**A-level Maths, Year 13 Half-term 2 Assessment**

**Section A: Pure Maths**

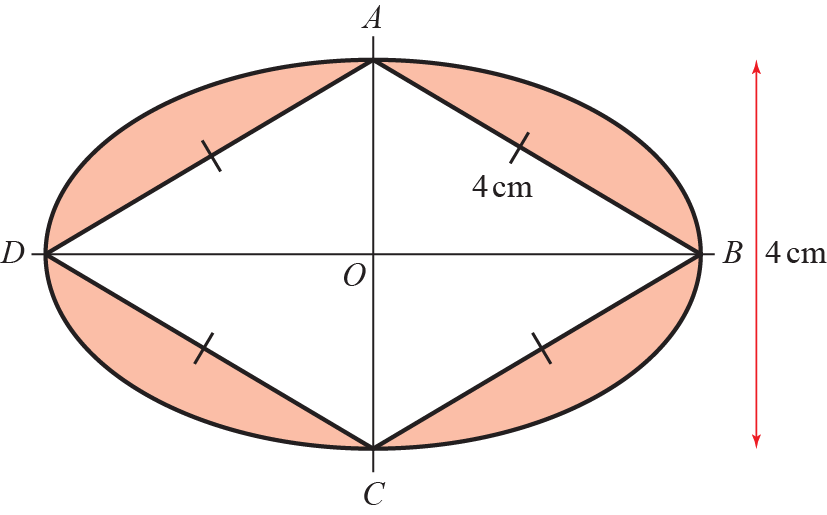
**1.** **a** Prove that  **(3 marks)**

**b** Use the result to solve, for , the equation 

Give your answer in terms of π. Check for extraneous solutions. **(4 marks)**

**2** Figure 1 shows a logo comprised of a rhombus surrounded by two arcs. Arc *BAD* has centre *C* and arc *BCD* has centre *A*. Some of the dimensions of the logo are shown in the diagram.

**Figure 1**

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Prove that the shaded area of the logo is **(8 marks)**

**3** A curve has the equation

Show that the equation of the tangent at the point with an *x*-coordinate of 1 is



**(6 marks)**

**4** The volume of a sphere *V* cm3 is related to its radius *r* cm by the formula

The surface area of the sphere is also related to the radius by the formula

Given that the rate of decrease in surface area, in cm2 s–1, is

find the rate of decrease of volume **(4 marks)**

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**Section B: Applied Maths**

**1** The table below shows the number of gold, silver and bronze medals won by two teams in an athletics competition.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Gold** | Silver | Bronze |
| **Team *A*** | 29 | 17 | 18 |
| **Team *C*** | 21 | 23 | 17 |

The events *G*, *S* and *B* are that a medal is gold, silver or bronze respectively. Let *A* be the event that team A won a medal and *C* team C won a medal. A medal winner is selected at random. Find

**a** P(*G*) **(2 marks)**

**b** P([*A**S*]') **(2 marks)**

**c** Explain, showing your working, whether or not events *S* and *A* are statistically independent. Give reasons for your answer. **(2 marks)**

**d** Determine whether or not events *B* and *C* are mutually exclusive. Give a reason for your answer. **(2 marks)**

**e** Given that 30% of the gold medal winners are female, 60% of the silver medal winners are female and 40% of the bronze medal winners are female, find the probability that a randomly selected medal winner is female. **(2 marks)**

**2.**

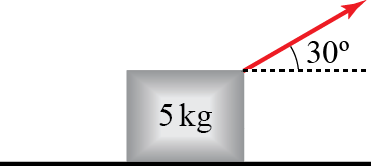
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**Figure 1**

A non-uniform rod *AB* has length 3 m and mass 4.5 kg. The rod rests in equilibrium, in a horizontal position, on two smooth supports at *P* and at *Q*, where *AP* = 0.8 m and *QB* = 0.6 m, as shown in Figure 1. The centre of mass of the rod is at *G*. Given that the magnitude of the reaction of the support at *P* on the rod is twice the magnitude of the reaction of the support at *Q* on the rod, find

(*a*) the magnitude of the reaction of the support at *Q* on the rod, **(3)**

(*b*) the distance *AG*. **(4)**

**3** An object resting on a rough surface is attached to a rope angled at 30° to the horizontal. The rope is pulled with a force of *P* N. The mass of the object is 5 kg.

