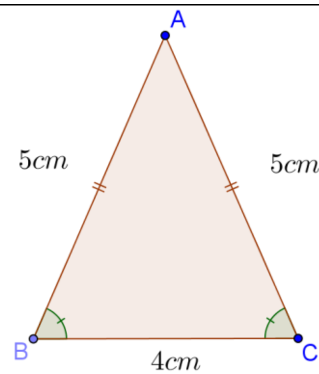
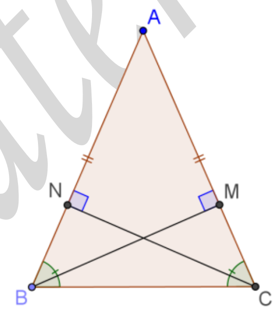
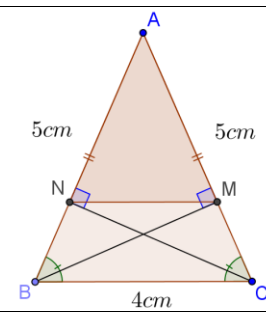
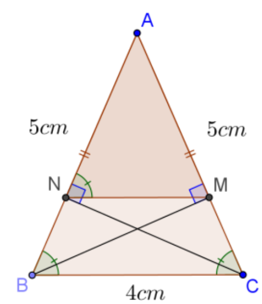
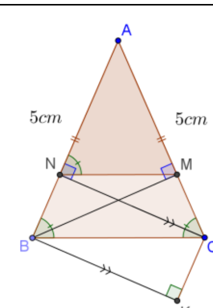
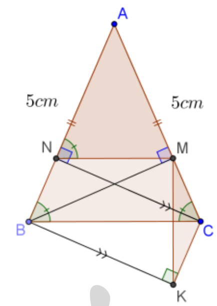
Q	Parts	Elements of solution
I	A	$A_1 = \frac{leg_1 \times leg_2}{2}$ ABC is right at A (given) $= \frac{AB \times AC}{2}$ $= \frac{2(x+1)\times(x+1)}{2}$ $A_1 = (x+1)^2 cm^2$ $A_2 = length \times width$ $DEFG$ is a rectangle (given) $= 4(x-3)(x-3)$ $A_2 = 4(x-3)^2 cm^2$ But, $A_1 = A_2$ (given) So, $4(x-3)^2 = (x+1)^2$ Which is a 2nd degree eqn in one unknown To solve it: we equate to zero then factorize $4(x-3)^2 - (x+1)^2 = 0$ $[2(x-3)-(x+1)][2(x-3)+(x+1)] = 0$ $(x-7)(3x-5) = 0$ If the product of two factors is zero then at least one of them is zero So, $(x-7) = 0$ or $(3x-5) = 0$ Hence, $x = 7$ or $x = \frac{5}{3}$ But, $x > 3$ (given) Thus, $x = 7$ is accepted & $x = \frac{5}{3}$ is rej.
	B 1 a	$x = 2\frac{1}{4} + \frac{3}{2}$ $= \frac{2}{1} + \frac{1}{4} + \frac{3}{2}$ $= \frac{8+1+6}{4}$ Thus, $x = \frac{15}{4}$ $y = 1 + \frac{1}{1+\frac{1}{2}}$ $= 1 + \frac{1}{\frac{3}{2}}$ $= 1 + \frac{2}{3}$ Thus, $y = \frac{5}{3}$
	B 1 b	$\frac{x}{y} = \frac{\frac{15}{4}}{\frac{5}{3}}$ So, $\frac{x}{y} = \frac{15\times3}{4\times5}$ Thus, $\frac{x}{y} = \frac{9}{4}$ But, $AB = \frac{x}{y} \times 2^2$ So, $AB = \frac{9}{4} \times 4$ Thus, $AB = 9$
	B 2	$AI = \frac{16^2 + 24^3}{128 \times 22} - \frac{1}{2}$ So, $AI = \frac{2^8 + 2^9 \times 3^3}{2^7 \times 2 \times 11} - \frac{1}{2}$ $= \frac{2^8(1 + 2\times3^3)}{2^8 \times 11} - \frac{1}{2}$ $= \frac{(1+54)}{11} - \frac{1}{2}$ $= \frac{55}{11} - \frac{1}{2}$ $= 5 - \frac{1}{2}$ Hence, $AI = \frac{9}{2}$ But, $AB = 9$ Thus, $AI = \frac{AB}{2} = \frac{9}{2}$
	B 3	In ΔABC we have: $AI = \frac{AB}{2}$ (proved) So, I is the midpoint of $[AB]$ (IJ) is parallel to (BC) (given) (IJ) cuts $[AC]$ at J (given) Thus, J is the midpoint of $[AC]$ (By converse of midpoint theorem in a Δ: St. line issued from midpoint of a side and parallel to the 2nd passes through the midpoint of the 3rd)

	C	1	To prove BC is double AM we expand both $BC=(2x+1)^2-\frac{1}{2}x(8x-1)+\frac{3}{2}x+3$ $=4x^2+4x+1-4x^2+\frac{x}{2}+\frac{3x}{2}+3$ $BC=6x+4$	$AM=x(-9x+3)+(3x-1)(3x+1)+3$ $=-9x^2+3x+(3x)^2-(1)^2+3$ $AM=3x+2$ Thus, $BC=2AM$
		2	In ΔABC we have: $BC=2AM$ (proved) So, M is the midpoint of $[BC]$	Then, AM is a median of $[BC]$ Thus, ΔABC is right at A (by converse of median relative the hypotenuse)
II	1	a	$Q(x)=(3x-6)(x+1)-x^2+4x-4$ $=3x^2+3x-6x-6-x^2+4x-4$ $Q(x)=2x^2+x-10$	The degree of $Q(x)$ is 2^{nd} since the highest power of the variable is 2
