F.6 Mathematics 2025 Mock Exam Paper I & II

Marking Scheme

This document was prepared for markers' reference. It should not be regarded as a set of model answers. Candidates and teachers who were not involved in the marking process are advised to interpret its contents with care.

General Marking Instructions

1. It is very important that all markers should adhere as closely as possible to the marking scheme. In many cases, however, candidates will have obtained a correct answer by an alternative method not specified in the marking scheme. In general, a correct answer merits ***all the marks*** allocated to that part, unless a particular method has been specified in the question. Markers should be patient in marking alternative solutions not specified in the marking scheme.

2. In the marking scheme, marks are classified into the following three categories:

'M' marks	awarded for correct methods being used;
'A' marks	awarded for the accuracy of the answers;
Marks without 'M' or 'A'	awarded for correctly completing a proof or arriving at an answer given in a question.

   In a question consisting of several parts each depending on the previous parts, 'M' marks should be awarded to steps or methods correctly deduced from previous answers, even if these answers are erroneous. However, 'A' marks for the corresponding answers should NOT be awarded (unless otherwise specified).

3. For the convenience of markers, the marking scheme was written as detailed as possible. However, it is still likely that candidates would not present their solution in the same explicit manner, e.g. some steps would either be omitted or stated implicitly. In such cases, markers should exercise their discretion in marking candidates' work. In general, marks for a certain step should be awarded if candidates' solution indicated that the relevant concept/technique had been used.

4. In marking candidates' work, the benefit of doubt should be given in the candidates' favour.

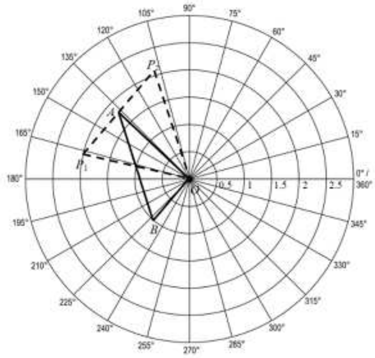
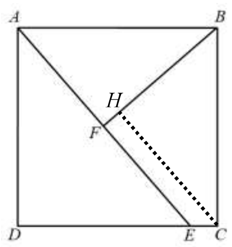
5. In the marking scheme, 'r.t.' stands for 'accepting answers which can be rounded off to' and 'f.t.' stands for 'follow through'. Steps which can be skipped are shaded whereas alternative answers are enclosed with rectangles. All fractional answers must be simplified.

Paper 1

Solution	Marks	Remarks
1. $(\frac{16x^{-3}}{y^{-2}})^2(2x^2y^{-3})^{-1}$		
$=\frac{16^2x^{-6}}{y^{-4}}\cdot 2^{-1}x^{-2}y^3$	1M	for $(a^h)^k=a^{hk}$ or $(ab)^l=a^lb^l$
$=\frac{2^8x^{-6}}{y^{-4}}\cdot 2^{-1}x^{-2}y^3$		
$=2^{8-1}x^{-6-2}y^{3-(-4)}$	1M	for $\frac{c^p}{c^q}=c^{p-q}$ or $d^{-r}=\frac{1}{d^r}$
$=2^7x^{-8}y^7$		
$=\frac{128y^7}{x^8}$	1A	
	--------(3)	
2. (a) $32ab^2-16b^3$		
$=16b^2(2a-b)$	1A	or equivalent
(b) $32ab^2-16b^3+a^2b-2a^3$		
$=16b^2(2a-b)-a^2(2a-b)$	1M	for using the result of (a)
$=(2a-b)(16b^2-a^2)$		
$=(2a-b)(4b+a)(4b-a)$	1A	or equivalent
	--------(3)	
3. $\frac{2}{7x+6}-\frac{3}{9-2x}$		
$=\frac{2(2x-9)+3(7x+6)}{(7x+6)(2x-9)}$	1M	
$=\frac{4x-18+21x+18}{(7x+6)(2x-9)}$	1M	
$=\frac{25x}{(7x+6)(2x-9)}$	1A	or equivalent
	--------(3)	

