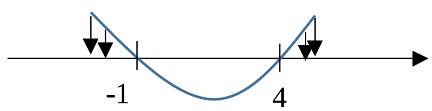
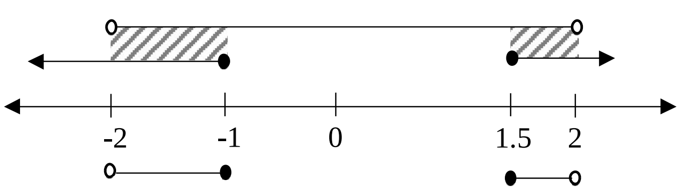
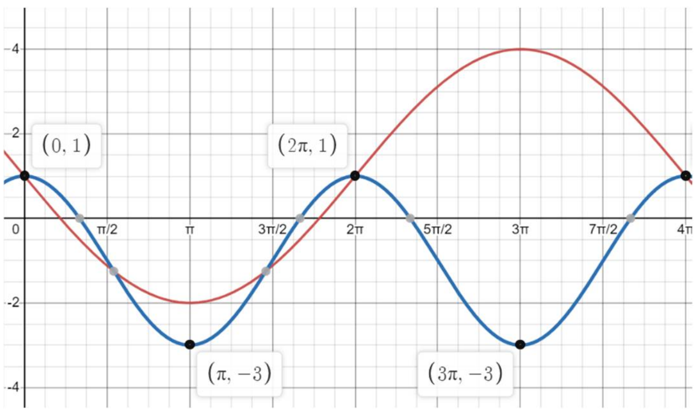
Qn	Solutions		Remarks
1a	$nx^2-4x+n<3$ $nx^2-4x+n-3<0$ For no real roots, D < 0 $(-4)^2-4(n)(n-3)<0$ $16-4n^2+12n<0$ $4n^2-12n-16>0$ $n^2-3n-4>0$ $(n-4)(n+1)>0$  $n<-1$ or $n>4$ Since $n<0$, $\therefore n<-1$		
1b	$x(2x-1)\geq 3$ and $x^2<4$ $2x^2-x-3\geq 0$ $x^2-4<0$ $(2x-3)(x+1)\geq 0$ $(x+2)(x-2)<0$ $x\leq -1$ or $x\geq \frac{3}{2}$ $-2<x<2$  The final solution range are $-2<x\leq -1$ or $1.5\leq x<2$.		

Qn	Solutions		Remarks
2	$y=\dfrac{e^{3x}}{x}$ $\dfrac{\mathrm{d}y}{\mathrm{d}x}=\dfrac{x\left(3e^{3x}\right)-e^{3x}\left(1\right)}{x^2}$ $=\dfrac{e^{3x}\left(3x-1\right)}{x^2}$ For increasing functions, $\dfrac{\mathrm{d}y}{\mathrm{d}x}>0$ $\dfrac{e^{3x}\left(3x-1\right)}{x^2}>0$ Since $e^{3x}>0$ and $x^2>0$, $3x-1>0$ $x>\dfrac{1}{3}$		-
3	$9^x=\dfrac{1}{27^y}$ $3^{2x}=3^{-3y}$ $2x=-3y$ ------- Equation 1 $8^y\div(\sqrt{2})^x=16\sqrt{2}$ $2^{3y}\div2^{\frac{x}{2}}=2^4\times2^{\frac{1}{2}}$ $2^{3y-\frac{x}{2}}=2^{4\frac{1}{2}}$ $3y-\dfrac{x}{2}=4\dfrac{1}{2}$ ------- Equation 2 Substitute Eqn 1 into Eqn 2:		