		b	$Q(x)$ is a 2^{nd} degree polynomial in x, and it is defined for all real values of x since it is a polynomial(no variables in the lower part and no variable under the radical)	
		c	$x=-1$ is a root of $Q(x)$ if $Q(-1)=0$ $Q(-1)=2(-1)^2+(-1)-10$	Hence, $Q(x)=-11\neq 0$ Thus, $x=-1$ is not a root of $Q(x)$
		d	$Q(x)=(3x-6)(x+1)-x^2+4x-4$ $=3(x-2)(x+1)-\left(x^2-2(x)(2)+(2)^2\right)$ $=3(x-2)(x+1)-(x-2)^2$	So, $Q(x)=(x-2)[2(x+1)-(x-2)]$ Thus, $Q(x)=(x-2)(x+4)$
		e	A root is a value of the variable that vanishes the expression. To find the roots of $Q(x)$ we solve $Q(x)=0$ So, $(x-2)(x+4)=0$ If the product of two factors is zero then at least one of them is zero	So, $(x-2)=0$ *or* $(x+4)=0$ Thus, $Q(x)$ admits the two distinct roots $x=2$ & $x=-4$
	2		If $x=2$ is a root of $P(x)$ Then, $P(2)=0$ $P(2)=(m-2)(2)^2-8+3(2-2)(2-1)$	$0=4m-8-8$ Thus, $m=4$
	3	a	$P(x)=2x^2-8+3(2-x)(x-1)$ $=2x^2-8+3(2x-2-x^2+x)$ $=2x^2-8+9x-3x^2-6$	Hence, $P(x)=-x^2+9x-14$ Where, $a=-1, b=9$ & $c=-14$
		b	$P(x)=-x^2+9x-14$ (proved) $-x^2+9x-14=-14$ Which is a 2^{nd} degree eqn in one unknown To solve it: we equate to zero then factorize	$-x^2+9x=0$ $x(-x+9)=0$ Thus the roots of the given equation are $x=0$ *or* $x=9$
		c	$P(x)=-x^2+9x-14$ $P\left(-\frac{1}{2}\right)=-\left(-\frac{1}{2}\right)^2+9\left(\frac{-1}{2}\right)-14$	$P\left(-\frac{1}{2}\right)=-\frac{1}{4}-\frac{9}{2}-14$ Thus, $P\left(-\frac{1}{2}\right)=-\frac{75}{4}$

<table>
<tr><td rowspan="4"></td><td></td><td>d</td><td>$P(x)=2x^2-8+3(2-x)(x-1)$
$=2(x^2-2^2)-3(x-2)(x-1)$
$=2(x-2)(x+2)-3(x-2)(x-1)$</td><td>So, $P(x)=(x-2)[2(x+2)-3(x-1)]$
Thus, $P(x)=(x-2)(-x+7)$</td></tr>
<tr><td rowspan="3">4</td><td>a</td><td colspan="2">$F(x)$ represents a literal fraction, since there is a variable in its denominator.</td></tr>
<tr><td>b</td><td colspan="2">
<table>
<tr><th>x</th><th>$F(x)$</th></tr>
<tr><td>2</td><td>$F(2)=\dfrac{(2-2)(-2+7)}{(2-2)(2(2)+5)}=\dfrac{0}{0}$, which admits infinite number of solutions</td></tr>
<tr><td>3</td><td>$F(3)=\dfrac{(3-2)(-3+7)}{(3-2)(2(3)+5)}=\dfrac{4}{11}$, which admits a unique solution</td></tr>
<tr><td>$-\dfrac{5}{2}$</td><td>$F(2)=\dfrac{\left(\left(\frac{-5}{2}\right)-2\right)\left(\frac{-5}{2}+7\right)}{\left(\left(\frac{-5}{2}\right)-2\right)\left(2\left(\frac{-5}{2}\right)+5\right)}=\dfrac{non\ zero}{0}$
which admits no solution</td></tr>
</table>
Conclusion: $F(x)$ is defined for al real values of x except $x=2\ \&\ x=-\dfrac{5}{2}$</td></tr>
<tr><td>c</td><td>$F(x)=\dfrac{(x-2)(-x+7)}{(x-2)(2x+5)}$
$=\dfrac{(-x+7)}{(2x+5)}$</td><td>$\dfrac{(-x+7)}{(2x+5)}=\dfrac{1}{2}$
So, $-2x+14=2x+5$
Hence, $x=\dfrac{9}{4}$ which is accepted, since it is in domain of $F(x)$</td></tr>
<tr><td rowspan="3">III</td><td colspan="2">1</td><td>$AB=\dfrac{1.05\times10^2\times20}{420}$