Solution	Marks	Remarks
4. (a) $x-3(x-4)>10$ or $x \geq -3$		
$x-3x+12>10$		
$-2x>-2$	1M	for putting x on one side
$x<1$	1A	
$x \geq -3$		
Thus, the required range is all real values of x.	1A	
(b) 1	1A	
	--------(4)	
5. Let \$$x$ be the marked price of the school bag.		
The cost of the school bag		
$=\frac{x}{(1+75\%)}$	1M	
$=\$\left(\frac{4x}{7}\right)$		
The selling price of the school bag		
$=\$(x-168)$	1M	
$\frac{4x}{7}(1+40\%)=x-168$	1M	
$x=840$	1A	
Thus, the marked price of the school bag is \$840.		
Let \$$c$ be the cost of the school bag.		
The marked price of the school bag		
= (1 + 75%)c	1M	
= \$1.75c		
The selling price of the school bag		
= (1 + 40%)c	1M	
= \$1.4c		
1.75c – 1.4c = 168	1M	
c = 480		
Thus, the marked price of the school bag is \$840.	1A	
	--------(4)	

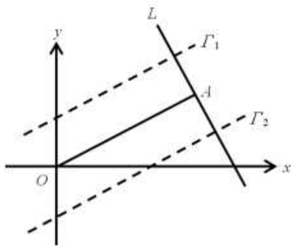
Solution	Marks	Remarks
6. (a) $3(m + 2x) = 4(2m - y)$		
$3m + 6x = 8m - 4y$	1M	
$6x + 4y = 8m - 3m$	1M	for putting m on one side
$6x + 4y = 5m$		
$m = \dfrac{6x+4y}{5}$	1A	
(b) Change in m		
$= \dfrac{6(x+7)+4(y+2)}{5} - \dfrac{6x+4y}{5}$		
$= \dfrac{6x+4y}{5} + 10 - \dfrac{6x+4y}{5}$		
$= 10$	1A	
	--------(4)	
7. Let $2k$ and $3k$ be the number of boys and girls respectively.		
In June,		
number of boys = $2k + 54$		
number of girls = $3k + 6$		
$\dfrac{2k+54}{3k+6} = \dfrac{3}{2}$	1M	
$k = 18$	1M	
In July,		
number of boys = $2(18) + 54 - 10 = 80$	1M	either one
number of girls = $3(18) + 6 - 12 = 48$		
Thus, the ratio of the number of boys to that of girls in July		
= 80 : 48		
= 5 : 3	1A	
	--------(4)	

Solution	Marks	Remarks
8. (a) $\angle AOB = 228^\circ - 138^\circ = 90^\circ$		
$AB^2 = (\sqrt{3})^2 + 1^2$		
$AB = 2$	1A	
$\angle OAB = \tan^{-1}\dfrac{1}{\sqrt{3}}$		
$\angle OAB = 30^\circ$	1A	
		
(b) $P(2,\ 138^\circ + 30^\circ) = P(2,\ 168^\circ)$ or	1A	
$P(2,\ 138^\circ - 30^\circ) = P(2,\ 108^\circ)$	1A	
	--------(4)	
9. (a) $\angle AFB = \angle EDA = 90^\circ$ (given)		
$\angle ABF = 180^\circ - 90^\circ - \angle BAF$ ($\angle$ sum of Δ)		
$= 90^\circ - \angle BAF$		
$= \angle EAD$		
$\Delta ABF \sim \Delta EAD$ (AA)		
Marking Scheme:		
Case 1 Any correct proof with correct reasons.	2	
Case 2 Any correct proof without reasons.	1	
(b) (i) $BC = AB = AD$ (properties of square)		
$\dfrac{AB}{EA} = \dfrac{BF}{AD}$ (corr. sides, $\sim\Delta$s)	1M	
$\dfrac{BC}{16} = \dfrac{9}{BC}$		
$BC = 12$ cm	1A	
(ii) Draw a line from C to BF such that $CH \perp BF$		
$CH = BC\sin\angle CBH$		
$= 12\sin(90^\circ - \angle ABF)$		
$= 12\cos\angle ABF$		
$= 12 \times \dfrac{9}{12} = 9$ cm	1M	
		
So, the shortest distance from C to BF is 9 cm which is not less than 9 cm.		
Thus, point G does not exist.	1A	
	--------(6)	

