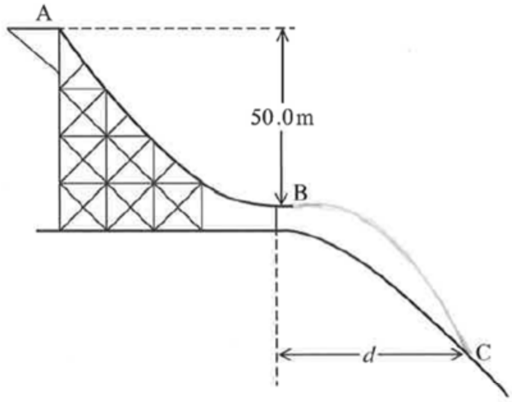
Mock Marking Candidate's Responses

Q1a Sample 1



(a) Calculate the speed of the ski jumper at B.

(2)

~~v = u + at~~ $v^2 = u^2 + 2as$

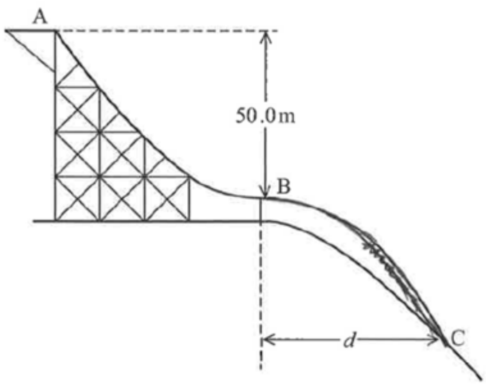
$v^2 = 0 + 2 \times 9.81 \times 50$

$v^2 = 981$

$v = 31.3\,ms^{-1}$

Speed = $31.3\,ms^{-1}$

Sample 2



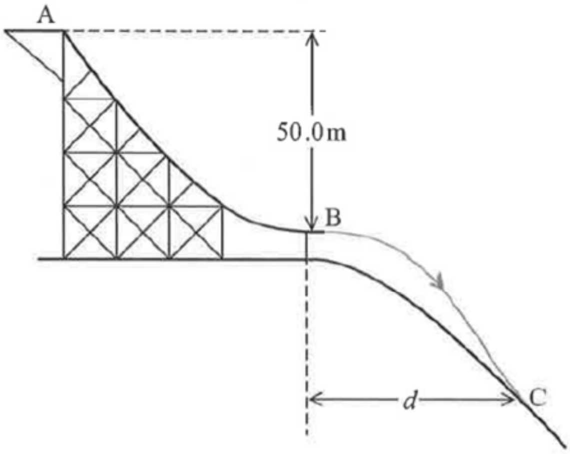
(a) Calculate the speed of the ski jumper at B.

(2)

$\frac{1}{2}v^2 = g\Delta h$ $\quad v = \sqrt{2 \times 50g} = 31.3\ ms^{-1}$

Speed = $31.3\ ms^{-1}$

Sample 3



(a) Calculate the speed of the ski jumper at B.

(2)

$\cancel{m}gh$ lost = $\frac{1}{2}\cancel{m}v^2$ gained

$2gh = v^2$

$2g(50) = v^2$

$v = 31.3 \text{ ms}^{-1}$

Speed = 31.3 ms^{-1}

Q1c Sample 1

The ski jumper leans forward an spreads his skis to maximise his surface area that is exposed to the air as he falls. This helps to maximize the amount of air resistance experienced so the vertical component acts to reduce the effect of the jumper's weight.
The low density of the skis helps to reduce the jumper's weight so he ~~has a~~ smaller acceleration downwards.

Sample 2

By angling his skis, the direction of the air resistance changes to have more of an upward component, allowing him to accelerate downwards slower, reach the ground later and so travel further.