$=\dfrac{105\times10^{-2}\times10^2}{21}$</td><td>So, $AB=\dfrac{5\times21}{21}$
Thus, $AB=5cm$</td></tr>
<tr><td rowspan="2">2</td><td>a</td><td>$BC=\dfrac{28}{75}\times\dfrac{45}{21}-5^{-1}+3\dfrac{2}{5}$
$=\dfrac{7\times4}{3\times25}\times\dfrac{9\times5}{7\times3}-\dfrac{1}{5}+3+\dfrac{2}{5}$</td><td>$BC=\dfrac{4}{5}-\dfrac{1}{5}+\dfrac{2}{5}+3$
$=1+3$
Thus, $BC=2^2cm$</td></tr>
<tr><td>b</td><td>$P_{ABC}=sum\ of\ sides$
$=AB+BC+AC$
But, ABC is isosceles A (given)
So, $AB=AC$ (legs of an iso. triangle)</td><td>Hence, $P_{ABC}=BC+AB$
$=10+4$
$=14$
Thus, $P_{ABC}=1.4\times10^1cm$ (scientific notation)</td></tr>
</table>

	3	a	 	
		b	In $\Delta s\ BCN \ \& \ BCM$ we have: $[BM)\&[CN)$ are respective heights of $[AC]\&[AB]$(given) So, $B\hat{N}C = B\hat{M}C = 90^{\circ}$ ABC is isosceles at A(given) So, $A\hat{B}C = B\hat{C}A$(base angles of an iso. triangle) $[BC]$is a common side. Hence, $BCN \ \& \ BCM$ are equal by R.H.A property Thus, $BN = CM$ (homologous elements) respectively	
		c	In $\Delta\ ANM$ we have: $AB = AC$ (proved) And, $BN = CM$ (proved) But, $N \ \& \ M$ are on $[AC]\&[AB]$(given) Hence, $AN = AM$ (by comparison) Thus, ANM is isosceles at $BN = CM$ (having 2 equal sides)	
	4		In quadrilateral $BNCM$ we have: $ABC \ \& \ ANM$ are two iso. triangles sharing same main vertex. And, $N \ \& \ M$ are on $[AC]\&[AB]$(given) So, $A\hat{N}M = A\hat{B}C$ Hence, $(NM) \parallel (BC)$(equal corresponding angles are held by parallel lines) But, $A\hat{B}C = B\hat{C}A$(proved) Thus, $BNCM$ is an isosceles trapezoid.	
	5	a	In quadrilateral $BNCK$ we have: $[CN)$ is a height of $[AB]$(given) So, $[CN) \perp (AB)$ And, $[CN) \parallel (BK)$(given) So, $(AB) \perp (BK)$(line perp. To one of 2 parallel lines is perp. to the other) And, $(CK) \perp (BK)$(given) Thus, $BNCK$ is a rectangle (having three right angles)	

		b	In ΔMCK we have: $BNCM$ is an isosceles trapezoid (proved) So, $BN = MC$ (legs of an iso. trapezoid) $BNCK$ is a rectangle (proved) So, $BN = CK$ (opp. Sides of a rect.) Hence, $MC = CK$ (by comparison) Thus, ΔMCK is isosceles at C (having 2 equal sides)	
	6		In ΔNOC we have: $BNCK$ is a rectangle of center O (given) So, $ON = OC$ (half of equal diagonals in a rectangle) So, ΔNOC is isosceles at O (having 2 equal sides) But, F is the orthogonal projection of O on $[NC]$ So, (OF) is a height relative to base $[NC]$ Then, (OF) is a median to $[NC]$ (height issued from main vertex of an iso. triangle) So, F is the midpoint of $[NC]$ Hence, $OF = \frac{CK}{2}$ (midpoint theorem in ΔNCK :segment joining midpoints of 2 sides of a triangle is half the 3rd side) But, $MC = CK$ (proved) Thus, $OF = \frac{MC}{2}$ (by substitution)