Physics. You work it out.

Home Gameboard Maths Constant Acceleration 2i

Constant Acceleration 2i

A Level

P P P

A stone is released from rest on a bridge and falls vertically into a lake. The stone has velocity $14\,\mathrm{m\,s^{-1}}$ when it enters the lake.

Part A Distance fallen

Calculate the distance the stone falls before it enters the lake.

Part B Time on entering the lake

Calculate the time after its release when it enters the lake. Give your answer to 3 significant figures.

Part C Acceleration

The lake is $15\,\mathrm{m}$ deep and the stone has velocity $20\,\mathrm{m\,s^{-1}}$ immediately before it reaches the bed of the lake.

Given that there is no sudden change in the velocity of the stone when it enters the lake, find the acceleration of the stone while it is falling through the lake. Give your answer to 2 significant figures.

Used with permission from UCLES, A Level, June 2016, OCR M1, Question 1

Gameboard:
Mechanics Practice: Constant Acceleration

Kinematics Graphs 3i

A Level

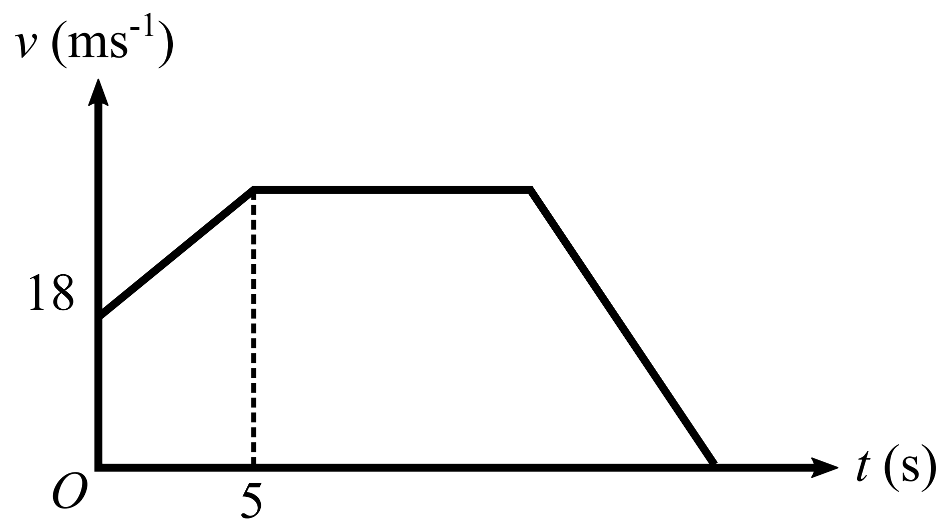

Figure 1

(t, v) graph of a car moving along a straight road.

Figure 1 shows the (t, v) graph of a car moving along a straight road, where $v\,\mathrm{m\,s^{-1}}$ is the velocity of the car at time $t\,\mathrm{s}$ after it passes through the point A. The car passes through A with velocity $18\,\mathrm{m\,s^{-1}}$, and moves with constant acceleration $2.4\,\mathrm{m\,s^{-2}}$ until $t = 5$. The car subsequently moves with constant velocity until it is $300\,\mathrm{m}$ from A. When the car is more than $300\,\mathrm{m}$ from A, it has constant deceleration $6\,\mathrm{m\,s^{-2}}$, until it comes to rest.

Part A Greatest speed

Find the greatest speed of the car.

Part B Deceleration

Find the value of t for the instant when the car begins to decelerate.

Part C Distance from A

Calculate the distance from A of the car when it is at rest.