Sample 3

By using less dense materials, the mass of the ski's will be less ($p = \frac{m}{v}$, $m = pv$) lower mass ski's means the weight acting downwards ($W = mg$) is less, reducing vertical acceleration and increasing the time of flight through the air. By adopting a more horizontal upper body position, the skier has less contact with the air, reducing the air resistance acting on him. This reduces the deceleration horizontally of the skier. A greater velocity leads to greater horizontal displacement ($s \times t = d$)

Sample 4

The position of the ski jumper makes air resistance at 45°C to the horizontal, this means equal resistive forces in the horizontal and verticle direction. Having ~~res~~ air resistance act upwards will increase the air time because the acceleration downwards will be less due to less resultant force downwards. Having a longer air time means that the ski jumper has more time in the air for which the horizontal component of velocity can act.

He uses low density material to decrease the weight acting downwards, this again, reduces the resultant downward force, decreasing the acceleration ~~of the~~ downwards, but ~~also~~ Also used to maintain a better lamina flow of the air so the force from air resistance is less, meaning less work done against air resistance.

(Total for Question 1 = 9 marks)

Q2 Sample 1

$E = \frac{V}{d}$ $E = \frac{F}{Q}$

$F = Bqv$

$\frac{V}{d} = \frac{F}{Q}$

$0.015 = 0.2v$

$\frac{60 \times 10^{-6}}{0.004} = \frac{F}{Q}$

$v = 0.075\ ms^{-1}$

$d = 1m$ $T = 0.075\ s^{-1}$

$\frac{F}{Q} = 0.015$

$f = \frac{40}{3}\ Hz$

$A = \pi r^2$

$F = 0.015 \times 1.6 \times 10^{-19}$

$A = \pi \times (2 \times 10^{-3})^2$

$F = 2.4 \times 10^{-21}$

$A = \frac{\pi}{250000}$

$V/s = \frac{\pi}{25000} \times \frac{40}{3}$

$= 1.68 \times 10^{-4}\ m^3 s^{-1}$

Sample 2

$F = Bqv$ $E = \frac{F}{Q}$ $\frac{V}{d} = \frac{F}{Q}$

$Bqv = \frac{VQ}{d}$

$B\ \text{Velocity} = \frac{\text{Voltage}}{\text{distance}}$

$0.2(\text{Vel}) = \frac{60 \times 10^{-6}}{4 \times 10^{-3}}$

Vel = $0.075\ ms^{-1}$ Volume =

$\pi (2 \times 10^{-3})^2 \times 0.075 = \text{Volume}$

$9.42 \times 10^{-7}\ m^3$

Sample 3

(b)

$F = BIL$ sine , $F = Bqv$ sine

$E = \frac{V}{d} = \frac{60 \times 10^{-6}}{4 \times 10^{-3}} = 0.015\ Vm^{-1}$

$E = \frac{F}{Q}$, $F = B\cancel{q}v = E\cancel{Q}$

$Bv = E$

$v = \frac{0.015}{0.2} = 0.075 ms^{-1}$

Cross sectional area of artery $= \pi \times (0.004)^2$

$= 5.03 \times 10^{-5} m^2$

∴ volume of blood per second =

$= 0.075 \times 5.03 \times 10^{-5}$

$= 3.77 \times 10^{-6} m^3 s^{-1}$

Q3ai Sample 1

(3)

In the graph, F (which is directly proportional to a) is directly proportionate to separation, x, as the line is linear.
Also, as the graph is negative, $F \propto -x$, or as $F = ma$
$ma \propto -x$ or $a \propto -x$, which defines
SHM

Sample 2

Simple harmonic motion occurs when force is proportional to displacement, directed towards to equilibrium point.
The graph shows that to the left of the equilibrium point (negative displacement), the force is positive, and when displacement is positive the force is negative.
It also shows that as displacement increases (from the equilibrium point at ~~10~~ 11.3×10^{-10} m), force increases, hence motion is simple harmonic

Sample 3

From the graph we can indicate that 1.13×10^{-10} m is the equilibrium point, as the force here is 0. As the ~~~~ separation increases, it is proportional to force increasing in the opposite direction, meaning displacement from equilibrium position is proportional to acceleration, whereby acceleration is always directed toward the equilibrium position. (As force = mass × acceleration.)

