NATIONAL APPLIED MATHS QUIZ – 10th MARCH 2018

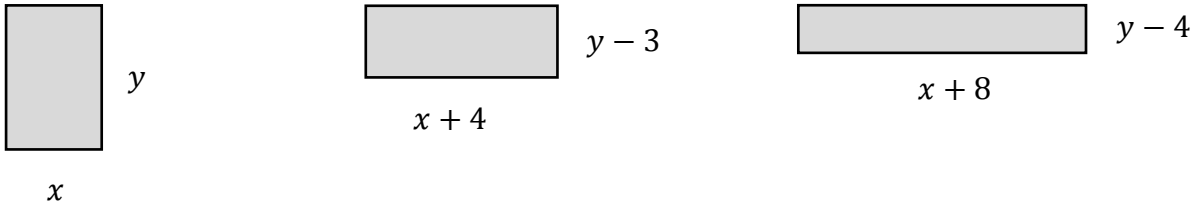
ROUND 1 – 8 Minutes

Marks may be lost for omission of correct units

Q1 In **2016, Guy Arnaud**, at **Lyons University**, was analysed in his take-off and landing during his long jump training. His **initial velocity** was recorded at $(\mathbf{10}\vec{\boldsymbol{\imath}} + \mathbf{4}\vec{\boldsymbol{\jmath}})\ \mathbf{m\ s^{-1}}$ and his **acceleration** was recorded at $(-\vec{\boldsymbol{\imath}} - \mathbf{10}\vec{\boldsymbol{\jmath}})\ \mathbf{m\ s^{-2}}$, and time until landing at $\mathbf{0 \cdot 8\ s}$.
What **horizontal distance** did he jump?

Q2 A particle is projected horizontally with initial velocity $(\boldsymbol{x}\vec{\boldsymbol{\imath}} + \mathbf{0}\vec{\boldsymbol{\jmath}})\ \mathbf{m\ s^{-1}}$. It travels **4 m horizontally** and **10 m vertically downwards**. Determine the **final speed** of the particle. Give your answer correct to **one decimal place**. [**Use** $\boldsymbol{g} = \mathbf{10\ m\ s^{-2}}$]

Q3 The three rectangles shown below all have the **same area**.



What is the value of $(\boldsymbol{x} + \boldsymbol{y})$?

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ROUND 2 – 8 Minutes

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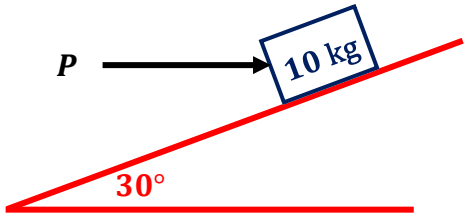
Q1 A woman of mass **60 kg** runs along a horizontal track at a constant speed of $\mathbf{4\ m\ s^{-1}}$. Air resistance amounts to **30 N**. She now comes to a hill inclined at an angle $\boldsymbol{\alpha}$ to the horizontal where $\mathbf{\sin \alpha = \frac{1}{20}}$. To allow for the hill, she reduces her speed to $\mathbf{3\ m\ s^{-1}}$ and maintains this constant speed as she runs up the hill. Air resistance now amounts to **40 N**. Calculate the **increase in the power** of the runner in order to run up the hill. [**Use** $\boldsymbol{g = 10\ m\ s^{-2}}$]

Q2 A body of mass **10 kg** rests on a **rough plane** inclined at an angle **30°** to the horizontal. Its stability is maintained by a horizontal force $\boldsymbol{P}$ which **just prevents** the mass from moving **down** the slope. The coefficient of **limiting friction** is $\mathbf{0 \cdot 5}$. Calculate the value of $\boldsymbol{P}$. Give your answer correct to **the nearest whole number**. [**Use** $\boldsymbol{g = 10\ m\ s^{-2}}$]



Q3 Two teenagers **Sean** and **Niamh** notice the following facts about their ages:

- The **difference** between the **squares** of their **ages** is **four times** the **sum** of their **ages**.
- The **sum of their ages** is **eight times the difference** between their **ages**.

What is the age of the **older** of the two?