Qn	Solutions		Remarks
	$(-2x)-\frac{x}{2}=4\frac{1}{2}$ $-\frac{5}{2}x=\frac{9}{2}$ $x=-\frac{9}{5}$ $-3y=2\left(-\frac{9}{5}\right)$ $y=\frac{6}{5}$		
4i **4ii**	LHS $=\sin x+\sin(2x+x)$ $=\sin x+\sin 2x\cos x+\cos 2x\sin x$ $=\sin x+2\sin x\cos x(\cos x)+\sin x(2\cos^2 x-1)$ $=\sin x+2\sin x\cos^2 x+2\sin x\cos^2 x-\sin x$ $=4\sin x\cos^2 x$ $=\text{RHS}$ $\sin 3x=-2\sin x$ $4\sin x\cos^2 x-\sin x=-2\sin x$ $4\sin x\cos^2 x-\sin x+2\sin x=0$ $4\sin x\cos^2 x+\sin x=0$ $\sin x(4\cos^2 x+1)=0$ $\sin x=0$ or $\cos^2 x=-\frac{1}{4}$ (NA) $\therefore x=0,\pi$		
	Alternative: $\sin x(4\sin^2 x-5)=0$ $\sin x=0$ or $\sin^2 x=\frac{5}{4}$ (rejected)		

Qn	Solutions		Remarks
5i	$\frac{d}{dx}\ln(2x+\cos x)$ $=\left(\frac{1}{2x+\cos x}\right)(2-\sin x)$ $=\frac{2-\sin x}{2x+\cos x}$		
5ii	$\int_{\frac{\pi}{6}}^{\frac{\pi}{2}} \frac{4-2\sin x}{2x+\cos x}\ dx$ $=2\int_{\frac{\pi}{6}}^{\frac{\pi}{2}} \frac{2-\sin x}{2x+\cos x}\ dx$ $=2\left[\ln(2x+\cos x)\right]_{\frac{\pi}{6}}^{\frac{\pi}{2}}$ $=2\left[\ln(\pi+\cos\frac{\pi}{2})-\ln\left(\frac{\pi}{3}+\cos\frac{\pi}{6}\right)\right]$ $=2\left[\ln(\pi)-\ln\left(\frac{\pi}{3}+\frac{\sqrt{3}}{2}\right)\right]$ $=2\left[\ln\frac{\pi}{\frac{\pi}{3}+\frac{\sqrt{3}}{2}}\right]$ $=2\ln\frac{6\pi}{2\pi+3\sqrt{3}}$ $a=3$ and $b=3$		-

Qn	Solutions		Remarks
6i	$2x^2 - \frac{10}{x} = 5x + 23$ $2x^3 - 10 = 5x^2 + 23x$ $2x^3 - 5x^2 - 23x - 10 = 0$ Let $f(x) = 2x^3 - 5x^2 - 23x - 10$. $f(-2) = 2(-2)^3 - 5(-2)^2 - 23(-2) - 10 = 0$ By Factor Theorem, $(x+2)$ is a factor. $(x+2)(ax^2 + bx + c) = 2x^3 - 5x^2 - 23x - 10$ By comparison, $a = 2$ $2c = -10$ $c = -5$ $2a + b = -5$ $4 + b = -5$ $b = -9$ $2x^3 - 5x^2 - 23x - 10 = 0$ $(x+2)(2x^2 - 9x - 5) = 0$ $(x+2)(2x+1)(x-5) = 0$ $x = -2, -\frac{1}{2}, 5$		-
6ii	$2(y-1)^3 - 5(y-1)^2 - 23y + 13 = 0$ $2(y-1)^3 - 5(y-1)^2 - 23(y-1) - 10 = 0$ Since $y - 1 = x$, $y = -1, \frac{1}{2}, 6$		

Qn	Solutions		Remarks
7ai	Maximum value of $y = 4$ Minimum value of $y = -2$ $c = \frac{4+(-2)}{2} = 1$		
7aii	$a = -3$ $b = 0.5$		
7b			
7c	There are 5 solutions		