Q4 Sample 1

When a star on the main sequence runs out of hydrogen fuel, the inward pressure of gravity exceeds the outward nuclear pressure. This increases the density of the core, triggering further fusion reactions between helium nuclei, producing elements up to iron. The outward nuclear pressure causes the star to expand into a red dwarf, which is red due to its lower surface temperature. When the fusion reaction of helium ceases, the red dwarf recontracts. No further fusion reactions occur, because iron has the highest binding energy per nucleon. Gravitational pressure condenses the red giant into a dense, hot white dwarf. ~~which eventually~~ ~~cools~~.

Sample 2

During the end of the main sequence of a star the fuel for fusion starts to run out. Therefore fusion ceases in the core and continues at the surface. This star begins to swell and grow in size ~~[illegible]~~ as the temperature decreases due to loss fusion, and luminosity increases. This is now called a red giant or red super giant if big enough. Once the fuel has completely ran out the star starts to die and shrinks to form a white dwarf. The luminosity decreases and temperature increases due to the star compressing into a ~~much~~ smaller size, becoming very dense.

Sample 3

(6)

When in the main sequence, stars undergo fusion by joining hydrogen nuclei together to form He nuclei and releasing energy. After this, the H runs out, and He fusion occurs in the core of the star, and the star increases in radius and luminosity to form a red giant. ~~so~~ Once the Helium in the core has been fused, the star is no longer hot enough to fuse any of the remaining elements, and the outer layers of the red dwarf ~~are~~ ~~go~~ drift into space, leaving the fusionless core, which is still hot and gives off light.

Sample 4

main sequence stars fuse hydrogen to form helium in the core of the star. They are in stable phase as gravitational force pulling the star inwards, and nuclear pressure exerted from the star outwards are equal.

When hydrogen in the core runs out, gravitational forces win over and cause collapse of the core causing it to heat up as GPE lose = KE gained. Core becomes hot enough for the fusion of helium atom nuclei, and hydogen in the outer envelope begin fusing. this causing the radius to increase and the star has become a red giant.

Eventually, helium begins to run out, and fusion in the core ceases again, causing further gravitational collapse.

Mass gets ejected from the star, and gravitational collapse is not great enough for fusion of larger elements, and so a white dwarf is formed

(Total for Question 4 = 6 marks)

Q5 Sample 1

$eV_s = \frac{hc}{\lambda} - \phi$

$V_s = \frac{hc}{e\lambda} - \frac{\phi}{e}$ $V_s = \left(\frac{hc}{e}\right)\frac{1}{\lambda} - \frac{\phi}{e}$. As in form

$y = mx + c$, then shows the relationship is linear (straight line)

(b) Use the student's graph to determine a value for h.

(4)

$\frac{dy}{dx} = \frac{2.4 - -0.7}{2.5 \times 10^{6}} = 1.24 \times 10^{-6}$

$1.24 \times 10^{-6} = \frac{hc}{e}$

$\frac{1.24 \times 10^{-6} e}{c} = h = 6.613 \times 10^{-34}$

$h = 6.613 \times 10^{-34}$ Js

No indication of triangle on graph

Sample 2

$\frac{hc}{\lambda} = \phi + eV_s$ $\therefore$ $eV_s = \frac{hc}{\lambda} - \phi$

where hc = gradient

and $-\phi$ is the y intercept

(b) Use the student's graph to determine a value for *h*.

(4)

gradient = hc

gradient = $\frac{\text{rise}}{\text{run}} = \frac{2.1 \times 1.6 \times 10^{-19}}{1.7 \times 10^{6}}$

$= 1.98 \times 10^{-25}$

$\therefore h = \frac{1.98 \times 10^{-25}}{3 \times 10^{8}} = 6.59 \times 10^{-34}$

h = 6.59×10^{-34}

Large triangle drawn on graph

Sample 3

$eV_s = \cancel{\phi} \frac{hc}{\lambda} - \phi$

$m = \frac{1}{\lambda}$

$V_s = \frac{hc}{e}\left(\frac{1}{\lambda}\right) - \frac{\phi}{e}$ $\quad y = mx + c$

(b) Use the student's graph to determine a value for h.

