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| EGC_Black | Student Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_    **Eastern Goldfields College**  Mathematics Specialist 2017  Investigation 1 - Part B1 |
| Working Time: 40 minutes | Total Marks: 26 marks |

***You are allowed to use Part A when completing Part B.***

***Answer all of the following questions. Show all working to obtain full marks.***

A moth flies at 50° to the light source L and measures its bearing and re-corrects its path 10 times in every revolution.



R0

R1

L

Aº

Bº

50º

Cº

Angle of attack

β

**1. [4 marks]**

a) Showing full working, produce a formula in exact terms for R10 in terms of R0.

b) Produce a formula in exact terms for Rn in terms of R0.

**2. [3 marks]**

a) From the details given in **Part A**, describe the flight path of the moth.

b) Let R0 = 20 cm. Complete the graph below for the first six R calculations.



**3. [5 marks]**

a) From the details given in **Part A**, determine **θ** , the ‘angle of attack’ which will produce

a circular flight path.

b) For what values of **θ** will the moth spiral inwards/outwards?

**4. [2 marks]**

From the details given in **Part A**, describe with reasoning what happens when the bearing is re-calculated 5 times instead of 10 times per revolution.

**5. [2, 1, 2 marks]**

a) A second moth again flies with **θ** = 50° but measures its bearing x times in one

revolution. What is the formula for **Rn** now?

1. Generalise your formula for a moth which flies at a constant bearing of **θ**° to the light

source and measures its bearing **x** times in one revolution.

c) Describe, with reasoning, the flight path for a moth where **θ** = 65° and **x** = 8.

**6. [1, 1, 3, 2 marks]**

Here are graphs of two moths flying where they re-measure their bearing 6 times every

revolution. **R** is the distance in metres measured from a very bright light source.



Moth 1 111

Moth 22

a) How far away from the light source was Moth 2 initially ?

b) The ‘angles of attack’ are 70° and 40°. Identify the ‘angle of attack’ for

each moth.

c) Calculate the next two R values for Moth 2, write them down here and

then plot them on the graph above.

d) A third moth is initially 20 metres from the light source with an ‘angle of

attack’ of 60°. Comment with reasoning on the flight path of this moth.

**Moth Spirals VALIDATION SOLUTIONS**

**Total marks 32**

**PART A ANSWERS [6 marks]**

1. Aº = Bº =  = 36º Cº = ‘angle of attack’ = 50º

****

2.  

****

3.  Now 

 

****

 

****

****

Evidence of further research :

**PART B [26 marks] *Part A may be referred to when answering Part B***

A moth flies at 50° to the light source L and measures its bearing and re-corrects its path 10 times in every revolution.

**1. [4 marks]**

a) Showing full working, produce a formula in exact terms for R10 in terms of R0.

  

****

****

 



****

b) Produce a formula in exact terms for Rn in terms of R0.



****

**2. [3 marks]**

MCDD01493_0000[1] a) From the details given in **Part A**, describe the flight path of the moth.

*Each successive value for R is smaller than the value before, therefore the*

*moth is spiralling inwards towards the light source.*

****

b) Let R0 = 20 cm. Complete the graph below for the first six R calculations.



*Values are there for the dots to be checked.*

15.4

11.8

****

9.1

7.0

5.3

4.1

**3. [5 marks]**

a) From the details given in **Part A**, determine **θ** , the ‘angle of attack’ which will produce

a circular flight path.

R0

R1

36º

θ

θ

*10 calculations per revolution,*

****

*central angle = 36º, and R1 must equal R2*

*for circular motion.*

*∴2θ = 144º*

****

*θ = 72º i.e. ‘attack angle for circular motion.*

b) For what values of **θ** will the moth spiral inwards/outwards?

*Spiral inwards if θ < 72º.*

****

*Spiral outwards if θ > 72º.*

**4. [2 marks]**

From the details given in **Part A**, describe with reasoning what happens when the bearing is re-calculated 5 times instead of 10 times per revolution.

*Central angle =  = 72º and attack angle = 50º*

***.*** *R1 here is greater than in original situation.*

****

*Therefore, it will take the moth longer to spiral inwards.*

****

**5. [2, 1, 2 marks]**

a) A second moth again flies with **θ** = 50° but measures its bearing x times in one

revolution. What is the formula for **Rn** now?

*Other angle = 180º − 50º − * ******

****

****

b) Generalise your formula for a moth which flies at a constant bearing of **θ**° to the light

source and measures its bearing **x** times in one revolution.

****

****

c) Describe, with reasoning, the flight path for a moth where **θ** = 65° and **x** = 8

*Let R0 = 10 cm, R1 = 10 *

****

*∴ R1 < R0 and so the moth will spiral inwards towards the light.*

****

**6. [1, 1, 3, 2 marks]**

Here are graphs of two moths flying where they re-measure their bearing 6 times every

revolution. **R** is the distance in metres measured from a very bright light source.

a) How far away from the light source was Moth 2 initially ?

****

*8 metres.*

b) The ‘angles of attack’ are 70° and 40°. Identify the ‘angle of attack’ for each moth.

*Moth 1 = 40º Moth 2 = 70º*

****

c) Calculate the next two R values for Moth 2, write them down here and

then plot them on the graph above.

*R4 = 8  = 18.11 m R5 = 18.11 = 22.22 m*

****

****

*One for graph*

d) A third moth is initially 20 metres from the light source with an ‘angle of

attack’ of 60°. Comment with reasoning on the flight path of this moth.

*Central angle =  = 60º and attack angle = 60º.*

****

****

*∴Equilateral triangle with R1 = R0. So the moth will be flying in a circle.*