Solution	Marks	Remarks
10. (a) $C = ax + by$, where a and b are non-zero constants.	1A	
So, we have $10a + 3b = 4550$ and $16a + 4b = 6760$.	1M	for either substitution
Solving, we have $a = 260$ and $b = 650$.	1A	for both correct
Thus, we have $C = 260x + 650y$.		
	--------(3)	
(b) $C = 260x + 650y$		
$2990 = 260x + 650y$		
$23 = 2x + 5y$	1M	
The possible ordered pair of x and y are (9, 1) and (4, 3).	1A+1A	1A for one pair + 1A for all
Thus, the possible numbers of students and teachers are 9 and 1 or 4 and 3 respectively.		
	--------(3)	
11. (a) Range = $(60 – 20) = $40	1M+1A	
IQR = $(48 – 35) = $13	1A	
	--------(3)	
(b) (i) After the three toys are sold, the price of the 21st toy must be $42 and the price of the 20th toy is at most $42 when the remaining 40 toys are arranged in ascending order of their prices.		
Median price of the remaining 40 toys		
$\leq \$\dfrac{42+42}{2}$	1M	
= $42		
Thus, the claim is agreed.	1A	f.t.
(ii) Let $$x$ be the mean price of the toys before the three toys are sold.		
$x - 0.5 = \dfrac{43x-(40+46+48)}{43-3}$	1M	
$x = 38$	1A	
Thus, the required mean price is $38.		
	--------(4)	

Solution	Marks	Remarks
12. (a) Let $p(x) = (2x^2 - x - 6)(ax + b)$, where a and b are constants.	1M	
By remainder theorem, $p(-3) = -90$ and $p(1) = 10$.		
Hence, we have $-3a + b = -6$ and $a + b = -2$.	1M	for either one
Solving, we have $a = 1$ and $b = -3$		
$p(x) = (2x^2 - x - 6)(x - 3)$ or $p(x) = 2x^3 - 7x^2 - 3x + 18$	1A	
	--------(3)	
(b) $p(x) = (2x + 3)(x - 2)(x - 3)$		
$p(x) = q(x)$		
$(2x + 3)(x - 2)(x - 3) = (x - 2)(4x^2 + k)$		
$(x - 2)[(2x^2 - 3x - 9) - (4x^2 + k)] = 0$		
$(x - 2)(2x^2 + 3x + 9 + k) = 0$	1A	
Since, the equation has three distinct real roots,		
$2x^2 + 3x + 9 + k$ has two distinct real roots.		
$(3)^2 - 4(2)(9 + k) > 0$	1M	
$k < -\frac{63}{8}$		
If $x = 2$ is a root of $2x^2 + 3x + 9 + k$, then $k = -23$.	1M	
Thus, $k < -\frac{63}{8}$ and $k \neq -23$.	1A	
	--------(4)	

Solution	Marks	Remarks
13. (a) Let c be the radius of C.		
Since the volume of C is 36 000π cm^3,		
$\frac{4}{3}\pi c^3 = 36000\pi$	1M	
$c = 30$	1A	
Thus, the radius of C is 30 cm.		
	--------(2)	
(b) Let S_A and S_B be the total surface area of A and B respectively.		
Since A and B are two similar solid right circular cones,		
$\frac{S_A}{S_B} = \left(\frac{1}{9}\right)^2$		
$S_B = 81S_A$	1M	
Note that sum of the total surface areas of A and C is equal to the total surface area of B		
$S_A + 4\pi(30)^2 = S_B$	1M	
$S_A + 3600\pi = 81S_A$		
$S_A = 45\pi$	1A	
Thus, the total surface area of A is 45π cm^2.		
	--------(3)	
(c) Let l cm be the slant height of B.		
Note that the ratio of radius of A to radius of B is 1 : 9.		
Radius of B = 3 × 9 = 27 cm		
$\pi(27)^2 + \pi(27)l = 81 \times 45\pi$		
$l = 108$		
Volume of B		
$= \frac{1}{3}\pi(27)^2(\sqrt{108^2 - 27^2})$	1M	
$= 25410.64373\pi$		
$< 36000\pi$		
Thus, the claim is disagreed.	1A	f.t.
	--------(2)	

