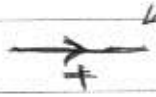
Mixed Exercise 1 – Answers
(First Lesson's Worksheet)

(1)

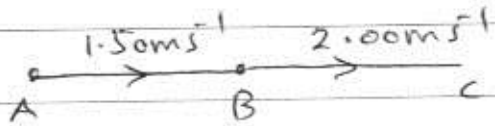
(a) To find the resultant velocity, you should add (combine) the vectors.

Method 1 (Using a sign convention)



Resultant velocity = (+1.50) + (+2.00)
= +3.50 ms^{-1}.

Method 2 (Using a diagram)



Resultant velocity = $\overrightarrow{AC}$
= 3.50 ms^{-1} →

(b)

Resultant velocity = (+1.50) + (−3.40)
= −1.90 ms^{-1}.

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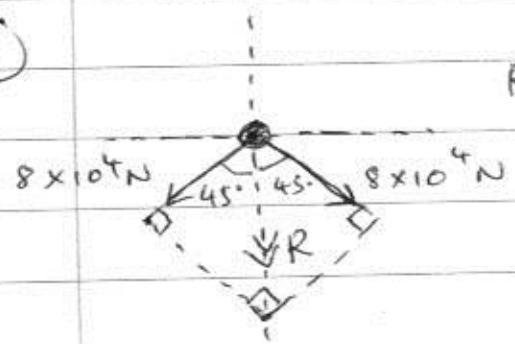
(2)



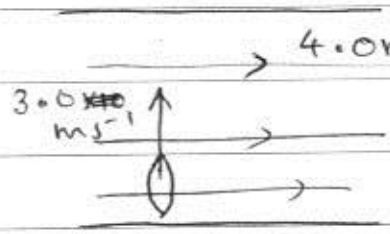
Resultant force,

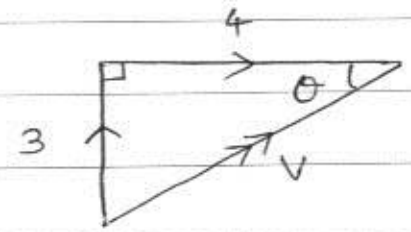
$R = \sqrt{(8\times10^4)^2 + (8\times10^4)^2}$

$R = 110\,000$ N (2 s.f.)

Direction: south.

③





$V = \sqrt{3^2 + 4^2} = 5 ms^{-1}$

$\tan\theta = \frac{3}{4} \Rightarrow \theta = 37^\circ$ (2 s.f.)

Resultant velocity = $5 ms^{-1}$, making 37° with the bank.

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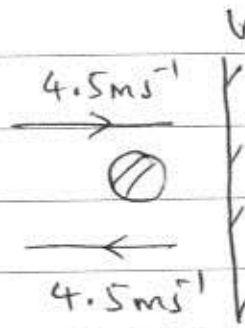
④



Change in velocity
= final velocity − initial vel.
$= (-4.5) - (+4.5)$
$= -9 ms^{-1}$

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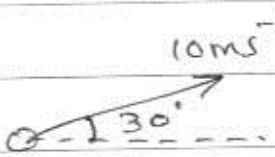
⑤



Initial horizontal component = $10\cos 30^\circ$
$= 8.7 ms^{-1}$ (2 s.f.)

Initial vertical component = $10\sin 30^\circ$
$= 5 ms^{-1}$

(6) (a) $300\cos 20 = 282\ N$ (3 s.f.)

(b) $300\sin 20 = 103\ N$ (3 s.f.)

(7.1)

(a) unit (b) base, derived

(c) magnitude, direction, magnitude.

