

2017 REGIONAL APPLIED MATHS QUIZ – 2<sup>nd</sup> MARCH 2017

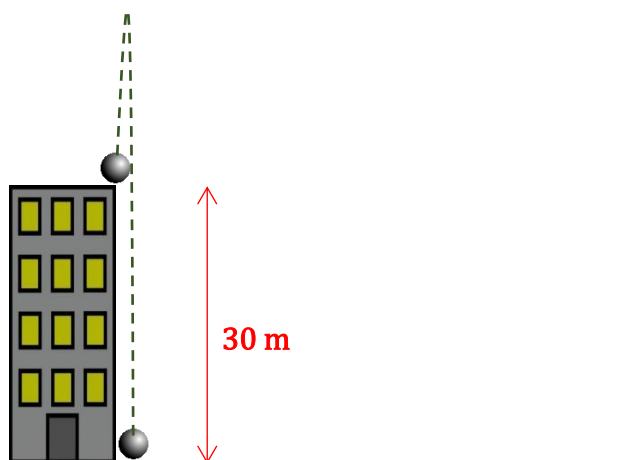
ROUND 1 – 6 Minutes

Marks may be lost for omission of correct units

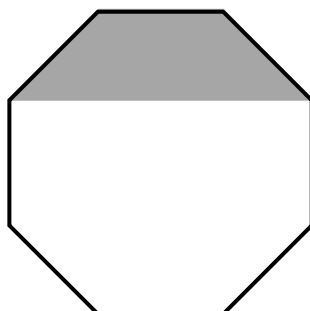
- Q1 A train takes **5 minutes** to cover a distance of **3 kilometres** between two stations, **P** and **Q**. Starting from **P** it accelerates at a constant rate to a speed of  **$12 \text{ m s}^{-1}$**  and maintains this speed until it is brought uniformly to rest at **Q**. If the train takes three times as long to decelerate as it does to accelerate, find the time taken by the train to accelerate.



- Q2 From the top of a building of height **30 metres** a girl throws a ball **vertically upwards** with an initial speed of  **$10\sqrt{3} \text{ m s}^{-1}$** . Find the speed with which the ball strikes the ground. [Use  $g = 10 \text{ m s}^{-2}$ ]



- Q3 The diagram shows a regular octagon. What is the **ratio of the area of the shaded trapezium** to the **area of the whole octagon**? Note: Each side of the octagon is of the same length.



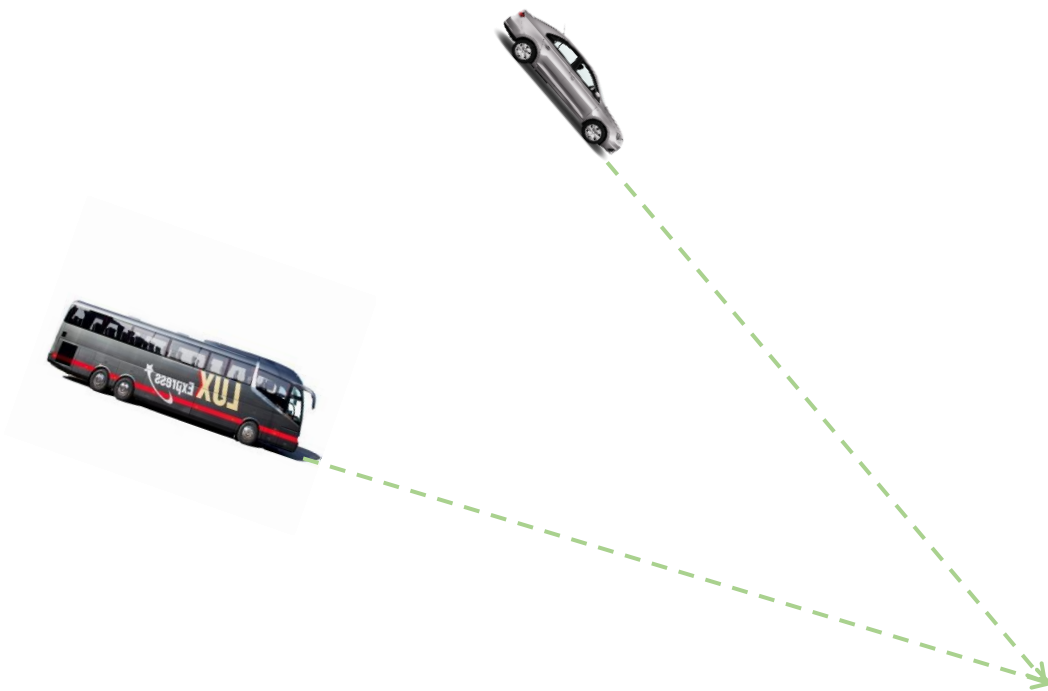
- A 1 : 4      B 5 : 16      C 1 : 3      D  $\sqrt{2} : 2$       E 3 : 8