Qn	Solutions		Remarks
8i	$T_{r+1}=\binom{8}{r}(x^2)^{8-r}\left(\frac{-p}{x^6}\right)^r$ $=\binom{8}{r}(-p)^r x^{16-8r}$ For term independent of x, $16-8r=0$ $r=2$ $T_3=7$ $\binom{8}{2}(-p)^2=7$ $28p^2=7$ $p=\pm 0.5$ $p=0.5$ (−ve rejected)		
8ii	For constant term, there is a x^{-8} term in the expansion of $\left(x^2-\frac{p}{x^6}\right)^8$. $16-8r=-8$ $r=3$ $T_4=\binom{8}{3}(-0.5)^3x^{-8}=-7x^{-8}$ $(1+x^8)\left(x^2-\frac{1}{2x^6}\right)^8=(1+x^8)(x^{16}-4x^8+7-7x^{-8}+...)$ The constant term in $(1+x^8)\left(x^2-\frac{1}{2x^6}\right)^8$ $=1(7)+x^8(-7x^{-8})$ $=0$ $\therefore$ There is no constant term.		
9i			

<table>
<tr><th>Qn</th><th>Solutions</th><th></th><th>Remarks</th></tr>
<tr><td></td><td>
<table>
<tr><td>v</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>$\lg F$</td><td>1.74</td><td>1.78</td><td>1.82</td><td>1.86</td><td>1.91</td></tr>
</table>

See graph behind
</td><td></td><td></td></tr>
<tr><td>9ii</td><td>Gradient
$= \dfrac{y_1 - y_2}{x_1 - x_2}$
= 0.0374 to 0.0453

$F = km^v$
$\lg F = (\lg m)v + \lg k$

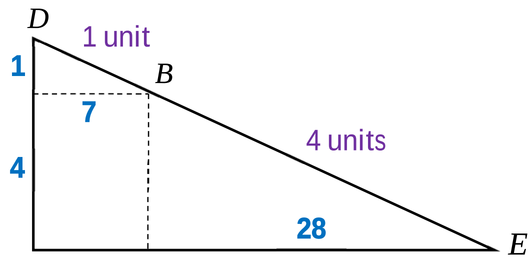
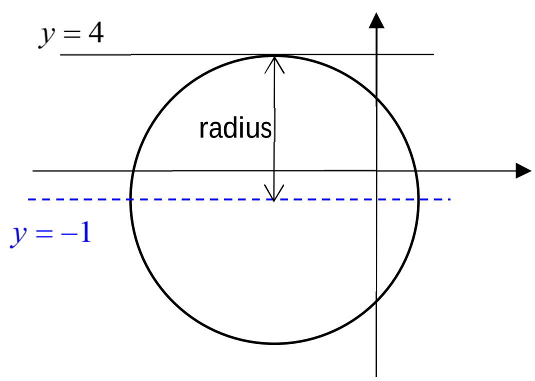
$\lg m = 0.0374 \text{ to } 0.0453$
$m = 1.09 \text{ to } 1.11$

$\lg k = 1.69 \text{ to } 1.71$
$k = 48.9 \text{ to } 51.3$

$F = (48.9)(1.09)^v$</td><td></td><td></td></tr>
<tr><td>9iii</td><td>Since $\lg 100 = 2$,

