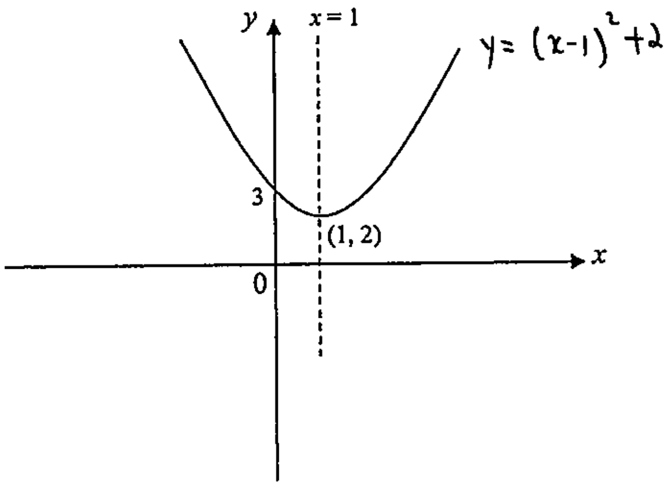
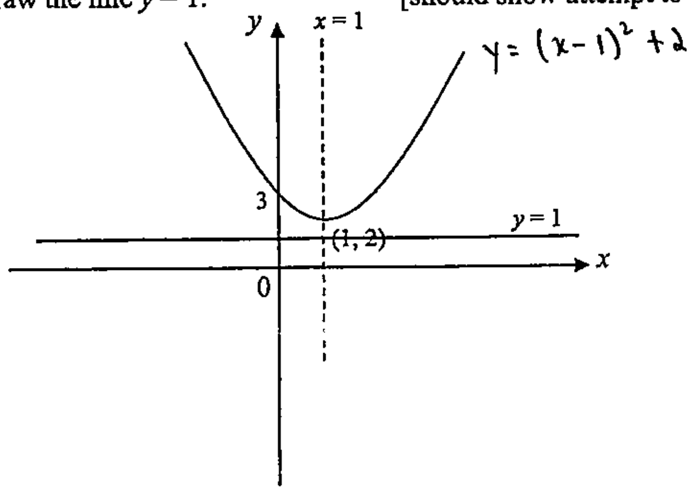
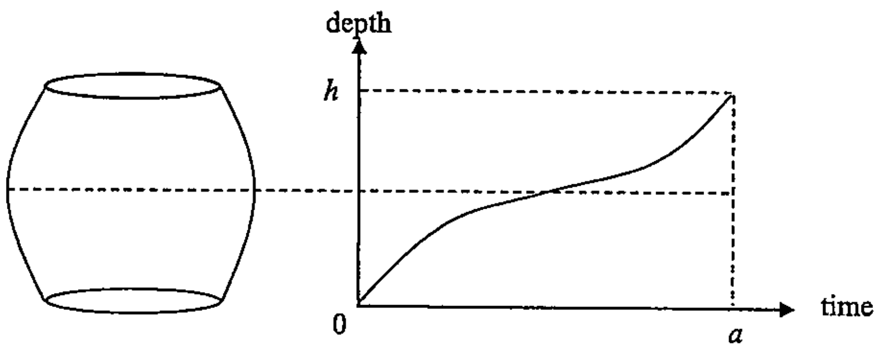
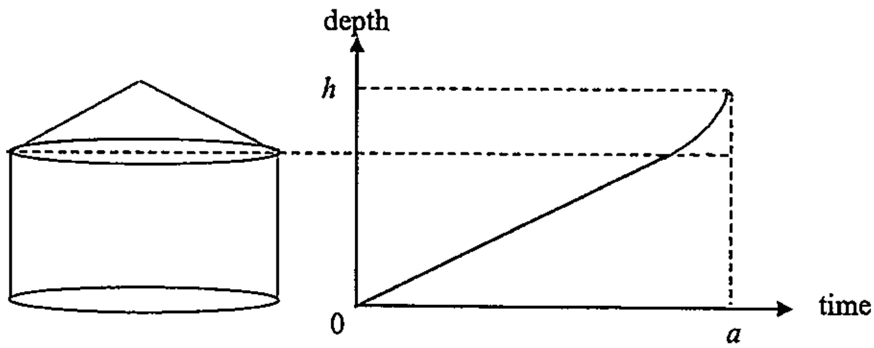
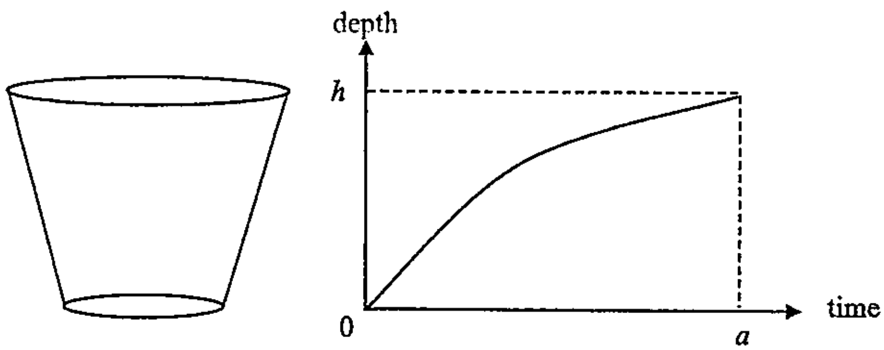
Mark Scheme for 3E paper 1