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**ROUND 2 – 6 Minutes**

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- Q1** Particle **A** has a velocity of  $(4\vec{i} + 5\vec{j}) \text{ m s}^{-1}$  relative to particle **B**.  
Particle **B** has a velocity of  $(3\vec{i} - 7\vec{j}) \text{ m s}^{-1}$  relative to particle **C**.  
Particle **C** has a velocity of  $(-4\vec{i} + 6\vec{j}) \text{ m s}^{-1}$  relative to particle **D**.  
Find the **speed** of **A** relative to **D**.
- Q2** At **10 am** a **bus** has a position vector of  $(-580\vec{i} + 330\vec{j})$  metres and a constant velocity of  $(10\vec{i} - 5\vec{j}) \text{ m s}^{-1}$ . One minute later a **car** has a position vector of  $(35\vec{i} + 75\vec{j})$  metres and has a constant velocity of  $(7\vec{i} - 14\vec{j}) \text{ m s}^{-1}$ . The vehicles are then on a **collision course**.  
How many **seconds after 10 am** is an accident likely if neither driver sees the danger?

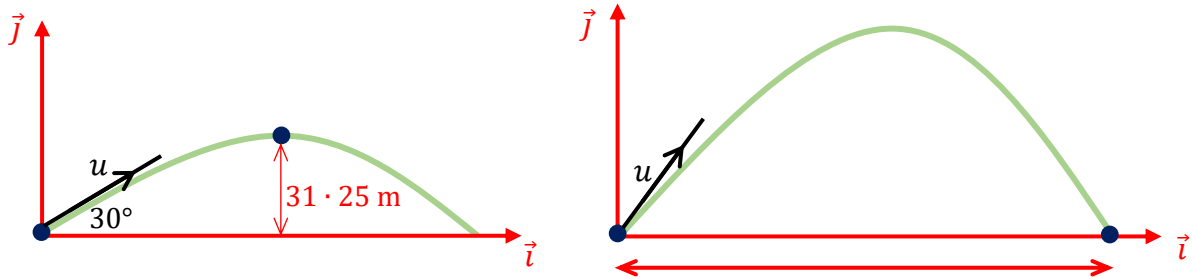


- Q3** Three friends are in a school day outing and decide to add up their total spending money for the day. **Niamh** has **three times** as many euros as **Siobhan** and **twice** as many euros as **Michael**. **Michael** has **seven** euros more than **Siobhan**. What is their **total spending money**?
- A €12      B €42      C €60      D €77      E €84**

