This is a Class 1 exam

Lebanon Evangelical School
for Boys and Girls — Loueizeh - Baabda

Stage Exam 01
11NOV2022

Do NOT write in this box. Your MARK will be placed here.

Max Mark 105.

Subject :	A Level : Physics 1 : SKW
Class :	11A and 12A
Teacher :	Mr. Steve
Duration :	1 hour

Your name :	SKW	*Time taken to complete exam*
Your Class :	P1	
Exam Room :	Solutions, Worked.	
How many sheets, including cover sheet :		

- Do not open this paper until the teacher in charge instructs you to do so.
- The most important thing to remember in taking an exam is NEVER PANIC.
- If you are caught cheating in this exam, you will be awarded zero for ALL exams that are taken on this day.

This is a REAL test.

Time allowed : 120 minutes MAX

Marks : 97 [please note that the number of marks is really the number of minutes I feel that you need to solve the problem, not the exact number of marks that will be awarded in the final markscheme]

You will probably not be able to finish it, don't worry.

Do as much as you can.

The MOST important thing is to show your working. NO marks without detailed working.

NOTE : some questions are starred (marked with a *). Do them last, they are the most challenging.

Question 1 [8 marks]

Evaluate without using a calculator, show all your working.

a	$\log_7 1$
b	$\log_{1/2} 2$
c	$\log 10^{14}$
d	$\log 10^{-23}$

e	$\log_{1/2}\left(\frac{1}{2}\right)$
f	$\log_{1/5} 5$
g	$\log_{3/4}\left(\frac{4}{3}\right)$
h	$\log_{2/3} 1$

Question 2 [4 marks]

Find a

a	$\ln a = 1$
b	$\log a = -1$
c	$\log_9 a = -1$
d	$\log_{12} a = 1$

Question 3 [4 marks]

Expand the logarithm. Simplify if possible.

a	$\log_3\left(9x^2\right)$
b	$\log_2\left(32x^7\right)$
c	$\log_6\left(36(x+y)^4\right)$
d	$\log\left(100x^2\right)$

Question 4 [4 marks]

Given $\log_3 x = a$, $\log_3 y = b$, and $\log_3 z = c$, write the following logarithms in terms of a, b, and and c.

a	$\log_3\left(27x^2y^3z\right)$
b	$\log_3\left(\frac{9x^2y}{z^3}\right)$

Question 5 [4 marks]

Find all x values such that :

$$\log_{12}(2x+6) + \log_{12}(x+2) = 2.$$

Question 6* [4 marks]

To solve this problem you can ONLY use log base 10 functions on your calculator

$$\text{Does } \log_{81}(2401) = \log_3(7) \text{ ?}$$

Question 7 [4 marks]

To solve this problem you can ONLY use log base 10 functions on your calculator

Find, giving your answer to 3 significant figures where appropriate, the value of x for which

(a) $5^x = 10$.

(b) $\log_x(x-2) = -1$.

Question 8 [10 marks]

You are given the following data for the stopping distance d of an object travelling at speed v:

v (m/s)	d (m)
1.18	3.01
1.93	6.03
2.95	14.1
4.57	36.2
8.12	85.0

Table 2: Data for log-log graphing exercise.

The expected relationship between d and v is:

$$d = Av^n \tag{3}$$

(a) By taking logs of both sides of equation (3), determine what values you have to plot on the y axis and the x axis of a graph to produce a straight line.

(b) Copy the table and add the two columns of data that you need to obtain the values required to plot a suitable straight line graph.

(c) Plot the graph and obtain values for A and n.

NOTE : Show ALL you working. Neatness and tidiness of the graph are very important.

Question 9 [4 marks]

From the top of a building 150 m tall, the angle of depression to the bottom of a second building is 18 degrees. From the same point, the angle of elevation to the top of the second building is 13 degrees.

(a) Draw a clearly labelled diagram of the situation.
(b) Calculate the distance between the two buildings.
(c) Calculate the height of the second building.

Question 10 [4 marks]

Karla is riding vertically in a hot air balloon, directly over a point P on the ground. Karla spots a parked car on the ground at an angle of depression of 30 degrees. The balloon rises 50 meters. Now the angle of depression to the car is 35 degrees.

