	$\frac{1}{2}MN\times NP\sin MNP=\frac{1}{2}\times\frac{40}{3}\times\sqrt{4^2+\left(\frac{10}{3}-2\right)^2}\sin\left\{\cos^{-1}\left(\frac{\left(\frac{4\sqrt{10}}{3}\right)^2+\left(\frac{40}{3}\right)^2-\left(4\sqrt{10}\right)^2}{2\times\frac{4\sqrt{10}}{3}\times\frac{40}{3}}\right)\right\}$	
	$=\frac{80}{3}$	A1
		(3)

Notes

(b)

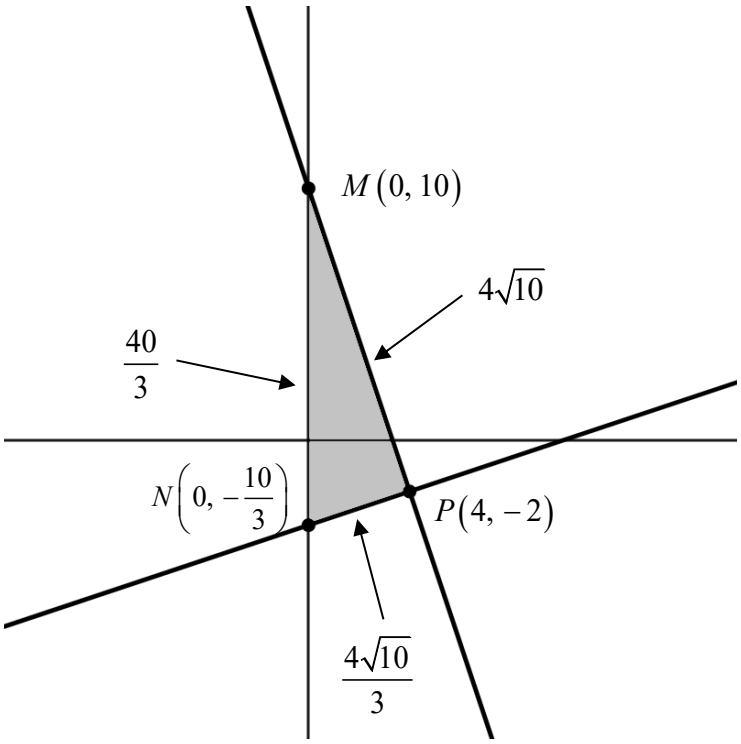
B1ft: States or uses coordinates of N as $\left(0,-\frac{10}{3}\right)$. Follow through on their $-\frac{c}{b}$ from part (a).
May be implied and may be seen on a diagram.

M1: Attempts area of triangle MPN using a **fully correct method** for their values.
Note that there are many different ways to find the required area so you may need to check their working carefully.
In all cases, the method must be fully correct for their values including correct use of e.g. Pythagoras or the cosine rule if they are used.
Note that *M* and *N* must both be on the *y*-axis so if e.g. they substitute $y = 0$ into either straight line equation and treat the resulting x values as y values, this scores M0

A1: For $\frac{80}{3}$ or **exact** equivalent e.g. $26\frac{2}{3}$ or $26.\dot{6}$ but not e.g. 26.6 or 26.7 unless the correct exact value is seen previously then apply isw. Allow recovery from inexact intermediate working provided the method is correct and the correct exact answer is obtained.
Ignore any reference to units.

		(6 marks)

Diagram for 2(b):



Question Number	Scheme	Marks
3(a)	$A=\frac{1}{2}ab\sin\theta \Rightarrow 60=\frac{1}{2}\times 15\times 10\times \sin\theta^\circ \Rightarrow \sin\theta^\circ=\frac{4}{5}$ * or e.g. $A=\frac{1}{2}\text{base}\times\text{height}=60 \Rightarrow 60=\frac{1}{2}\times 15\times h=60 \Rightarrow h=8 \Rightarrow \sin\theta=\frac{8}{10}=\frac{4}{5}$ or e.g. by verification $A=\frac{1}{2}ab\sin\theta=\frac{1}{2}\times 15\times 10\times\frac{4}{5}=60 \Rightarrow \sin\theta^\circ=\frac{4}{5}$	B1*

Notes

Condone use of a different letter in (a) e.g. $\frac{1}{2}\times 15\times 10\times\sin C \Rightarrow \sin C=\frac{4}{5}$

B1*: Score for a correct equation using the area is 60, e.g. $60=\frac{1}{2}\times 15\times 10\times\sin\theta$ followed by $\sin\theta=\frac{4}{5}$ with no incorrect work seen or uses $A=\frac{1}{2}\text{base}\times\text{height}=60$ to deduce the height is 8 and hence $\sin\theta=\frac{4}{5}$.

Condone

The alternative by verification requires showing that $\frac{1}{2}\times 15\times 10\times\frac{4}{5}=60$ followed by a (minimal) conclusion e.g. so $\sin\theta^\circ=\frac{4}{5}$, QED, ✓ etc. with no incorrect work seen.

