2016 SENIOR APPLIED MATHS QUIZ - 3RD MARCH 2016

ROUND 1 – 6 Minutes

Marks may be lost for omission of correct units

Q1 A motorist is approaching roadworks when she notices that she is driving in excess of the speed limit. She is in fact driving at 18 m s^{-1}. By a slight deceleration of $\frac{1}{3}$ m s^{-2} her speed is reduced to the speed limit of 60 km hr^{-1}.

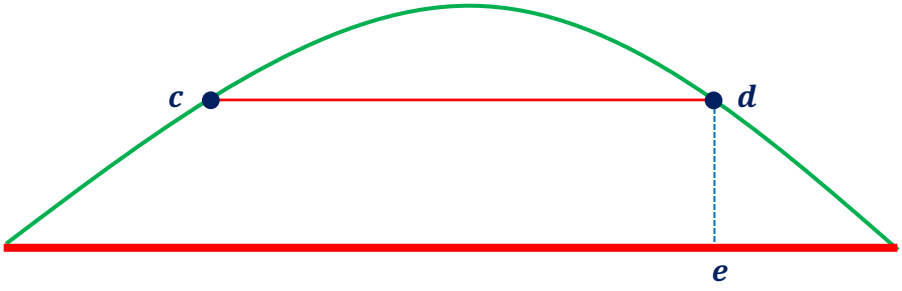
For how long did the deceleration require?

Q2 A particle is projected vertically upwards with an initial speed of 50 m s^{-1} .
After how many seconds does the particle reach half its maximum height for the first time?
Give you answer correct to one decimal place. [**Use $g = 10$ m s^{-2}**]

Q3 Three different **positive integers** have a **mean of 8**.

What is the largest positive integer that could be one of them?

A 20 **B** 22 **C** 21 **D** None of these



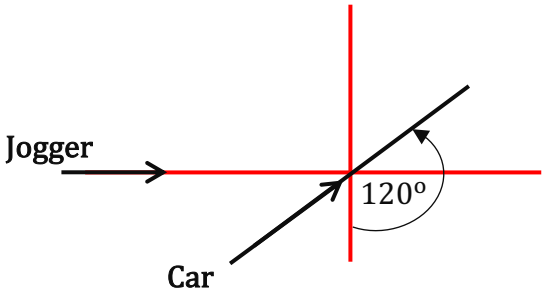
2016 SENIOR APPLIED MATHS QUIZ - 3RD MARCH 2016

ROUND 2 – 6 Minutes

Marks may be lost for omission of correct units

Q1 A Point $\boldsymbol{X}$ is $\mathbf{156\ m}$ north of a point $\boldsymbol{Y}$. Sean cycles at a constant speed from $\boldsymbol{X}$ to $\boldsymbol{Y}$ and then returns to $\boldsymbol{X}$ at a constant speed. Sean cycles at a constant speed of $\mathbf{8\ m\ s^{-1}}$ if there is no wind blowing.
If there is a wind blowing from the South at $\mathbf{5\ m\ s^{-1}}$ during the entire journey, how long does the journey last? [Neglect the turnaround time]

Q2 A jogger and a car are approaching a junction as in diagram. The car has a constant speed of 10 m s^{-1} and the jogger that of 5 m s^{-1}. The jogger first sights the car when the car is at the intersection and the jogger is 100 m away from the intersection.
Calculate the shortest distance between the car and the jogger.
Give you answer correct to the nearest metre.



Q3 What is the sum of all the solutions to the equation $\mathbf{6}\boldsymbol{x} = \dfrac{\mathbf{150}}{\boldsymbol{x}}$, $\boldsymbol{x} \neq \mathbf{0}$

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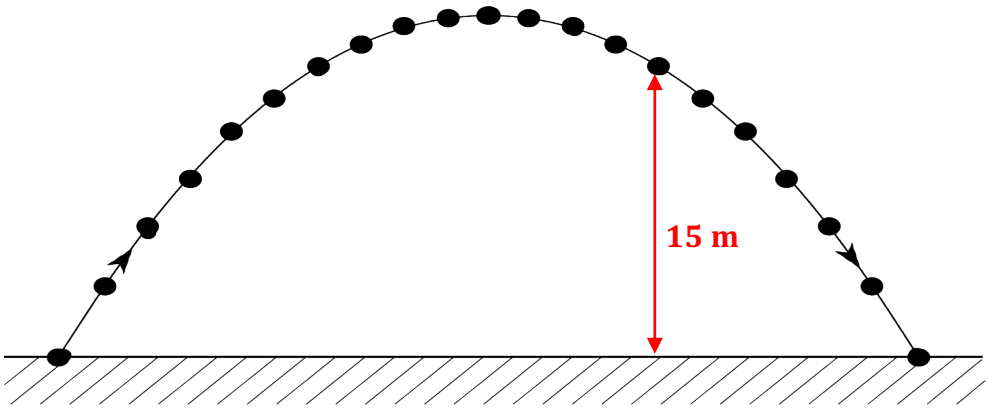
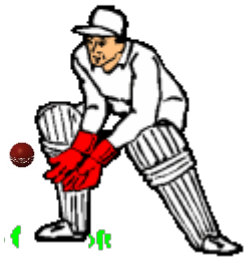
ROUND 3 – 6 Minutes

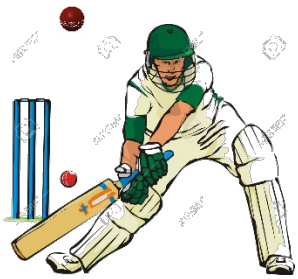
Marks may be lost for omission of correct units

