OCR
Oxford Cambridge and RSA

H

Wednesday 4 November 2015 – Morning

GCSE APPLICATIONS OF MATHEMATICS

A381/02 Applications of Mathematics 1 (Higher Tier)

Duration: 1 hour 15 minutes

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

* Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
* Use black ink. HB pencil may be used for graphs and diagrams only.
* Answer **all** the questions.
* Read each question carefully. Make sure you know what you have to do before starting your answer.
* Your answers should be supported with appropriate working. Marks may be given for a correct method even if the answer is incorrect.
* Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
* Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

* The number of marks is given in brackets **[ ]** at the end of each question or part question.
* Your quality of written communication is assessed in questions marked with an asterisk (*****).
* The total number of marks for this paper is **60**.
* This document consists of **16** pages. Any blank pages are indicated.

You are permitted
to use a calculator
for this paper

OCR is an exempt Charity

Turn over
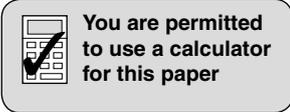
Formulae Sheet: Higher Tier

Area of trapezium $= \frac{1}{2}(a+b)h$
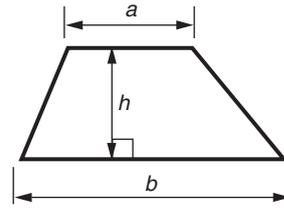
Volume of prism = (area of cross-section) × length
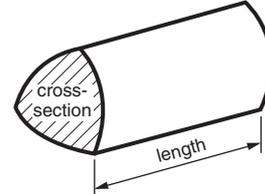
In any triangle *ABC*

Sine rule $\quad \dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C}$

Cosine rule $\;a^2 = b^2 + c^2 - 2bc\cos A$

Area of triangle $= \frac{1}{2}ab\sin C$
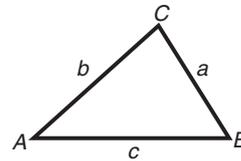
Volume of sphere $= \frac{4}{3}\pi r^3$

Surface area of sphere $= 4\pi r^2$
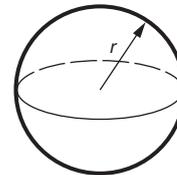
Volume of cone $= \frac{1}{3}\pi r^2 h$

Curved surface area of cone $= \pi r l$
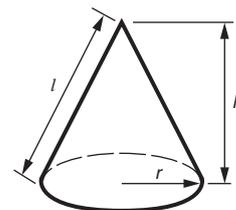
The Quadratic Equation

The solutions of $ax^2 + bx + c = 0$,
where $a \neq 0$, are given by

$$x = \frac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$$

PLEASE DO NOT WRITE ON THIS PAGE

Answer **all** the questions.

1 (a) SolAir passenger aircraft have four different classes of seats:

- First

- Business

- Premium economy

- Economy

This information is about the seats on one aircraft:

- 15 seats are first class

- $\frac{1}{5}$ of the seats are business class

- 15% of the seats are premium economy class

- There are 4 times as many economy class seats as premium economy

Calculate the number of seats on the SolAir passenger aircraft.
Show how you calculate your answer.

(a) .... seats **[5]**

Turn over

(b) Temperature drops with height above the ground.
This drop in temperature, $d\,°C$, at h kilometres above ground level, is given by this formula.

$$d = 6.4h$$

(i) Complete this table of results.

h (km)	0	5	10	15
d (°C)	0			96

[1]

