Write your name here

Surname

Other names

Pearson Edexcel
Level 1/Level 2 GCSE (9 - 1)

Centre Number

Candidate Number

Mathematics AO3
Mathematical problem solving

Silver Test

Grades 6-9

Time: 45-60 minutes

Paper Reference
1MA1

You must have: Ruler graduated in centimetres and millimetres, protractor, pair of compasses, pen, HB pencil, eraser.

Total Marks

Instructions

*   Use **black** ink or ball-point pen.
*   **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
*   Answer **all** questions.
*   Answer the questions in the spaces provided
    – *there may be more space than you need*.
*   **Calculators must not be used in questions marked with an asterisk (*).**
*   Diagrams are NOT accurately drawn, unless otherwise indicated.
*   You must **show all your working out** with your **answer clearly identified** at the **end of your solution**.

Information

*   This silver test is aimed at students targeting grades 6-9.
*   This test has 8 questions. The total mark for this paper is 37.
*   The marks for **each** question are shown in brackets
    – *use this as a guide as to how much time to spend on each question*.

Advice

*   Read each question carefully before you start to answer it.
*   Keep an eye on the time.
*   Try to answer every question.
*   Check your answers if you have time at the end.

*1. Rectangle *ABCD* is mathematically similar to rectangle *DAEF*.
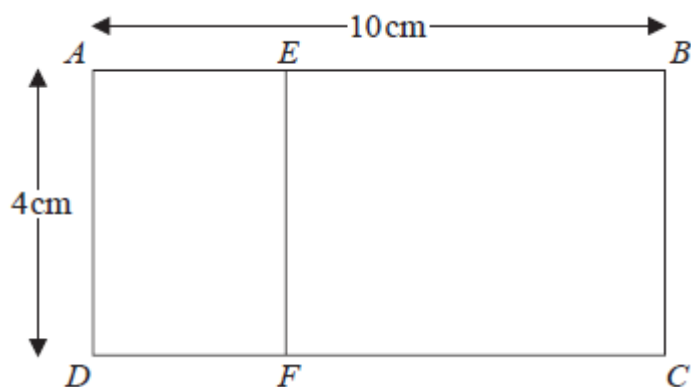
AB = 10 cm.
AD = 4 cm.

(a) Find the ratio $\dfrac{AD}{AB}$.

....
(1)

(b) Find the distance *AE*.

.... cm
(1)

(c) Thus work out the area of rectangle *DAEF*.

...........................cm^2
(1)

(Total for Question 1 is 3 marks)

*2.   *A*(-2, 1), *B*(6, 5) and *C*(4, *k*) are the vertices of a right-angled triangle *ABC*.
Angle *ABC* is the right angle.

(a) Draw a sketch of the triangle described above.

(b) Find an equation for the line *AB*.

…………………………………..
(1)

(c) Thus find an equation for the line *BC*.

…………………………………..
(1)

(d) Thus find the value of *k*.

$$k = \text{……………..}$$

(1)

(e) Thus find an equation of the line that passes through *A* and *C*, giving your answer in the form $ay + bx + c$ where *a, b* and *c* are integers.

……………………………………..

(2)

(Total for Question 2 is 5 marks)

4

*3. John has an empty box.
He puts some red counters and some blue counters into the box.

The ratio of the number of red counters to the number of blue counters is 1 : 4

Linda takes at random 2 counters from the box.

The probability that she takes 2 red counters is $\dfrac{6}{155}$.

How many red counters did John put into the box?

(a) Write an algebraic expression for the probability that Linda takes one red counter out of the box.

………………………………………..
(1)

(b) Write an algebraic expression for the probability that Linda takes a second red counter out of the box.

………………………………………….

(c) Use your answers to parts (a) and (b) to create an equation for the probability that Linda takes two red counters out of the box.