A: 15 **B: 16** **C: 17** **D: 18** **E: 19**

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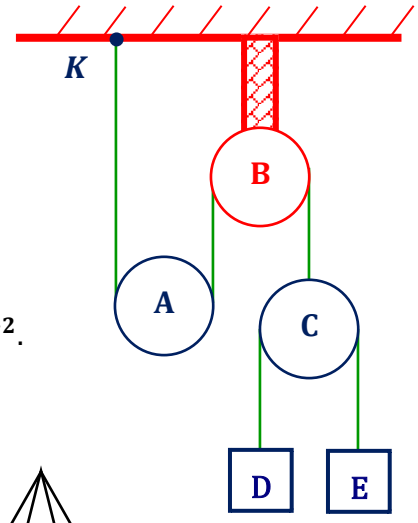
ROUND 3 – 8 Minutes

Marks may be lost for omission of correct units

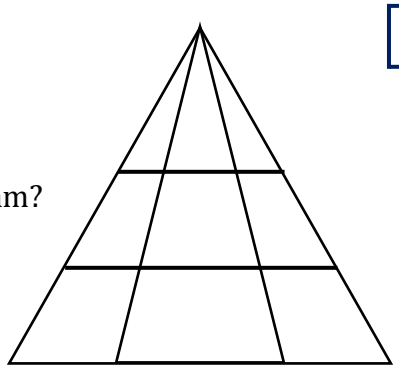
Q1 On 12 July 2015, near Buttevant, Co. Cork, a car of mass **1 · 2 tonnes** collided with a stationary van of mass **2 · 4 tonnes**. After the collision the two vehicles became entangled and skidded **15 m** before stopping. Gárda forensics estimated that the skid force amounted to **2880 N**. Assuming that the collision occurred along a straight horizontal line, calculate, to **one decimal place**, the **speed** of the car just before the collision.
(No serious injuries resulted!)

Q2 The diagram shows a light inextensible string having one end fixed at **K**, passing under a movable pulley **A** and then over a fixed light pulley **B**. The other end of the string is attached to a light pulley **C**. Over pulley **C**, a second light inextensible string is passed, having particles **D** and **E** attached. When the system is released from rest, **A** moves upwards with an **acceleration** of $\mathbf{1\ m\ s^{-2}}$.
$\mathbf{A = 4\ kg,\ D = 2\ kg,\ E < 2\ kg}$.
Calculate the **relative acceleration** between **D** and **C**.
[**Use** $\boldsymbol{g = 10\ m\ s^{-2}}$]



Q3 How **many triangles** can you count in the diagram?

A: 7 **B: 9** **C: 15** **D: 18** **E: 21**



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ROUND 4 – 8 Minutes

Marks may be lost for omission of correct units

Q1 A balloon **rises** from the ground with a **constant velocity** of $\mathbf{4\ m\ s^{-1}}$. After $\boldsymbol{t}$ seconds some ballast is dropped from the balloon. The ballast takes $\mathbf{6\ s}$ to reach the ground.
Find the value of $\boldsymbol{t}$. [**Use** $\boldsymbol{g} = \mathbf{10\ m\ s^{-2}}$]

Q2 In a schools' championship race, coming close to the finishing line, $\boldsymbol{A}$ had a speed of $\mathbf{8\ m\ s^{-1}}$ and was $\mathbf{0 \cdot 4\ m}$ ahead of $\boldsymbol{B}$ who had a speed of $\mathbf{8 \cdot 5\ m\ s^{-1}}$. Assuming that both runners maintained that speed in the $\vec{\boldsymbol{i}}$ direction towards the line and that both crossed the line in a dead heat, calculate the distance of $\boldsymbol{B}$ from the line when those speeds were recorderd.

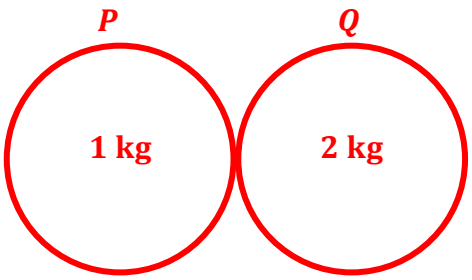
Q3 In a party of **35 people** there are **twice as many women as children** and **twice as many children as men**. How many **men** are there?

