Government of South Australia

SACE Board of SA

External Examination 2012

2012 MATHEMATICAL APPLICATIONS, Semester 2

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RE-MARKED

ATTACH SACE REGISTRATION NUMBER LABEL TO THIS BOX

Graphics calculator ☐

Brand _____

Model _____

Computer software ☐

Tuesday 30 October: 9 a.m.

Time: 1½ hours in total (to complete two question booklets, one on each topic studied in Semester 2)

Pages: 10
Questions: 3

Topic 1: Applied Geometry

Examination material: two question booklets
two SACE registration number labels

Approved dictionaries, notes, calculators, and computer software may be used.

Instructions to Students

1. You will have 10 minutes to read the question booklets. You must not write in your question booklets or use a calculator during this reading time but you may make notes on the scribbling paper provided.
2. Each of the following five topics is printed in a separate question booklet. ***Tick the boxes by the two topics you have studied in Semester 2:***
   - Topic 1: Applied Geometry ☐
   - Topic 2: Investment and Loans ☐
   - Topic 3: Mathematics and Small Business ☐
   - Topic 6: Share Investments ☐
   - Topic 7: Statistics and Working with Data. ☐
3. The total mark for each topic is 35.
4. Answer ***all*** parts of Questions 1 to 3 in the spaces provided in this question booklet. There is no need to fill all the space provided. You may write on page 10 if you need more space, making sure to label each answer clearly.
5. Show all working in this booklet. (You are strongly advised ***not*** to use scribbling paper. Work that you consider incorrect should be crossed out with a single line.)
6. Use only black or blue pens for all work other than graphs and diagrams, for which you may use a sharp dark pencil.
7. Appropriate steps of logic and correct answers are required.
8. Marks may be deducted if you do not clearly show all steps in the solution of problems, if your answers have an inappropriate number of decimal places, or if you use incorrect units.
9. Diagrams, where given, are not necessarily drawn to scale.
10. Complete the box on the top right-hand side of this page with information about the electronic technology you are using in this examination.
11. Attach one of your SACE registration number labels to the box at the top of this page.
12. At the end of the examination, place one question booklet inside the back cover of the other question booklet.

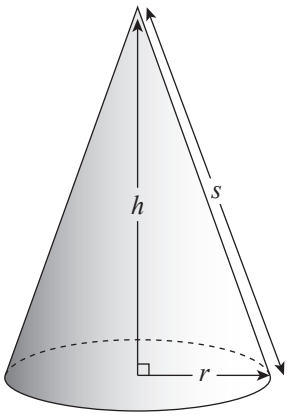
QUESTION 1

Refer to the following information in answering this question:

$1\,m^3 = 1000$ litres

volume (V) of a cone $= \frac{1}{3}\pi r^2 h$

surface area of a cone (without base) $= \pi rs$



A group of children enter a sandcastle-building contest. They have made a castle with a simple conical design. The castle is approximately the same height (h) as the smallest child in the group (115 centimetres).

The circumference (perimeter) of the base of the castle is 4.3 metres.

(a) Show that the radius of the base of the castle is just less than 70 centimetres.

(2 marks)

(b) Calculate, in cubic metres (m^3), the approximate volume of sand used to make the castle.

(2 marks)

(c) The buckets used by the children hold 2.4 litres.

How many full buckets of sand did the children use to make their castle?

(2 marks)

(d) The children have decorated their castle with shells and stones collected from the beach.

What area did they have to cover to decorate the entire castle?

(2 marks)

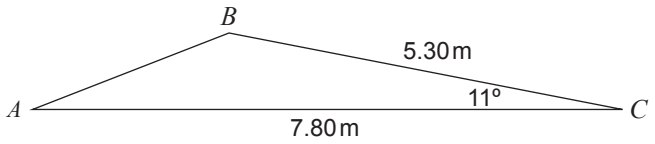
(e) One prize will be awarded for the castle with the greatest volume. The only other large castle in the contest is estimated to be 500 cubic centimetres (cm^3) less than the castle made by the children.

How reasonable is it to give the prize to the children?

(2 marks)

QUESTION 2

A truss is to be built for the roof of a new house, using the design shown below:



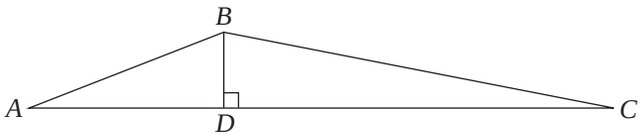
(a) Show that the length of timber needed for the shorter side of the truss (AB) is 2.79 metres.

(2 marks)

(b) Using the sine rule, find the pitch of the truss at angle BAC.

(2 marks)

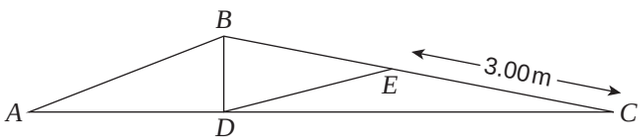
(c) A post (BD) will be used to strengthen the truss, as shown in the diagram below:



Find the length of the post (BD), correct to the nearest millimetre.