Used with permission from UCLES, A Level, June 2013, OCR M1, Question 4

Gameboard:

Mechanics Practice: Kinematics Graphs

Vectors: Diagrams and Proof 1i

A Level

P P P

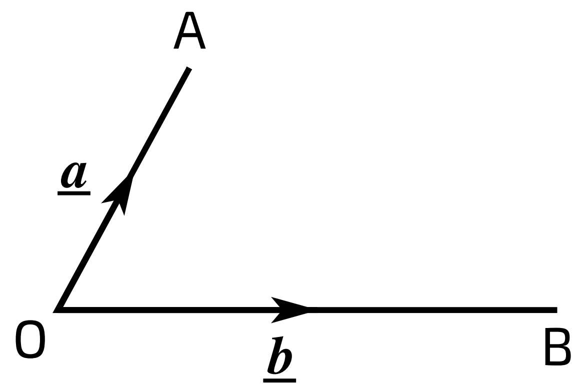

Figure 1: Three points O, A and B, and vectors joining them.

Figure 1 shows points O, A and B, with $\vec{OA} = \underline{\boldsymbol{a}}$ and $\vec{OB} = \underline{\boldsymbol{b}}$.

Part A Sketch

Make a sketch of the diagram and mark the points C and D such that $\vec{OC} = \underline{\boldsymbol{a}} + 2\underline{\boldsymbol{b}}$ and $\vec{OD} = 2\underline{\boldsymbol{a}} + \underline{\boldsymbol{b}}$.

Choose the correct sketch from the 3 options below.