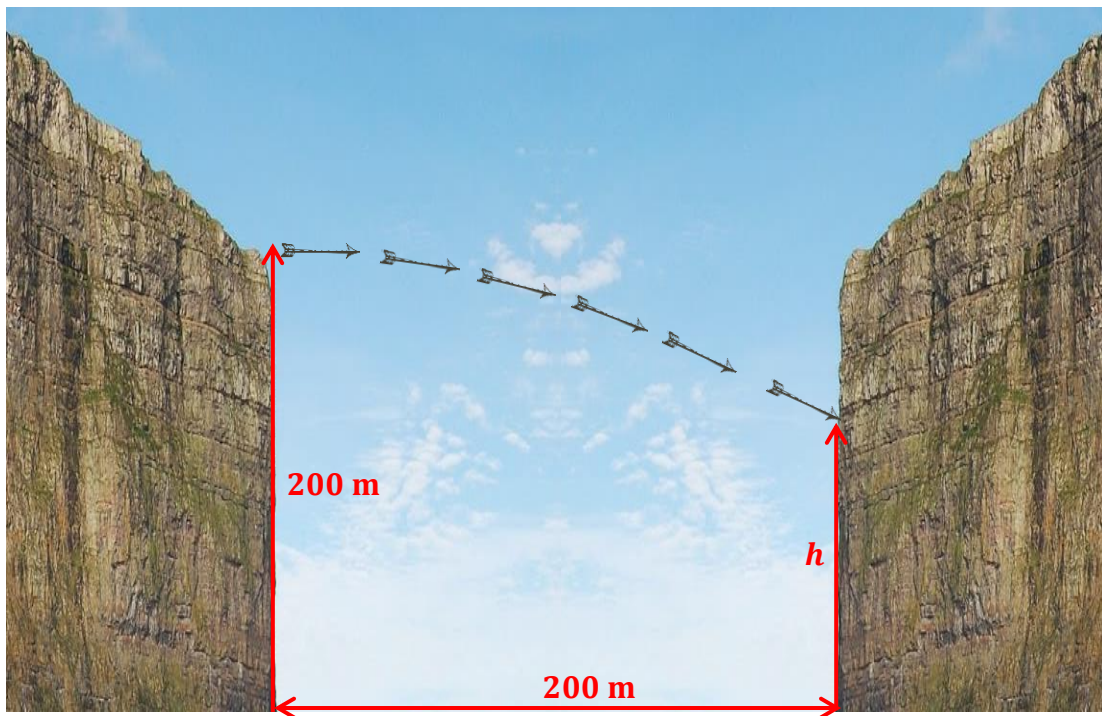
**ROUND 3 – 6 Minutes**

Marks may be lost for omission of correct units

- Q1** A projectile is fired at an angle of  $30^\circ$  to the horizontal. It reaches a maximum height of  $31.25$  metres. A second projectile is fired with the **same initial speed**. What is the **maximum range** which this projectile can achieve?



- Q2** An arrow is shot **horizontally** at a speed of  $80 \text{ m s}^{-1}$  across the chasm between two cliffs, as shown. Find the height  $h$  above the chasm floor that the arrow hits the second cliff. [Use  $g = 10 \text{ m s}^{-2}$ ]



- Q3** A little monkey had **60 peaches**. On the **first day**, he decided to keep  $\frac{3}{4}$  of his peaches. He gave the rest away. Then he ate one.  
 On the **second day**, he decided to keep  $\frac{7}{11}$  of his peaches. He gave the rest away. Then he ate one.  
 On the **third day**, he decided to keep  $\frac{5}{9}$  of his peaches. He gave the rest away. Then he ate one.  
 On the **fourth day**, he decided to keep  $\frac{2}{7}$  of his peaches. He gave the rest away. Then he ate one.

**How many peaches did the monkey have left at the end of the fourth day?**

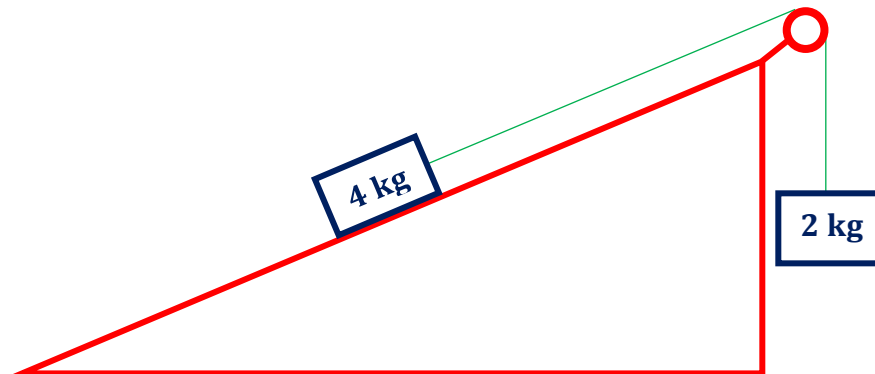
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ROUND 4 – 6 Minutes