Solution	Marks	Remarks
14. (a) Slope of $OA = \frac{3}{4}$		
The equation of L is		
$y - 3 = -\frac{4}{3}(x - 4)$		
$y = -\frac{4}{3}x + \frac{25}{3}$	1M	(or $4x + 3y - 25 = 0$)
Let (a, b) be the coordinates of B.		
$b = -\frac{4}{3}a + \frac{25}{3}$		
Note that $AB = 2$.		
$(a-4)^2 + (-\frac{4}{3}a + \frac{25}{3} - 3)^2 = 2^2$		
$a = \frac{26}{5}$ or $a = \frac{14}{5}$	1A	
$b = -\frac{4}{3}\left(\frac{26}{5}\right) + \frac{25}{3} = \frac{7}{5}$ or $b = -\frac{4}{3}\left(\frac{14}{5}\right) + \frac{25}{3} = \frac{23}{5}$		
Thus, the coordinates of B are $(\frac{26}{5}, \frac{7}{5})$ or $(\frac{14}{5}, \frac{23}{5})$	1A --------(3)	for either one
(b) (i) Γ is parallel to OA.	1A	
(ii) Since the area of ΔPOA is always equal to 5 square units, the height of ΔPOA is equal to 2 units.		
Thus, Γ passes through B.		
 		
The equation of Γ is		
$y - \frac{7}{5} = \frac{3}{4}(x - \frac{26}{5})$	1M	for either one
$y = \frac{3}{4}x - \frac{5}{2}$ (or $3x - 4y - 10 = 0$)	1A	for either one
or $y - \frac{23}{5} = \frac{3}{4}(x - \frac{14}{5})$		
$y = \frac{3}{4}x + \frac{5}{2}$ (or $3x - 4y + 10 = 0$)		

Solution	Marks	Remarks
14. (b) (iii) Radius of $C=\frac{5}{2}$ units		
Length of $SQ=2\times\sqrt{\left(\frac{5}{2}\right)^2-2^2}=3$ units	1M	
Area of $\triangle ASQ=\frac{3\times 2}{2}$	1A	
$=3$ sq.units	--------(5)	
	1M	
15. $\log_9 y-24=3(\log_{27}x-7)$	1M	any one
$\log_9 y=\log_{27}x^3+3$		
$\log_9 y=\log_{27}19683x^3$		
$\log_9 y=\frac{\log_9 19683x^3}{\log_9 27}$		
$\log_9 y=\frac{2}{3}\log_9 19683x^3$	1A	
$y=729x^2$	--------(5)	
16. (a) The required probability	1M	for denominator
$=\frac{C_1^{14}C_2^{16}}{C_3^{14+16}}$	1A	r.t. 0.414
$=\frac{12}{29}$		
(b) The required probability		for numerator
$=1-\frac{\frac{C_1^{13}C_2^{15}}{C_3^{30}}}{\frac{12}{29}}$	1M	r.t. 0.664
$=\frac{3}{16}$	1A	

Solution	Marks	Remarks
17. (a) $A(1)+A(2)+...+A(n)$		
$=1.005+1.005^2+...+1.005^n$		
$=\dfrac{1.005(1.005^n-1)}{1.005-1}$	1M	
$=201(1.005^n-1)$	1A	
	--------(2)	
(b) (i) $S(1+\dfrac{6\%}{12})+S(1+\dfrac{6\%}{12})^2+...+S(1+\dfrac{6\%}{12})^{36}\geq 1000000$		
$S(1.005)+S(1.005)^2+...+S(1.005)^{36}\geq 1000000$		
$201S(1.005^{36}-1)\geq 1000000$		
$S\geq \dfrac{1000000}{201(1.005^{36}-1)}$	1M	for using the result of (a)
$S\geq 25295.46015$		
Thus, the minimum value of S is \$25300.	1A	r.t. \$25300
(ii) $15000(1.005)+15000(1.005)^2+...+15000(1.005)^n\geq 1000000$		
$15000\times 201(1.005^n-1)\geq 1000000$		
$1.005^n\geq \dfrac{1000000}{15000\times 201}+1$		
$n\log 1.005\geq \log\left(\dfrac{1000000}{15000\times 201}+1\right)$	1M	
$n\geq \dfrac{\log\left(\dfrac{1000000}{15000\times 201}+1\right)}{\log 1.005}$		
$n\geq 57.43060315$		
Thus, the minimum time required is 58 months.	1A	
	--------(4)	