(ii) Draw the graph connecting d and h on the grid. **[2]**
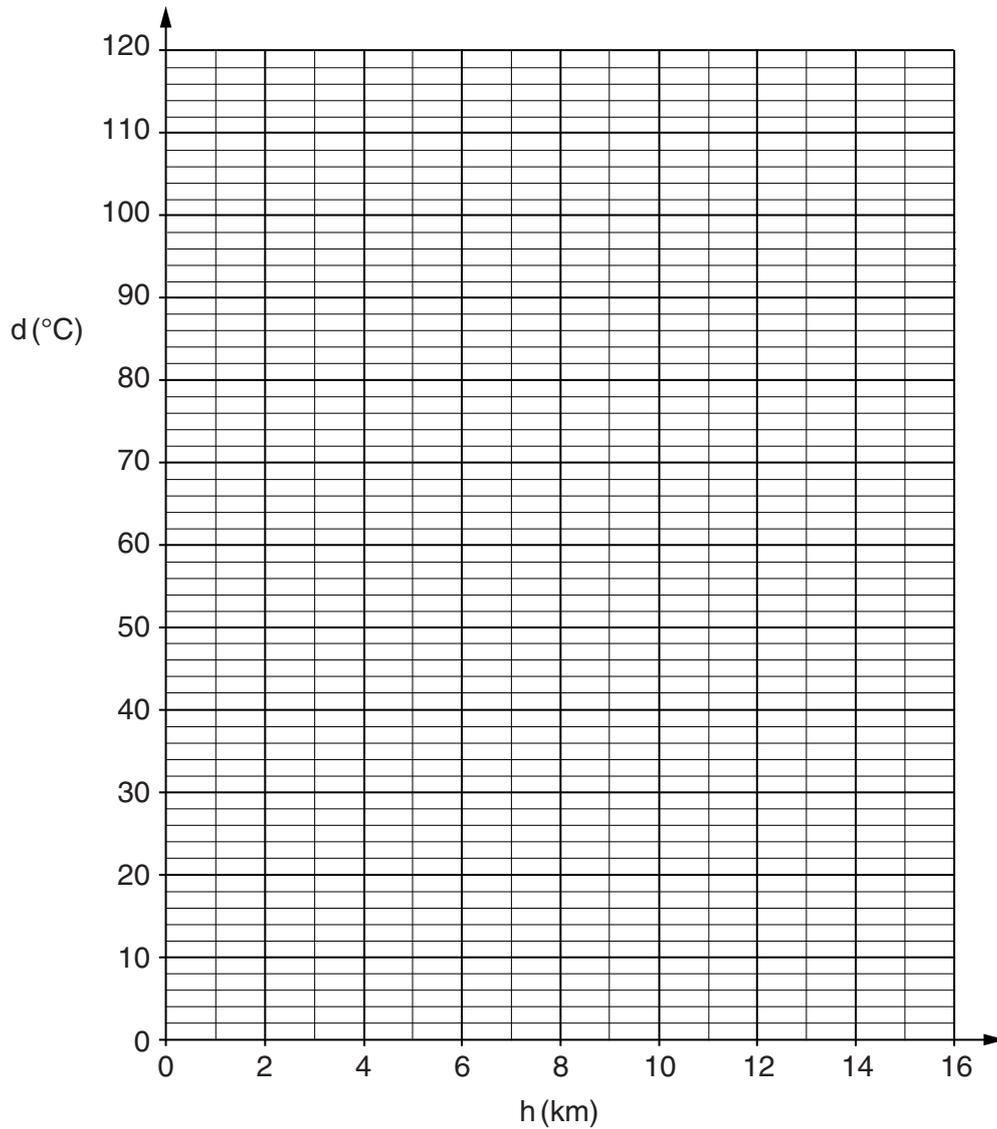
(iii) Jamil reads that a typical cruising height for a passenger jet is about 30 000 feet.
He knows that 1000 feet is 0.3 km.
Jamil says "The outside temperature for a passenger jet is more than 60°C lower at cruising height than the temperature on the ground."

Use your graph to help you check if Jamil is correct.
Show your working and how you used your graph.

....

....

.... **[3]**

(iv) Shenice flies a light aircraft.
The temperature is 10°C at ground level.
Shenice is 2.5 km above the ground at the highest point on the flight.