Note that any reference to the value of θ can be ignored as long as the rest of the working is correct e.g. allow $60=\frac{1}{2}\times 15\times 10\times\sin\theta^\circ \Rightarrow \theta=53.1...^\circ \Rightarrow \sin\theta^\circ=\frac{4}{5}$

Ignore any units seen e.g. $A=\frac{1}{2}ab\sin\theta \Rightarrow 60=\frac{1}{2}\times 15\times 10\times\sin\theta^\circ \Rightarrow \sin\theta^\circ=\frac{4}{5}$ radians.

(b)	Deduces that $(\theta=)180-53.1=\text{awrt } 127$	B1
	e.g. $(BC^2)=10^2+15^2-2\times 10\times 15\cos 126.9^\circ$	M1
	$\Rightarrow BC=\sqrt{505}$ awrt 22.5 (m)	A1
		(3)

Notes

B1: Deduces that $(\theta=)180-53.1=\text{awrt}\,127$ or uses $\cos\theta=-\frac{3}{5}$ which may be implied.

May be implied by the sight or use of awrt 127

M1: Attempts to use the cosine rule (condone the omission of the lhs) to find BC or BC^2

Must be using either the obtuse angle

$\theta=180-\sin^{-1}\frac{4}{5}\left(\text{or } \cos\theta=-\frac{3}{5}\right)$ and a correct formula with the sides in the correct places

or the acute angle: $\theta=\sin^{-1}\frac{4}{5}\left(\text{or } \cos\theta=\frac{3}{5}\right)$ and a correct formula with the sides in the correct places.

For reference, use of the acute angle leads to $BC=\sqrt{145}\left(=12.04...\right)$

If they use e.g. $BC=\sqrt{10^2+15^2+2\times10\times15\mathbf{cos53.1°}}$ this is correct for the obtuse angle.

But do not allow if this follows e.g. $BC=\sqrt{a^2+b^2+2ab\cos C}$

Note that incorrectly using $\theta=\frac{4}{5}$ e.g. $\left(BC^2\right)=10^2+15^2-2\times10\times15\cos\left(\frac{4}{5}\right)$ scores M0

A1: Length BC is awrt 22.5 (m) but allow exact value of $\sqrt{505}$ (m)

Units are **not** required but if any are given they must be correct.

Allow the use of radians to score for equivalent work in (b) e.g.

$$\theta=\pi-0.927...=\text{awrt } 2.21\Rightarrow\left(BC^2\right)=10^2+15^2-2\times10\times15\cos2.21\Rightarrow BC=22.5$$

(c)	$\frac{\sin ABC}{10}=\frac{\sin'126.9°'}{'22.5'}\Rightarrow\sin ABC=...$ or e.g. $60=\frac{1}{2}\times15\times'22.5'\times\sin ABC\Rightarrow\sin ABC=...$ or e.g. $10^2=15^2+'505'-2\times15\sqrt{'505'}\cos ABC\Rightarrow\cos ABC=...$	M1
	Smallest angle (ABC) = awrt $20.9°$ (or awrt $20.8°$)	A1
		(2)

Notes:

Allow equivalent work in radians but the final answer must be in degrees.

M1: Full attempt to find sin ABC or cos ABC using angle $BAC=\sin^{-1}\frac{4}{5}$ which may be acute or obtuse and follow through their answer to part (b).

Score for $\frac{\sin ABC}{10}=\frac{\sin'126.9°'\left(\text{or }'53.1°'\right)}{'22.5'}\left(\text{or e.g. }\frac{4/5}{'22.5'}\right)\Rightarrow\sin ABC=...$

or $60=\frac{1}{2}\times15\times'22.5'\times\sin ABC\Rightarrow\sin ABC=...$

or $10^2=15^2+'505'-2\times15'\sqrt{505}'\cos ABC\Rightarrow\cos ABC=...$

Note that incorrectly using $\theta=\frac{4}{5}$ e.g. $\frac{\sin ABC}{10}=\frac{\sin\left(\frac{4}{5}\right)}{'22.5'}\Rightarrow\sin ABC=...$ scores M0

Allow alternative methods that correctly find angle ACB first and then $ABC=180-\sin^{-1}\frac{4}{5}-ACB$

e.g. $60=\frac{1}{2}\times10\times'22.5'\times\sin ACB\Rightarrow ACB=...(32.2...)\Rightarrow ABC=180-\sin^{-1}\frac{4}{5}-'32.2'$

or e.g. $\frac{\sin ACB}{15}=\frac{\sin'126.9°'\left(\text{or }'53.1°'\right)}{'22.5'}\Rightarrow ACB=...\left(32.2...\right)\Rightarrow ABC=180-\sin^{-1}\frac{4}{5}-'32.2'$

A1: Awrt $20.9°$ or awrt $20.8°$ following correct work in (b) e.g. do not allow this mark if the 22.5 was obtained fortuitously in part (b). (Unless they start again).

The degrees symbol is **not** required.

If both other angles have been found then the awrt $20.9°$ or awrt $20.8°$ must clearly be selected.

For reference use of the acute angle in (a) leading to $BC=\sqrt{145}$ in (b) gives an answer of $41.6...°$ in (c)

		(6 marks)