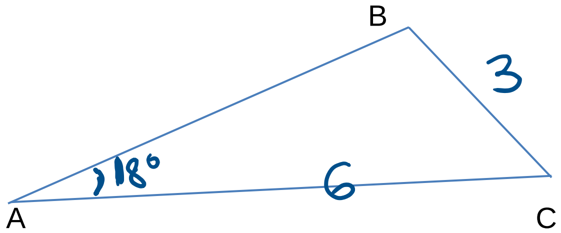
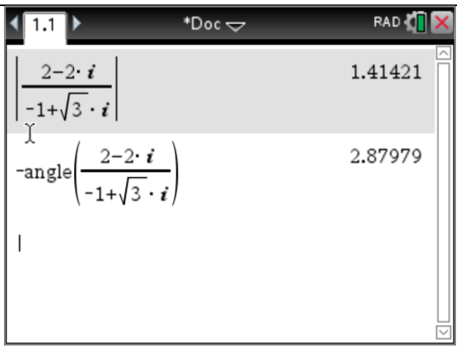
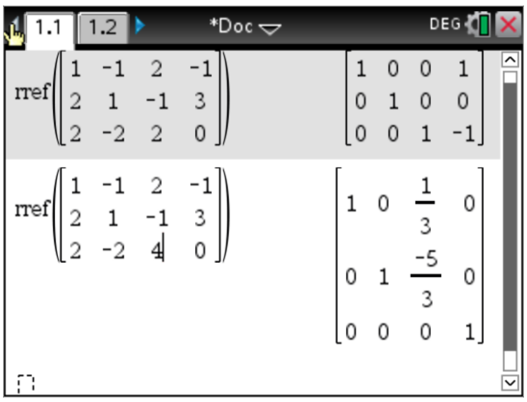
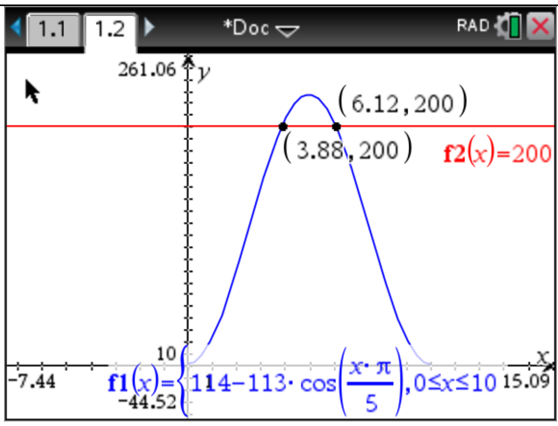
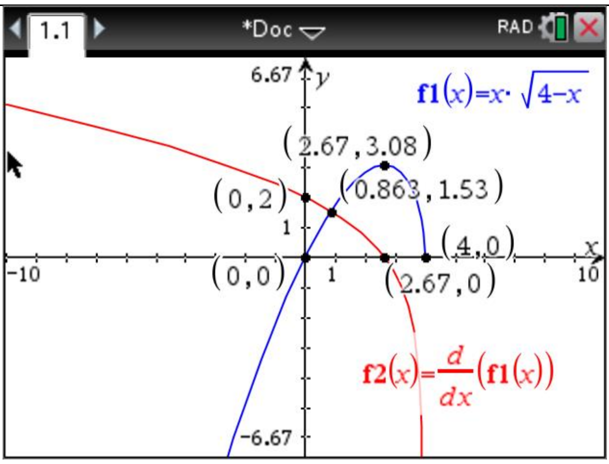
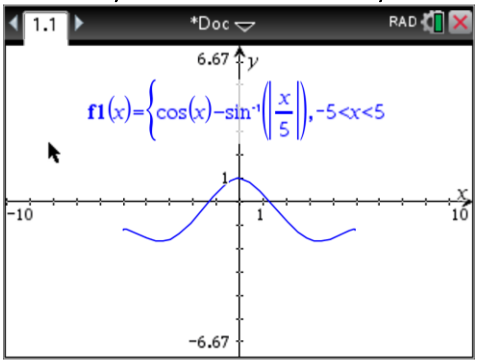
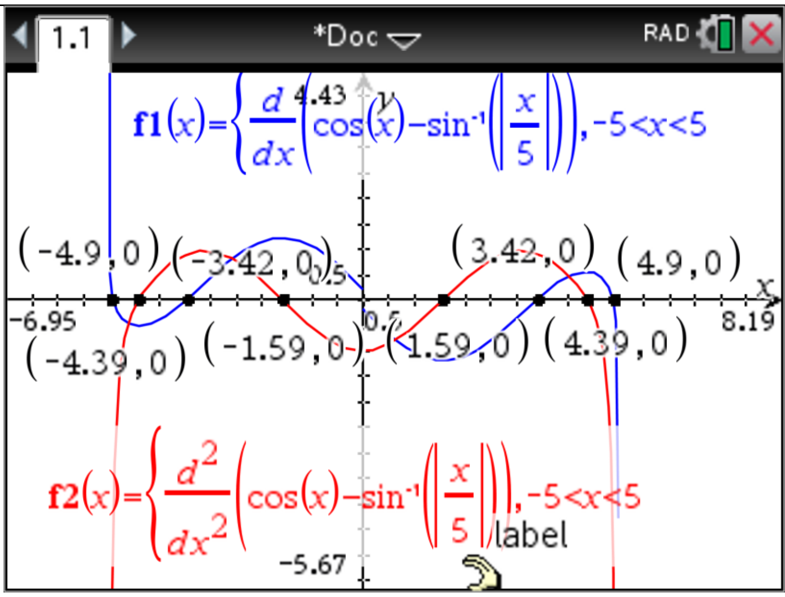
<table>
<tr><td>1.</td><td>