(4)

$\frac{2.8 - (-0.4)}{2.85\times10^{6} - 0.25\times10^{6}} = 1.23 \times 10^{-6} = \frac{hc}{e}$

$\frac{1.6\times10^{-19} \times 1.23\times10^{-6}}{3.00^{8}} = 6.56 \times 10^{-34}$

$e =$

$h =$ 6.56×10^{-34}

Large triangle on graph

Q7 Sample 1

Height of balloon h / m	Atmospheric pressure p / Pa	$\ln p$
5000	53 500	~~10.887~~ 10.9
10 000	28 700	~~10.265~~ 10.3
15 000	15 300	9.64
20 000	8210	9.01
25 000	4390	8.39

(8)

$p = p_0 e^{-kh}$ $\quad \ln p = \ln p_0 + \ln e^{-kH}$

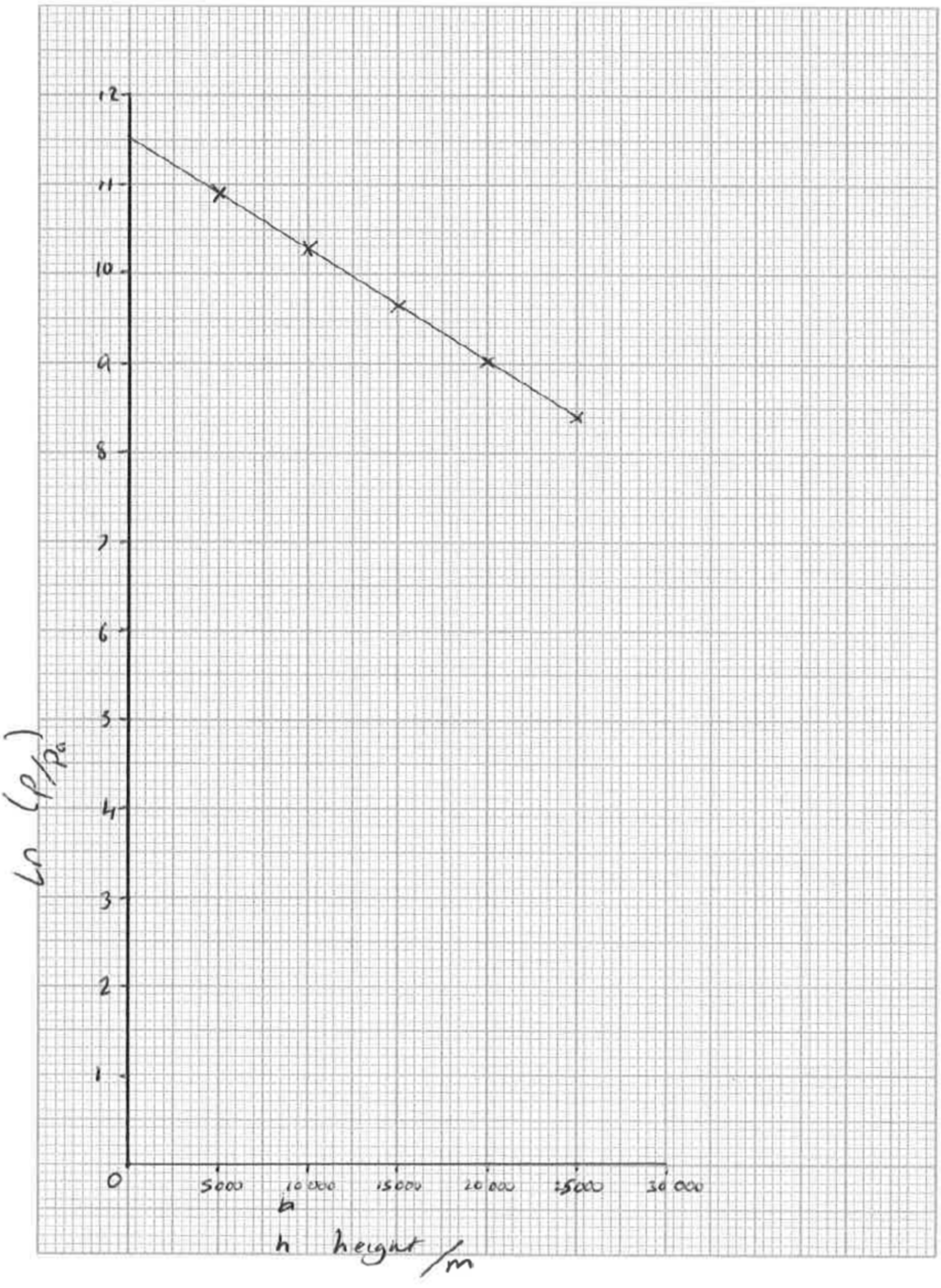
$\ln p = \ln p_0 - Kh$

$\ln p = -K h + \ln p_0$

$y = m x + c$

values drawn on graph
If graph fits line $\ln p = -Kh + \ln p_0$
where $\ln p_0$ is the y intercept and the gradient is
a negative constant then the equation works