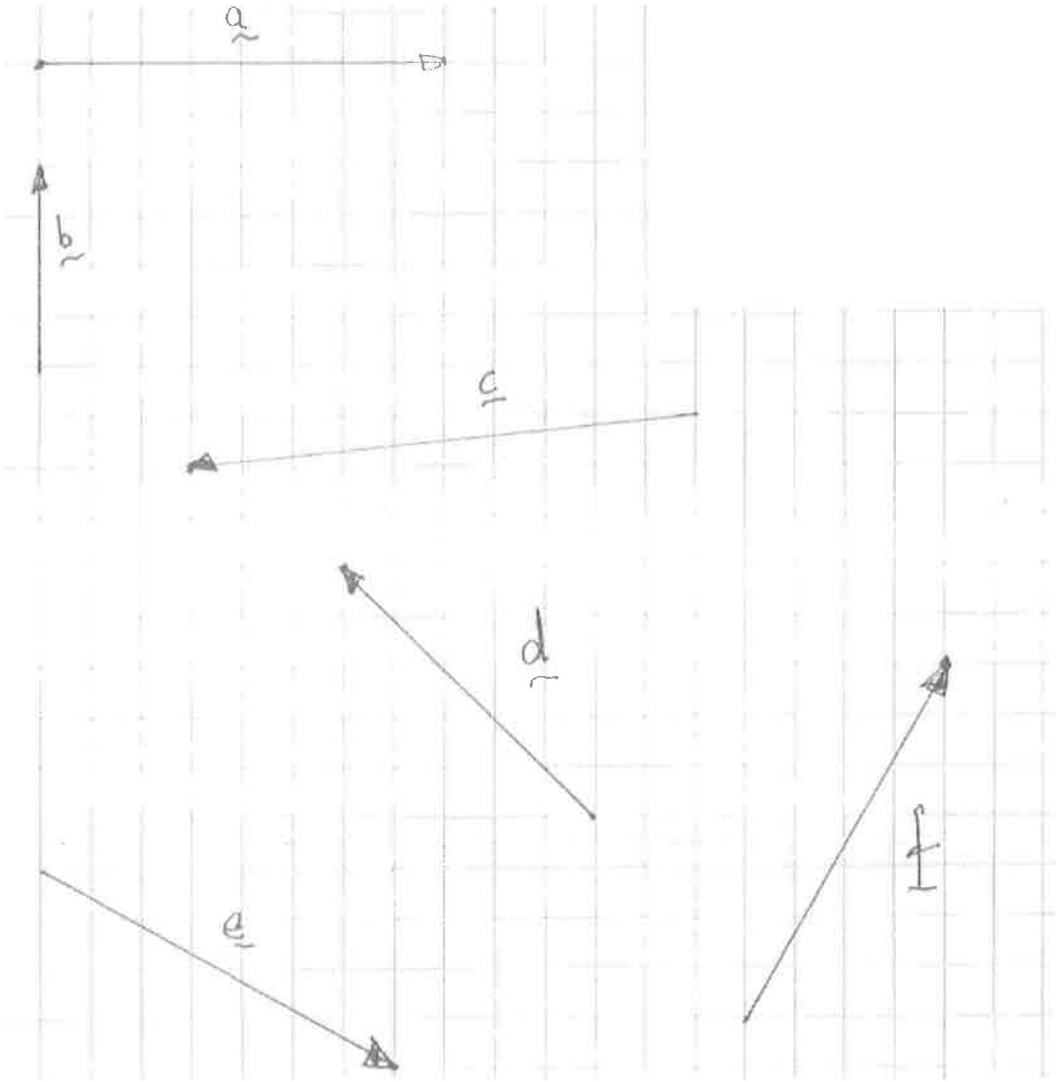
(a) Draw a clearly labelled diagram to illustrate the situation.
(b) How far is the car from point P?
(c) What was the INITIAL height of the ballon above the ground?

Question 11 [4 marks]

Below are SIX scaled vectors. Using a squared sheet of paper, DRAW vector diagrams to determine the following 3 vectors :

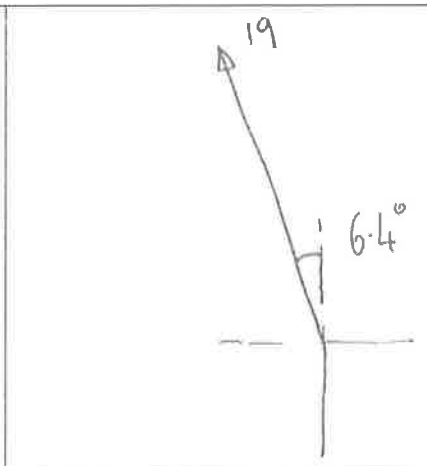
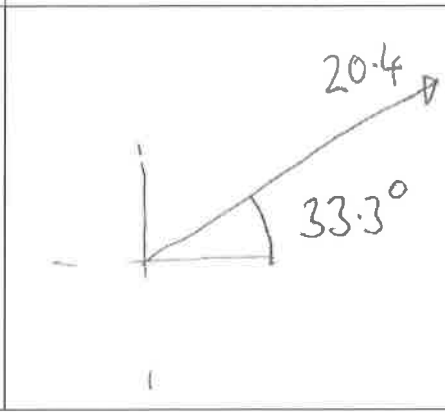
$\underset{\sim}{k} = \underset{\sim}{d} + \underset{\sim}{b}$ $\quad \underset{\sim}{m} = \underset{\sim}{e} - \underset{\sim}{f}$

$\underset{\sim}{p} = \underset{\sim}{c} - \underset{\sim}{b}$



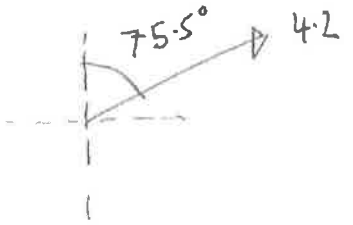
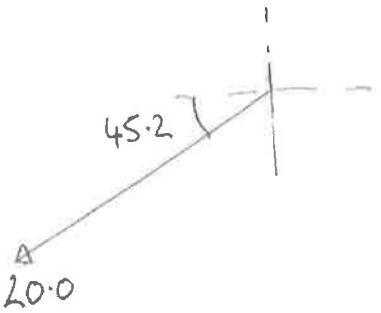
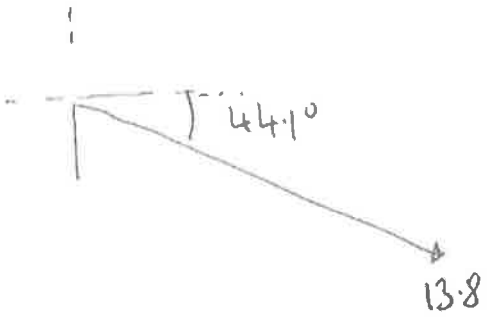
Question 12 [6 marks]

