HARRISON COLLEGE

END OF YEAR EXAMINATION 2017

THIRD YEAR MATHEMATICS

DURATION: 1 Hour and Forty-Five Minutes

GENERAL INSTRUCTIONS TO CANDIDATES

1) This Examination Paper consists of **SEVEN** printed pages.
2) Write your name clearly on **EACH** sheet of foolscap used.
3) All **TWENTY** questions are to be attempted.
4) 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.
5) Calculators are allowed.
6) 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**.
7) The maximum mark for this Examination is **78**.

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

LIST OF FORMULAE

Volume of 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.

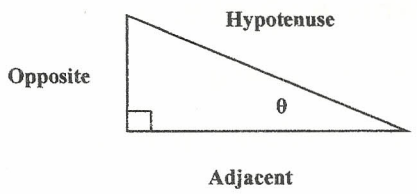
Area of Trapezium — $A = \frac{1}{2}(a+b)h$ where a and b are the lengths of the parallel sides and h is the perpendicular distance between the parallel sides.

Trigonometric ratios

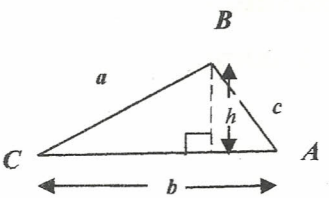
$$\sin\theta = \frac{opposite\ \ side}{hypotenuse}$$

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

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



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



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

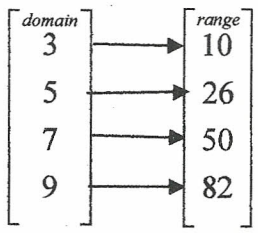
where $s = \frac{a+b+c}{2}$

WRITE ON THE FOOLSCAP PROVIDED the **LETTER** that matches your response for Questions **1)** to **10).**

1) $4x - 3(x + 5) =$

(A) $7x - 15$ **(B)** $x + 15$ **(C)** $-7x + 15$ **(D)** $x - 15$

2)



The diagram above represents the mapping

(A) $x \to 3x + 1$ **(B)** $x \to x^2 + 1$ **(C)** $x \to x + 2$ **(D)** $x \to x^2 + 10$

3) The surface area of a sphere is

(A) $2\pi r\,(r + h)$ **(B)** $2\pi h$ **(C)** $4\pi r^2$ **(D)** $2\pi rh$

4) $\dfrac{3m}{5r} + \dfrac{4n}{7s} =$

(A) $\dfrac{3m + 4n}{5r + 7s}$ **(B)** $\dfrac{21ms + 20nr}{35rs}$ **(C)** $\dfrac{3mn}{21rs}$ **(D)** $\dfrac{12mn}{21rs}$

5) If x and y are both integers, then $2(x - y)^2$ means

(A) two times the difference of their squares

(B) four times their difference

(C) two times the x squared minus y squared.

(D) two times the square of their difference

6) The gradient of the line perpendicular to $3x - 2y = 5$ is

(A) $-\dfrac{2}{3}$ **(B)** $\dfrac{3}{2}$ **(C)** -2 **(D)** 3

7) If $p \nabla q = p^2 - 3q$, then $5 \nabla 2 =$

(A) -11 **(B)** 19 **(C)** 21 **(D)** 25

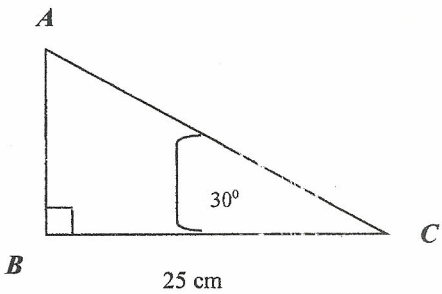
8) If $\frac{5x-3}{2} = 6$, then $x =$

(A) 5 **(B)** 3 **(C)** 17 **(D)** 25

9) A plane is heading on a bearing 055^0, and changes course in a clockwise direction to 125^0. The angle through which the plane turns is

(A) 70^0 **(B)** 180^0 **(C)** 235^0 **(D)** 90^0

10)



The triangle ***ABC*** above is right-angled at ***B***. Angle ***ACB*** = 30^0 and ***BC*** = 25 cm.

The length of ~~***AB***~~ AC, in cm, is

(A) $25 \sin 30^0$ **(B)** $\frac{25}{\sin 30^0}$ **(C)** $\frac{25}{\cos 30^0}$ **(D)** $25 \cos 30^0$

[Total: **10**]

20

All working MUST be clearly shown for Questions 11 – 21

11) A cottage is bought for $ 160 000. It appreciates in value at the rate of 2.75 % per annum. Calculate

(i) the amount of appreciation after one year. [2]

(ii) the value of the cottage after three years. [3]

12) Simplify fully $\left(x^{\frac{1}{2}}\right)^3 \times \sqrt{x^9}$. [3]

13) r is directly proportional to the cube root of s and $r = 10$ when $s = \frac{1}{8}$.

