MATHEMATICS **0626/06**

Paper 6 (Extended) **May/June 2018**

MARK SCHEME

Maximum Mark: 96

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the May/June 2018 series for most Cambridge IGCSE™, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

This document consists of **9** printed pages.

Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5:

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

GENERIC MARKING PRINCIPLE 6:

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

MARK SCHEME NOTES

The following notes are intended to aid interpretation of mark schemes in general, but individual mark schemes may include marks awarded for specific reasons outside the scope of these notes.

Types of mark

M   Method marks, awarded for a valid method applied to the problem.

A   Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. For accuracy marks to be given, the associated Method mark must be earned or implied.

B   Mark for a correct result or statement independent of Method marks.

When a part of a question has two or more 'method' steps, the M marks are in principle independent unless the scheme specifically says otherwise; and similarly where there are several B marks allocated. The notation '**dep**' is used to indicate that a particular M or B mark is dependent on an earlier mark in the scheme.

Abbreviations

awrt	answers which round to
cao	correct answer only
dep	dependent
FT	follow through after error
isw	ignore subsequent working
nfww	not from wrong working
oe	or equivalent
rot	rounded or truncated
SC	Special Case
soi	seen or implied

Question	Answer	Marks	Partial Marks
1(a)	22	3	**M2** for $\dfrac{427-350}{350}$ oe or $\dfrac{427}{350} \times 100$ oe or **M1** for $\dfrac{427}{350}$ oe or $427 - 350$ oe
1(b)	$5640 \times (1.025)^{10}$	**M1**	
	7220 or 7219 or 7219.6 to 7219.7	**A1**	
	Yes and shows that $5640 \times (1.025)^9$ (= 7043.587) is less than 7100	**B1**	
1(c)	459	3	**M2** for $\dfrac{344.25}{1-0.25}$ or **B1** for value of $100 - 25$ oe seen
1(d)	255.67 or 255.68	3	**B1** for 1.455 and **M1** for $\dfrac{372}{their\,1.455}$
2(a)	No, with full justification	5	**B4** for 26.2 to 26.3 (litres used) or 790 to 791.3 (km per tank) or 592 to 594 (km per ¾ tank) or 370 to 371 (miles before refill) or 0.47[4] of a tank left or **B3** for 5.7 to 5.8 (gallons used) or 494 to 495 (miles per tank) or **M3** for $\dfrac{45 \times 1.6}{4.55} \times 50$ or $416 \div \dfrac{45 \times 1.6}{4.55}$ soi or **M2** for $\dfrac{416}{45 \times 1.6}$ or $\dfrac{45 \times 1.6}{4.55}$ or $\dfrac{416 \div 1.6}{45}$ soi or **M1** for any correct, relevant, previously unused unit conversion, or for $\dfrac{50}{4}\,[\times 3]$ For 5 marks, must say "no", otherwise maximum of 4