Add these two vectors using the cosine rule. You answer should be the magnitude and direction of the resultant vector.

a	
b	

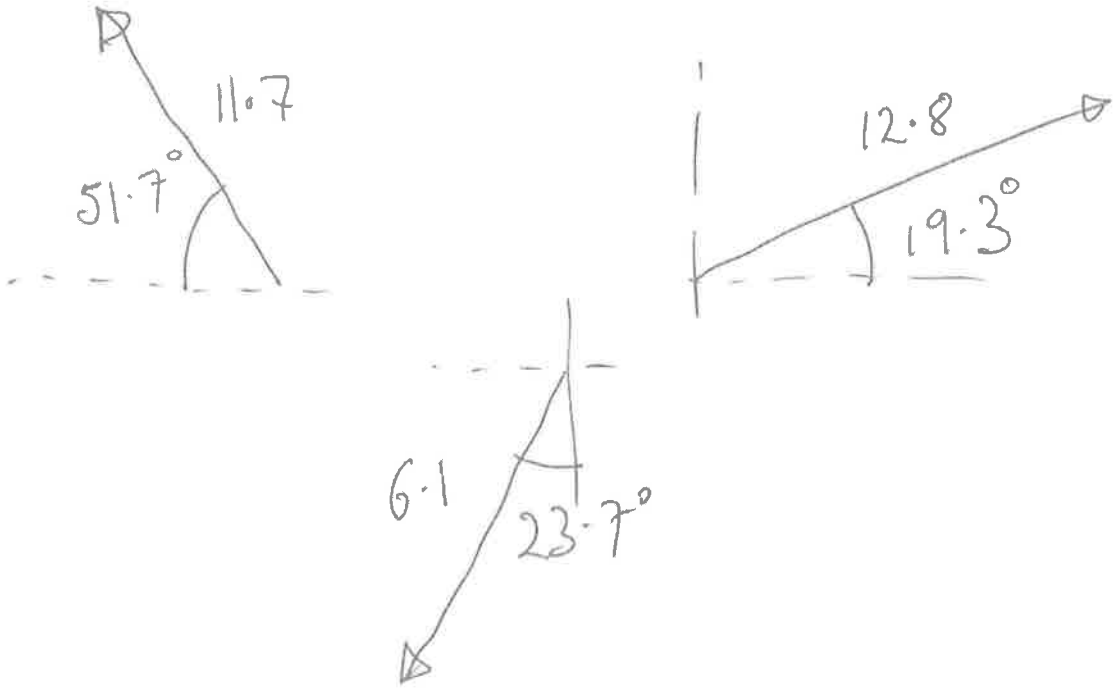
Question 13 [4 marks]

Determine the horizontal and vertical components of the following three vectors :

a	
b	
c	

Question 14 [7 marks]

Using the method of resolution of vectors, determine the sum of these three vectors.



Question 15 [4 marks]

A boat travels at 8 m/s and heads straight across a river 240 m wide. The river flows at 4 m/s.

(a) Draw a diagram to illustrate the situation.
(b) What is the boat's resultant velocity with respect to the riverbank?
(c) How long does it take the boat to reach the other side?

Question 16 [4 marks]

A man is able to row at 5 m/s in still water. He points his boat at a 50 degrees angle from the shore in an upstream direction in a river that is flowing at 4 m/s.

(a) Draw a diagram to illustrate the situation.
(b) How far, either up or downstream will he land on the other side of the river if the river is 45 m across?

Question 17 [8 marks]

A plane is travelling at 150m/s and needs to get to its destination 450 km due north of its starting position. A cross wind of 50m/s is blowing in a direction 110ºT.

(a) Draw a diagram to illustrate the situation.
(b) What direction must the pilot point the plane to get to its destination?
(c) What is the RESULTANT speed of the plane?
(d) How long will it take the plane to arrive at its destination?

Question 18** [10 marks]

An airliner is travelling at 220m/s and needs to get to its destination which is 590 km away on a bearing of 45 degrees of its starting position. A cross wind of 72m/s is blowing in a direction 280ºT.

(a) Draw a diagram to illustrate the situation.
(b) What direction must the pilot point the plane to get to its destination?
(c) What is the RESULTANT speed of the plane?
(d) How long will it take the plane to arrive at its destination?

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①

(a) $\log_7 1 = x$, $1 = 7^x$, $x = 0$ (1)

(b) $\log_{\frac{1}{2}} 2 = x$, $2 = \frac{1}{2}^x$, $x = -1$ (1)

(c) $\log 10^{14} = x$, $10^{14} = 10^x$, $x = 14$ (1)

(d) $\log 10^{-23} = x$, $10^{-23} = 10^x$, $x = -23$ (1)

(e) $\log_{\frac{1}{2}} \frac{1}{2} = x$ $\frac{1}{2} = \frac{1}{2}^x$, $x = 1$ (1)

(f) $\log_{1/5} 5 = x$, $5 = \frac{1}{5}^x$, $x = -1$ (1)

(g) $\log_{\frac{3}{4}} \frac{4}{3} = x$ $\frac{4}{3} = \frac{3}{4}^x$, $x = -1$ (1)

(h) $\log_{\frac{2}{3}} 1 = x$, $1 = \frac{2}{3}^x$, $x = 0$ (1)

