

1	☐ V is directly proportional to H ☒ V is inversely proportional to H ☒ V is directly proportional to $\frac{1}{H}$ ☐ V is inversely proportional to $\frac{1}{H}$	B1	
---	--	----	--

2	Alternative method 1		
	$P = kQ^2$ or $1.25 = k \times 0.5^2$ or $Q = \frac{c}{R}$ or $0.5 = \frac{c}{6}$	M1	oe
	$k = \frac{1.25}{0.5^2}$ or $k = 5$ or $P = 5Q^2$ or $c = 0.5 \times 6$ or $c = 3$ or $Q = \frac{3}{R}$	M1	oe
	$P = 5Q^2$ and $Q = \frac{3}{R}$ or $k = 5$ and $c = 3$	A1	oe
	$0.8 = \text{their } 5 \times \left(\frac{\text{their } 3}{R}\right)^2$ or $(R =) \sqrt{\frac{\text{their } 5 \times (\text{their } 3)^2}{0.8}}$	M1	ft their equations of the form $P = kQ^2$ and $Q = \frac{c}{R}$ oe eg $(Q =) \sqrt{\frac{0.8}{\text{their } 5}}$ or $Q = 0.4$ and $(R =) \frac{\text{their } 3}{\text{their } 0.4}$
	7.5 or $7\frac{1}{2}$ or $\frac{15}{2}$	A1ft	ft their equations of the form $P = kQ^2$ and $Q = \frac{c}{R}$ with 3rd M1 scored

2 cont	Alternative method 2		
	$P = \frac{k}{R^2}$ or $1.25 = \frac{k}{6^2}$	M1	oe
	$k = 1.25 \times 6^2$	M1dep	oe
	$P = \frac{45}{R^2}$ or $k = 45$	A1	oe
	$0.8 = \frac{\text{their } 45}{R^2}$ or $(R =) \sqrt{\frac{\text{their } 45}{0.8}}$	M1	oe ft their equation of the form $P = \frac{k}{R^2}$
	7.5 or $7\frac{1}{2}$ or $\frac{15}{2}$	A1ft	ft their equation of the form $P = \frac{k}{R^2}$ with 3rd M1 scored
	Additional Guidance		
	Allow k and c to be any letters, including using both as k in Alt 1		
	Alt 1 $kP = Q^2$ leading to $k = 0.2$	M1M1	
	Alt 2 $kP = \frac{1}{R^2}$ leading to $k = \frac{1}{45}$ (allow 0.022...)	M1M1A1	

Q	Answer	Mark	Comments
3(a)	Alternative method 1		
	$L = kD^2$	M1	oe equation
	$85 = 10^2k$ or $85 = 100k$ or $(k =) 0.85$	M1dep	oe implies M2
	$L = 0.85D^2$	A1	oe equation
	Alternative method 2		
	$cL = D^2$	M1	oe equation
	$85c = 10^2$ or $85c = 100$ or $(c =) \frac{100}{85}$	M1dep	oe allow $(c =) [1.176, 1.18]$ implies M2
	$\frac{100}{85}L = D^2$	A1	oe equation allow $[1.176, 1.18]L = D^2$
	Additional Guidance		
	Condone use of $\propto$ for up to M1M1A0 eg Alt 1 $L \propto kD^2$ $85 \propto 100k$ $L \propto 0.85D^2$	M1 M1 A0	
	$L = 0.85D^2$ oe	M1M1A1	
	$L \propto D^2$ is M0 with no further correct working		

Q	Answer	Mark	Comments
3(b)	Alternative method 1 If using alt 1 in (a)		
	their $k \times 5^2$	M1	oe their k from (a)
	21.25	A1ft	oe correct or ft their $k \times 5^2$
	Alternative method 2 If using alt 2 in (a)		
	$5^2 \div \text{their } c$	M1	oe their c from (a)
	21.25	A1ft	oe correct or ft $5^2 \div \text{their } c$ do not follow through an approximated value for $\frac{100}{85}$
	Additional Guidance		
	$L \propto 21.25$ on answer line	M1A0	
	Alt 2 (a) $1.18L = D^2$ (scores 3 marks in (a)) (b) $25 \div 1.18 = 21.19$	M1A0	

Q	Answer	Mark	Comments
4(a)	Alternative method 1		
	$G \propto \sqrt{H}$ or $G = k\sqrt{H}$ or $16 \div 2 \times 3 = k\sqrt{16}$ or $24 = k\sqrt{16}$	M1	oe equation k may be any letter
	$k = \frac{\text{their } 24}{\sqrt{16}}$ or $k = 6$ or $G = \text{their } 6\sqrt{H}$	M1dep	their 24 must be the result of $16 \div 2 \times 3$
	their $6 \times \text{their } \sqrt{100}$ or 60	M1dep	dep on M2
	60 : 100 or 3 : 5	A1	oe ratio
	Alternative method 2		
	100 $\div$ 16 or 6.25	M1	
	$\sqrt{\text{their } 6.25}$ or 2.5	M1dep	
	2 $\times$ their 2.5 or 5 or 24 $\times$ their 2.5 or 60	M1dep	dep on M2
	60 : 100 or 3 : 5	A1	oe ratio
	Additional Guidance		
	Ignore an incorrect attempt to simplify a correct ratio eg 60 : 100 followed by 3 : 4		M1M1M1A1
	$k = 6$ implies M2 unless from incorrect working		
	$G \propto k\sqrt{H}$ is M0 unless recovered		
	$G = k\sqrt{H}$ $\sqrt{16} = 4$ $G : H = 6 : 4$ $6 = k \times 4$ $k = \frac{6}{4}$ followed by $G = 1.5 \times 10$ 150 : 100		M1M0M0A0
	$G = 24$ with no correct further work		M0