………………………………………..
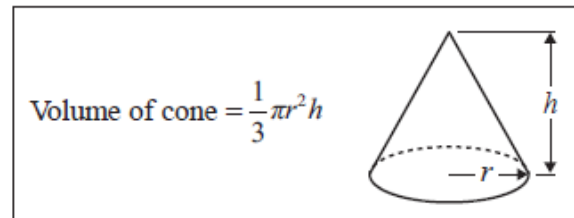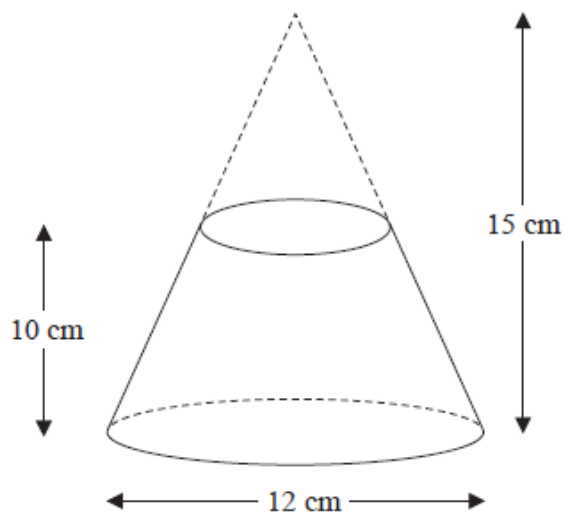**(1)**

(d) Solve your answer to part (c) to find how many red counters John put into the box.

....
(2)

(Total for Question 3 is 4 marks)

4. A frustum is made by removing a small cone from a large cone as shown in the diagram.

15 cm

10 cm

12 cm

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

h

r

The frustum is made from glass.

(a) Use the formula to work out the volume of the large cone.

……………………….. cm^3

(1)

(b) Use the formula to work out the volume of the small cone.

……………………….. cm^3

(1)

(c) Use your answers to parts (a) and (b) to work out the volume of the frustum.

……………………….. cm^3

(1)

The glass has a density of 2.5 g / cm^3

(f) Work out the mass of the frustum.
   Give your answer to an appropriate degree of accuracy.

..........................g

(2)

(Total for Question 4 is 5 marks)

_____

5. Louis and Robert are investigating the growth in the population of a type of bacteria.
They have two flasks A and B.

At the start of day 1, there are 1000 bacteria in flask A.
The population of bacteria grows exponentially at the rate of 50% per day.

(a) Write down the population of bacteria at the start of the first few days to show that the population of bacteria in flask A forms a geometric progression, giving the common ratio.

…………………………………………………………………………………………………

(2)

The population of bacteria in flask A at the start of the 10th day is k times the population of bacteria in flask A at the start of the 6th day.

(b) Find expressions for the population of bacteria at the start of the 6th and 10th days.

....

....
(1)

(c) Use your answers to part (b) to find the value of k.

....
(1)

At the start of day 1 there are 1000 bacteria in flask B.
The population of bacteria in flask B grows exponentially at the rate of 30% per day.

(c) Sketch a graph to compare the size of the population of bacteria in flask A and in flask B.

(1)

(Total for Question 5 is 5 marks)

6. In triangle *RPQ*,

$RP = 8.7$ cm
$PQ = 5.2$ cm
Angle $PRQ = 32°$

Assuming that angle *PQR* is an acute angle,

(a) sketch the triangle *RPQ*.

(b) Write down an appropriate formula to help solve this question.

....

(c) Use your answer to part (b) and rearrange to find the angle *PQR*.

angle *PQR* = ...°

(1)

(d) Hence find the angle *RPQ*.

angle *RPQ* = ...°

(1)