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(2) (a) $\log_e a = 1$

$a = e^1 = e$ (1)

(b) $\log a = -1$, $a = 10^{-1} = 0.1$ (1)

(c) $\log_9 a = -1$ $a = 9^{-1} = 0.111$ (1)

(d) $\log_{12} a = 1$, $a = 12^1 = 12$ (1)

(3)

(a) $\log_3(9x^2)$

$\log_3 9 + \log_3 x^2$

$\log_3 9 = 2$

$2 + 2\log_3 x$

$2(1 + \log_3 x)$ (1)

(b) $\log_2(32x^7)$

$\log_2 32 + \log_2 x^7$

$\log_2 32 = 5$ $\quad 5 + 7\log_2 x$ (1)

(c) $\log_6(36(x+y)^4)$

$\log_6 36 + \log_6 (x+y)^4$

$\log_6 36 = 2$ $\quad 2 + 4\log_6(x+y)$

$2 + 4\log_6(x+y)$

$2(1 + 2\log_6(x+y))$ (1)

(3) cont'd.

(d) $\log(100x^2)$

$= \log_{10} 100 + \log_{10} x^2$

$= 2 + 2\log_{10} x$

$= 2(1 + \log_{10} x)$ (1)

(4) $\log_3(27x^2y^3z)$

$\log_3 27 + \log_3 x^2 + \log_3 y^3 + \log_3 z$

$3 + 2\log_3 x + 3\log_3 y + \log_3 z$

$3 + 2a + 3b + c$ (2)

See Page (4b) for Q4, b

(5) $\log_{12}(2x+6) + \log_{12}(x+2) = 2$

$\log_{12}(2x+6)(x+2) = 2$ (1)

$(2x+6)(x+2) = 144 = 12^2$ (1)

$2x^2 + 10x + 12 = 144$

$x^2 + 5x + 6 = 72$

$x^2 + 5x - 66 = 0$ (1)

$(x-6)(x+11)$

$x = 6, \quad x = -11$ (1)

(4)

(b) $\log_3\left(\frac{9x^2y}{z^3}\right)$

$\log_3(9x^2y) - \log_3 z^3$

$= \log_3 9 + \log_3 x^2 + \log_3 y - \log_3 z^3$

$= 2 + 2a + b - 3c$ (2)

(5)

(6) $\log_{81}(2401) = x$, $x = ?$

$2401 = 81^x$ (1)

$\log 2401 = \log 81^x$

$\log 2401 = x \log 81$

$x = \log 2401 / \log 81$

$x = 1.771243$ (1)

$\log_3 7 = x$, $x = ?$

$7 = 3^x$

as above (1)

$\log 7 / \log 3 = x$

$x = 1.771243$ (1)

Yes it does!

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(a) $5^x = 10$

$\log 5^x = \log_{10} 10$

$x \log 5 = 1$

$x = 1 / \log 5 = 1.43$ (2)

(b) $\log_3 (x-2) = -1$

$x - 2 = 3^{-1}$

$= \frac{1}{3}$

$3x - 6 = 1$

$3x = 7$

$x = 7/3 = 2.33$

(2)

(8)