Using cosine rule $3^2 = AB^2 + 6^2 - 2(6)AB\cos 18°$
$AB^2 - 12\cos 18° AB + 27 = 0$
AB = 3.35 or 8.06.</td><td>Surprising numbers of students could not find the additional answer or did not attempt to do so.</td></tr>
<tr><td>2a</td><td>

$|z| = |z^*| = 1.41$ or $\sqrt{2}$ from GDC
$\arg(z) = -\arg(z^*) = 2.88$ or $\frac{11\pi}{12}$ or 165^0 from GDC</td><td rowspan="2">Quite a number of students used long tedious way to find the modulus and argument when this could be found more simply using the GDC. Several students misinterpreted the question and found the wrong argument.</td></tr>
<tr><td>(b)</td><td>$\arg(-z) = \arg(-1) + \arg(z)$
$= \pi + 2.88 = 6.02 = 6.02 - 2\pi = -0.263$ or $-\frac{\pi}{12}$ or -15^0</td></tr>
<tr><td>3. (a)</td><td>x=1, y=0, z= -1

</td><td rowspan="2">Generally ok. When using GDC, the workings must be shown or else marks deducted.</td></tr>
<tr><td>(b)</td><td>Based on the result of RREF above, the system has no solutions.</td></tr>
</table>

4(a)	k = 10.	Generally ok.
(b)	Max H=227m when $\cos(\frac{t}{5}\pi) = -1$ Min H = 1m when $\cos(\frac{t}{5}\pi) = 1$	
(c)	 Duration = 6.12 - 3.88 = 2.24 min	
5(a)	${}^{19}C_5 = 11628$	Good.
(b)	${}^{5}C_1 \times {}^{14}C_4 = 5005$ [1 adult from 5 to choose and 4 remaining children to choose from 14]	
6(a)	If $P = R\cos y$ and $Q = R\sin y$ $\therefore P^2 = R^2\cos^2 y$ and $Q^2 = R^2\sin^2 y$ $P^2 + Q^2 = R^2(\cos^2 y + \sin^2 y) = R^2$ Or a suitable diagram to show proof	Generally well done. Its possible to show diagrams as part of proof.
(b)	$\frac{Q}{P} = \frac{R\sin y}{R\cos y} = \tan y$ $\therefore y = \arctan\left(\frac{Q}{P}\right)$	Some used inverse trigonometric functions and could not find the proof or steps are unclear.