Question	Answer	Marks	Partial Marks
2(b)(i)	9.84×10^3 or 9.85×10^3 or $9.848... \times 10^3$	3	**B2** for $9848[.48...]$ or 9850 or $9848\frac{16}{33}$ OR **M1** for using the formula e.g. $\dfrac{650}{\text{figs } 66}$ or $\dfrac{650}{\text{figs } 33}$ or $\dfrac{650}{2 \times \text{figs } 33}$ **M1** for converting from cm^2 to m^2 at some point **M1** for *their* pressure converted to standard form Maximum of 2 marks if answer is incorrect
2(b)(ii)	Valid explanation involving the pressure is less	1	
2(c)	12.9 or 12.89[…]	4	**B1** for midpoints soi **M1** for the sum of *their* midpoints × frequencies soi **M1 dep** for *their* 980 ÷ *their* 76
3(a)(i)	Correct speed-time graph	2	**B1** for a horizontal line from (8, 12) to (28, 12) **B1** for a straight line from (*their* 28, 12) to (*their* 28 + 12, 0)
3(a)(ii)	1.5 oe isw	1	
3(b)(i)	Correct speed-time graph	4	**B3** for 4 or 5 correct points plotted (can be implied by curve passing through these points) or **B2** for 3 points plotted correctly (can be implied by curve passing through these points) or **M1** for 2 of 3 values correct in table
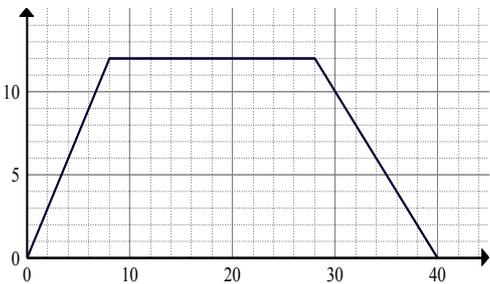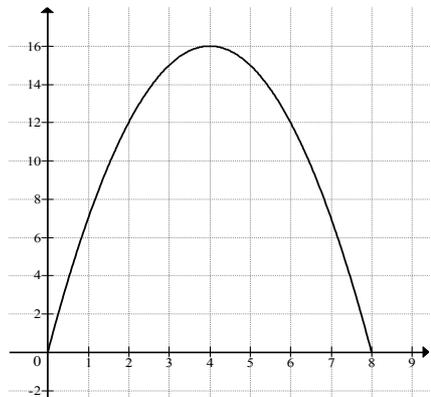
Question	Answer	Marks	Partial Marks
3(b)(ii)	Tangent drawn leading to gradient of -5 to -3	**3**	**B2** for a close attempt at a tangent drawn at $t = 6$ with answer in range OR **B1** for an attempt at tangent drawn at $t = 6$ **M1** for attempting to correctly calculate the gradient for their tangent
4(a)	40	**1**	
4(b)	Correct cumulative frequency diagram	**2**	**B1** for at least 5 correct plots or for reasonable graph through all *their* points (within half a square)
4(c)(i)	14 to 15	**1**	
4(c)(ii)	6 to 8	**2**	**M1** for either UQ between 18 and 19 or LQ between 11 and 12
4(c)(iii)	15 to 17	**2**	**FT** *their* graph; 100 – *their* 84 evaluated **M1** for *their* 84 found using $t = 21$ on a reasonable cf diagram soi
5(a)(i)	$\dfrac{5}{8}$ or 0.625	**1**	
5(a)(ii)	$8x^3 - 2x + 1$	**2**	**M1** for $(2x)^3 - 2x + 1$
5(b)	3×9^x	**3**	**B1** for 3^{2x+1} soi **B1** for $3(3^{2x})$ **B1** for $3^{2x} = 9^x$ seen Maximum of 2 marks if answer not correct
6(a)	32	**4**	**B3** for 96 or **M3** for $\dfrac{128}{4}$ [×3] oe or for $\dfrac{128}{128-x} = \dfrac{4}{3}$ oe or **M2** for $\sqrt{\dfrac{17600}{9900}}$ oe (= $\dfrac{4}{3}$ or $\dfrac{74.84}{56.14}$) or **M1** for $\dfrac{17600}{9900}$ oe

Question	Answer	Marks	Partial Marks
6(b)	$[r_1 =] \sqrt{\dfrac{17\,600}{\pi}}$ (= 74.84) soi or $[r_2 =] \sqrt{\dfrac{9900}{\pi}}$ (= 56.14...) soi	**B1**	
	$[A_1 =] \pi \times their\,74.8 \times 128$ or $[A_2 =] \pi \times their\,56.1 \times (128 - their\,32)$ soi	**M1**	
	The difference in *their* curved surface areas soi	**M1**	
	A correct calculation with the correct answer given to more than 3 sf	**A1**	
7(a)	$2x + y \geqslant 100$ oe	1	
7(b)	*their* $2x + y = 100$ ruled	2	must be an equation in terms of x and y; **B1 FT** for line with y-intercept *their* 100 or x-intercept *their* 50 or with 2 correct FT points for *their* line
	correct region shaded out	1	
7(c)	[Teen-Art =] 120 and [Super-Draw =] 60	2	**M1** for correct strategy to find maximum e.g. looking at corners of region or for solving equations $4y + 3x = 600$ and $x = 2y$
8(a)	222 or 221.69 to 222.46	5	**M2** for $\sin[...] = \dfrac{28\sin 15}{35}$ or **M1** for $\dfrac{\sin[...]}{28} = \dfrac{\sin 15}{35}$ oe **A1** for 11.9[4.....] **M1** for $\dfrac{1}{2} \times 35 \times 28 \times \sin(165 - their\,11.9)$ OR **M2** for $AB^2 - 54.09AB - 441 = 0$ or **M1** $35^2 = 28^2 + AB^2 - 2 \times 28 \times AB \times \cos 15$ **A1** for $AB = 61.29$ **M1** for $\dfrac{1}{2} \times their\,AB \times 28 \times \sin 15$
8(b)	awrt 16.5	4	**B1 FT** for $[CAD = 40 - their\,11.9 =]$ *their* 28.1 **M2** for cosine rule $[CD^2 =] 35^2 + 30^2 - 2(35)(30)\cos their\,28.1$ or **M1** for cosine rule with other angle e.g. 40 or 20