Q	Answer	Mark	Comment
5(a)	Alternative method 1		
	$H \propto \frac{1}{\sqrt[3]{L}}$ or $H = \frac{k}{\sqrt[3]{L}}$	M1	oe equation any letter implied by $7 = \frac{k}{\sqrt[3]{64}}$
	$(k =) 7 \times \sqrt[3]{64}$ or $(k =) 28$	M1dep	oe
	$H = \frac{28}{\sqrt[3]{L}}$	A1	oe equation SC1 $H = \frac{7}{4}\sqrt[3]{L}$ or $\frac{4}{7}H = \sqrt[3]{L}$
	Alternative method 2		
	$H \propto \frac{1}{\sqrt[3]{L}}$ or $cH = \frac{1}{\sqrt[3]{L}}$	M1	oe equation any letter implied by $7c = \frac{1}{\sqrt[3]{64}}$
	$(c =) \frac{1}{7 \times \sqrt[3]{64}}$ or $(c =) \frac{1}{28}$	M1dep	oe
	$\frac{H}{28} = \frac{1}{\sqrt[3]{L}}$	A1	oe equation SC1 $H = \frac{7}{4}\sqrt[3]{L}$ or $\frac{4}{7}H = \sqrt[3]{L}$
	Additional Guidance		
	Up to M2 may be awarded for correct work, with no or incorrect answer, even if this is seen amongst multiple attempts		
	$(k =) 28$ or $(k \propto) 28$ or $(c =) \frac{1}{28}$ or $(c \propto) \frac{1}{28}$		M1M1
	Condone use of $\propto$ for up to M1M1A0 eg $H \propto \frac{k}{\sqrt[3]{L}}$ $k \propto 28$ $H \propto \frac{28}{\sqrt[3]{L}}$		M1 M1dep A0

Q	Answer	Mark	Comment
5(b)	$\frac{\text{their } 28}{\sqrt[3]{2744}}$ or $\frac{\text{their } 28}{14}$	M1	oe
	2	A1ft	ft their equation of the form $H = \frac{k}{\sqrt[3]{L}}$ or $cH = \frac{1}{\sqrt[3]{L}}$ SC1 24.5
	Additional Guidance		
	$k = 56$ in part (a) then $H = \frac{56}{\sqrt[3]{2744}}$ and $H = 4$		M1A1ft

Q	Answer	Mark	Comments						
6(a)	<table><tr><td>2</td><td>6</td><td>8</td></tr><tr><td>120</td><td>40</td><td>30</td></tr></table>	2	6	8	120	40	30	B2	B1 40 or 8 in the correct position or $(k=)$ 120×2 or $(k=)$ 240 seen
	2	6	8						
	120	40	30						
	Additional Guidance								
$(k=)$ 240 or $(k=)$ 120×2 may be seen anywhere on the page									
240 may be seen embedded in the formula eg $120 = \frac{240}{2}$		B1							

Q	Answer	Mark	Comments
7	$P \propto Q$ or $P = kQ$ or $8 = k \times 2$ or $R \propto \frac{1}{Q^2}$ or $R = \frac{c}{Q^2}$ or $10 = \frac{c}{3^2}$	M1	oe
	$k = \frac{8}{2}$ or $k = 4$ or $c = 10 \times 3^2$ or $c = 90$	M1dep	oe implied by $P = 4Q$ implied by $R = \frac{90}{Q^2}$
	$P = 4Q$ and $R = \frac{90}{Q^2}$ or $k = 4$ and $c = 90$	A1	oe
	$Q = \frac{0.5}{\text{their } 4}$ and $R = \frac{\text{their } 90}{\left(\text{their } \frac{0.5}{4}\right)^2}$ or $R = \frac{\text{their } 90}{0.125^2}$	M1	oe eg $R = \frac{1440}{0.25}$ ft their equations of the form $P = kQ$ and $R = \frac{c}{Q^2}$ their 90 must not be 4
	5760	A1ft	ft their equations of the form $P = kQ$ and $R = \frac{c}{Q^2}$ with 3rd M1 scored
	Additional Guidance		
	Allow k and c to be any letters, including using both as k		
	Correctly using constants on the left side of their equations – follow the spirit of the mark scheme		
	5760 with no errors in working		5 marks
	$P \propto kQ$ or $R \propto \frac{c}{Q^2}$ is M0 unless recovered		