$$d = Av^n$$

$$\log d = \log(Av^n)$$

$$\log d = \log A + \log v^n$$

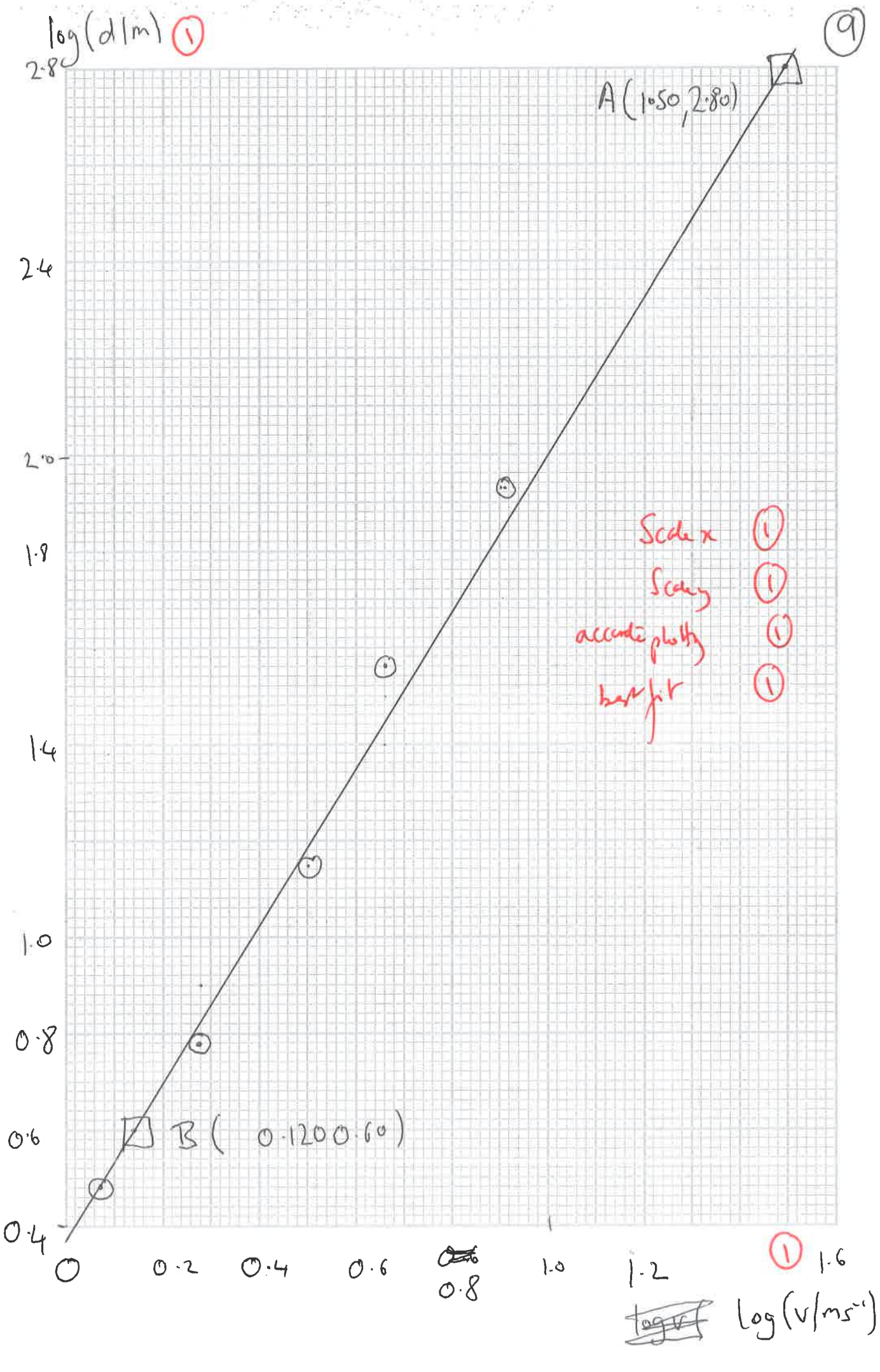
$$\log d = \log A + n \log v$$

$$\downarrow \quad \downarrow \quad \downarrow \quad \downarrow$$

$$y = c + m\,c$$ (1)

If we plot log d on y axis and log v on x axis we should obtain a st line graph of gradient n (assuming that n is constant) and y axis intercept log A. (1)

$v(ms^{-1})$	$d(m)$	$\log(v/ms^{-1})$ (1)	$\log(d/m)$ (1)
1.18	3.01	0.0719	0.479
1.93	6.03	0.286	0.780
2.95	14.1	0.470	1.15
4.57	36.2	0.660	1.56
8.12	85.0	0.910	1.93
		(1)	(1)


log(d/m) (1)
(9)
2·8
2·4
2·0
1·9
1·4
1·0
0·8
0·6
0·4
A (1·50, 2·80)
B (0·12 0·60)
Scale x (1)
Scale y (1)
accurate plotting (1)
best fit (1)
0
0·2
0·4
0·6
0·8
1·0
1·2
(1) 1·6
log(v/ms⁻¹)
~~log v~~

(c)

large Δ (1)

gradient = $\frac{\Delta y}{\Delta x}$ Using A and B

$$\frac{2.8 - 0.6}{1.50 - 0.12} = 1.59$$

(1)

$n = 1.59$

1.43 → 1.75 (range)

Intercept. As we do not have an intercept on the graph we will use the equation.

$$\log d = \log A + n \log V$$

using point A

$$2.80 = \log A + 1.5942 \times 1.50$$

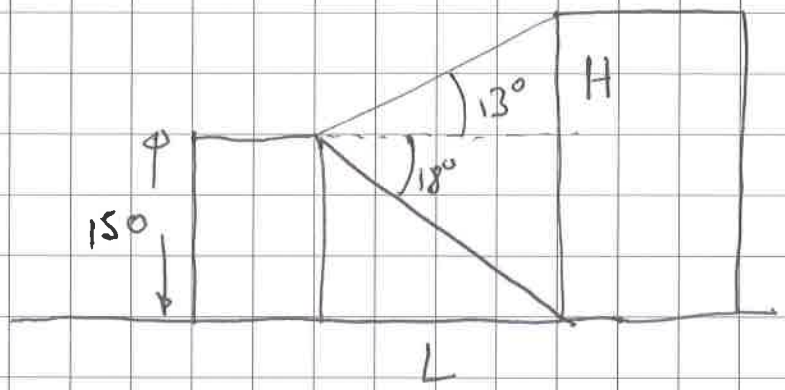
$$\log A = 0.409$$

$$\Rightarrow A = 10^{0.409} = 2.56$$ (1)

[Units must be S.I. ~~d x v~~ A x v = d

(1) $ms^{-1} = m$]

(9)



(1) (2) (1) for diagram

$\tan 18 = 150/L$ ✓ (1)

$\tan 13 = H/L$ (1)

$L = \dfrac{150}{\tan 18}$

$\tan 13 = \dfrac{H}{150} \cdot \tan 18$

$H = \dfrac{150 \times \tan 13}{\tan 18} = 106.85808\,m$

(1)

$\Rightarrow$ Building is $150 + 106.\ldots = 257\,m$ (3sf)

$L = 150/\tan 18 = 462\,m.$ (1)

(10)

(a)