Question	Answer	Marks	Partial Marks
9(a)	Valid comment	**1**	
9(b)(i)	$8x^3 + \dfrac{1}{8}$	**2**	**B1** for one correct expression seen
9(b)(ii)	$-\dfrac{1}{4}$	**2**	**M1** for $their\left(8x^3 + \dfrac{1}{8}\right) = 0$
9(b)(iii)	$\left[\dfrac{\mathrm{d}^2 y}{\mathrm{d}x^2} = \right] their(24x^2)$	**M1**	or considers $their\left(8x^3 + \dfrac{1}{8}\right)$ above and below $their -\dfrac{1}{4}$
	States or shows this is positive [therefore minimum]	**A1**	states or shows that the gradient changes from negative to positive [and so a minimum]
9(b)(iv)	$-\dfrac{8}{9}$	**3**	**M1** for substituting $x = \dfrac{1}{2}$ into $their$ $8x^3 + \dfrac{1}{8}$ **A1** for $\dfrac{9}{8}$ **B1** for $\dfrac{-1}{their\,\dfrac{9}{8}}$ Maximum of 2 marks if answer incorrect or unsimplified
10(a)	40	**1**	
10(b)	$\dfrac{1}{32}\begin{pmatrix} 4 & -6 \\ 2 & 5 \end{pmatrix}$ or $\begin{pmatrix} \frac{1}{8} & -\frac{3}{16} \\ \frac{1}{16} & \frac{5}{32} \end{pmatrix}$ oe	**2**	**B1** for $\dfrac{1}{32} \times \left(\quad \right)$ or for $\dfrac{1}{k} \times \begin{pmatrix} 4 & -6 \\ 2 & 5 \end{pmatrix}$
10(c)	$\begin{pmatrix} -17 & 13 \\ -6 & 18 \end{pmatrix}$	**2**	**M1** for $\begin{pmatrix} 10 & 12 \\ -4 & 8 \end{pmatrix} - \begin{pmatrix} 27 & -1 \\ 2 & -10 \end{pmatrix}$ or **B1** for 3 correct elements or $\begin{pmatrix} 17 & -13 \\ 6 & -18 \end{pmatrix}$
10(d)	$\begin{pmatrix} 16 & 0 \\ 40 & 80 \end{pmatrix}$	**2**	**B1** for any 2 or 3 correct elements
11(a)	$\dfrac{30}{x}$	**B1**	
11(b)	$\dfrac{30}{x-10}$	**B1**	
11(c)	$their\left(\dfrac{30}{x-10}\right) + their\left(\dfrac{30}{x}\right) = 1$	**M1**	

Question	Answer	Marks	Partial Marks
	$their\,(30x + 30 \times (x-10) = x \times (x-10))$	**M1**	or $\dfrac{30x + 30(x-10)}{x(x-10)} = 1$
	$x^2 - 70x + 300 = 0$	**A1**	
	$x = \dfrac{70 \pm \sqrt{70^2 - 4(1)(300)}}{2}$	**M1**	
	65.4 to 65.414 (mph) only	**A1**	65.4138… or 4.5861…. implies previous **M1**