MARKSCHEME

May 2014

MATHEMATICAL STUDIES

Standard Level

Paper 1

1. (a) $\dfrac{2\cos 45° - \tan 45°}{\sqrt{8192} - 64}$ *(M1)*

$= 0.015625$ *(A1)* *(C2)*

> **Notes:** Accept $\dfrac{1}{64}$ and also 1.5625×10^{-2}.

(b) (i) 0.02 *(A1)(ft)*

(ii) 0.01563 *(A1)(ft)*

> **Notes:** For parts (i) and (ii), accept equivalent standard form representations.

(iii) 1.5625×10^{-2} *(A2)(ft)* *(C4)*

> **Notes:** Award *(A1)(A0)* for correct mantissa, between 1 and 10, with incorrect index.
> Follow through from their answer to part (a).
> Where the candidate has correctly rounded their mantissa from part (a) and has the correct exponent, award *(A0)(A1)*
> Award *(A0)(A0)* for answers of the type: 15.625×10^{-3}.

[6 marks]

2. (a) 3 *(A1)* *(C1)*

(b) 4 *(M1)(A1)* *(C2)*

> **Note:** Award *(M1)* for ordered list of numbers seen.

(c) 5.5 *(A1)* *(C1)*

(d) $5.5 - 3$ *(M1)*

> **Note:** Award *(M1)* for 3 and their 5.5 seen.

$= 2.5$ *(A1)(ft)* *(C2)*

> **Note:** Follow through from their answer to part (c).

[6 marks]

3. (a) **If** the food is well cooked **and** the drinks are chilled **then** dinner
is **not spoilt**. *(A1)(A1)(A1)* *(C3)*

> **Note:** Award *(A1)* for "If…then" (then must be seen), *(A1)* for the two
> correct propositions connected with "and", *(A1)* for "not spoilt".
> Only award the final *(A1)* if correct statements are given in the
> correct order.

(b)

p	q	r	$p \wedge q$	$\neg r$	$(p \wedge q) \Rightarrow \neg r$
T	T	T	**T**	**F**	**F**
T	T	F	**T**	**T**	**T**
T	F	T	**F**	**F**	**T**
T	F	F	**F**	**T**	**T**
F	T	T	**F**	**F**	**T**
F	T	F	**F**	**T**	**T**
F	F	T	**F**	**F**	**T**
F	F	F	**F**	**T**	**T**

(A1)(A1)(A1)(**ft**) *(C3)*

> **Notes:** Award *(A1)* for each correct column.
> The final column must follow through from the previous two
> columns.

[6 marks]

4. (a) Country chosen and gender are independent. *(A1)* *(C1)*

> **Notes:** Accept there is no association between country chosen and gender.
> Do not accept "not related" or "not correlated" or "influenced".

(b) 2 *(A1)* *(C1)*

(c) (i) 9.17 (9.16988…) *(A1)*

> **Notes:** Accept 9.169.

(ii) 0.0102 (0.0102043…) *(A1)* *(C2)*

> **Notes:** Award *(A1)* for 0.010, but *(A0)* for 0.01.

(d) Since $0.0102 > 0.01$, we accept the null hypothesis. *(R1)(A1)*(ft)

OR

Since $9.17 < 9.210$, we accept the null hypothesis. *(R1)(A1)*(ft) *(C2)*

> **Notes:** To award *(R1)* there should be value(s) given in part (c). If a value
> is given in (c), we do not need it explicitly stated again in (d).
> It is sufficient to state a correct comparison.
> e.g. p-value > significance level **OR** $\chi^2_{calc} <$ critical value
> Do not award *(R0)(A1)*. Follow through from part (c).

[6 marks]

5. (a) $6600 \times \dfrac{1}{8.2421}$ *(M1)*

   $= 800.77$ *(A1)* *(C2)*

   (b) 3000×0.028 *(M1)*

   $= 84.00$ (accept 84) *(A1)* *(C2)*

   (c) $(3000 - 84) \times 1.29903$ *(M1)*

   OR

   $3000 \times 1.29903 \times 0.972$ *(M1)*

   $= 3787.97$ *(A1)***(ft)** *(C2)*

Notes: Follow through from their answer to part (b).

   Note: Do not penalize in part (c) if conversion process has been reversed consistently ie, multiplication by 8.2421 in part (a) and division by 1.29903 in part (c).

[6 marks]

6.   (a)   10   *(A1)*   *(C1)*

(b)

$s\left(\mathrm{km\,h^{-1}}\right)$	$0 < s \le 50$	$50 < s \le 70$	$70 < s \le 80$	$80 < s \le 90$	$90 < s \le 100$
Frequency	**10**	**20**	34	**12**	4

(A1)(ft)   *(C1)*

Note: Follow through from their answer to part (a).