Solution	Marks	Remarks
18. (a) By sine formula, we have		
$\dfrac{SQ}{\sin\angle QPS}=\dfrac{PS}{\sin\angle PQS}$	1M	
$SQ=\dfrac{40}{\sin 20^\circ}\times\sin 120^\circ$		
$SQ\approx 101.2835554\text{cm}$		
By cosine formula, we have		
$SQ^2=SR^2+QR^2-2(SR)(QR)\cos\angle QPS$	1M	
$101.2835554^2=60^2+QR^2-2(60)(QR)\cos 35^\circ$		
$QR^2-120\cos 35^\circ(QR)+60^2-101.2835554^2=0$		
$QR=144.4066413$ or $QR=-46.10839601$ (rejected)		
$QR\approx 144\,\text{cm}$	1A	r.t. 144 cm
	--------(3)	
(b) Area of the metal sheet.		
= Area of ΔSPQ + Area of ΔSQR		
$=\dfrac{1}{2}(PS)(SQ)\sin\angle PSQ+\dfrac{1}{2}(SR)(QR)\sin\angle QRS$	1M	
$=\dfrac{1}{2}(40)(101.2835554)\sin(180^\circ-120^\circ-20^\circ)$ $+\dfrac{1}{2}(60)(144.4066413)\sin\angle 35^\circ$		
≈ 3786.923692		
$\approx 3790\text{ cm}^2$	1A	r.t. 3790 cm^2
	--------(2)	

Solution	Marks	Remarks
18. (c) (i) Extend RS and QP to meet at a point T such that $PT \perp ST$.		
$ST = 40\sin(180° - 120°)$	1M	
$= 34.64101615$		
The required distance		
$= 34.64101615 \sin 34°$	1M	
$= 19.3710104$ cm		
≈ 19.4 cm	1A	r.t. 19.4 cm
18. (c) (ii) Draw a perpendicular line from R to QP to cut QP at V.		
$RV = QR \sin\angle RQP = 144.4066413 \sin 39.86374756°$		
$= 92.55947276$ cm	1M	
The distance from R to the horizontal ground		
$= RV \sin 34°$		
$= 92.55947276 \sin 34°$		
$= 51.75860031$ cm		
The required angle		
$= \sin^{-1}\left(\dfrac{\text{distance from } R \text{ to the horizontal ground}}{QR}\right)$		
$= \sin^{-1}\left(\dfrac{51.75860031}{144.4066413}\right)$	1M	
$= 21.00335255°$		
$> 20°$		
Thus, the claim is disagreed.	1A	f.t.
	--------(6)	

Solution	Marks	Remarks
19. (a) $(x-2)^2+(y-6)^2=r^2$	1A	
	--------(1)	
(b) (i) Let A' be the centre of C'.		
$A' = (-2, 6-c)$		
Since AA' is perpendicular to PQ, we have		
$-\frac{1}{2}\times\frac{6-c-6}{-2-2}=-1$	1M	
$c=8$	1A	
(ii) $A' = (-2, -2)$		
Mid-point of PQ = Mid-point of AA'		
$= (0, 2)$	1M	
The equation of PQ is $y=-\frac{1}{2}x+2$.	1A	$x+2y-4=0$
(iii) Sub. $y=-\frac{1}{2}x+2$ into $(x-2)^2+(y-6)^2=r^2$, we have		
$(x-2)^2+(-\frac{1}{2}x+2-6)^2=r^2$		
$5x^2+80-4r^2=0$ ……(*)	1M	
Since a and d are the roots of *, we have		
$a+d=0$, $ad=\frac{80-4r^2}{5}$	1M	
$(a-d)^2=(a+d)^2-4ad$		
$=\frac{16r^2}{5}-64$	1A	
$5x^2+80-4r^2=0$ ……(*)		
$x=\pm\sqrt{\frac{4r^2-80}{5}}$	1M	
Since a and d are the roots of *, we have		
$(a-d)^2=(2\sqrt{\frac{4r^2-80}{5}})^2=4\times\frac{4r^2-80}{5}=\frac{16r^2}{5}-64$	1A	
	--------(7)	

Solution	Marks	Remarks
19. (c) $(e-b)^2=\left[-\frac{1}{2}d+2-\left(-\frac{1}{2}a+2\right)\right]^2$		
$(e-b)^2=\left(-\frac{1}{2}d+2+\frac{1}{2}a-2\right)^2$		
$=\frac{1}{4}(a-d)^2$	1M	
$PQ=4\sqrt{5}$		
$(a-d)^2+(e-b)^2=(4\sqrt{5})^2$		
$(a-d)^2+\frac{1}{4}(a-d)^2=80$		
$(a-d)^2=64$		
$\frac{16r^2}{5}-64=64$		
$r^2=40$	1M	
$AB^2=(-1-2)^2+(1-6)^2$		
$=34$		
<40		
So, $B(-1, 1)$ lies inside C.		
Thus, the claim is agreed.	1A	f.t.
	--------(3)	