NATIONAL APPLIED MATHS QUIZ – 10th MARCH 2018

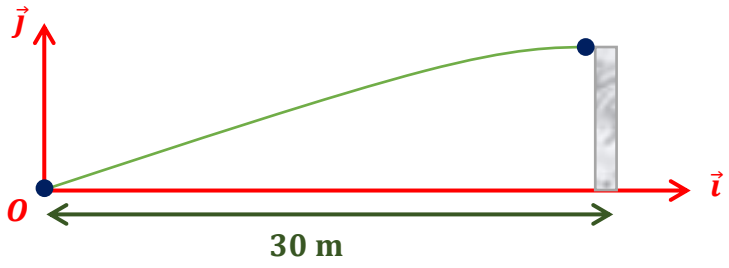
ROUND 5 – 8 Minutes

Marks may be lost for omission of correct units

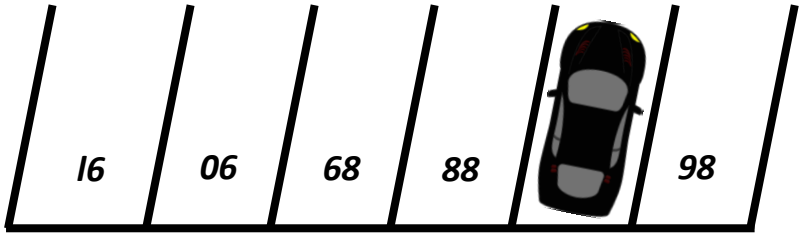
Q1 A smooth sphere $\boldsymbol{P}$, of mass **1 kg** strikes a stationary sphere $\boldsymbol{Q}$ of mass **2 kg** which is at **rest**. $\boldsymbol{P}$ is travelling at $\mathbf{2\ m\ s^{-1}}$ and at an angle of $\mathbf{30°}$ to the line joining the centres at impact. If this impact has a duration of $\mathbf{0 \cdot 01\ s}$, calculate the **force** which $\boldsymbol{P}$ exerts on $\boldsymbol{Q}$. Give your answer to the **nearest whole number**. $\left[\textbf{Coefficient of restitution e} = \frac{1}{2}\right]$



Q2 A particle is projected from a point $\boldsymbol{O}$ on level ground towards a smooth vertical wall **30 m** from $\boldsymbol{O}$. The particle hits the wall when **travelling horizontally** with a speed of $\mathbf{15\ m\ s^{-1}}$. Find the **initial speed** of the particle. [Use $\boldsymbol{g} = \mathbf{10\ m\ s^{-2}}$]



Q3 What is the **number** of the **parking space** containing the car?



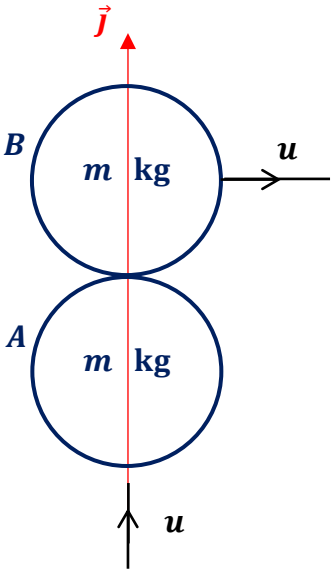
NATIONAL APPLIED MATHS QUIZ – 10th MARCH 2018

ROUND 6 – 8 Minutes

Marks may be lost for omission of correct units

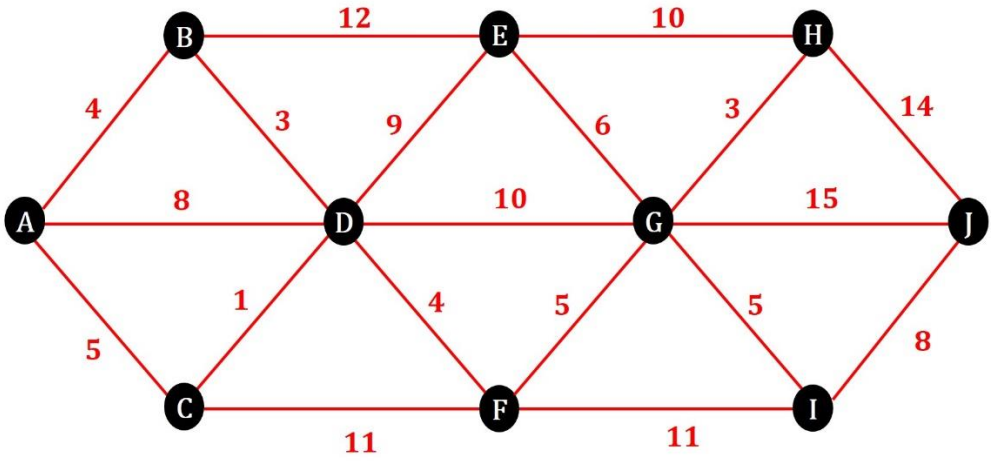
Q1 A smooth sphere $\boldsymbol{A}$, moving with speed $\boldsymbol{u}$ **m s**$^{-1}$, collides with an identical smooth sphere $\boldsymbol{B}$ which is moving in a perpendicular direction with the same speed. The line of centres at the instant of impact is perpendicular to the direction of motion of sphere $\boldsymbol{B}$. As a result of the impact $\boldsymbol{B}$ is turned through an angle $\tan^{-1}\left(\frac{3}{4}\right)$.