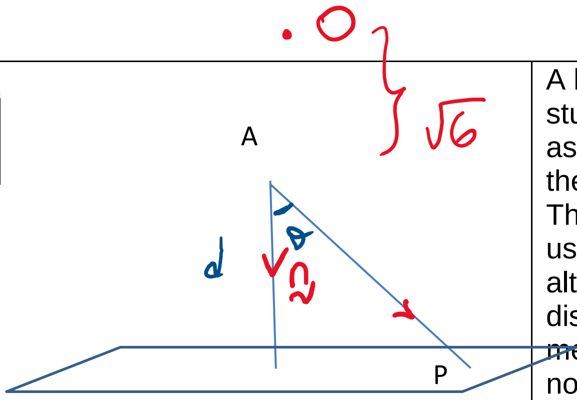
(c)	$P\cos x + Q\sin y$ $= R\cos x\cos y + R\sin x\sin y$ $= R\cos(x-y)$	Generally good.
(d)	$3\cos x + 4\sin x = 5\cos(x-0.927)$ This implies $5\cos(x-0.927)=5$ $(x-0.927)=0$ $x = 0.927$ or 53.13^0	Not well done. Students could not link the previous parts to solve this part. Generally weak in trigonometry
7(a)	Largest possible domain is $x \le 4$ Alternative answer: $]-\infty, 4]$.	Some give the wrong domain x < 4.
(b)	 	Some did not plot the correct inverse function or the correct intersections. Some did not label all the intercepts and stationary point.
(c)	Draw y = f ' (x) $x < 0.863$ Alternative answer: $]-\infty, 0.863[$	Depending on previous part, usually if graph is correct, they could find the intersections. Some give the wrong domain or wrong inequality sign.
8(a)	$\frac{DC}{\beta} = \frac{2\alpha}{\alpha} \Rightarrow DC = 2\beta$ [using similar triangles] $\measuredangle AOB = \arcsin\beta$	Mostly ok.

	Area = $\frac{1}{2}(2\alpha)(2\beta)-\frac{1}{2}(1)^2\arcsin\beta$ = $2\alpha\beta-\frac{1}{2}\arcsin\beta$ sq units [SHOWN]	
(b)	If $\alpha=\beta\Rightarrow\arcsin\beta=\frac{\pi}{4}$ $\&\ 2\alpha\beta=2\alpha^2=1[\because\alpha^2+\beta^2=1\Rightarrow 2\alpha^2=1]$ Therefore the area is $1-\frac{\pi}{8}$ sq units [Shown]	Some could not figure out the angle as 45 degrees and could not show the relevant step in the proof.
9(a)	Using the graph drawn in GDC, the graph y axis is the line of symmetry, ie, symmetrical about the y axis hence it is an even function.  Or $f(-x)=\cos(-x)-\arcsin\left\lvert\frac{-x}{5}\right\rvert=\cos x-\arcsin\left\lvert\frac{x}{5}\right\rvert=f(x)$	Some students did not show the graph or the algebraic working to show that it is even.
(b)	 	Quite a number of students are not able draw the correct graphs. Either completely wrong or only the right side is correct. Some will do their own differentiation first but they are not correctly done.
(c)	the x coordinates are -4.39, -1.59, 1.59 and 4.39	Some give

		coordinates but out of those who give the coordinates, some gave wrong y values.
(d)	$-4.39 < x < -1.59 \quad \& \quad 1.59 < x < 4.39$	Some gave wrong range as they use f'(x) not f"(x).
10(a)	If $\overrightarrow{OA} \perp \overrightarrow{OB} \& \overrightarrow{OC}$ therefore $\begin{pmatrix}1\\a\\-1\end{pmatrix} \bullet \begin{pmatrix}-1\\2\\b\end{pmatrix} = 0 \ \& \begin{pmatrix}1\\a\\-1\end{pmatrix} \bullet \begin{pmatrix}2\\1\\4\end{pmatrix} = 0$ $2+a-4=0 \Rightarrow a=2$ $-1+4-b=0 \Rightarrow b=3$ Alternative $\begin{pmatrix}-1\\2\\b\end{pmatrix} \times \begin{pmatrix}2\\1\\4\end{pmatrix} = \begin{pmatrix}8-b\\4+2b\\-5\end{pmatrix} = k\begin{pmatrix}1\\a\\-1\end{pmatrix} \Rightarrow k=5 \quad \therefore b=3 \ \& \ a=2$	Many did cross product and some made mistakes. They did not realise they could just use $\overrightarrow{OA}$ instead. With the mistakes error carry into other parts.
(b)	the eqn of the plane $\pi : \mathbf{r} \bullet \begin{pmatrix}1\\2\\-1\end{pmatrix} = d$ $d = \begin{pmatrix}11\\1\\1\end{pmatrix} \bullet \begin{pmatrix}1\\2\\-1\end{pmatrix} = 12$ Therefore $\pi : \mathbf{r} \bullet \begin{pmatrix}1\\2\\-1\end{pmatrix} = 12 \Rightarrow x+2y-z=12$	Generally method is correct but accuracy not there. Some students gave wrong form, vector eqn form.
(c)	Eqn of line AC: $\mathbf{r} = \begin{pmatrix}1\\2\\-1\end{pmatrix} + t\begin{pmatrix}2-1\\1-2\\4+1\end{pmatrix} \Rightarrow, \mathbf{r} = \begin{pmatrix}1\\2\\-1\end{pmatrix} + t\begin{pmatrix}1\\-1\\5\end{pmatrix} t \in \mathbb{R}$ $1+t+4-2t+1-5t=12 \Rightarrow t=-1$ Pt of intersection is P(0, 3, -6).	Generally students get the idea but they are not presenting the working accurately. Did not state $t \in \mathbb{R}$. Some students gave wrong form, position vector form.