(2 marks)

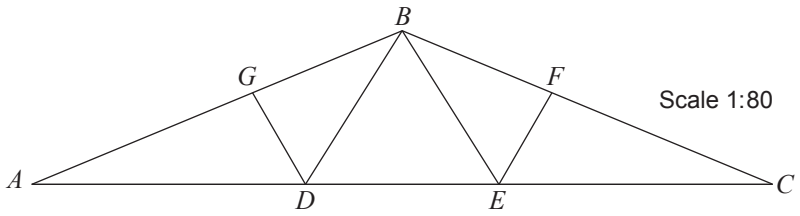
(d) Another post (DE) is placed in the truss, as shown in the diagram below:



Given that the length of EC is 3.00 metres, calculate the length of the new post (DE), correct to the nearest millimetre.

(4 marks)

(e) An alternative symmetrical truss design for the same roof is shown to scale in the diagram below:



(i) Measure the diagram and calculate the total length (in metres) of timber needed to build this truss.

(3 marks)

(ii) Calculate the maximum relative (percentage) error that might be expected in your result in part (e)(i).

(3 marks)

(f) (i) State *one* assumption, apart from the accuracy of measurements, made in the calculations for the truss.

(1 mark)

(ii) How would this assumption affect the reasonableness of using your answer to part (e)(i) when ordering timber to build the truss?

(1 mark)

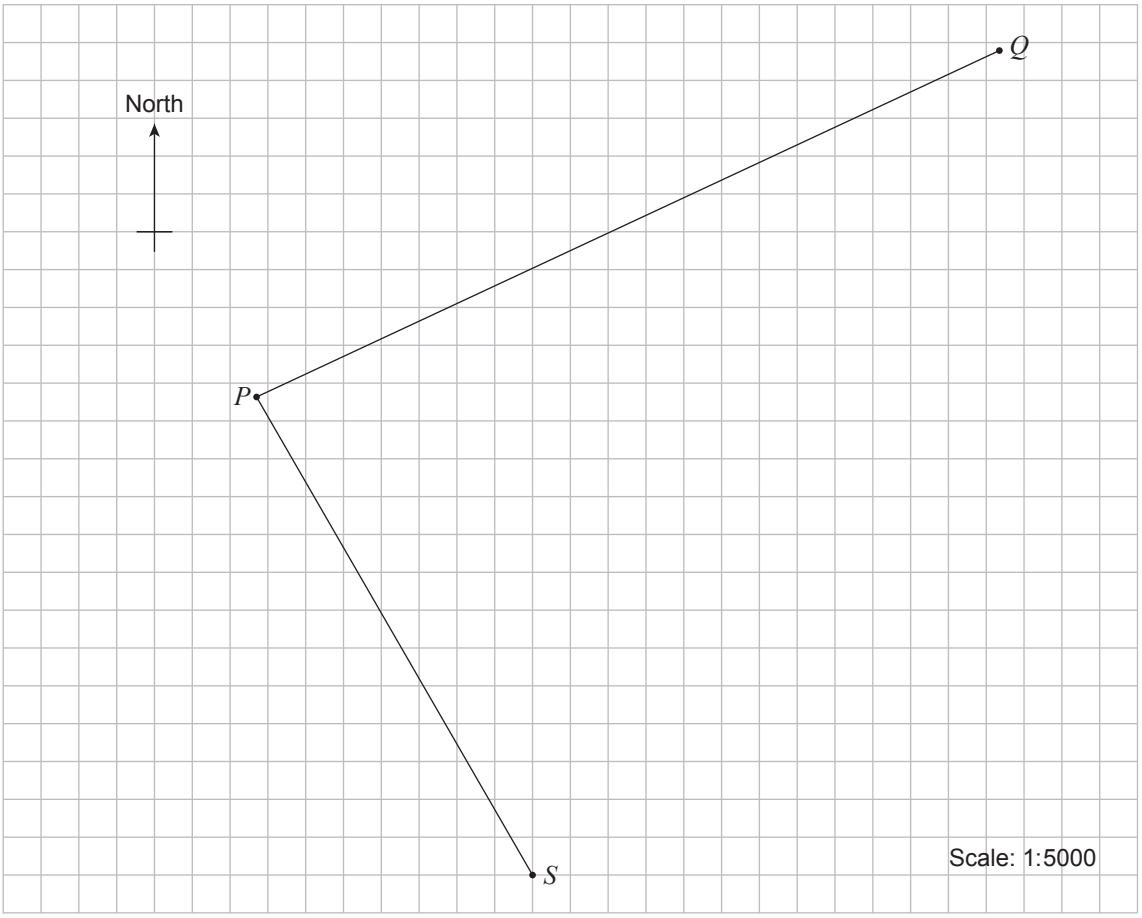
QUESTION 3

A triangular orienteering course has been set up.

The following instructions describe the first two stages of the course:

- Stage 1 — from S (the start), travel on a bearing of 330°T for 365 metres to reach point P.
- Stage 2 — from point P, travel on a bearing of 65°T for 542 metres to reach point Q.

(a) On the diagram below, display all the information given above.



(2 marks)

(b) Using the diagram opposite, find the distance from point Q back to the start (S).

(1 mark)

(c) The triangular orienteering course is covered in thick scrub. One orienteer is missing and is presumed to be somewhere inside the course. It is necessary to determine the area of the course so that a search party can be organised.

(i) Using the cosine rule, find angle PQS.

The following rearrangement of the cosine rule may help you in this calculation:

$$\cos A = \frac{b^2 + c^2 - a^2}{2bc}.$$

(2 marks)

(ii) Hence, or otherwise, calculate the area of the course in hectares.

Note that 1 hectare = 10 000 square metres.

(2 marks)

You may write on this page if you need more space to finish your answers to Topic 1. Make sure to label each answer carefully (e.g. 'Question 1(d) continued').