The graph is straight line and negative, meaning the approximation is correct. Also, y intercept = 11.5, so $\ln p_0 = 11.5$ $\quad p_0 = e^{11.5} = 98716$ Pa, a sensible value for atmospheric pressure, and is similar to the initial value of pressure


12
11
10
9
8
7
6
5
4
3
2
1
0
5000
10 000
15000
20 000
25000
30 000
Ln (p/p₀)
h height /m

Sample 2

Height of balloon h / m	Atmospheric pressure p / Pa
5000	53 500
10 000	28 700
15 000	15 300
20 000	8210
25 000	4390

$p = p_0 e^{-kh}$

$\ln p = \ln p_0 e^{-kh}$

$\ln p = \ln p_0 + \ln e^{-kh}$

$\ln p = \ln p_0 - kh$

$\ln p = -kh + \ln p_0$

$\cancel{p_0 = 1.01 \times 10^5 \text{ Pa}}$ $\quad p_0 = 1.01 \times 10^5$

$\ln p_0 = 11.52$

$\cancel{53{,}500 = p_0 e^{-k(5000)}}$ $\quad \cancel{10{,}000}$

$\ln 53{,}500 = \ln p_0 - 5000k \quad \cancel{\ln 28{,}700 = \ln p_0 - 10000k}$

$\cancel{500}$

$\cancel{k = \frac{\ln p_0 - \ln 53{,}500}{5000}} \quad k = \frac{\ln p_0 - \ln 28{,}700}{10{,}000}$