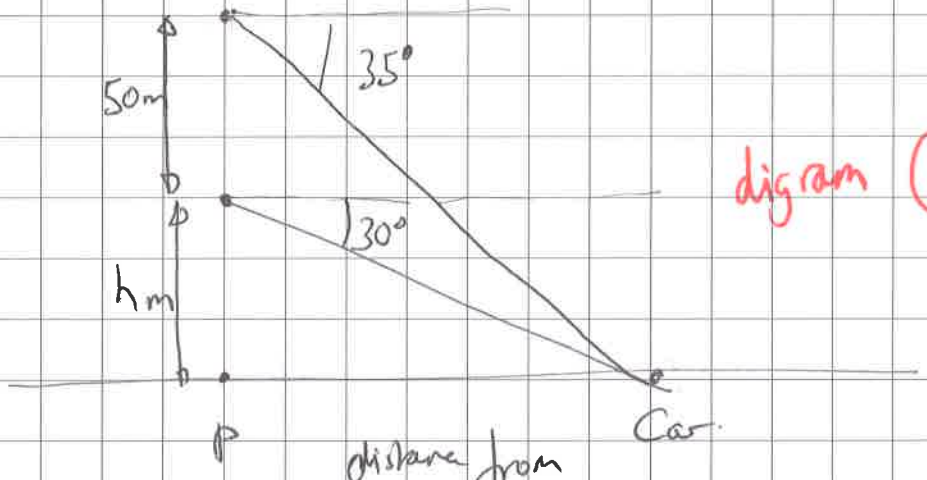


diagram (1)

$\tan 30 = h/L$ (1)

$\tan 35 = (h+50)/L$ (1)

$$\frac{\tan 30}{\tan 35} = \frac{h}{(h+50)}$$

$0.82454(h+50) = h$

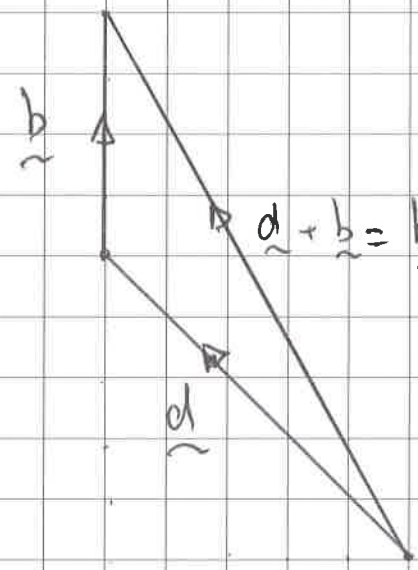
$41.22708 = 0.17546h$

$h = 235\text{m}$ (1) → answer to (c)

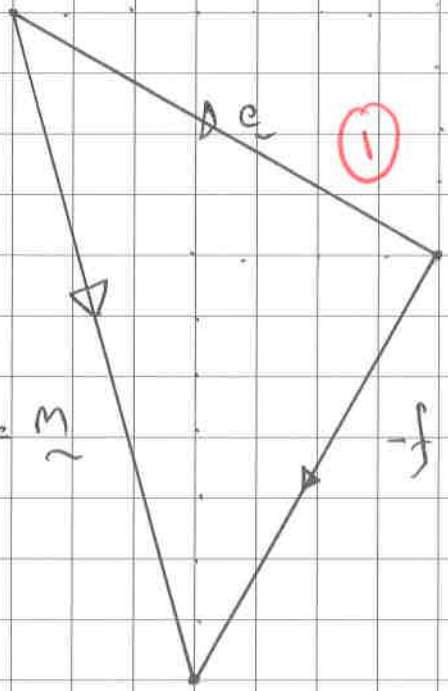
$L = h/\tan 30$

$L = 407\text{ m}$ (1)

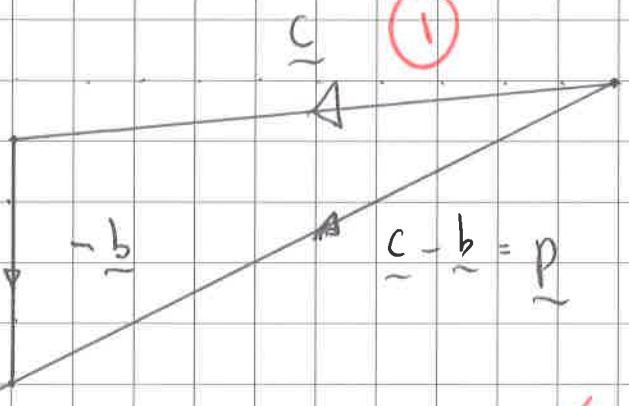
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$\underset{\sim}{d} + \underset{\sim}{b} = \underset{\sim}{k}$ (1)



$\underset{\sim}{e} - \underset{\sim}{f} = \underset{\sim}{m}$ (1)

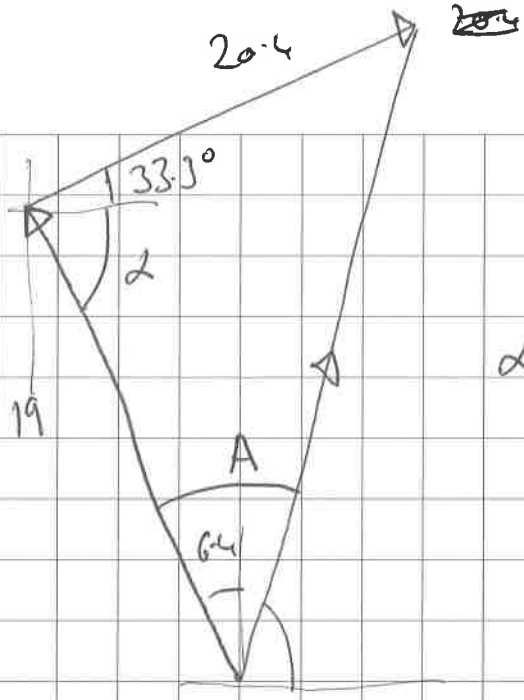


$\underset{\sim}{c} - \underset{\sim}{b} = \underset{\sim}{p}$ (1)