(c)   60   *(A1)*   *(C1)*

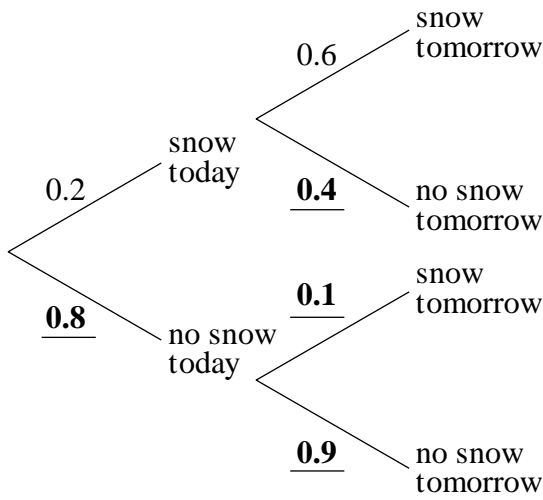(d)   (i) $67.5 \left(\mathrm{km\,h^{-1}}\right)$ *(A2)(ft)*

Notes: Award *(M1)* for an attempt to use the formula for the mean with at least two midpoint values consistent with their answer to part (c). Follow through from their table in part (b).

(ii) $18.6 \,(18.6413\ldots)$ *(A1)(ft)*   *(C3)*

Note: Follow through from their table in part (b).

[6 marks]

7. (a)

                      (A1)(A1)(A1) *(C3)*

> **Note:** Award *(A1)* for each correct pair of probabilities.

(b) $0.2 \times 0.6 + 0.8 \times 0.1$ *(A1)(ft)(M1)*

> **Note:** Award *(A1)(ft)* for two correct products of probabilities taken from
> their diagram, *(M1)* for the addition of their products.

$$= 0.2 \ \left(\frac{1}{5}, \ 20\% \right)$$ *(A1)(ft)* *(C3)*

> **Note:** Accept any equivalent correct fraction.
>   Follow through from their tree diagram.

[6 marks]

8. (a) $\tan 27.9° = \dfrac{9}{\text{OV}}$ *(M1)*

> **Note:** Award *(M1)* for correct substitution in trig formula.

$\text{OV} = 17.0 \,(\text{cm}) \ (16.9980...)$ *(A1)* *(C2)*

(b) $\dfrac{\pi(9)^2(16.9980...)}{3} + \dfrac{1}{2} \times \dfrac{4\pi(9)^3}{3}$ *(M1)(M1)(M1)*

> **Note:** Award *(M1)* for correctly substituted volume of the cone, *(M1)* for correctly substituted volume of a sphere divided by two (hemisphere), *(M1)* for adding the correctly substituted volume of the cone to *either* a correctly substituted sphere *or* hemisphere.

$= 2970 \,\text{cm}^3 \ (2968.63...)$ *(A1)***(ft)** *(C4)*

> **Note:** The answer is $2970 \,\text{cm}^3$, the units are required.

[6 marks]

9. (a) 12 *(A1)* *(C1)*

> **Note:** Award *(A1)* for $(12, 18)$.

(b) $\dfrac{26-10}{0-24}$ *(M1)*

> **Note:** Accept $\dfrac{26-18}{0-12}$ or $\dfrac{18-10}{12-24}$ (or equivalent).

$=-\dfrac{2}{3}\quad\left(-\dfrac{16}{24},-0.666666...\right)$ *(A1)* *(C2)*

> **Note:** If either of the alternative fractions is used, follow through from their answer to part (a).
> The answer is now *(A1)***(ft)**.

(c) gradient of $OM=\dfrac{3}{2}$ *(A1)***(ft)**

> **Note:** Follow through from their answer to part (b).

$-\dfrac{2}{3}\times\dfrac{3}{2}$ *(M1)*

> **Note:** Award *(M1)* for multiplying their gradients.

Since the product is -1, OAM is a right-angled triangle *(R1)***(ft)**

> **Notes:** Award the final *(R1)* only if their conclusion is consistent with their answer for the product of the gradients.
> The statement that OAM is a right-angled triangle without justification is awarded no marks.

OR

$(26-18)^2+12^2$ and 12^2+18^2 *(A1)***(ft)**

$\left((26-18)^2+12^2\right)+(12^2+18^2)=26^2$ *(M1)*

> **Note:** This method can also be applied to triangle OMB.
> Follow through from (a).

Hence a right angled triangle **(R1)(ft)**

Note: Award the final **(R1)** only if their conclusion is consistent with their **(M1)** mark.

OR

$OA = OB = 26\,(cm)$ an isosceles triangle **(A1)**

Note: Award **(A1)** for $OA = 26\,(cm)$ and $OB = 26\,(cm)$.

Line drawn from vertex to midpoint of base is perpendicular to the base **(M1)**

Conclusion **(R1)** **(C3)**

Note: Award, at most **(A1)(M0)(R0)** for stating that OAB is an isosceles triangle without any calculations.

[6 marks]

10. (a) $\left(f'(x) = \right)\ 4x^3$ *(A1)*   *(C1)*

(b) 4×2^3 *(M1)*

> **Note:** Award *(M1)* for substituting 2 into their derivative.

   $= 32$ *(A1)(ft)*   *(C2)*

> **Note:** Follow through from their part (a).