Use the **formula** for temperature drop to help you find the outside temperature at the highest point on Shenice's flight.

(b)(iv) .... °C **[2]**

2 Two docks, X and Y are situated on the banks of a large lake.
The sketch below shows the two docks and a boat, B, at 4.15 pm.
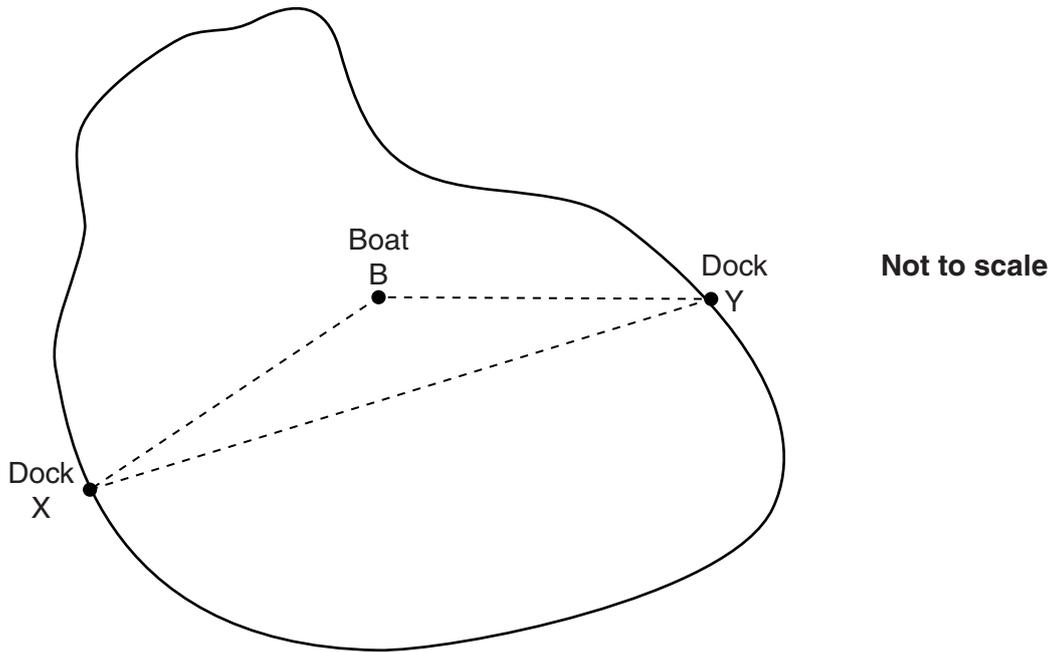
(a) The boat left Dock Y at 3 pm and travelled due West at a steady speed of 27 km/h.
Calculate the distance travelled by the boat by 4.15 pm.

(a) .... km **[2]**

(b) Dock Y is on the bank of the lake at a bearing of 070° from Dock X.
At 4.15 pm the boat, B, is on a bearing of 050° from Dock X.

(i) **Calculate** angle BYX.

(b)(i) ....° **[2]**

(ii) Give a geometric reason why the boat, B, must be equidistant from Dock X and Dock Y
at 4.15 pm.

....