(e) Thus calculate the area of triangle *RPQ*.
Give your answer correct to 3 significant figures.
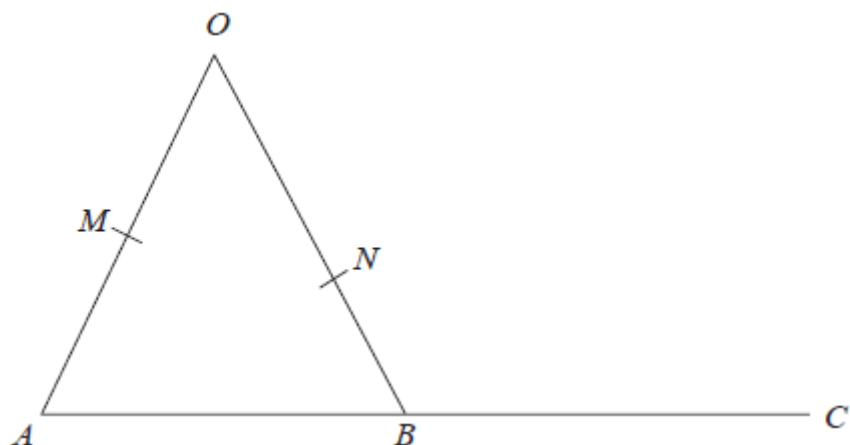
.... cm^2

(2)

(f) If you did not know that angle *PQR* is an acute angle, what effect would this have on your calculation of the area of triangle *RPQ*?

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

(1)

(Total for Question 6 is 5 marks)

7.

OMA, ONB and *ABC* are straight lines.
M is the midpoint of *OA*.
B is the midpoint of *AC*.

$\overrightarrow{OA} = 6\mathbf{a}$ $\overrightarrow{OB} = 6\mathbf{b}$ $\overrightarrow{ON} = k\mathbf{b}$ where k is a scalar quantity.

(a) Find $\overrightarrow{MC}$ in terms of **a** and **b**, giving your answer in its simplest form.

$\overrightarrow{MC}$ = ……………………..

(3)

(b) Find $\overrightarrow{MN}$ in terms of **a** and **b**.

$\overrightarrow{MN}$ = ……………………..

(1)

(c) Given that *MNC* is a straight line, find the value of *k*.

$k =$ ……………………..

(1)

(Total for Question 7 is 5 marks)

8. *VABCD* is a solid pyramid.
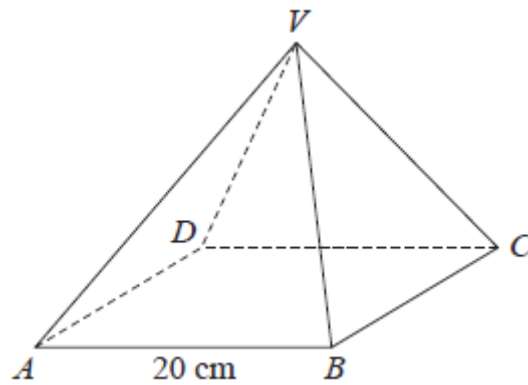
ABCD is a square of side 20 cm.

The angle between any sloping edge and the plane *ABCD* is 55°.

(a) Find the distance *AC*.

$AC = $ …………………………. cm

(1)

(b) Use trigonometry and your answer to part (a) to find the height of the pyramid.

…………………………. cm

(1)

(c) Use your answer to part (b) to find the height of a triangular face of the pyramid.

..................................cm

(1)

(d) Thus calculate the surface area of the pyramid.
     Give your answer correct to 2 significant figures.

..................................cm^2

(1)

(Total for Question 8 is 5 marks)

TOTAL FOR PAPER IS 37 MARKS

Mathematical problem solving: Silver Test Grades 6-9			
Question	Working	Answer	Notes
1 (a)		6.4	P1 Start to process e.g. find scale factor (0.4) or $\dfrac{AE}{4} = \dfrac{4}{10}$
(b)			P1 Complete process to find area
(c)			A1
2 (a-b)		$3y - 4x = 11$	P1 process to start e.g. draw a diagram, find gradient of AB (0.5)
(c)			P1 process to use gradients, e.g. find gradient of BC (–2)
(d)			P1 Process to find y coordinate of C (9)
(e)			P1 Process to find equation of AC
			A1
3 (a)		25	P1 For process to start to solve, e.g. use of x and $4x$ or $x/5x$ and $4x/5x$
(b-c)			P1 process to form equation, eg. $\dfrac{x}{5x} \times \dfrac{x-1}{5x-1} = \dfrac{6}{155}$
(d)			P1 Processes to eliminate fractions and reduce equation to linear form, e.g. $155x - 155 = 150x - 30$
(e)			A1