Calculate

(i) the value of the constant of proportionality [3]

(ii) the value of s when $r = 12$. [3]

14) (a) Make x the subject of $y = \frac{p+x}{1-px}$ [4]

(b) A rectangular room is 6 metres longer than its width x.

Its perimeter must not exceed 126 metres.

(i) write an inequality in x to represent this information. [1]

(ii) determine the greatest length the room may have. [4]

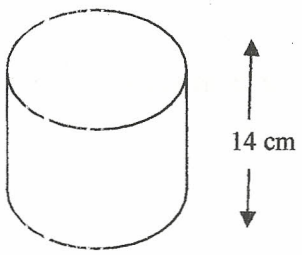
15) Solve for p and q, the simultaneous equations: $\begin{aligned} 3p - 4q &= 11 \\ 5p + 9q &= -13 \end{aligned}$ [5]

16) (i) Find the equation of the straight line joining the points (– 2, 1) and (3, 4). [3]

(ii) Determine the equation of the line passing through (3, 4) which is perpendicular to the line in (i). [3]

(iii) Calculate the distance between the point (– 2, 1) and the point where the line in (ii) meets the y-axis. [3]

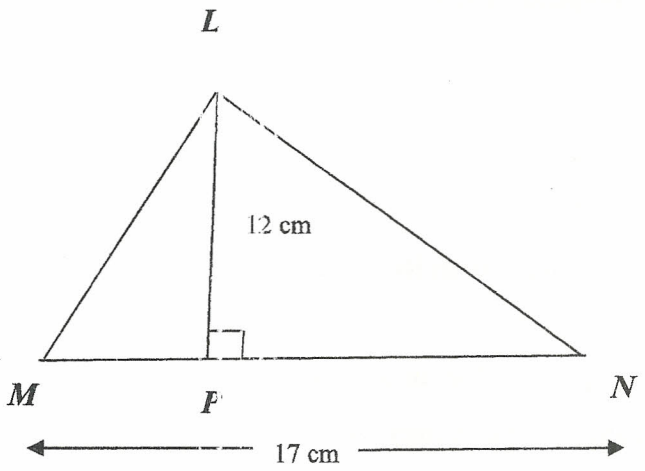
17)



The closed cylinder above (**not drawn to scale**) is of length 14 cm. The circular ends have a circumference 35 cm. Calculate, **giving your answer in terms of π**

(i) the radius of the cylinder. [2]
(ii) the total surface area of the cylinder. [3]
(iii) the capacity of the cylinder. [5]

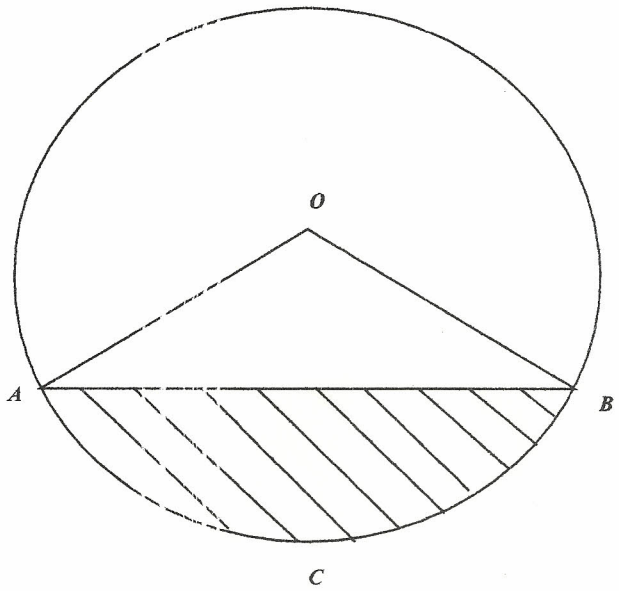
18)



In triangle ***LMN*** above (**not drawn to scale**) ***MN*** = 17 cm. ***LP*** is perpendicular to ***MN***. ***LP*** = 12 cm and angle ***PLN*** = angle ***PNL***.

(i) State the length of ***PN***. Give a reason for your answer. [2]
(ii) Calculate the length of ***LM***. [2]
(iii) Calculate the size of angle ***LMP***. [2]

19) For this question use $\pi = 3.14$. In the diagram below, (**not drawn to scale**), ***O*** is the centre of the circle of radius 9 cm. Chord ***AB*** is 13.8 cm and angle ***AOB*** = 100^0.



(a) Calculate the length of the arc ***ACB***. [2]

(b) Calculate

(i) the area of the sector ***OACB***. [2]

(ii) the area of triangle ***OAB***. [4]

(iii) the area of the shaded segment ***ABC*** of the circle. [2]

20) **COPY** and **COMPLETE** the table below by inserting the missing expression at the rows marked (ii) and (iii). [5]

(i)	a	$\frac{a}{2} + \left(\frac{1}{3} \times 2\right)$	$\frac{3a+4}{6}$
(ii)	ab	$\frac{ab}{2} + \left(\frac{b}{3} \times 2\right)$	
(iii)	abc		$\frac{3abc+4bc}{6}$

End of Examination