(c) $y - 16 = -\dfrac{1}{32}(x - 2)$ **or** $y = -\dfrac{1}{32}x + \dfrac{257}{16}$ *(M1)(M1)*

> **Note:** Award *(M1)* for their gradient of the normal seen, *(M1)* for point substituted into equation of a straight line in only x and y (with any constant 'c' eliminated).

   $x + 32y - 514 = 0$ **or** any integer multiple   *(A1)(ft)*   *(C3)*

> **Note:** Follow through from their part (b).

[6 marks]

11. (a) 1.5   *(A1)*   *(C1)*

(b) $C = 2.5$ (accept $y = 2.5$)   *(A1)(A1)*   *(C2)*

Notes: Award *(A1)* for C (or y) = a positive constant, *(A1)* for the
     constant $= 2.5$.
     Answer must be an equation.

(c) $2.4 = 2.5 - 2^{-t}$ *(M1)*

Note: Award *(M1)* for setting the equation equal to 2.4 or for a horizontal
     line drawn at approximately $C = 2.4$.
     Allow x instead of t.

   OR

   $-t \ln(2) = \ln(0.1)$ *(M1)*
   $t = 3.32192...$ *(A1)*
   $t = 3$ hours and 19 minutes (199 minutes)   *(A1)(ft)*   *(C3)*

Note: Award the final *(A1)(ft)* for correct conversion of **their** time in
     hours to the nearest minute.

                                                                                            [6 marks]

12. (a) 4   *(A1)*   *(C1)*

(b) $320\,000\left(1+\dfrac{10}{2\times100}\right)^{2\times2}$ *(M1)(A1)*

Note: Award *(M1)* for substituted compound interest formula, *(A1)* for correct substitutions.

OR

$N=2$
$I\%=10$
$PV=-320\,000$
$P/Y=1$
$C/Y=2$ *(A1)(M1)*

Note: Award *(A1)* for $C/Y=2$ seen, *(M1)* for correctly substituted values from the question into the finance application.

OR

$N=4$
$I\%=10$
$PV=-320\,000$
$P/Y=2$
$C/Y=2$ *(A1)(M1)*

Note: Award *(A1)* for $C/Y=2$ seen, *(M1)* for correctly substituted values from the question into the finance application.

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amount to repay $=388\,962$ *(A1)*   *(C3)*

Note: Award *(C2)* for final answer $389\,000$ if $388\,962$ not seen previously.

(c) $\left|\dfrac{360\,000-388\,962}{388\,962}\right|\times100$ *(M1)*

Note: Award *(M1)* for correctly substituted percentage error formula.

$=7.45\,(\%)\,(7.44597\ldots)$ *(A1)*(ft)   *(C2)*

Notes: Follow through from their answer to part (b).

[6 marks]

13.   (a)   5   *(A1)*   *(C1)*

(b)   *at least one of the following equations required*

$a(4)^2 + 4b + 5 = 13$

$4 = -\dfrac{b}{2a}$

$a(8)^2 + 8b + 5 = 5$ *(A2)(A1)*   *(C3)*

> **Note:**   Award *(A2)(A0)* for one correct equation, or its equivalent, and *(C3)*
> for any two correct equations.
> Follow through from part (a).
> The equation $a(0)^2 + b(0) = 5$ earns no marks.

(c) $a = -\dfrac{1}{2}, b = 4$ *(A1)(ft)(A1)(ft)*   *(C2)*

> **Note:**   Follow through from their equations in part (b), but only if their
> equations lead to unique solutions for *a* and *b*.

[6 marks]

14. (a) $q \Rightarrow p$ *(A1)(A1)*   *(C2)*

> **Note:** Award the first *(A1)* for seeing the implication sign, the second *(A1)* is
> for a correct answer only. Not using the implication earns **no** marks.

(b) $p \Rightarrow q$ *(A1)*(ft)   *(C1)*

> **Note:** Award *(A1)***(ft)** where the propositions in the
> implication in part (a) are exchanged.

(c)   Not equivalent; a kite or an isosceles trapezium (for example) can
have diagonals that are equal in length.   *(A1)(R1)*   *(C2)*

> **Notes:** Accept a valid sketch as reasoning.
> If the reason given is that *a square has diagonals of equal length,
> but is not a rectangle*, then award *(R1)(A0)*.
> Do not award *(A1)(R0)*.
> Do not accept solutions based on truth tables.

(d)   Inverse   *(A1)*   *(C1)*

> **Note:** Do not accept symbolic notation.

[6 marks]

15. (a) $3x^2 + k$ *(A1)*   *(C1)*

(b) $3(2)^2 + k = 0$ *(A1)*(ft)*(M1)*

> **Note:** Award *(A1)*(ft) for substituting 2 in their $\dfrac{dy}{dx}$, *(M1)* for setting their $\dfrac{dy}{dx} = 0$.

    $k = -12$ *(A1)*(ft)   *(C3)*

> **Note:** Follow through from their derivative in part (a).

(c) $2^3 - 12 \times 2$ *(M1)*

> **Note:** Award *(M1)* for substituting 2 and their -12 into equation of the curve.

    $= -16$ *(A1)*(ft)   *(C2)*

> **Note:** Follow through from their value of k found in part (b).

[6 marks]