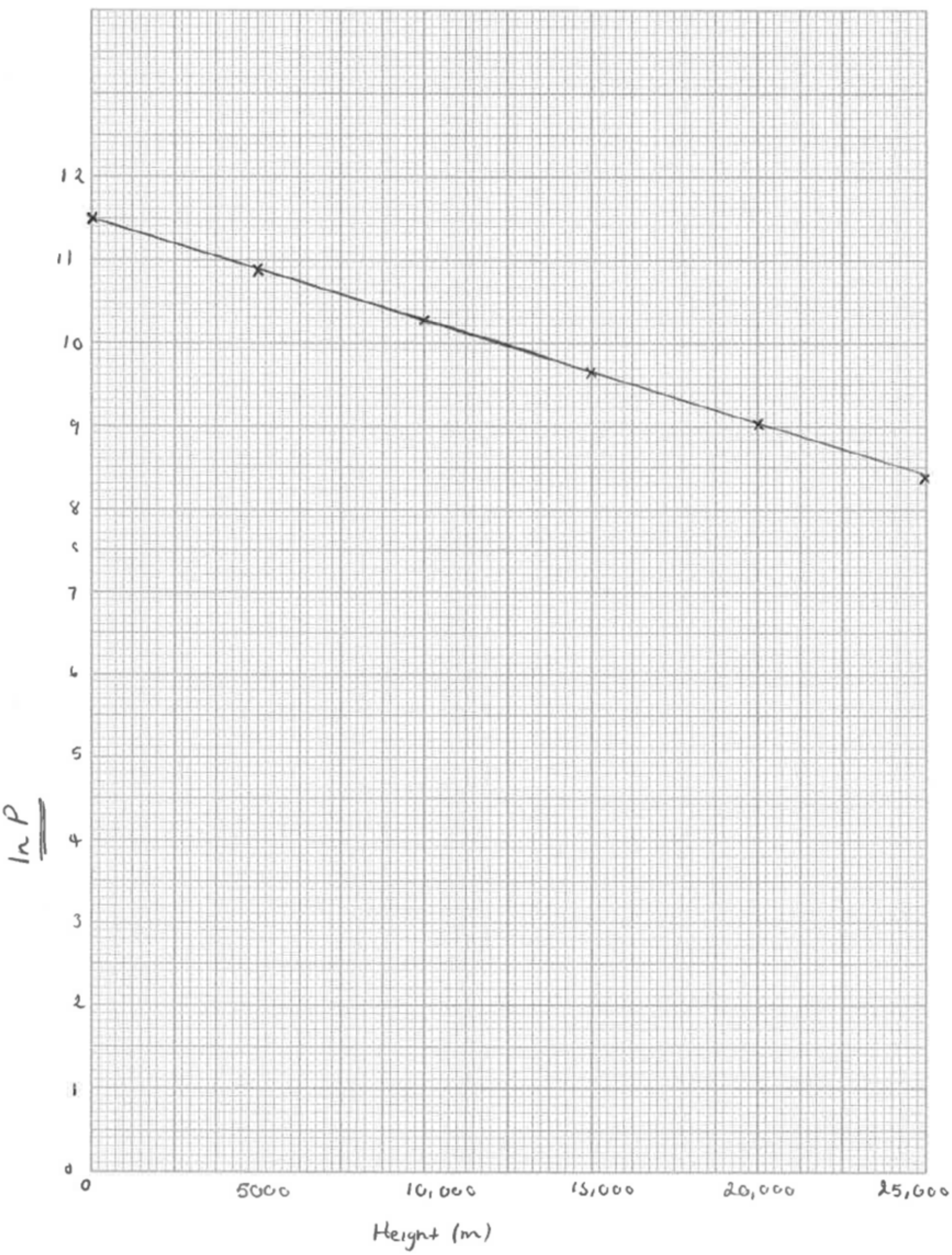
$\cancel{\frac{\ln p_0 - \ln 53{,}500}{5000} = \frac{\ln p_0 - \ln 28{,}700}{10{,}000}}$

$10{,}000 \ln p_0 - 10000 \ln 53{,}500 = 5000 \ln p_0 - 5000 \ln 28{,}700$

$\cancel{5000} \ln p_0 = 32.0$

$e^{32.0} = p_0$

Straight line produced supports suggestion



ln P
12
11
10
9
8
7
6
5
4
3
2
1
0
0
5000
10,000
15,000
20,000
25,000
Height (m)

Sample 3

Height of balloon h / m	Atmospheric pressure p / Pa	$\ln P$
5000	53 500	10.89
10 000	28 700	10.26
15 000	15 300	9.64
20 000	8210	9.01
25 000	4390	8.39

(8)