**a** By resolving forces in the horizontal and vertical directions, calculate the magnitude of each force in the diagram, giving your answers in terms of *P* where appropriate. **(4)**

**b** If *P* = 20, the object does not slip. Use this information to give a bound on in the form of an inequality.

**(6)**

**END OF TEST (52 MARKS)**

**Mark Scheme**

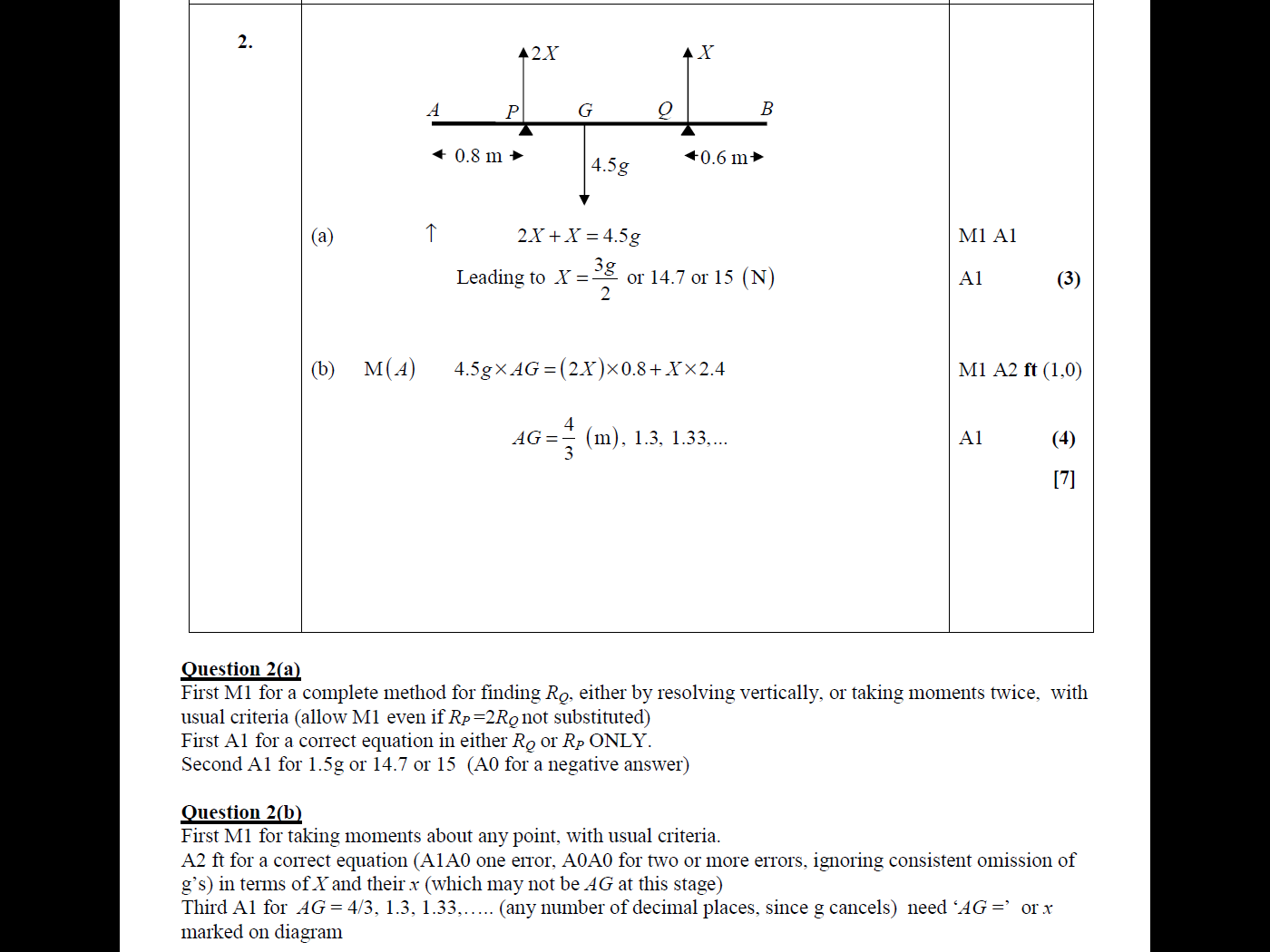
|  |  |  |
| --- | --- | --- |
| **1** | Use Pythagoras’ theorem to show that the length oforor states | **M1** |
|  | Makes an attempt to findor.  For example,is seen. | **M1** |
|  | Correctly states thator | **A1** |
|  | Makes an attempt to find the area of the sector with a radius of 4 and a subtended angle of  For example,is shown. | **M1** |
|  | Correctly states that the area of the sector is | **A1** |
|  | Recognises the need to subtract the sector area from the area of the rhombus in an attempt to find the shaded area.  For example,is seen. | **M1** |
|  | Recognises that to find the total shaded area this number will need to be multiplied by 2. For example, | **M1** |
|  | Using clear algebra, correctly manipulates the expression and gives a clear final answer of | **A1** |
|  |  | **8** |