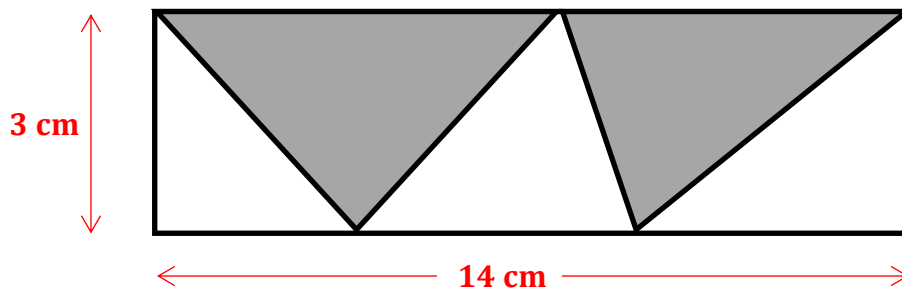
Marks may be lost for omission of correct units

- Q1 A horse draws a sledge horizontally across a snow-covered field. The horse and sledge move at constant speed. The horse pulls the sledge with a force of **200 N** at an angle  $\theta$  above the horizontal ground where  $\theta = \sin^{-1}\left(\frac{3}{5}\right)$ . The sledge has a mass of **80 kg**. Find the coefficient of friction between the sledge and the snow. Give your answer correct to **two decimal place**. [Use  $g = 10 \text{ m s}^{-2}$ ]

- Q2 A particle **A** of mass **4 kg** rests on a smooth plane inclined at an angle  $\sin^{-1}\left(\frac{1}{20}\right)$  to the horizontal. A particle **B** of mass **2 kg** is connected to particle **A** by a light inextensible string passing over a smooth pulley. How far does **A** move up the plane after  $\frac{1}{10}$  of a second. [Use  $g = 10 \text{ m s}^{-2}$ ]



- Q3 What is the area of the **shaded region** in the rectangle?



- A –  $21 \text{ cm}^2$    B –  $22 \text{ cm}^2$    C –  $23 \text{ cm}^2$    D –  $24 \text{ cm}^2$    E – more information needed

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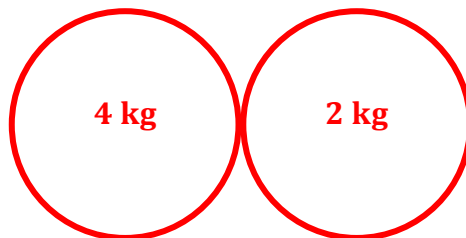
**ROUND 5 – 6 Minutes**

Marks may be lost for omission of correct units

- Q1** A smooth sphere *P* of mass **4 kg** moving with a velocity of **3 m s<sup>-1</sup>** collides directly with a second smooth sphere *Q* of mass **2 kg** moving in the **same direction** with a velocity of **2 m s<sup>-1</sup>**.

The coefficient of restitution for the collision is  $\frac{1}{2}$ .

Find the **magnitude of the impulse** imparted to each sphere during the collision.



- Q2** A ball is dropped from a height of **5 metres** on to a flat horizontal surface so that it bounces vertically upwards. What height does the ball rise after the **second** bounce if the coefficient of restitution for the collision is  $\frac{1}{2}$ .

Give your answer correct to **two decimal place**. [Use  $g = 10 \text{ m s}^{-2}$ ]



- Q3** Christmas day 2016 fell on a Sunday. How many **Sundays** were there in **2016**?

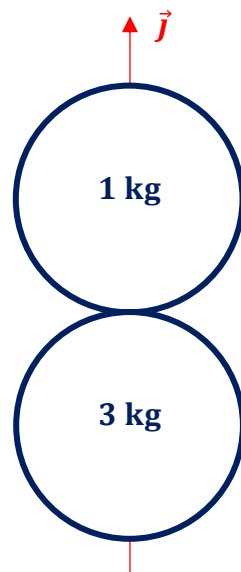
A 12      B 51      C 52      D 53

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ROUND 6 – 8 Minutes

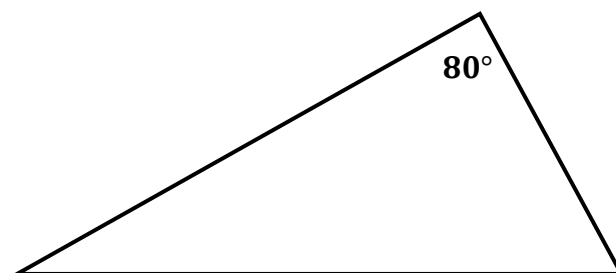
Marks may be lost for omission of correct units