.... **[2]**

(iii) The scale diagram below is a map of the lake.
On the map, mark accurately the position of the boat, B, at 4.15 pm.
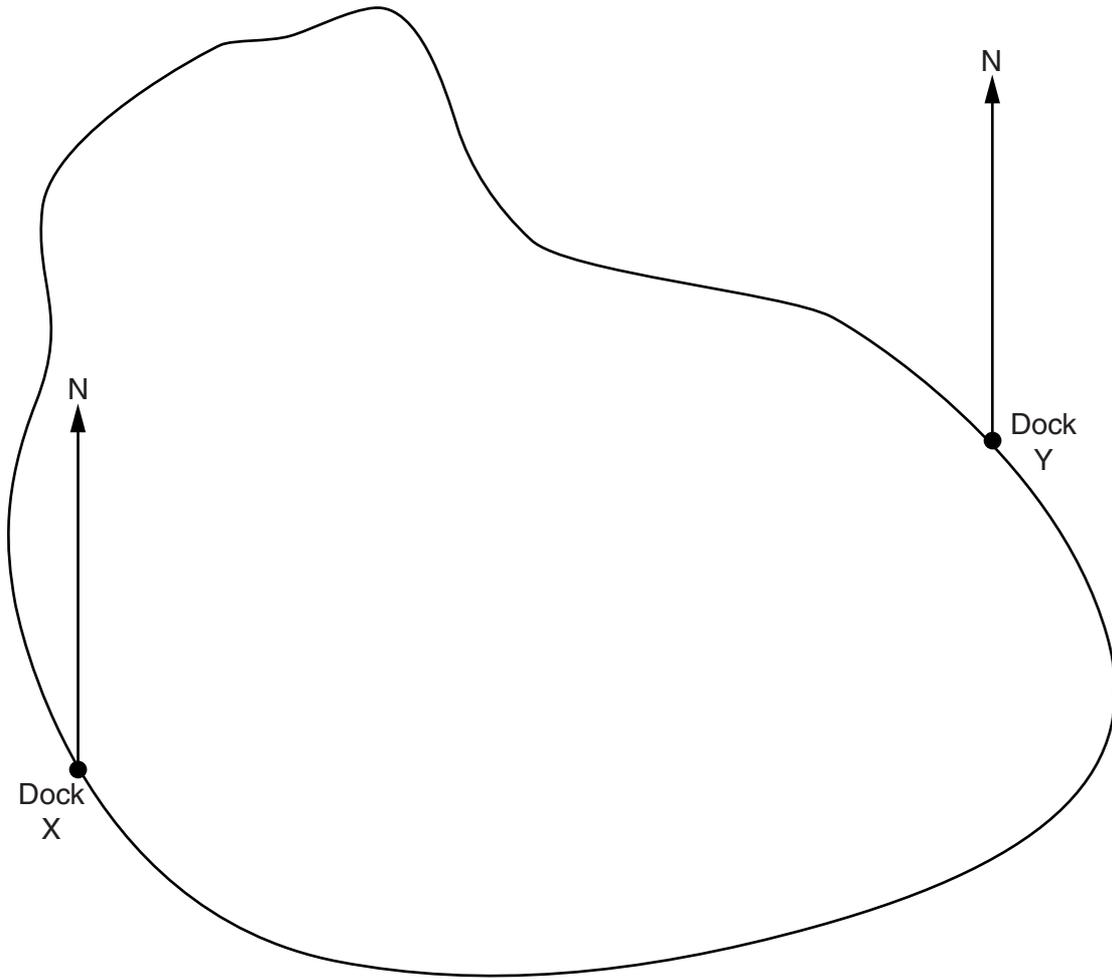
[3]

(iv) By taking a suitable measurement from the map, and using your answer to part **(a)**, show that the scale on the map is approximately 1 cm represents 5 km.

....

....

....

.... **[3]**

3 (a)* Tickets for rides at a fairground can be bought individually or as a Saver Ticket.

Individual Ride tickets

Price per ride

Adults...................... £2.75

Children £1.90

Saver Tickets

6 rides for just £9.50

Tickets valid for adults or children.

The fairground owner claims that a Saver Ticket saves at least 25% compared with the cost of buying 6 individual ride tickets.

Diann says, "The fairground owner's claim is always true."
Nhish says, "The fairground owner's claim is sometimes true."
Katherine says, "The fairground owner's claim is never true."

Who is correct?
Show how you decide.

....

....

....

....

....

....

....

....

....

....

.... **[4]**

One of the fairground rides, the Drop Tower, is a vertical tower.
Riders are lifted to the top of the tower and then released from rest.
The riders free-fall to part-way down the ride before decelerating to a stop at the bottom of the tower.

