

OLLSCOIL NA hÉIREANN, GAILLIMH
NATIONAL UNIVERSITY OF IRELAND, GALWAY
COLLEGE OF ENGINEERING AND INFORMATICS

ENGINEERING MATHS QUALIFYING EXAMINATION 2019

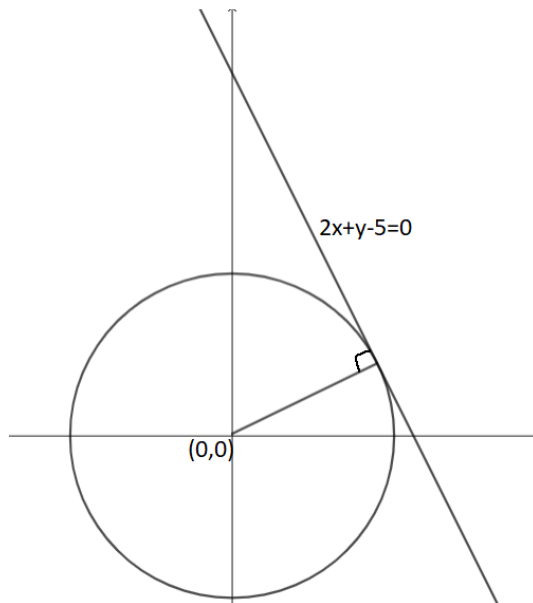
Second Paper

Time allowed: *Two* hours

Candidates for Computer Science & Information Technology and Project & Construction Management should take 4 questions out of 6. All other candidates should take 5 questions out of 6.

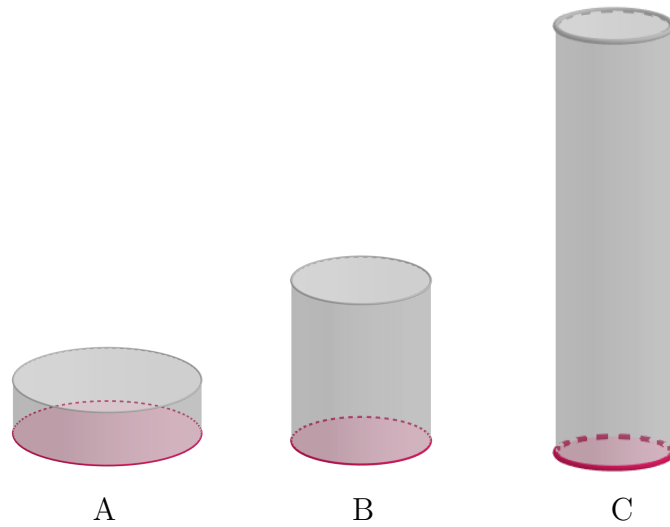
Formulae and Tables booklets are provided by the Exams Office
Calculators are permitted

1. (a) The line $2x + y - 5 = 0$ is a tangent to the circle with centre $(0, 0)$. Find the length of the radius of the circle.



- (b) The pendulum of a clock swings through the points $(-3, -3)$, $(0, -4)$ and $(4, -2)$ on a circle c . Find the coordinates of the centre and the radius length of c .

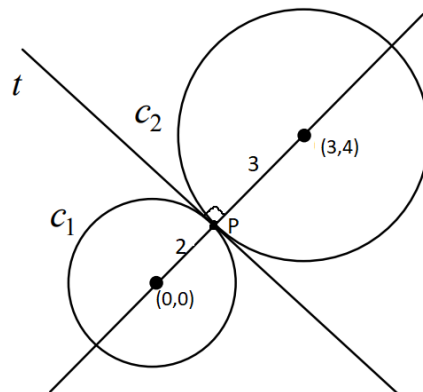
2. (a) Three cylinders A, B and C, have radii in the ratio $5 : 3 : 2$ and heights in the ratio $3 : 8 : 19$ (diagram not to scale). Arrange the cylinders from the smallest to the greatest volume. Support your choice with calculations.



- (b) A cylindrical container of radius 12 cm is partly filled with water. When a spherical ball is immersed in the water, the level of water in the cylinder rises by 2 cm. Calculate the radius of the ball.

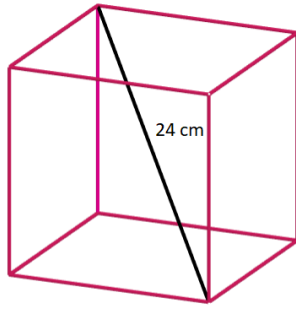
3. (a) Two boats leave a harbour at $O(0, 0)$. One boat sails along a straight line to $P(3, 6)$ and the other sails straight to $Q(6, 3)$. Find the angle between the two paths, OP and OQ , correct to the nearest degree.

- (b) The circles c_1 , with centre $(0, 0)$ and radius 2, and c_2 , with centre $(3, 4)$ and radius 3, touch externally as shown.

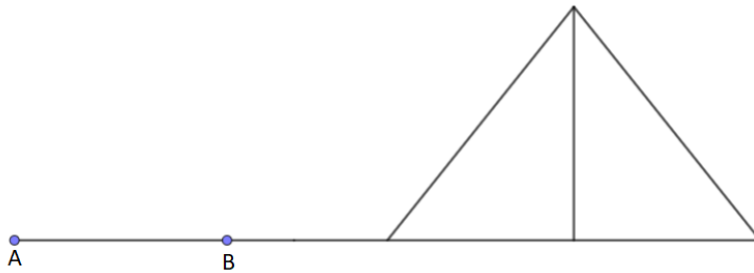


- (i) Find the coordinates of P , the point of contact of c_1 and c_2 .
(ii) Find the equation of the tangent, t , common to c_1 and c_2 .

4. (a) The diagonal of a cube is 24 cm long. Work out the length of the side of this cube.



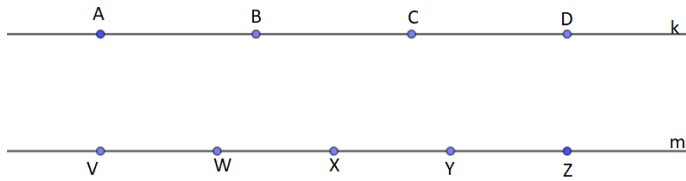
- (b) The angle of elevation to the top of the pyramid measured at point A is 16.3° , while the angle of elevation measured at B is 20° . Points A and B are 100 metres apart, as shown in the diagram. Calculate the height of the pyramid and write your answer correct to the nearest metre.



5. (a) How many arrangements are there of the letters CHAMPIONS:
- (i) if there are no restrictions,
 - (ii) if CH are side by side, in that order,
 - (iii) if C and H are separated,
 - (iv) if consonants are grouped together?

If three letters are chosen at random from the word CHAMPIONS without replacement, what are the chances that the first letter is H, second is A and third is M?

- (b) Two parallel lines k and m contain points A, B, C, D and V, W, X, Y, Z , respectively, as shown in the diagram.



How many triangles can be formed by taking one point from line k and two points from line m (for example VWA).

6. (a) The probability that a horse will win a given race is 0.4. What is the probability that in five races
- (i) the horse will win the first, third and fifth race and lose the others?
 - (ii) the horse will win exactly three races?
- (b) A multiple-choice test has five questions. Each question has three alternative answers with only one answer correct. If a student guesses each answer, calculate the probability that:
- (i) he gets all five answers correct,
 - (ii) he gets exactly one answer correct,
 - (iii) he gets his third correct answer on the fifth question.