/60

(13)

(12)



$\alpha = 90 - 64$

$= 83.6°$ ✓ (1)

$a^2 = b^2 + c^2 - 2bc \cos A$ (1)

$A = 83.6 + 33.3 = 116.9$ (1)

$a^2 = 20.4^2 + 19^2 - 2 \times 20.4 \times 19 \times \cos 116.9$

$|a| = 33.6$ (1)

$20.4^2 = 19^2 + 33.6^2 - 2 \times 19 \times 33.6 \times \cos A$ (1)

$A = 32.7999°$

$32.7999 - 64 = 26.3999°$

So result is $26.4°$ E of N (1)

OR $63.6°$ N of E

(14)

(13)

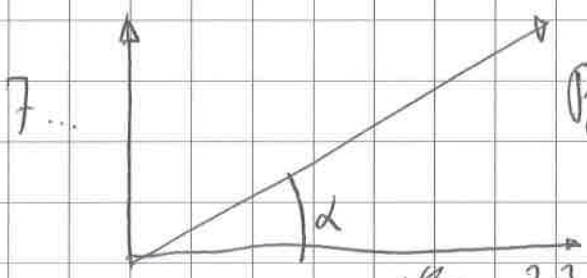
	H	V
a	$42\sin 75.5$	$42\cos 75.5$
	4.07 (1)	10.5 (1)
b	$-20\cos 45.2$	$-20\sin 45.2$
	-14.1 (1)	-14.2 (1)
c	$13.8\cos 44.1$	$-13.8\sin 44.1$
	9.91 (1)	-9.60 (1)

No mark without the work.

14

	H	V
11.7	$-11.7\cos 51.7$ (1) -7.25141	$11.7\sin 51.7$ (1) 9.18188
12.8	$12.8\cos 19.3$ (1) 12.08065	$12.8\sin 19.3$ 4.230584 (1)
6.1	$-6.1\sin 23.7$ (1) -2.45188	$-6.1\cos 23.7$ (1) -5.58554
	2.37736 (1)	7.826922 (1)

(1) diagram



8.18 (1)

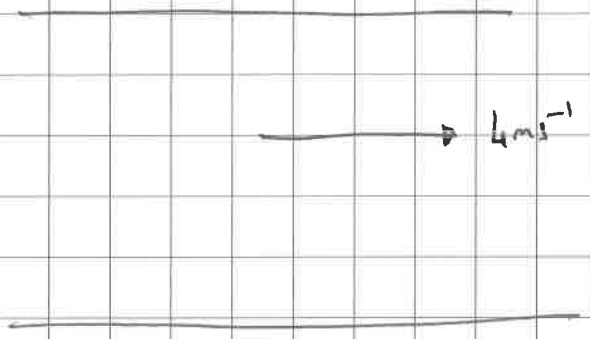
Pythag → ~~1886~~

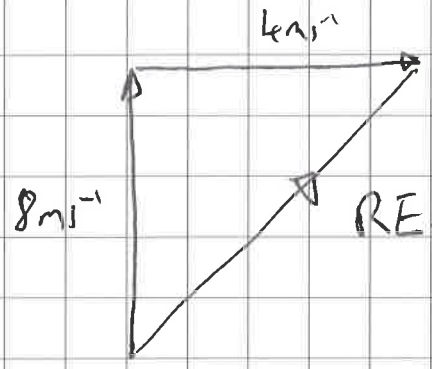
~~182~~ . 2.3...

$\tan\alpha = 7.82... / 2.3...$

$\alpha = 73.1°$ (1) NGE

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① ② 3 sig fig.

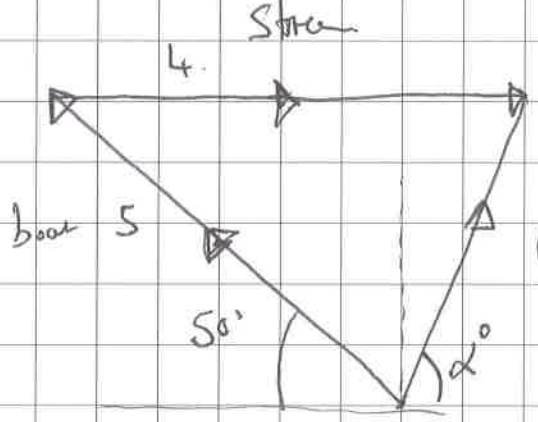
Pythag: $V^2 = 8^2 + 4^2$, $V = 8.94 ms^{-1}$ ①

$V = s/t$ ①

V across the river $= 8 ms^{-1}$

$8 = 240/t$, $t = 30s$. ①

(16)



& (3) forall vectors.

RES is @ angle α

[V] $\quad R\times\sin\alpha = 5\times\sin 50$

[H] $\quad -5\cos 50 + 4 = R\cos\alpha$

$R\sin\alpha = 3.830$

$R\cos\alpha = 0.78606$

$\tan\alpha = 4.87238.$

$\alpha = 78.4^\circ$

Now check time to cross R river.