(b) The speed of the ride, v m/s, is directly proportional to the **square root** of the distance dropped, d metres.
After dropping 10 metres from the top of the ride, the speed is 14 m/s.

Calculate the speed of the ride after dropping 16 metres from the top of the ride.
Give your answer correct to 1 decimal place.

(b) .... m/s **[4]**

Turn over

(c) Once the brakes are applied the ride decelerates at a constant rate until it comes to rest at the bottom of the ride.

The deceleration, a m/s², is given by this formula

$$a = \frac{9.8d}{h - d}$$

where d metres is the distance dropped from the top of the ride to the point where the brakes are applied and
h metres is the total drop from the top to the bottom of the ride.

The total drop of the Drop Tower is 120 metres.

The brakes are applied at $\frac{3}{5}$ of the distance from the top of the ride.

Calculate the deceleration of the ride after the brakes are applied.

(c) .... m/s² **[3]**

(d) The number of visitors to the fairground is recorded.

(i) In 2007 there were 516 298 visitors to the fairground.
In 2008, the number of visitors was 23% greater than in 2007.
In 2009, the number of visitors was 13% greater than in 2008.

Calculate the number of visitors to the fairground in 2009.

(d)(i) .... **[3]**

(ii) In 2012, the number of visitors was 5% greater than in 2011.
In 2013, the number of visitors was p% **less** than in 2012.
The overall decrease in visitors from 2011 to 2013 was 16%.

Calculate the value of p.

(ii) .... **[3]**

(e) Heather spends £8.92 at the sweet stall.
She buys 8 Fizzy Fish and 12 Candy Crowns.

  (i) Using *f* for the cost, in pence, of each Fizzy Fish and *c* for the cost, in pence, of each Candy Crown, form an equation in *f* and *c* and show that it simplifies to

$$2f + 3c = 223$$

  ....

  ....

  .... **[1]**

  (ii) Mike spends £4.57 and buys 6 Fizzy Fish and 5 Candy Crowns.

  Form a second equation in *f* and *c*.
  Solve the two simultaneous equations algebraically to find the costs of each Fizzy Fish and each Candy Crown.

(e)(ii) Cost of a Fizzy Fish = ... pence

Cost of a Candy Crown = ... pence **[4]**

 (f) Katherine spends £95.46 in the fairground gift shop buying souvenirs for her friends.
 She buys 4 T-Shirts, 7 caps and 8 key rings.
 A cap costs a third of the price of a T-Shirt.
 Five key rings cost the same price as two caps.

 Using t for the cost, in pounds, of a T-Shirt, form an equation in t and solve it.

 (f) $t =$ .... **[4]**

4 Crossrail is a new railway being built across London.

(a) Between 8 am and 9 am, Crossrail trains will arrive at Oxford Circus station every 2.5 minutes and Central Line underground trains will arrive at Oxford Circus station every 2 minutes.

From 8 am to 9 am, what is the greatest number of times that a Crossrail train and a Central Line underground train could arrive in the station at the same time?

(a) .... **[3]**

(b) Tunnel boring machines are needed to dig 42 km of new tunnels.
Each tunnel boring machine can dig about 100 m of tunnel each week.

At this rate, how long would it take 3 tunnel boring machines to dig the 42 km of tunnels?
Give your answer in years and weeks.
Assume that all 3 tunnel boring machines work for all 52 weeks of the year.

(b) .... years .... weeks **[3]**

(c) A scale model of a tunnel boring machine is displayed at an exhibition.
On the real machine, the surface area of the cutting face is 40.8 m².
On the model machine, the surface area of the cutting face is 0.8 m².
On the real machine each of the cutting teeth is 40 cm long.

Calculate the length of the cutting teeth on the model machine.

(c) .... cm **[3]**

END OF QUESTION PAPER

PLEASE DO NOT WRITE ON THIS PAGE