(d)

$$\overrightarrow{PA}=\begin{pmatrix}1\\2\\-1\end{pmatrix}-\begin{pmatrix}0\\3\\-6\end{pmatrix}=\begin{pmatrix}1\\-1\\5\end{pmatrix}$$



Distance, $d=PA\cos\theta$

$$=\frac{\overrightarrow{AP}\bullet\mathbf{n}}{|\mathbf{n}|}\quad\text{since } \overrightarrow{PA}\bullet\mathbf{n}=\left|\overrightarrow{PA}\right||\mathbf{n}|\cos\theta$$

$$=\left|\frac{\begin{pmatrix}1\\-1\\5\end{pmatrix}\bullet\begin{pmatrix}1\\2\\-1\end{pmatrix}}{\sqrt{6}}\right|=\sqrt{6}\text{ units}$$

Or OA= $\sqrt{6}$ units

Distance of the Plane from the origin = $\frac{12}{\sqrt{6}}$ units

Need to check if A and the plane is the same side as O. $\begin{pmatrix}1\\2\\-1\end{pmatrix}\bullet\begin{pmatrix}1\\2\\-1\end{pmatrix}=6$

[ie: $\mathbf{a}\bullet\mathbf{n}=\mathrm{d}$]

Since d=6 same side as the eqn of plane, then same side.

Hence distance is $\frac{12}{\sqrt{6}}-\sqrt{6}=\sqrt{6}$

Common Method:

Line passing through A perpendicular to Plane

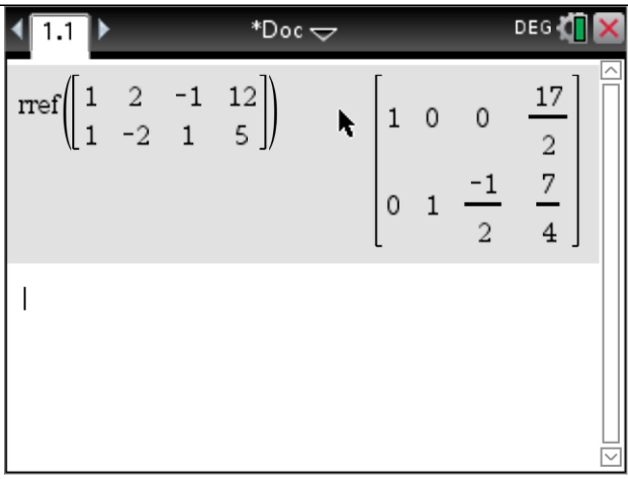
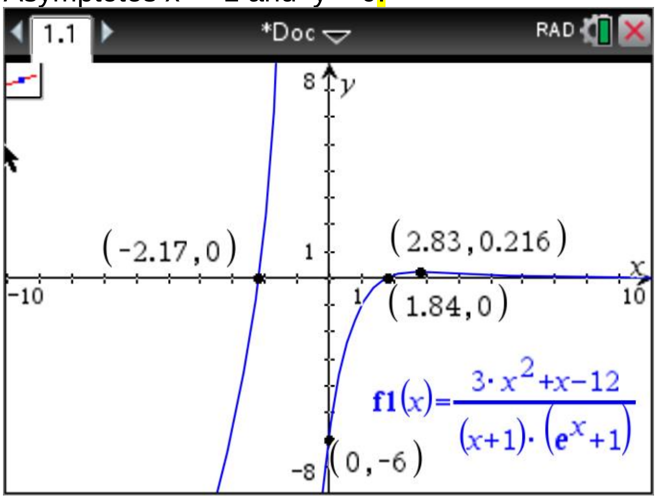
$$\mathbf{r}=t\begin{pmatrix}1\\2\\-1\end{pmatrix},t\in\mathbb{R}$$