- Q1 Two smooth spheres,  $P$  of mass  $3 \text{ kg}$  and  $Q$  of mass  $1 \text{ kg}$  collide obliquely. Their velocities before impact are  $(-3\vec{i} + 2\vec{j}) \text{ m s}^{-1}$  and  $(1\vec{i} - 5\vec{j}) \text{ m s}^{-1}$  respectively. The impact takes place along the  $\vec{j}$  – axis. After the collision the heavier sphere moves along the  $\vec{i}$  – axis. Find the **speed** of the **lighter** sphere after the collision. Give your answer correct to **one decimal place**.



- Q2 A boat has to travel by the shortest route to a point  $294\vec{j}$  metres from its present position. The velocity of the river is  $(4\vec{i} - 3\vec{j}) \text{ m s}^{-1}$ , and the boat has a maximum speed of  $6 \text{ m s}^{-1}$  in still water. If  $a\vec{j} \text{ m s}^{-1}$  is the **actual velocity** of the boat on its journey, find the time taken for the boat to reach its destination. Give your answer correct to the **nearest second**.

- Q3 Sean draws a **scalene triangle** (no two sides equal). One of the angles is  $80^\circ$ . Which of the following could be the **difference between the other two angles** in Sean's triangle?



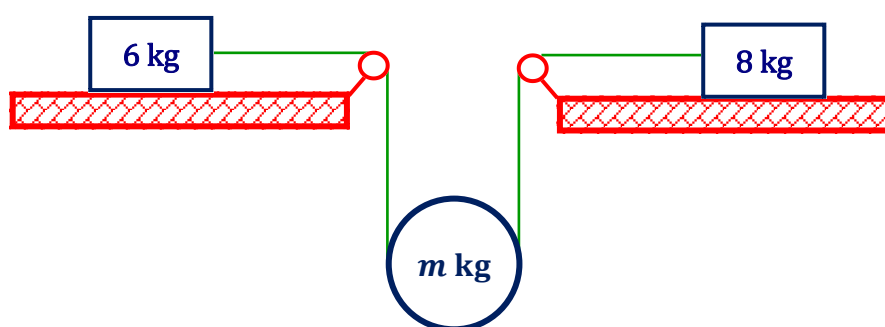
- A:  $0^\circ$       B:  $60^\circ$       C:  $80^\circ$       D:  $100^\circ$       E:  $120^\circ$

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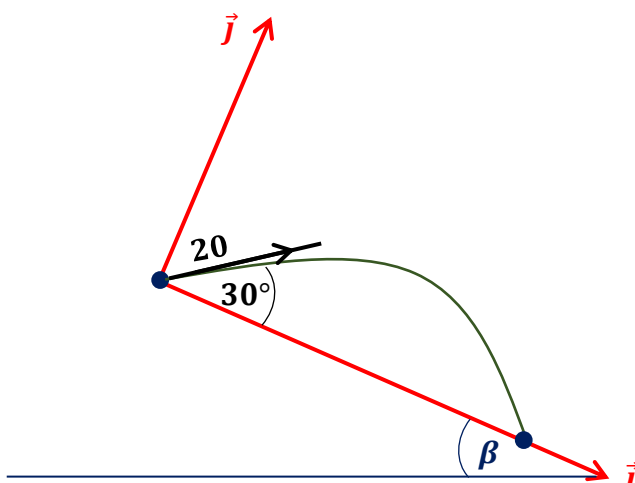
ROUND 7 – 8 Minutes

Marks may be lost for omission of correct units

- Q1 Two blocks, *A* and *B*, of mass 6 kg and 8 kg respectively, lie at rest on rough horizontal tables. The coefficient of friction is the same in both cases. The blocks are connected by a light inextensible string which passes under a smooth movable pulley *C* of mass *m* kg. When the system is released from rest, *A* accelerates at  $2 \text{ m s}^{-2}$  and *B* accelerates at  $1 \cdot 25 \text{ m s}^{-2}$ . Find the value of *m* kg correct to one decimal place.