↑ $5\sin 50$ = vel ⊥ to bank

$V = \frac{S}{t}$ $\quad t = 45 / 5\sin 50$

$= 11.748\text{s}$ (1)

Meanwhile h is horiz downstream with a vel // to bank of

$-5\cos 50 + 4 = 0.78606\ \text{ms}^{-1}$ (1)

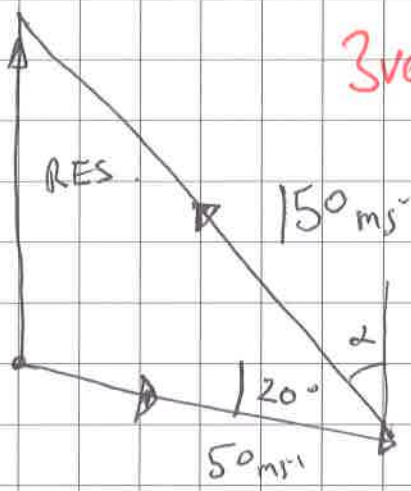
So $V = S/t$ $\quad S = Vt = 0.78606 \times 11.748\text{s}$ (1)

$= 9.23\text{m}$ (1)

Downstream.

17

(a)



3 vectors (3)

(b) What is α

Horiz components of 50 and 150 have equal magnitude

$50\cos 20 = 150\sin\alpha$ (1)

$\alpha = 18.3°$ W of N. (1)

(c) Cat no horiz component, Resultant is just Vertical vector sum of 50 + 150

$-50\sin 20 + 150\cos\alpha = 125.3 \text{ ms}^{-1}$ (1)

$= 125 \text{ ms}^{-1}$ (1) (3sf)

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...lighting the lives that burn for eternity...
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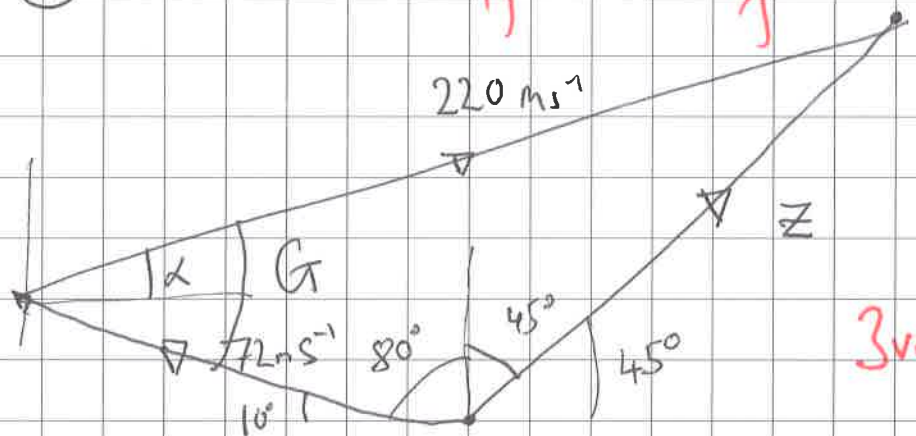
$V = \frac{S}{t}$ (1)

$t = \frac{S}{V} = \frac{450,000}{125.3128} = 3591.0345$

$= 0.998 \text{ hrs.}$ (1)

either

(18) Not included in final mark for this Q.



3 vects (3)

	H	V
	$220\cos\alpha$	$220\sin\alpha$
220		
72	$-72\cos10$	$72\sin10$
Z	$Z\cos45$	$Z\sin45$

$$220\cos\alpha - 72\cos10 = Z\cos45$$

$$220\sin\alpha + 72\sin10 = Z\sin45$$

$$\frac{220\cos\alpha - 70.906}{220\sin\alpha + 12.502} = \frac{1}{\tan45}$$

$$= 1$$

$220\cos\alpha - 70.906 = 220\sin\alpha + 12.5026$

$220\cos\alpha - 220\sin\alpha = 83.4086$

$\cos\alpha - \sin\alpha = 83.4086 / 220$

$= 0.37913$

TRY cosine rule soln.

$a^2 = b^2 + c^2 - 2bc\cos A$

$220^2 = 72^2 + Z^2 - 2 \times 72 \times Z \times \cos(80+45)$

$43216 = Z^2 + 82.595Z$

$0 = Z^2 + 82.595Z - 43216$

$x_1 = 170.6°$

$x_2 = -253.2$ REJECT

$Z = 170.6 ms^{-1}$ [resultant speed plane]

Work angle G

$(170.6)^2 = 72^2 + 220^2 - 2 \times 72 \times 220 \times \cos G$

$G = 39.4°$

$G - 10° = 29.4°$

29.4°

Pilot should plan to plane @ ~~39~~ N of E.

(d) 590,000 m

~~Speed~~ $V = S/t$ $t = S/V$

$= 590,000 / 170.6$

3458 s

0.961 hr.

CHECK by other method.

$\cos\alpha - \sin\alpha = 0.37913$

$\cos 29.4 - \sin 29.4 = 0.38031$

Same to one part in 380 ✓

check again to see if it is solvable

$\cos\alpha - \sin\alpha = 0.3793$.

$\cos^2\alpha + \sin^2\alpha = 1$

$\sin\alpha = \sqrt{1-\cos^2\alpha}$

$\cos\alpha - z = \sqrt{1-\cos^2\alpha}$.

$\cos^2\alpha + z^2 - 2z\cos\alpha = (1-\cos^2\alpha)$

$2\cos^2\alpha - 2z\cos\alpha + z^2 - 1 = 0$.

$2\cos^2\alpha - 0.75826\cos\alpha - 0.85626 = 0$

$\cos\alpha = 0.87078$

$= -0.49168$. (reject)

$\alpha = 29.4^\circ$

it is! XAD.