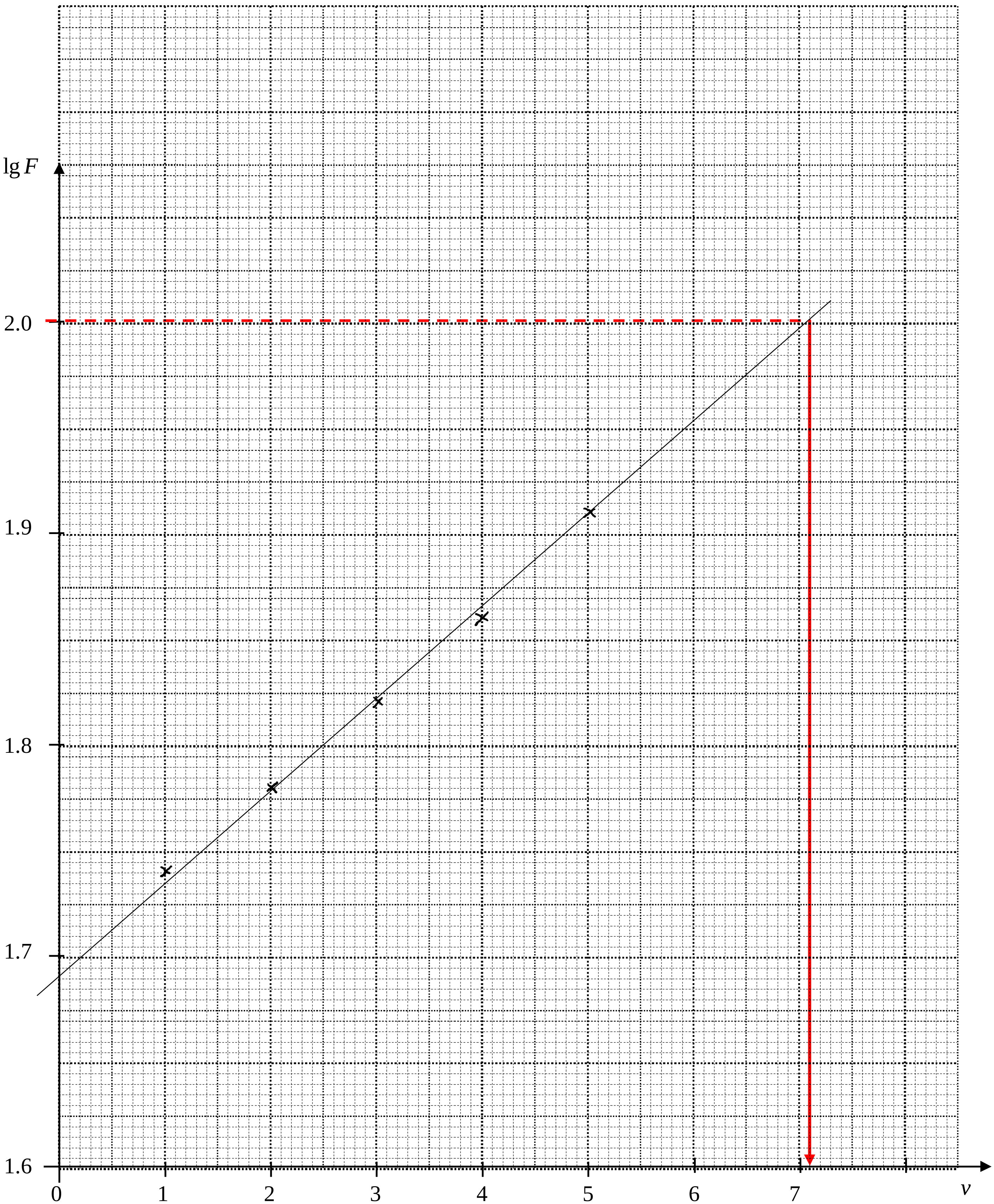
$v = 7.1$ m/s from the graph</td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>10i</td><td>Equation of AC is
$y - 30 = 7(x - 4)$
$y = 7x + 2$</td><td></td><td></td></tr>
</table>

Qn	Solutions		Remarks
10ii	From equation of AC, $A(0,2)$ and $D(0,27)$ Diagonals of kite are perpendicular. $\therefore m_{BD} = -\frac{1}{7}$ Equation of BD is $y = -\frac{1}{7}x + 27$ Solve AC and BD simultaneously: $7x + 2 = -\frac{1}{7}x + 27$ $49x + 14 = -x + 189$ $50x = 175$ $x = 3\frac{1}{2}$ When $x = 3\frac{1}{2}$, $y = 7\left(3\frac{1}{2}\right) + 2 = 26\frac{1}{2}$ $\therefore M\left(3\frac{1}{2}, 26\frac{1}{2}\right)$		
10iii	M is the midpoint of BD. Let $B(x, y)$ $\left(3\frac{1}{2}, 26\frac{1}{2}\right) = \left(\frac{0+x}{2}, \frac{27+y}{2}\right)$ $x = 3\frac{1}{2} \times 2 = 7$ and $y = \left(26\frac{1}{2} \times 2\right) - 27 = 26$ $\therefore B(7, 26)$		
10iv	Because both triangles share the same height CM, $\frac{BD}{BE} = \frac{1}{4}$		