1	$6x+y=1$ .... (1) $x+\frac{y}{3}=1 \rightarrow 3x+y=3$ ....(2) (1) − (2): $3x=-2$ $x=-\frac{2}{3}$ Then, $y=1-6\left(-\frac{2}{3}\right)=5$ Also accept answers obtained through substitution method: From (2): Sub $x=1-\frac{y}{3}$ into (1): $6\left(1-\frac{y}{3}\right)+y=1$ $6-y=1$ $y=5$ Then $x=-\frac{2}{3}$	M1 A1 A1
2(a)	$2x-11\leq 15$ $2x\leq 26$ $x\leq 13$	B1
2(b)	No, because there are 6 prime numbers less than or equal to 13 (2, 3, 5, 7, 11 and 13). Clear workings: students must list all the 6 prime numbers.	B1
3(a)	$y=-\frac{1}{x}$	B1
3(b)	$y=1-x^2$	B1
3(c)	$y=x^3$	B1
3(d)	$y=\frac{2}{x^2}$	B1
4(a)	It is for $y=ka^x$ because when $x=0, y=k\neq 0$. It is for $y=ka^x$ because it is an exponential graph, not a power graph. Accept either of the above.	B1
4(b)	Sub (0, 2): $2=ka^0 \rightarrow k=2$ Sub (4, 1250): $1250=2a^4$ $a^4=625=5^4$ $a=5$ Deduct one mark if students obtain $a=\pm 5$	B1 B1

5(a)	$\left(\dfrac{x^2}{5}\right)^3 \div \dfrac{50}{3x^0} = \dfrac{x^6}{125} \times \dfrac{3}{50}$ (method mark for either $\dfrac{x^6}{125}$ or $x^0 = 1$) $= \dfrac{3x^6}{6250}$	M1 A1
5(b)	$\left(\dfrac{(3a)^2 b}{20c^5}\right)^{-1} \times \dfrac{a^3 b^{-2}}{4c} = \left(\dfrac{9a^2 b}{20c^5}\right)^{-1} \times \dfrac{a^3}{4b^2 c}$ (M1 for $\dfrac{20c^5}{9a^2 b}$ or $\dfrac{a^3}{4b^2 c}$) $= \dfrac{20c^5}{9a^2 b} \times \dfrac{a^3}{4b^2 c} = \dfrac{20a^3 c^5}{36a^2 b^3 c}$ $= \dfrac{5ac^4}{9b^3}$	M1 A1
6(a)		G1 – correct shape and y-intercept G1 – correct turning point
6(b)	$(x-1)^2 = -1 \rightarrow (x-1)^2 + 2 = 1$ Draw the line $y = 1$. [should show attempt to obtain $y = 1$]  Since the line $y = 1$ does not intersect the graph of $y = (x-1)^2 + 2$, the equation has no real solution.	B1 B1

7(a)	$y=\frac{k}{x^2}$ Sub $x=3, y=10$: $10=\frac{k}{3^2} \rightarrow k=90$ Hence $y=\frac{90}{x^2}$ (M1 for getting $k=90$ or for $y=\frac{90}{x^2}$) Sub $y=4.5$: $4.5=\frac{90}{x^2}$ $x^2=20$ $x=+\sqrt{20}=4.47$	M1 A1
7(b)	$y=k\sqrt[3]{x}$ When x is doubled, $y=k\sqrt[3]{2x}$ (no marks for writing this only) $\frac{k\sqrt[3]{2x}-k\sqrt[3]{x}}{k\sqrt[3]{x}}\times 100\% = \frac{\sqrt[3]{2}-1}{1}\times 100\%$ $=26.0\%$ (3 sf)	 M1 A1
8(a)		B1
8(b)		B1
		B1

