Solution	Marks
REG-2425-MOCK-SET 2-MATH-CP 1	
Suggested solutions	
1. $\frac{(m^{-2}n^5)^3}{m^6n^{-7}} = \frac{m^{-6}n^{15}}{m^6n^{-7}}$	1M
$= \frac{n^{15+7}}{m^{6+6}}$	1M
$= \frac{n^{22}}{m^{12}}$	1A
2. (a) $2x^2 - 3x - 2 = (2x+1)(x-2)$	1A
(b) $6x^2y + 3xy - 2x^2 + 3x + 2 = 3xy(2x+1) - (2x+1)(x-2)$	1M
$= (2x+1)(3xy - x + 2)$	1A
3. (a) 11	1A
(b) 10.16	1A
(c) 10.2	1A
4. (a) $\frac{3x-7}{4} < 2x+5$	
$-\frac{5x}{4} < \frac{27}{4}$	
$x > -\frac{27}{5}$	1A
$x + 2 \geq 0$	
$x \geq -2$	
Thus, $x > -\frac{27}{5}$.	1M
(b) $4x + 13 < 9$	
$x < -1$	1A
Thus, $-\frac{27}{5} < x < -1$.	1M
Required sum $= (-5) + (-4) + (-3) + (-2) = -14$	1A
5. (a) $P(-3,\ -4)$ and $Q(3,\ 4)$	1A+1A
(b) $P'(-4,\ 3)$	
Slope of $OP' = \frac{3-0}{-4-0} = -\frac{3}{4}$ and slope of $OQ' = \frac{-4}{3} \neq -\frac{3}{4}$.	1M
They are not collinear.	1A
6. $2(-k)^2 + k(-k) - 6 = k$	1M
$k^2 - k - 6 = 0$	1A
$k = 3$ or -2	1A

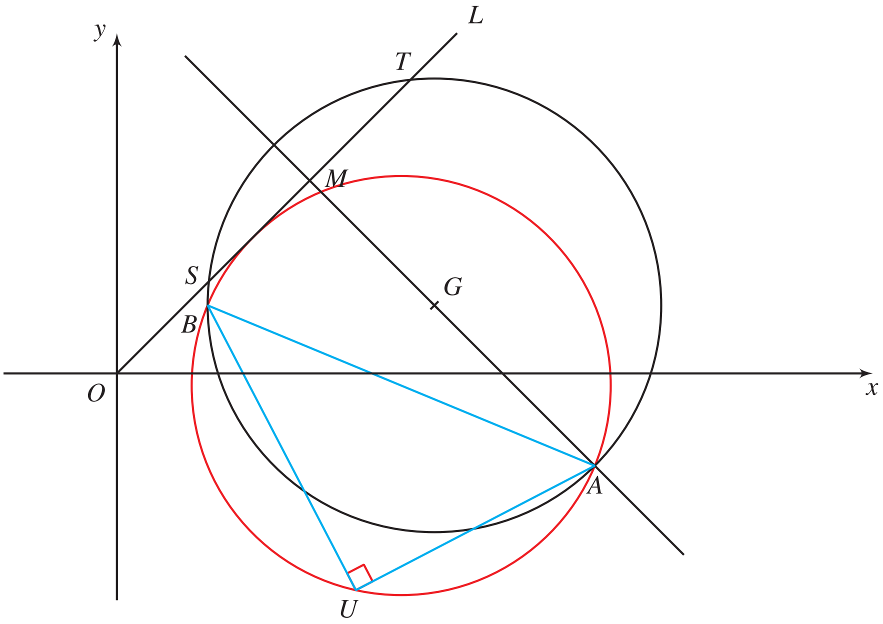
Solution	Marks
7. (a) Least possible capacity $= 350 - \frac{1}{2} = 349.5$ mL	1M+1A
(b) Least possible total capacity $= 349.5 \times 6$	
$= 2097$ mL	
> 2050 mL	1M
It is not possible.	1A
8. (a) Let a and b be the numbers of packages A and packages B bought by Hailey respectively.	
$\begin{cases} 12a + 20b = 444 \\ a = b(1 - 20\%) \end{cases}$	1A 1A
$12(0.8b) + 20b = 444$	1M
$b = 15$	
Required number $= 15 + 0.8(15) = 27$	1A
(b) Required ratio $= 12(12) : 20(15)$	
$= 12 : 25$	1A
9. $\angle ADB = \angle BDC = 32°$	1A
$\angle ABD = 90°$	1A
$\angle BAD = 180° - 90° - 32° = 58°$	1A
$\angle BCD = 180° - 58° = 122°$	1M+1A
10. (a) Let $C = ad + bn$, where a and b are non-zero constants.	1A
$\begin{cases} 58\,500 = 3a + 25b \\ 78\,000 = 5a + 20b \end{cases}$	1M
Solving, we have $a = 12\,000$ and $b = 900$.	1A
Total cost $= 12\,000(4) + 900(33) = \$77\,700$	1A
(b) When $d = 5$ and $n = 35$, $C = 12\,000(5) + 900(35) = 91\,500$.	
Percentage increase in the amount paid by each student	
$= \dfrac{\frac{91\,500}{30} - \frac{77\,700}{30}}{\frac{77\,700}{30}} \times 100\%$	1M
$\approx 17.8\%$	
$> 15\%$	
The amount paid by each student is increased by more than 15%.	1A