- Q2 A projectile of unit mass is fired down an inclined plane with an initial speed of  $20 \text{ m s}^{-1}$ . The plane is inclined at an angle  $\beta = \tan^{-1}\left(\frac{3}{4}\right)$  to the horizontal and the angle of projection is  $30^\circ$  to the inclined plane. The projectile strikes the foot of the plane after 2.5 seconds. Calculate, to the nearest joule, the loss in potential energy. [Use  $g = 10 \text{ m s}^{-2}$ ]



- Q3 On a Monday all prices in Readwell bookstore are 10% more than normal. On a Friday all prices are 10% less than normal. Sinéad bought a book on Monday for €5.50. What would be the price on another copy of the book on Friday?

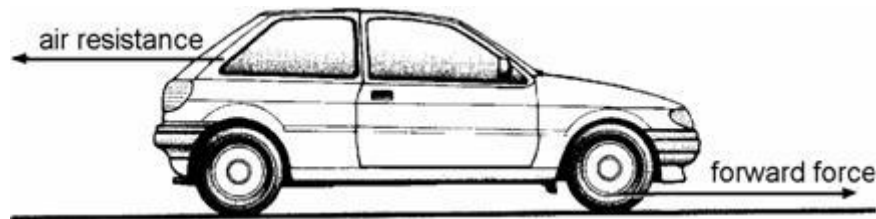
A: €5.50      B: €5.00      C: €4.95      D: €4.50      E: €4.40

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**ROUND 8 – 8 Minutes**

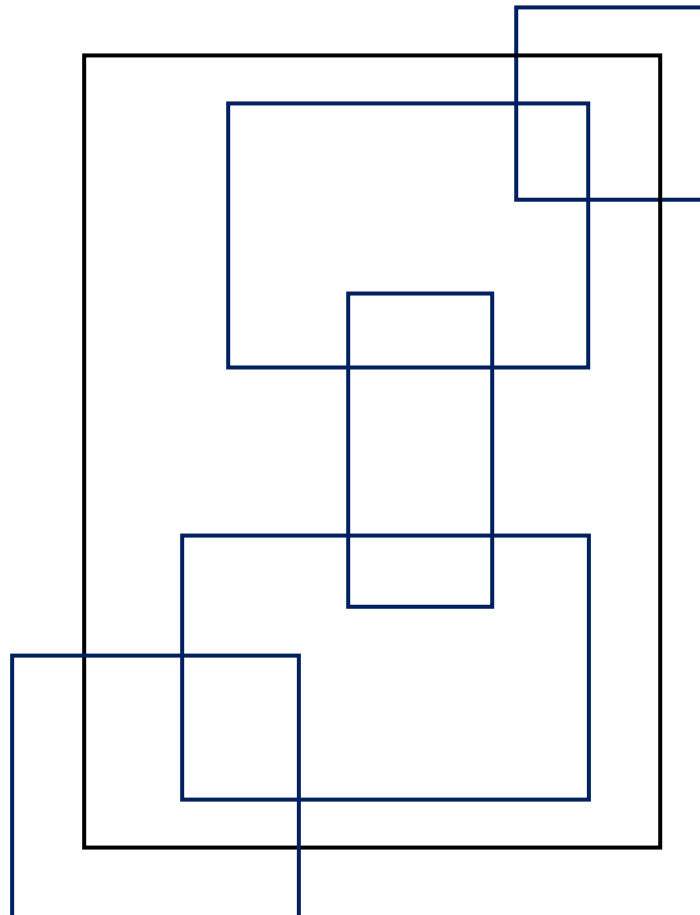
Marks may be lost for omission of correct units

- Q1** A car of mass **500 kg** moves along a straight horizontal road against a resistance of  **$50v$  N**, where  **$v \text{ m s}^{-1}$**  is the speed of the car. The engine exerts a constant power of **50 kW**. Calculate the value of  **$v$**  when the acceleration of the car is  **$0.5 \text{ m s}^{-2}$** . Give answer to nearest whole number.



