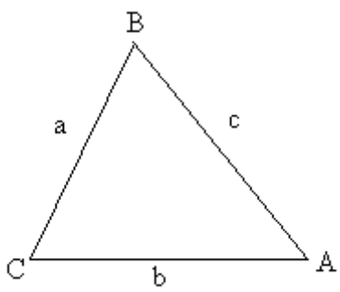
Area of a sector $A = \frac{\theta}{360} \times \pi r^2$ where θ is the angle of the sector, measured in degrees



Trigonometric ratios $sin\theta = \frac{opposite\ side}{hypotenuse}$

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

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



Sine rule $\frac{a}{sinA} = \frac{b}{\sin B} = \frac{c}{sinC}$

Cosine rule $a^2 = b^2 + c^2 - 2bc\ cosA$

Area of triangle $Area\ of\ \Delta ABC = \frac{1}{2}ab\ sinC$

SECTION A

Write the letter that matches your response to each question.

1. If $y = -3$ and $z = 5$, then $\sqrt{z^2 - y^2} =$

A: 4 B: $\sqrt{34}$ C: 8 D: $\sqrt{2}$

2. Given that $x = \frac{av+b}{v}$, which of the following correctly expresses v as the subject of the formula?

A: $v = \frac{x-b}{a}$ B: $v = \frac{b}{x-a}$

C: $v = \frac{-b}{a+x}$ D: $v = \frac{b+a}{x}$

3. A rectangle has a length of $(x - 3)$ and a width of $(3x^2 + 4x)$. What is its perimeter?

A: $3x^3 - 5x^2 - 12x$ B: $3x^3 + 4x^2 - 3$

C: $6x^2 + 10x - 6$ D: $3x^2 + 5x - 3$

4. Written as a single fraction $\frac{2}{x} + \frac{1}{x-2}$ is

A: $\frac{3}{2(x-1)}$ B: $\frac{3}{x(x-2)}$ C: $\frac{x-4}{2(x-1)}$ D: $\frac{3x-4}{x(x-2)}$

5. $\frac{x^2-4x-21}{x+3} =$

A: $x + 7$ B: $x - 7$ C: $x - 11$ D: none of these

6. If $x^2 + y^2 = 85$ and $xy = 9$ then $(x + y)^2 =$

A: 103 B: 94 C: 76 D: 67

7. The number that must be added to $x^2 - 8x + 10$ to make it a perfect square is

A: -74 B: -26 C: 6 D: 54

8. In a class of 30 students, 22 study Spanish and 18 study French. The largest possible number of students who may **not** study either of these subjects is

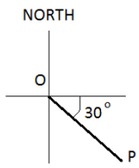
A: 12 B: 8 C: 10 D: 4

9. If $f: x \to 2x^2 + 3$, then $f^{-1}(x)$ = ?

A: $\frac{1}{2}\sqrt{x} - 3$ B: $\sqrt{\frac{x-3}{2}}$ C: $\frac{x-3}{\sqrt{2}}$ D: $2\sqrt{(x-3)}$

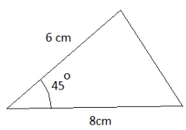
10. If $g(x) = \frac{3x+2}{x-5}$ then the value of x that cannot be in the domain of g is

A: $-\frac{2}{3}$ B: 0 C: 5 D: $-\frac{7}{2}$



11. From the figure above, what is the bearing of P from O?

A: 330° B: 240° C: 120° D: 30°



12.

The area of the triangle above is

A: 24 cm^2 B: $12\sqrt{2}$ cm^2 C: 12 cm^2 D: 16.5 cm^2

13. If vectors $\boldsymbol{a} = \begin{pmatrix} -3 \\ 5 \end{pmatrix}$ and $\boldsymbol{b} = \begin{pmatrix} 12 \\ x \end{pmatrix}$ are parallel then x =

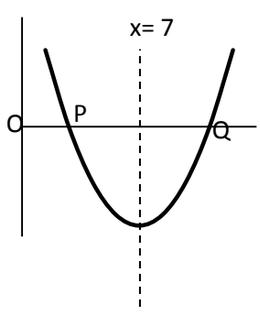
A: 15 B: 9 C: -15 D: -20

14. The position vectors of the points P and Q are $\begin{pmatrix} -4 \\ 3 \end{pmatrix}$ and $\begin{pmatrix} 6 \\ 1 \end{pmatrix}$ respectively.