(d) resultant vector

(e) component

(f) component, magnitude, cosine

(7.2)

(a) $F = ma$

$\downarrow \quad \downarrow \downarrow$

$N = kgms^{-2}$ Ans: $kgms^{-2}$

Special Name: Newton

(b) $P = \frac{F}{A}$

$\downarrow$

$Pa = \frac{N}{m^2} = \frac{kgms^{-2}}{m^2} = kgm^{-1}s^{-2}$

Ans: In base units → $kgm^{-1}s^{-2}$

Special name → Pascal

(7.3)

(a) Force → $kgms^{-2}$

Cross-sectional area → m^2

velocity → ms^{-1}

density → kgm^{-3}

Density $= \frac{m}{V}$

$\downarrow$

$\frac{kg}{m^3} = kgm^{-3}$

(b) 'LHS' means 'Left Hand Side'.

RHS → Right hand side.

(i) $F = kA^2\rho v$

LHS → N → $kgms^{-2}$

RHS → $m^4 \times kgm^{-3} \times ms^{-1}$

$= kgs^{-1}m^2$

LHS ≠ RHS

∴ This equation doesn't correctly link the variables.

(ii) $F = kA\rho^2 v$

LHS → $kgms^{-2}$

RHS → $m^2 \times (kgm^{-3})^2 ms^{-1}$

$= m^2 \times kg^2 m^{-6} \times ms^{-1}$

$= kg^2 m^{-3} s^{-1}$

LHS ≠ RHS

∴ This doesn't correctly link the variables.

(iii) $F = kA\rho v^2$

LHS → $kgms^{-2}$

RHS → $m^2 kgm^{-3} (ms^{-1})^2$

$= m^2 kgm^{-3} m^2 s^{-2}$

$= kgms^{-2}$

LHS = RHS.

∴ This equation correctly links the variables.

7.4

(a) $2\,000\,000\,000\,J = 2 \times 10^9\,J$

$= \underline{2\,GJ}$

(b) $5900\,g = 5.9 \times 10^3\,g$

$= \underline{5.9\,kg}$

(c) $0.005\,s = 5 \times 10^{-3}\,s$

~~$= 5\,ms^2$~~ $= \underline{5\,ms}$

(d) $345\,000\,N = 345 \times 10^3\,N$

$= \underline{345\,kN}$

(e) $0.000\,02\,m = 2 \times 10^{-5}\,m$

$= 20 \times 10^{-6}\,m$

$= \underline{20\,\mu m}$

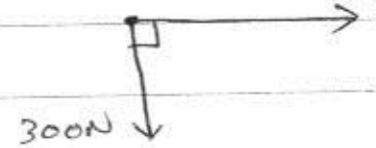
7.5

(a) 600N ← ⊗ → 475N

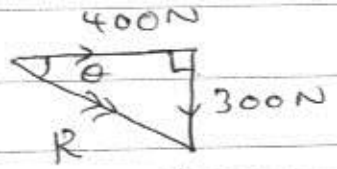
(b) Resultant force = 125N, to the left.

7.6

(a)



(b)



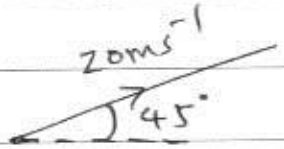
$R = \sqrt{400^2 + 300^2} = 500N$

$\theta = \tan^{-1}\left(\frac{300}{400}\right) = 36.9°$ (3 s.f.)

Magnitude = 500N

Direction = 36.9° South of East.

(7.7)

(a) 

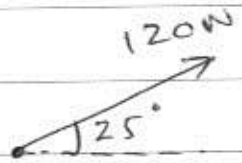
Vertical → $20\sin 45$

$= 14\ ms^{-1}$ (2 s.f.)

(b) Horizontal → $20\cos 45$

$= 14 ms^{-1}$ (2 s.f.)

(7.8)

(a) 

Horizontal → $120\cos 25°$

$= \underline{109\ N}$ (3 s.f.)

(b) Vertical → $120\sin 25°$

$= \underline{50.7\ N}$ (3 s.f.)

(8)

$$F = \frac{G m_1 m_2}{r^2}$$

$$Fr^2 = G m_1 m_2$$

$$G = \frac{Fr^2}{m_1 m_2}$$

SI Unit of $G = \frac{Nm^2}{kg \times kg}$

$= \underline{N kg^{-2} m^{-2}}$