Qn	Solutions		Remarks
	 $x_E = 7 \times 5 = 35$ $y_E = 27 - (1+4) = 22$ $\therefore E(35, 22)$		
11i	Midpoint of chord joining the two given points $= \left(\frac{-2-2}{2}, \frac{-4+2}{2}\right)$ $= (-2, -1)$ As the perpendicular bisector of a chord passes through centre of a circle, the *y*-coordinate of its centre $= -1$  Radius of the circle = $4 - (-1) = 5$ Let centre of circle be $(x, -1)$.		

Qn	Solutions		Remarks
	$(-2-x)^2+(-4+1)^2=5^2$ $4+4x+x^2+9=25$ $x^2+4x-12=0$ $(x-2)(x+6)=0$ $x=2$ (reject) or $x=-6$ Centre of C_1 $(-6,-1)$		
11ii	Centre of reflected circle $(-6,3)$ Radius of reflected circle = 5 units $(x+6)^2+(y-3)^2=25$		
11iii	$x^2-4x+y^2-8y-16=0$ $(x-2)^2+(y-4)^2-4-16-16=0$ $(x-2)^2+(y-4)^2=6^2$ Centre of C_3 $(2,4)$ and the Radius of $C_3=6$ Distance between the centres of the two circles $=\sqrt{(2+6)^2+(4+1)^2}$ $=\sqrt{89}$ Since the distance is < the sum of the radii of the two circles i.e. $\sqrt{89}<5+6$, the two circles intersect each other.		
12i	$3x+2l=120$ $l=60-\frac{3}{2}x$ Let the height of equilateral be h		

Qn	Solutions		Remarks
12ii	$\cos 30° = \frac{h}{x}$ $h = x\cos 30°$ $h = \frac{\sqrt{3}}{2}x$ $A = \frac{1}{2}\times(x)\times(\frac{\sqrt{3}}{2}x) + x(60 - \frac{3}{2}x)$ $= (\frac{\sqrt{3}}{4})x^2 + 60x - \frac{3}{2}x^2$ $= \left(\frac{\sqrt{3}-6}{4}\right)x^2 + 60x$ $\frac{\mathrm{d}A}{\mathrm{d}x} = (2)\left(\frac{\sqrt{3}-6}{4}\right)x + 60$ $= \left(\frac{\sqrt{3}-6}{2}\right)x + 60$ For stationary value, $\frac{\mathrm{d}A}{\mathrm{d}x} = 0$ $\left(\frac{\sqrt{3}-6}{2}\right)x + 60 = 0$ $x = \frac{40\left(\sqrt{3}+6\right)}{11}$ or 28.1 cm (3 s.f) $\frac{\mathrm{d}^2A}{\mathrm{d}x^2} = \frac{\sqrt{3}-6}{2} < 0$ Therefore the x value gives the maximum area possible.		Alternative Method $A = \frac{1}{2}x^2\sin 60° + x(60 - \frac{3}{2}x)$ $= \frac{\sqrt{3}}{4}x^2 + 60x - \frac{3}{2}x^2$ $= \left(\frac{\sqrt{3}-6}{4}\right)x^2 + 60x$ Calculation of $\frac{\mathrm{d}^2A}{\mathrm{d}x^2}$ and correct conclusion when verifying A is indeed maximum


lg F
2.0
1.9
1.8
1.7
1.6
0
1
2
3
4
5
6
7
v