The length of the vector $\overrightarrow{PQ}$ is

A: 10.2 B: 2.83 C: 4.47 D: 9.8

15: The graph below shows part of a parabola with the equation of the form $y = (x + a)^2 + b$



The equation of the axis of symmetry of the parabola is $x = 7$.

Q is the point (11, 0). State the coordinates of P.

A: (4, 0) B: (0, 8) C: (3, 0) D: (5, 0)

SECTION B

16. A sports club has 80 members.
For the three activities Swimming (S), Cycling (C) and Weight lifting (W),

8 members take part in all three activities

3 members do not take part in any of the three activities

22 members take part in only Swimming

23 members take part in Swimming and Cycling

19 members take part in Swimming and Weight lifting

14 members take part in Cycling and Weightlifting

x members take part in only Weight lifting

the number of members who take part in only Cycling is twice the number of members who take part in only Weight lifting

(i) Draw a Venn diagram to show all of the above information. [4]

(ii) Determine the value of *x*. [2]

(iii) Determine $n[S \cap (W \cup C)]$ [1]

17. Factorise completely

(i) $10xy - 8x - 15ny + 12n$ [2]

(ii) $5x^2 - 125$ [2]

(ii) $2x^2 - 9x - 5$ [2]

18. (i) Solve $2x^2 - 6x + 3 = 0$ giving your answers to 2 decimal places. [4]

(ii) Solve the simultaneous equations

$y = 20 - 3x$

$y = 2x^2$ [4]

19. The functions *f* and *g* are such that

$f(x) = 2x + 3$ and $g(x) = x^2 + x + 2$

(i) Evaluate $fg(2)$. [2]

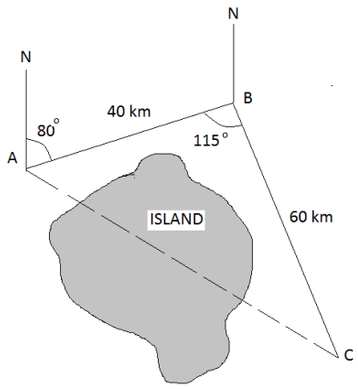
(ii) Write expressions in *x* for

(a) $fg(x)$ in its simplified form. [2]

(b) $f^{-1}x$ [2]

(iii) Solve $ff(x) = f(x)$ [3]

20.



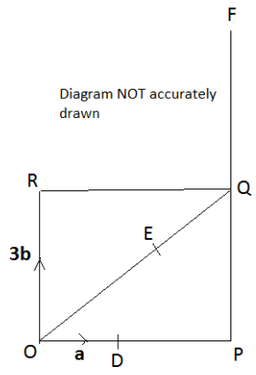
To avoid an island a ship travels 40 km from A to B and then 60 km from B to C.
The bearing of B from A is 080° and the angle ABC is 115°.

(a) Find the bearing of C from B. [2]

(b) Calculate to the nearest km, the straight line distance AC. [4]

(c) Determine the bearing of C from A. [4]

21.



In the diagram, OPQR is a rectangle.

D is the point on OP such that $OD = \frac{1}{3}OP$

E is the point on OQ such that $OE = \frac{2}{3}OQ$

PQF is the straight line such that $QF = \frac{1}{3}PQ$

$\overrightarrow{OD} = \mathbf{a}$ and $\overrightarrow{OR} = \mathbf{3b}$.

(a) Find the following in terms of **a** and **b**, giving your answers in their simplest form.

(i) $\overrightarrow{OQ}$

(ii) $\overrightarrow{OE}$

(iii) $\overrightarrow{DE}$ [3]

(b) Use a vector method to prove that DEF is a straight line. [2]