Solution	Marks
11. (a) Range $= 13.1 - 1.8$	1M
$= 11.3\text{ g}/100\text{mL}$	1A
Interquartile range $= 9.2 - 5.4$	
$= 3.8\text{ g}/100\text{mL}$	1A
(b) New mean $= \dfrac{7.2 \times 20 + 2.4 + 4.6 + 7.5 + 10.4 + 13.4}{20 + 5}$	1M
$= 7.292\text{ g}/100\text{mL}$	1A
New median is the 13th datum in ascending order.	
New median is 7.5 g/100mL.	1M+1A
12. (a) (i) Let $P(x,\ y)$.	
$\dfrac{y+1}{x-5} \times \dfrac{y-5}{x+3} = -1$	1M+1M
$(x+3)(x-5) + (y+1)(y-5) = 0$	
$x^2 + y^2 - 2x - 4y - 20 = 0$	1A
The equation of locus of P is $x^2 + y^2 - 2x - 4y - 20 = 0$.	
(ii) The locus of P is a circle with AB as diameter, excluding points A and B.	1A
(b) Centre of C is at $(9,\ 8)$.	
Distance between centres $= \sqrt{(9-1)^2 + (8-2)^2} = 10$.	1M
Sum of radii $= \sqrt{25} + 5 = 10 =$ distance between centres	1M
The circles touch each other externally.	
The claim is disagreed.	1A
13. (a) Volume $= 4^2(6) - \dfrac{1}{3}\left(\dfrac{(4)(4)}{2}\right)\left(\dfrac{6}{2}\right)$	1M+1A
$= 88\text{ cm}^3$	1A
(b) Total surface area of $ABCDEFGH$	
$= 2[4^2 + (4)(6)(2)]$	
$= 128\text{ cm}^2$	
$\dfrac{AP}{PQ} = \sqrt{\dfrac{128}{512}}$	1M
$= \dfrac{1}{2}$	
Difference in volume $= 88 \times \left[\left(\dfrac{2}{1}\right)^3 - 1\right]$	1M+1A
$= 616\text{ cm}^3$	
$> 600\text{ cm}^3$	
The difference in volume is not less than 600 cm^3.	1A

Solution	Marks
14. (a) $f(x) = (8x^2 + ax + 8)(3x^2 + 7x + r) + bx + c$	1M
$= 24x^4 + (56 + 3a)x^3 + \ldots$	
$56 + 3a = 47$	1M
$a = -3$	1A
(b) (i) Let $g(x) = A(8x^2 + ax + 8) + bx + c$, where A is a constant.	1M
$f(x) - g(x) = [(8x^2 + ax + 8)(3x^2 + 7x + r) + bx + c] - [A(8x^2 + ax + 8) + bx + c]$	
$= (8x^2 + ax + 8)(3x^2 + 7x + r - A)$	
Thus, $f(x) - g(x)$ is divisible by $8x^2 + ax + 8$.	1
(ii) $f(x) - g(x) = 0$	
$(8x^2 - 3x + 8)(3x^2 + 7x + r - A) = 0$	
$8x^2 - 3x + 8 = 0$ or $3x^2 + 7x + r - A = 0$	1M
For $8x^2 - 3x + 8 = 0$,	
$\Delta = (-3)^2 - 4(8)(8) = -247 < 0$. The equation has no real roots.	1M
For $3x^2 + 7x + r - A = 0$, the equation has at most 2 real roots.	
Thus, $f(x) - g(x) = 0$ has at most 2 real roots.	
The claim is disagreed.	1A
15. (a) Required probability $= \dfrac{C_3^{20}C_2^{15}}{C_5^{35}}$	1M
$= \dfrac{4275}{11\,594}$	1A
(b) Required probability $= \dfrac{C_3^{20}C_2^{10}}{C_3^{20}C_2^{15} + C_4^{20}C_1^{15} + C_5^{20}}$	1M
$= \dfrac{900}{3647}$	1A
16. (a) Let the mean and standard deviation of the distribution be μ and σ respectively.	
$\begin{cases} \dfrac{60 - \mu}{\sigma} = 1.25 \\ \dfrac{44 - \mu}{\sigma} = 0.25 \end{cases}$	1M
Solving, we have $\mu = 40$ and $\sigma = 16$.	1A+1A
(b) New standard score of Carol $= \dfrac{44(1 + 10\%) - 40(1 + 10\%)}{16(1 + 10\%)}$	1M
$= 0.25$	
The claim is not correct.	1A

