Arholiadau Ysgoloriaeth Ionawr 2020

Scholarship Examinations January 2020

Amser a ganiateir : 2 awr MATHEMATEG

Time allowed: 2 hours MATHEMATICS

*You may attempt any of the questions. Credit will be given for complete answers.*

[Assume *g* = 9.8 m.s-2]

1. The sum of the first 3 terms of an arithmetic series is 90 and the sum of the first 5 terms is 210. Find the sum of the first 10 terms.

2. Find all the solutions to the equation

3. Evaluate the definite integral

4. Find the equation of the normal to the circle

from the point (10, 8), and the tangent to the circle at the point (3, 1).

5. Express

in partial fractions.

6. Expand

in ascending powers of *x*, up to the term in *x3*.

For what values of *x* is the expansion valid?

Find an approximation to the fifth root of 1.01 using the first two terms of the expansion. How accurate is your approximation?

7. Rearrange the expression



to yield an expression for *x*.

Hence solve

8. The vertices *A*, *B*, *C* of a triangle have position vectors ***a***, ***b***, ***c***. Point *X* lies on the line *AB* such that *AX* : *XB* = 4 : 3. Write an expression for the position vector of *X* in terms of ***a***, ***b***, ***c***.

Find, in terms of ***a***, ***b***, ***c,*** the position vector of point *P* which divides *XC* in the ratio

*XP* : *PC* = ** : 1 - **

9. A body of mass 6 kg is suspended from a light string. The string is looped over a frictionless pulley and the other end attached to a 8 kg mass on a frictionless plane inclined at 40 degrees to the horizontal. Draw a sketch of the system. If the two masses are initially at rest, in which direction will the masses begin to move? How long will it take the vertically suspended mass to move 1 cm?

10. Solve the differential equation

with initial condition .

11. The continuous random variable *X* has probability density function *f* defined by

Find the parameter **, and the mean and standard deviation of *f*. Sketch the probability density function.

12. Three balls are chosen at random from a box containing 7 red balls, and 6 blue balls. Find the probability that

a) two red balls and one blue ball are chosen (in some order)

b) all three balls will be the same colour

13. The length of a pencil on a stationery production line comes from a normal distribution, with mean 15cm and standard deviation 0.15cm.

Calculate the probability that a randomly chosen pencil’s length is between 14.90cm and 14.95cm.