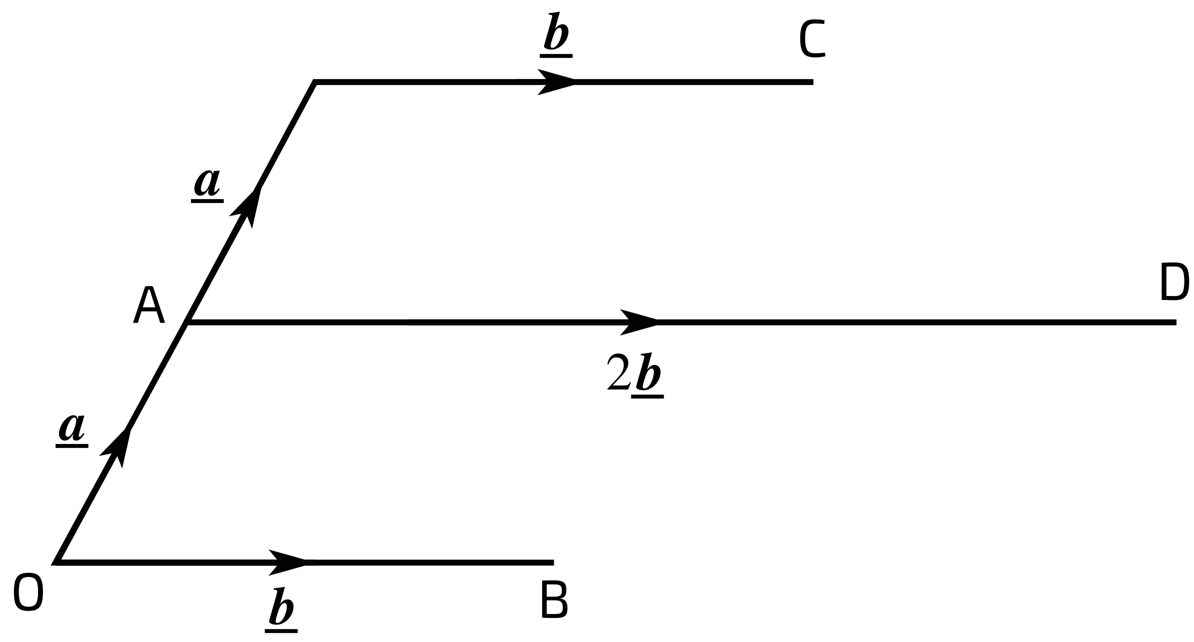

Figure 2: Option A

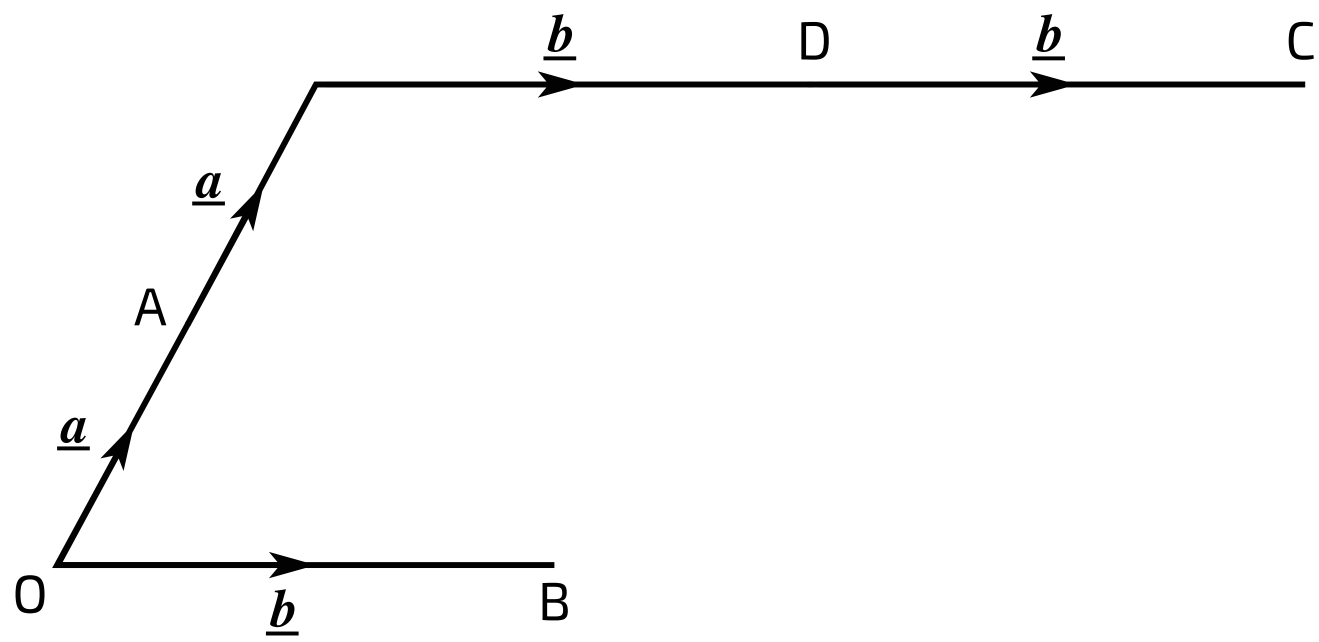

Figure 3: Option B

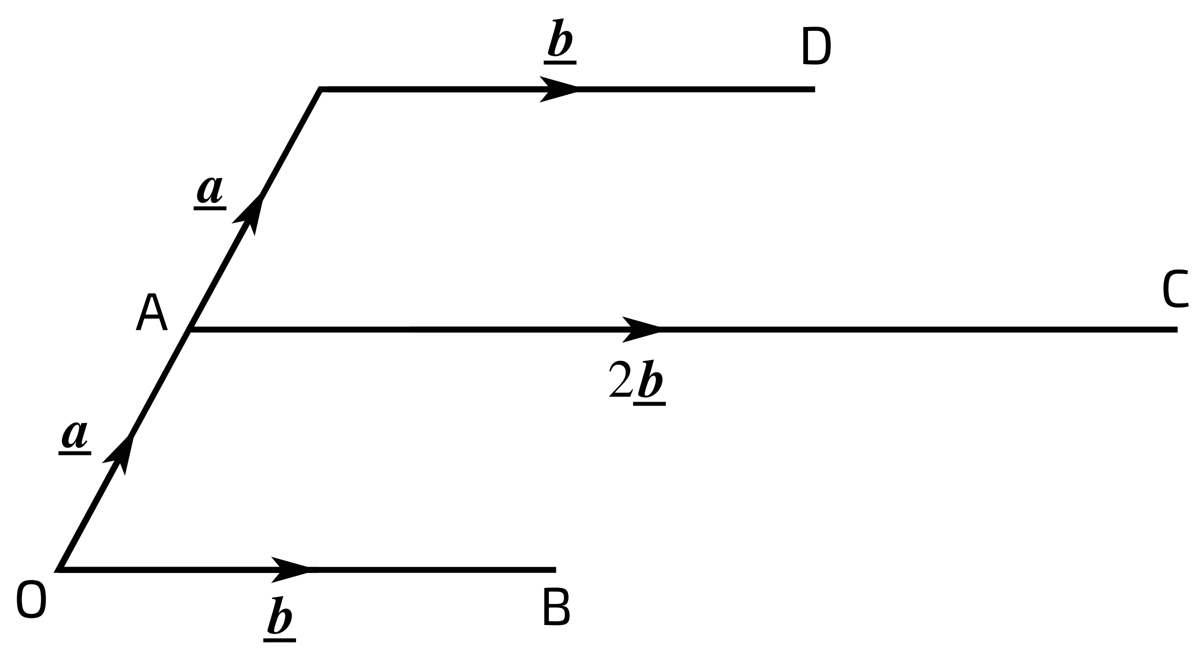

Figure 4: Option C

- Option A
- Option B
- Option C

Part B Vector $\vec{DC}$

Express $\vec{DC}$ in terms of $\underline{\boldsymbol{a}}$ and $\underline{\boldsymbol{b}}$, simplifying your answer.

The following symbols may be useful: `a, b`

Part C Proof

Prove that $ABCD$ is a parallelogram.

Sides $\vec{AD}$ and [ ] are both equal to [ ]. Therefore they are parallel and of equal length.

Sides $\vec{AB}$ and [ ] are both equal to [ ]. Therefore they are parallel and of equal length.

The quadrilateral $ABCD$ has two pairs of parallel sides of equal length. Therefore $ABCD$ is a parallelogram.

Items:

$\vec{CD}$ | $\mathbf{a} - \mathbf{b}$ | $\mathbf{b} - \mathbf{a}$ | $\vec{BC}$ | $-\mathbf{a} - \mathbf{b}$ | $\mathbf{a} + \mathbf{b}$ | $\vec{CB}$ | $\vec{DC}$

Adapted with permission from UCLES, A Level, Jan 2003

Physics. You work it out.

Home Gameboard Maths Simple Force Diagrams 1ii

Simple Force Diagrams 1ii

A Level

P P P

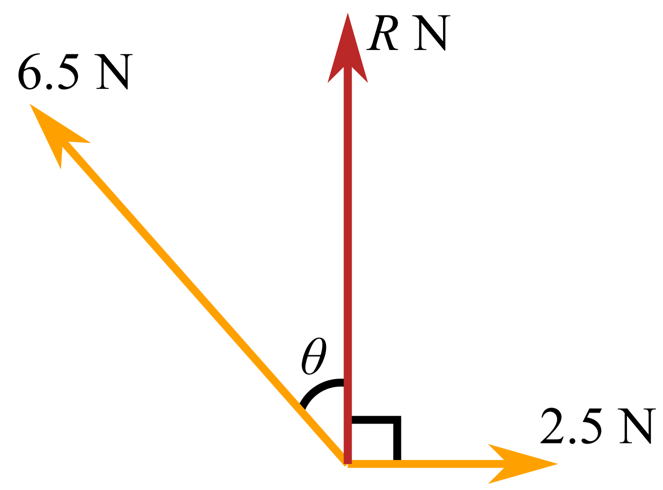

Figure 1: Diagram of 3 forces acting at a point.

Forces of magnitudes $6.5\,\mathrm{N}$ and $2.5\,\mathrm{N}$ act at a point in the directions shown in **Figure 1**. The resultant of the two forces has magnitude $R\,\mathrm{N}$ and acts at right angles to the force of magnitude $2.5\,\mathrm{N}$.

Part A Finding θ

Find the angle θ correct to 3 significant figures.

Part B Finding R

Find the value of R.