- Q2** In a motor race, **Ferrari** is **1 km** from the finishing line and it travelling at  **$35 \text{ m s}^{-1}$**  with a uniform acceleration of  **$0.4 \text{ m s}^{-2}$** . **Mercedes**, at the same instant, is **200 m** behind **Ferrari** and is travelling at  **$44 \text{ m s}^{-1}$**  with a uniform acceleration of  **$0.5 \text{ m s}^{-2}$** . How many metres before the finishing line does Mercedes overtake its rival?
- Q3** How many different rectangles can you count in the figure below?

**A: 13      B: 15      C: 11**





## TIE BREAKER – 6 Minutes per Question

- Q1** How many times does the digit 9 appear in the answer to  $987654321 \times 9$ ?
- Q2** A body of mass  $5m$  has its speed increased from  $3u$  to  $8u$  by a constant force.  
Calculate its % gain in kinetic energy. Give your answer to the nearest whole number.
- Q3** Airport  $X$  is 200 kilometres south of airport  $Y$ . There is a wind blowing from the east at  $80 \text{ km hr}^{-1}$ . An aeroplane can fly at  $400 \text{ km hr}^{-1}$  in still air.  
How long does a journey take from  $Y$  to  $X$ .  
Give your answer correct to the nearest whole number.

## MARKING SCHEME

### AWARD 2 MARKS FOR A CORRECT SOLUTION

[Deduct a maximum of 1 mark for rounding errors and/or incorrect Units]

#### Round 1

- Q1 25 s [Unit required for 2 marks – if unit is omitted award 1 mark]  
Q2 30 m s<sup>-1</sup> [Unit required for 2 marks – if unit is omitted award 1 mark]  
Q3 A = 1:4 [No unit required]

#### Round 2

- Q1 5 m s<sup>-1</sup> [Unit required for 2 marks – award 1 mark for  $3\vec{i} + 4\vec{j}$  m s<sup>-1</sup> ]  
Q2 65 s [Unit required for 2 marks – if unit is omitted award 1 mark]  
Q3 D = €77 [No unit required]

#### Round 3

- Q1 250 m [Unit required for 2 marks – if unit is omitted award 1 mark]  
Q2 168 · 75 m [Unit required for 2 marks – award 1 mark for 31 · 25 m ]  
Q3 3 [No unit required]

#### Round 4

- Q1 0 · 24 [No unit required – award 1 mark for  $\frac{4}{17}$  or 0 · 23 ]  
Q2  $\frac{3}{200}$  m = 0 · 015 m [Unit required for 2 marks – if unit is omitted award 1 mark]  
Q3 A = 21 cm<sup>2</sup> [No unit required]

#### Round 5

- Q1 2 N s / kg m s<sup>-1</sup> [Unit required for 2 marks – if unit is omitted award 1 mark]  
Q2 0 · 31 m [Unit required for 2 marks – award 1 mark for  $\frac{5}{16}$  or 0 · 3125 ]  
Q3 C = 52 [No unit required]

#### Round 6

- Q1 1 · 4 m s<sup>-1</sup> [Unit required for 2 marks – award 1 mark for  $\sqrt{2}$  or  $(1\vec{i} + 1\vec{j})$  m s<sup>-1</sup> ]  
Q2 200 s [No unit required]  
Q3 C = 80° [No unit required]

#### Round 7

- Q1 4 · 3 kg [Unit required for 2 marks – award 1 mark for  $\frac{288}{67}$  kg ]  
Q2 [371 J – 373 J] [No unit required]  
Q3 D: €4 · 50 [No unit required]

#### Round 8

- Q1 29 m s<sup>-1</sup> [Unit required for 2 marks – award 1 mark for  $\frac{288}{67}$  kg ]  
Q2 220 m [Unit required for 2 marks – if unit is omitted award 1 mark]  
Q3 B: 15 [No unit required]

#### TIE BREAKER

- Q1 1 [No unit required]  
Q2 611 % [No unit required]  
Q3 31 minutes [No unit required]