|  |  |  |
| --- | --- | --- |
| **2a** |  | **M1** |
| Usesandto write:  Award one mark for each correct use of a trigonometric identity. | **A2** |
|  | **(3)** |
| **2b** | States that: | **B1** |
| Simplifies this to write: | **M1** |
| Correctly finds  Additional answers might be seen, but not necessary in order to award the mark. | **M1** |
| States  Note that. For these values 3*θ* lies in the third quadrant, thereforeandare both negative and cannot be equal to a positive surd. | **A1** |
|  | **(4)** |

|  |  |  |
| --- | --- | --- |
| **3** | Makes an attempt to differentiate *y* = ln 3*x* using the chain rule, or otherwise. | **M1** |
| Differentiatesto obtain | **A1** |
| Evaluates at | **A1** |
| Evaluates at *x* = 1 | **M1** |
| Attempts to substitute values into  For example,  is seen. | **M1 ft** |
| Shows logical progression to simplify algebra, arriving at: | **A1** |
|  |  | **6** |

|  |  |  |
| --- | --- | --- |
| **4** | Recognises the need to use the chain rule to find  For exampleis seen. | **M1** |
| Findsand | **M1** |
| Makes an attempt to substitute known values. For example, | **M1** |
| Simplifies and states | **A1** |
| (4 marks) | | |

|  |  |  |
| --- | --- | --- |
| 1a | = | M1 |
| = 0.4 | A1 |
|  | (2) |
| 1b | = | M1 |
| = 0.864 | A1 |
|  | (2) |
| 1c | P(*S**A*) == 0.136 ≠ P(*S*) × P(*A*) ==0.163… | **M1** |
| So, *S* and *A* are not statistically independent. | **A1** |
|  | **(2)** |
| 1d | *B* and *C* are not mutally exclusive | B1 |
| Being in team *C* does not exclude the possibility of winning a bronze medal | B1 |
|  | (2) |
| 1e | = | M1 |
| = 0.424 | A1 |
|  | (2) |



|  |  |  |
| --- | --- | --- |
| **3** |  |  |
|  |  |
| **3a** | Res(→) *F* = *P* cos 30 | **M1** |
|  | **A1** |
| Res(↑) *R* = 5*g* − *P* sin 30 | **M1** |
|  | **A1** |
|  | **(4)** |
| **3b** | If *P* = 20,  Substitute into *R*  *R* = 39 N | **M1**  **A1** |
| Substitute into F  *F* = or 17.320… (N) | **M1**  **A1** |
| If limiting equilibrium, *μ*or 0.444…  So *μ* ⩾or *μ* ⩾ 0.44 | **M1**  **A1ft** |
|  | **(6)** |