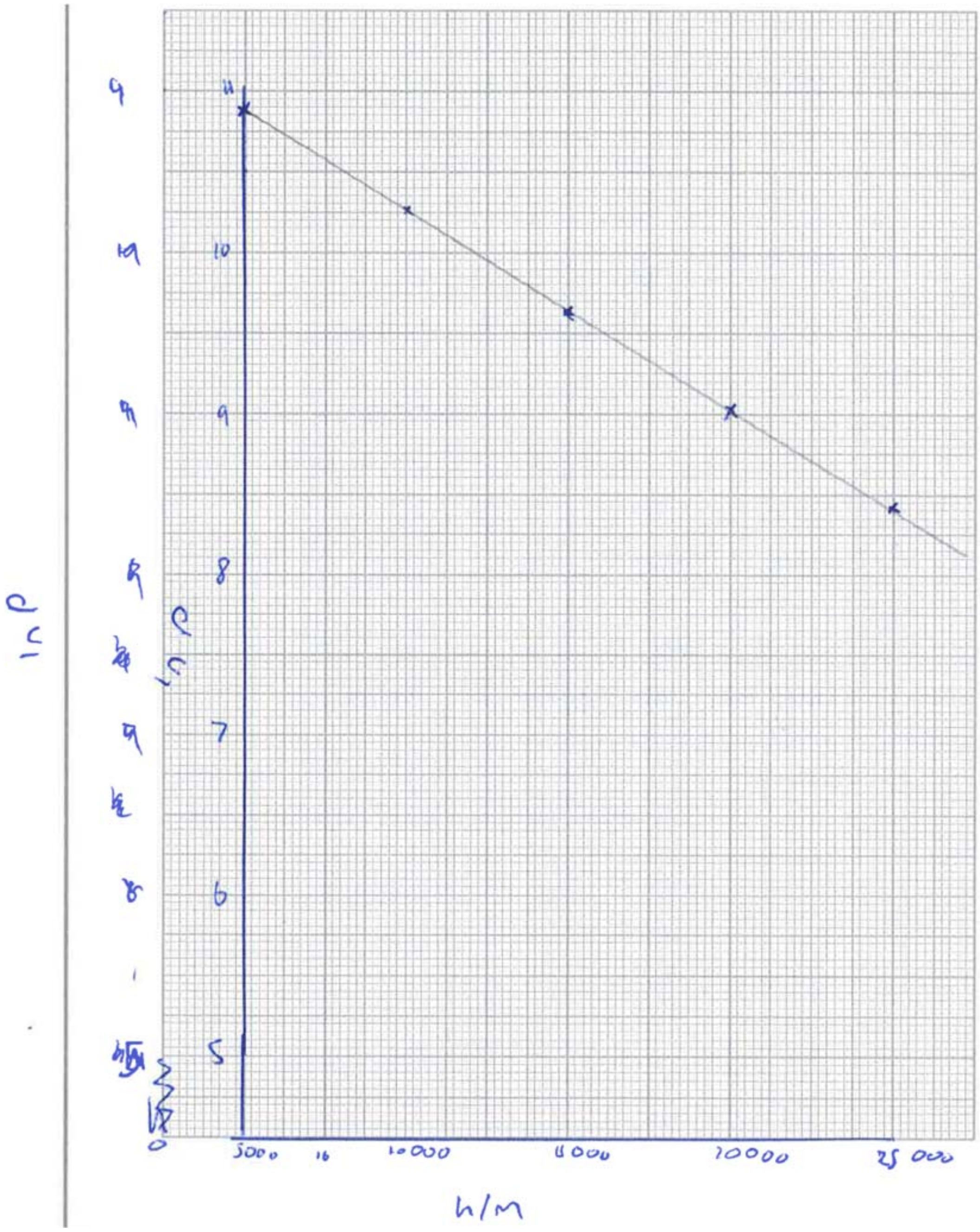
$$\frac{P}{P_0} = e^{-kh}$$

$$\ln\left|\frac{P}{P_0}\right| = -kh$$

$$\ln P - \ln P_0 = -kh$$

$$\ln P = -kh + \ln P_0$$

when using natural log, graph achieven has been a straight line with $\ln P$ on y and h on the x axis, I can conclude that this suggestion is valid


ln P
11
10
9
8
7
6
5
0
5000
10000
15000
20000
25 000
h/m