Solution	Marks
17. (a) Required amount	
$= 3.24\times 10^{10}[1+(1+5\%)+(1+5\%)^2+\ldots+(1+5\%)^{14}]$	1M
$= \dfrac{3.24\times 10^{10}(1.05^{15}-1)}{1.05-1}$	1M
$\approx \$6.99\times 10^{11}$	1A
(b) $3.24\times 10^{10}(1+1.05+1.05^2+\ldots+1.05^{n-1}) > 10^{12}$	1M
$\dfrac{3.24\times 10^{10}(1.05^{n}-1)}{1.05-1} > 10^{12}$	
$1.05^n > \dfrac{206}{81}$	
$n\log 1.05 > \log\dfrac{206}{81}$	1M
$n > 19.1$	
The least value of n is 20.	1A
18. (a) (i) Note that $\triangle ABC$ is equilateral.	
$CE = \dfrac{AC}{2} = 10\text{ cm}$	
$CD = \sqrt{10^2+12^2}$	1M
$= 2\sqrt{61}\text{ cm}$	1A
$\approx 15.6\text{ cm}$	
Note that $BE\perp AC$.	
$BE = \sqrt{20^2-10^2} = 10\sqrt{3}\text{ cm}$	
$BD = \sqrt{BE^2+12^2}$	
$= 2\sqrt{111}\text{ cm}$	1A
$\approx 21.1\text{ cm}$	
(ii) $CD^2 = 20^2 + BD^2 - 2(20)(BD)\cos\angle DBC$	1M
$\angle DBC \approx 44.6°$	
$\angle ABC = 2\angle DBC$	
$\approx 89.2°$	1A
(b) Consider the quadrilateral $ABCD$. Denote the intersection of AC and BD by F.	
$AC^2 = 20^2+20^2-2(20)(20)\cos\angle ABC$	1M
$AC \approx 28.1\text{ cm}$	
When P is at F, the distance travelled by the ant is the shortest.	
When P is at B, the distance travelled by the ant is $2\times 20 = 40\text{ cm}$.	
When P is at D, the distance travelled by the ant is $2CD =\approx 31.2\text{ cm}$.	
The distance travelled by the ant decreased from 40 cm to 28.1 cm;	
and then increases to 31.2 cm.	1A

Solution	Marks
19. (a) $\sqrt{(h-6)^2+(9-3)^2}=\sqrt{(h-a)^2+(11-3)^2}$	1M
$h^2-12h+72=h^2+a^2-2ah+64$	
$h=\dfrac{a^2-8}{2a-12}$	
The coordinates of G are $\left(\dfrac{a^2-8}{2a-12},\ 3\right)$.	1A
(b) (i) $\dfrac{11-3}{a-\frac{a^2-8}{2a-12}}=\dfrac{4}{3}$	1M
$24(2a-12)=4[a(2a-12)-(a^2-8)]$	
$0=4a^2-96a+320$	
$a=4$ or 20	
When $a=4$, $h=-2<0$; when $a=20$, $h=14>0$.	
So, $a=20$.	1A
(ii) Coordinates of G are $(14,\ 3)$. The equation of C is	
$(x-14)^2+(y-3)^2=(6-14)^2+(9-3)^2$	1M
$x^2+y^2-28x-6y+105=0$	
$x^2+(kx)^2-28x-6kx+105=0$	1M
$(1+k^2)x^2+(-28-6k)x+105=0$	
x-coordinate of $M=\dfrac{1}{2}\times\dfrac{28+6k}{1+k^2}$	
$=\dfrac{14+3k}{1+k^2}$	1
(iii) Since $\angle OMG=90°$, $OM=2\sqrt{41}$.	
$\sqrt{\left(\dfrac{14+3k}{1+k^2}\right)^2+\left(\dfrac{k(14+3k)}{1+k^2}\right)^2}=2\sqrt{41}$	1M
$\dfrac{(14+3k)^2}{1+k^2}=164$	
$-155k^2+84k+32=0$	
$k=\dfrac{4}{5}$ or $-\dfrac{8}{31}$ (rejected)	
Coordinates of M are $(10,\ 8)$.	1M
M, G and A are collinear.	
Coordinates of B are $(4,\ 3)$.	1M
When the area of circle AUB is the least, $\angle AUB=90°$.	1M
slope of AM × slope of $BM=\dfrac{8-3}{10-14}\times\dfrac{8-3}{10-4}$	1M
$=-\dfrac{25}{24}\neq-1$	
So, $\angle AMB\neq90°$ and $\angle AUB+\angle AMB\neq180°$.	
A, M, B and U are not concyclic.	1A

Solution	Marks
	

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