Used with permission from UCLES, A Level, June 2006, OCR M1, Question 2

Physics. You work it out.

Home Maths Applying Trigonometry

Applying Trigonometry

A Level

A rower attempts to row across a river from a place A where the banks of the river are straight and parallel. They wish to reach a point B which is directly opposite to A on the other bank (i.e. on a line perpendicular to the bank at point A).

They start to row towards B, keeping the boat aligned in a direction parallel to $\underline{\boldsymbol{j}}$, but discover that there is a current flowing in a direction $\underline{\boldsymbol{i}}$ parallel to the banks, such that their resultant travel is along a vector $\underline{\boldsymbol{v}} = \underline{\boldsymbol{i}} + 4\underline{\boldsymbol{j}}$.

Part A Speed of the rower

Find the magnitude of vector $\underline{\boldsymbol{v}}$.

The following symbols may be useful: v

Part B Angle between $\underline{\boldsymbol{v}}$ and $\underline{\boldsymbol{i}}$

Find the angle between vectors $\underline{\boldsymbol{v}}$ and $\underline{\boldsymbol{i}}$. Give your answer to no more than 3 sig figs.

Part C Direction of travel

If they are to arrive at B, but can adjust their rowing speed to cross to the other bank in the same time that it would take if there were no current, in what direction should they actually row? Give your answer as a vector in terms of the unit vectors i and j.

The following symbols may be useful: `i`, `j`, `v_row`

What is the angle between $\underline{\boldsymbol{v}}$ and $\underline{\boldsymbol{j}}$? Give your answer to no more than 3 sig figs.

Part D A tower in the distance

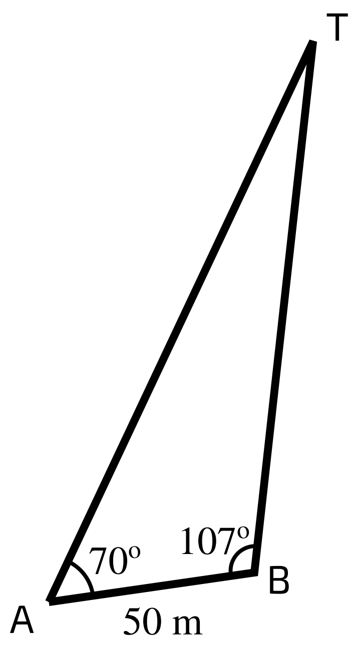

Figure 1: The tower, and points A and B.

Some walkers see a tower, T, in the distance and want to know how far away it is. They take a bearing from point A and walk for $50\,\mathrm{m}$ in a straight line before taking another bearing from point B. They find that the angle TAB is 70° and angle TBA is 107° (see **Figure 1**).

Find the distance of the tower from A. Give your answer to three significant figures.

Part E Distance from C

They continue walking in the same direction for another $100\,\mathrm{m}$ to a point C, so that AC is $150\,\mathrm{m}$. What is the distance of the tower from C? Give your answer to three significant figures.

Part F Shortest distance from A to C

Find the shortest distance of the walkers from the tower as they walk from A to C. Give your answer to three significant figures.

Part G Area swept out

D is the point on AC such that TD is the shortest distance of the walkers from the tower.

Find the area of ground represented by the triangle ATD. Give your answer in km^2 and to 3 significant figures.

Adapted with permission from SAW 2017 and UCLES, A Level, January 2009, Paper 4722, Question 5.

Physics. You work it out.

Trigonometry: Identities and Equations 3ii

A Level
P P P

Solve each of the following equations for $0° \leq x \leq 180°$.

Part A Equation 1

$\sin 2x = 0.5$. Give the largest value of x in the stated range to 2 significant figures.

Part B Equation 2

$2\sin^2 x = 2 - \sqrt{3}\cos x$. Give the smallest value in the range stated to 2 significant figures.

Used with permission from UCLES, A Level Maths, January 2011, OCR C2, Question 7

Gameboard:
Pure Maths Practice: Trigonometry - Identities and Equations