9(a)	$\frac{18-0}{6-0}=3\text{ m/s}^2$	B1
9(b)	$m=\frac{9-18}{12-6}=-\frac{3}{2}$ Sub (6, 18) into $y=-\frac{3}{2}x+c$ $18=-\frac{3}{2}(6)+c=-9+c \rightarrow c=27$ Henec $y=-\frac{3}{2}x+27$ Sub $x=10$, $y=-\frac{3}{2}(10)+27=12\text{ m/s}$ Accept other methods: eg. Similar triangles. Alternatively: Let speed at $t=10$ s be x. $\frac{x-18}{10-6}=\frac{9-18}{12-6}$ $\frac{x-18}{4}=-\frac{3}{2}$ $x-18=-\frac{3}{2}\times 4$ $=-6$ $x=-6+18$ $=12$ $\therefore$ speed $=12$ m/s	B1
9(c)	Area under graph = distance travelled $8\times 9+\frac{1}{2}(a-20)(9)=108$ $\frac{1}{2}(a-20)(9)=36$ $a-20=8$ $a=28$	B1
10(a)	$5x+2(1-3x)=5x+2-6x$ $=2-x$ Accept $-x+2$	M1 A1
10(b)	$4ay-2by+6a-3b=2y(2a-b)+3(2a-b)$ $=(2a-b)(2y+3)$	M1 A1
11(a)	Length ratio = 10 : 12 = 5 : 6 Area ratio = $5^2 : 6^2 = 25 : 36$ (method mark for correct area ratio) Total s.a. of larger container = $\frac{650}{25}\times 36=936\text{ cm}^2$	M1 A1
11(b)	Volume ratio = 400 : 686 = 200 : 343 Length ratio = $\sqrt[3]{200} : \sqrt[3]{343} = \sqrt[3]{200} : 7$ (M1 for length or area ratio) Area ratio = $(\sqrt[3]{200})^2 : 7^2 = (\sqrt[3]{200})^2 : 49$ Total s.a of smaller container = $\frac{300}{49}\times(\sqrt[3]{200})^2 = 209\text{ cm}^2$ (3 sf)	M1 A1

12(a)	$p^2-\frac{1}{16}=\left(p+\frac{1}{4}\right)\left(p-\frac{1}{4}\right)$	B1
12(b)	$6x^2+12x-18=6\left(x^2+2x-3\right)$ $=6(x+3)(x-1)$	M1 A1
13(a)	$EG^2=250^2=62500$ $EF^2+FG^2=150^2+200^2=62500$ Since, $EF^2+FG^2=EG^2$, by the converse of Pythagora's Theorem, triangle EFG is a right angle triangle, and $\angle EFG=90°$. Or, by cosine rule, $\angle EFG=\cos^{-1}\left(\frac{150^2+200^2-250^2}{2(150)(200)}\right)=90°$	M1 A1
13(b)	$\frac{150}{250}=\frac{3}{5}$	B1
13(c)	$-\frac{150}{250}=-\frac{3}{5}$	B1
14(a)	<u>Map</u> <u>actual</u> 10 cm 800 m 1 cm 80 m 20.5 cm 1640 m 1.64 km	M1 A1
14(b)	<u>Map</u> <u>actual</u> 1 cm 80 m (1 cm)^2 (80 m)^2 1 cm^2 6400 m^2 <u>0.113 cm^2</u> 725 m^2 Accept $\frac{29}{256}$ cm^2	M1 A1

15(a)	Gradient $= m = \frac{6-3}{5-2} = 1$ Sub (2, 3) into $y = x + c$ $3 = 2 + c \rightarrow c = 1$ Hence $y = x + 1$	M1 A1
15(b)	$\sqrt{(0-6)^2+(k-5)^2} = \sqrt{\frac{169}{4}}$ $36+(k-5)^2 = \frac{169}{4}$ $(k-5)^2 = \frac{25}{4}$ $k-5 = \pm\sqrt{\frac{25}{4}}$ $k = 5+\sqrt{\frac{25}{4}}$ or $k = 5-\sqrt{\frac{25}{4}}$ $= 7.5$ $= 2.5$ Hence C (7.5, 0) or C (2.5, 0) (answer mark is for both correct)	M1 A1
15(c)	Set $\frac{1}{2}(\text{base})(3) = 12$ $5 - 8 = -3$ base $= 8$ $5 + 8 = 13$ Hence $D(-3, 6)$ and $D(13, 6)$ (answer mark is for both correct)	M1 A1
16(a)	$15 \times 4 = 60$ $20 \times 4 = 80$ $AB = \sqrt{60^2 + 80^2} = \sqrt{10000} = 100$ In ΔACB, $AC = \sqrt{100^2 + 160^2}$ $= \sqrt{35600} = 189$ cm (3 s.f.)	M1 A1
16(b)	$ED = \sqrt{20^2 + 160^2} = 161.245$ Angle $ADE = \tan^{-1}\left(\frac{15}{161.245}\right) = 5.3°$ (1 dp)	M1 A1