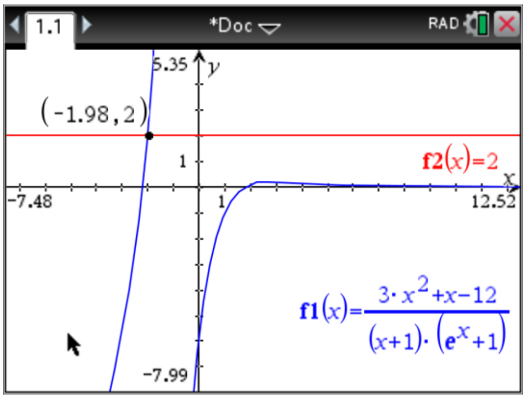
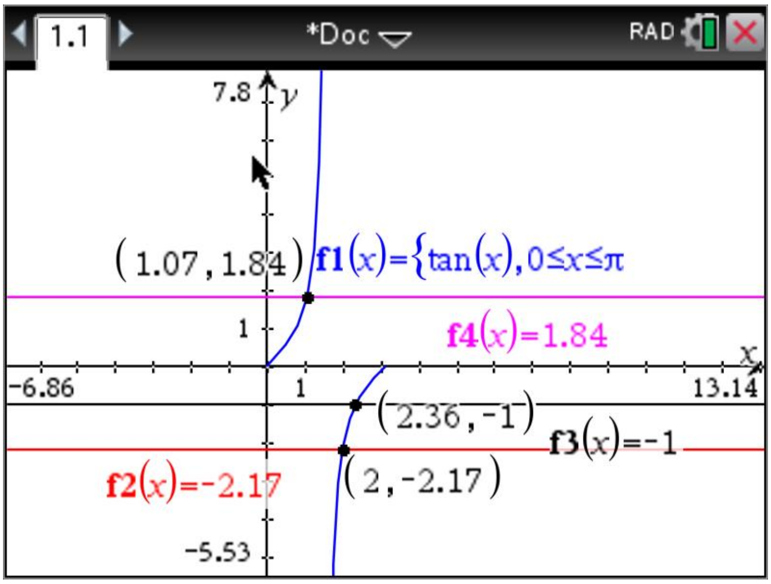
Substitute into plane: $t+2t-t=12$
$\Rightarrow t=2$

Point of intersection F(2, 4, -2)

$$\overrightarrow{AF}=\begin{pmatrix}2\\4\\-2\end{pmatrix}-\begin{pmatrix}1\\2\\-1\end{pmatrix}=\begin{pmatrix}1\\2\\-1\end{pmatrix}\Rightarrow\left|\overrightarrow{AF}\right|=\sqrt{1+4+1}=\sqrt{6}$$

A lot of students assume PA is the distance. Those who use the alternative distance method, did not check if the point and plane are on the same side of O.

(e)	 $x = \frac{17}{2}$ & $4y = 2z + 7$	Many students did not give the correct form, they might have given but final gave vector form which reflect clearly that they do not know their definition well.
11(a)	k = - 1	Ok except some either gave k=1 or x=-1.
(b)	Asymptotes x= - 1 and y = 0.  	Many students could not give complete information. Either not able to give correct x or y-intercepts or y = 0, x=-1.
(c)	$\frac{3x^2-x-14}{2(x+1)}=e^x$ $3x^2-x-14=2(x+1)e^x$ $3x^2-x-14+2(x+1)=2(x+1)e^x+2(x+1)$ $3x^2+x-12=2(x+1)e^x+2(x+1)$ $\frac{3x^2+x-12}{(x+1)(e^x+1)}=2$	Many students are not able to manipulate the algebra and hence could not get the straight line. Some did not simplify but the GDC will still draw the y=2. But

	Draw y = 2  x = - 1.98	students will be penalized.
(d)	(i) - 2.17 < x < -1 or x > 1.84 (ii) - 2.17 < tan θ < -1 or tan θ > 1.84  2< θ < 2.36 or 1.07< θ < 1.57 Alternative answer: 2< θ < $\frac{3\pi}{4}$ or 1.07< θ < $\frac{\pi}{2}$	(i)Ok if they draw the graph correctly. (ii) not many draw the graph hence a number of the students did no get the inequality right, the upper bound was not given.