Mathematical problem solving: Silver Test Grades 6-9			
Question	Working	Answer	Notes
4 (a)		1361	P1 process using similar triangles to find base of small cone, e.g. 4 cm used as diameter or 2 cm used as radius
(b)			P1 process to find volume of one cone
(c)			P1 complete process to find volume of frustum
(d)			P1 complete process to find mass or 1360 – 1362
			A1 1361 or 1360 or 1400
5 (a)	1000, 1500, 2250, ...	Correct Argument	M1 Method to find 1st 3 terms
			C1 Convincing reason, e.g. common ratio is 1.5
(b)	$1000 \times 1.5^9 = k \times 1000 \times 1.5^5$	5.0625	P1 Process to find the value of k
(c)	$k = \dfrac{1.5^9}{1.5^5}$		A1
(d)		Correct sketches	C1 Draws both exponential curves intersecting on y axis and clearly labelled

Mathematical problem solving: Silver Test Grades 6-9			
Question	Working	Answer	Notes
6 (a-c)		22.55	P1 start to process, e.g. draw a labelled triangle or use of sine rule $\dfrac{\sin Q}{8.7} = \dfrac{\sin 32}{5.2}$
(d)			P1 process to find of Q, e.g. $Q = \sin^{-1}\left[\dfrac{\sin 32}{5.2} \times 8.7\right]$
(e)			P1 process to find area of triangle *PRQ*.
			A1 22.5 – 22.6
(f)			C1 angle *PRQ* is obtuse so need to find area of two triangles.
7 (a) (b) (c)	$\overrightarrow{OM} = \mathbf{3a}$ $\overrightarrow{AB} = 6\mathbf{b} - 6\mathbf{a}$ $\overrightarrow{MC} = 3\mathbf{a} + 2(6\mathbf{b} - 6\mathbf{a})$ $= 12\mathbf{b} - 9\mathbf{a}$ $= 3(4\mathbf{b} - 3\mathbf{a})$ $\overrightarrow{MN} = k\mathbf{b} - 3\mathbf{a}$ *MNC* is a straight line so	4	P1 For process to start e.g. $\overrightarrow{OM} = 3\mathbf{a}$ **or** $\overrightarrow{MA} = \mathbf{3a}$ P1 For process to find $\overrightarrow{AB}$ $(= 6\mathbf{b} - 6\mathbf{a})$ P1 For process to find $\overrightarrow{MC} = (3\mathbf{a} + 2(6\mathbf{b} - 6\mathbf{a}))$ **and** $\overrightarrow{MN}$ $(= k\mathbf{b} - 3\mathbf{a})$ P1 For correct process to find k, e.g. $3k\mathbf{b} - 9\mathbf{a} = 12\mathbf{b} - 9\mathbf{a}$ A1

Mathematical problem solving: Silver Test Grades 6-9			
Question	Working	Answer	Notes
8 (a)	$AC^2 = 20^2 + 20^2 = 800$	1300	Let X be centre of base, M be midpoint of AB P1 process to find AC or AX
	$AX^2 = 10^2 + 10^2 = 200$		P1 process to find VX or VA
(b)	$\sqrt{200} \times \tan 55 = VX \quad (=20.19...)$		P1 process to find height of sloping face or angle of sloping face.
(c)	$VM^2 = \sqrt{"20.19"^2 + 10^2} \quad (=22.54...)$		P1 process to find surface area of one triangular face.
(d)	$4 \times \dfrac{1}{2} \times "22.54" \times 20 + 20^2$		A1 for $1300 - 1302$