Find the value of $\boldsymbol{e}$, the coefficient of restitution for the impact.



Q2 At an instant ship $\boldsymbol{A}$ is due **east** of ship $\boldsymbol{B}$, which is travelling in a direction **60° East of North** at a speed of **9 m s**$^{-1}$. Ship $\boldsymbol{A}$ is travelling at a **constant velocity** and sets out to intercept ship $\boldsymbol{B}$ in the shortest possible time. If the **initial displacement** is **600 m**, calculate to the **nearest second** the time which elapses before interception occurs.

Q3 Find the **shortest distance** from $\boldsymbol{A}$ to $\boldsymbol{J}$ on the network below.

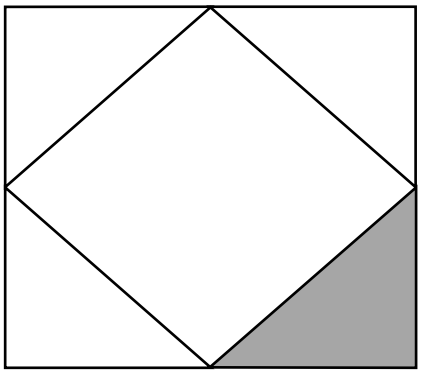


A: 27 **B: 28** **C: 29** **D: 30** **E: 31** **F: 32**

TIE BREAKER – 8 Minutes per Question

Q1 At 17:00 hours, local time, 9 February 2018 in the Olympic Stadium, South Korea, the Olympic flame was lit. It burned until 11:00 Irish time of 25 February 2018. South Korean time is 9 hours in advance of Irish time. For how many hours did the flame burn?

Q2 The diagram shows a square of perimeter 20 cm inscribed inside a square of perimeter 28 cm. What is the area of the shaded triangle?



Q3 Three students undertake a summer job of mowing a large lawn. Working individually, their average working times are: James (70 minutes), Ciaran (80 minutes) and Orla (60 minutes). If they worked together without getting in one another's way, how long would their combined efforts take to complete the job? Answer to the nearest minute.

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	$7 \cdot 68$ m	[Unit required for 2 marks]
Q2	$\lvert\vec{v}\rvert = 14 \cdot 4$ m s^{-1}	[Unit required for 2 marks– award 1 mark for $\sqrt{208} = 4\sqrt{13}$ m s^{-1}]
Q3	$x + y = 10$	[No unit required - award 1 marks for $x = 4$ or $y = 6$]

Round 2

Q1	90 W	[Unit required for 2 marks – award 1 marks for 210 W]
Q2	6 N	[No unit required]
Q3	D: 18	[No unit required]

Round 3

Q1	$14 \cdot 7$ m s^{-1}	[Unit required for 2 marks – award 1 marks for $3\sqrt{24} = 6\sqrt{6}$ m s^{-1}]
Q2	$2 \cdot 5$ m s^{-2}	[Unit required for 2 marks]
Q3	D: 18	[No unit required]

Round 4

Q1	$t = 39$ s	[No unit required]
Q2	$6 \cdot 8$ m	[Unit required for 2 marks]
Q3	5	[No unit required]

Round 5

Q1	173 N	[Unit required for 2 marks – award 1 marks for $100\sqrt{3}$ N]
Q2	$u = 25$ m s^{-1}	[No unit required – award 1 mark for $\vec{u} = 15\vec{\imath} + 20\vec{\jmath}$ m s^{-1}]
Q3	87	[No unit required]

Round 6

Q1	$e = 0 \cdot 5$	[No unit required]
Q2	77 s	[No unit required]
Q3	B: 28	[No unit required]

TIE BREAKER

Q1	387 hours	[No unit required]
Q2	6 cm^2	[No unit required]
Q3	23 min	[No unit required]