Q1 A particle is projected with an initial velocity of $\mathbf{30}\vec{\boldsymbol{\imath}} + \mathbf{20}\vec{\boldsymbol{\jmath}}\ \mathbf{m\ s^{-1}}$. On its descent it is photographed when at a vertical height of **15 metres**. How long is the particle in flight at the instant of the photograph? [**Use** $\boldsymbol{g}$ $\mathbf{=10\ m\ s^{-2}}$]



Q2 A cricketer hits a ball with an initial speed **of 30 m s^{-1}**. The ball was caught by a second player **2 seconds** later from the same height as it was hit. At what angle to the vertical was the ball hit? Give your answer to the nearest degree. [**Use** $\boldsymbol{g} = \mathbf{9 \cdot 8}$ **m s^{-2}**]





Q3 Yesterday, **Wednesday 2nd March**, I opened a savings account with a lodgement of **€20**. This plan for holiday pocket money entails a deposit of **€10** on every Wednesday from now until I fly out to sunny Spain on Wednesday 8th June 2016.
[A special date for some students!]
If I maintain my resolution, what will be my minimum holiday fund?

[Exclude the date of departure and any interest earned or fees charged]

2016 SENIOR APPLIED MATHS QUIZ - 3RD MARCH 2016

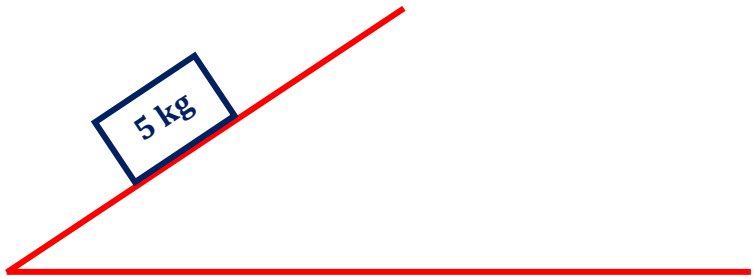
ROUND 4 – 6 Minutes

Marks may be lost for omission of correct units

Q1 A block of mass **5 kg** starting from rest slides down a rough plane which is inclined at an angle of $\tan^{-1}\left(\frac{4}{3}\right)$ to the horizontal.

The coefficient of friction between the block and the plane is $\frac{1}{3}$.

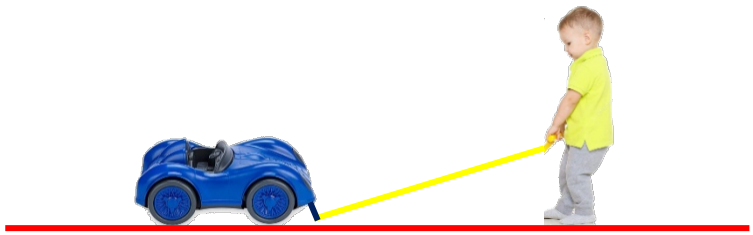
Calculate in terms of g how far down the plane the block slides in one second?



Q2 A child pulls a toy car of mass **4 kg** along a floor by means of a string inclined at 30^{o} to the horizontal. The tension in the string is **20 N** and the child and toy car move at a constant speed of $0 \cdot 3 \text{ m s}^{-1}$.

Calculate the **coefficient of dynamic friction** between the toy car and the floor.

Give your answer to 2 decimal places. [**Use** $g = 9 \cdot 8 \text{ m s}^{-2}$]



Q3 There is a system behind the arrangement of the letters below. Which of the letters in the second line should logically take the place of the question mark?

Y P I D ?

T Z Q A L M

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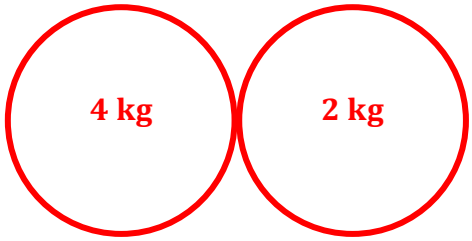
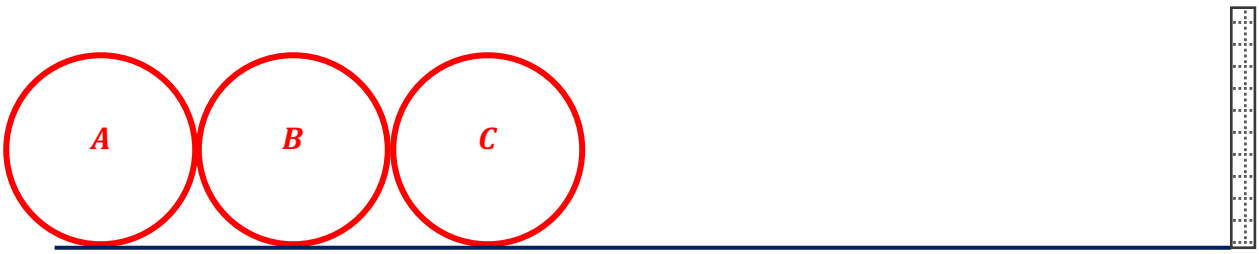
ROUND 5 – 6 Minutes

Marks may be lost for omission of correct units

Q1 A smooth sphere $\boldsymbol{P}$, of mass $\mathbf{4\ kg}$, moving with speed $\mathbf{3\ m\ s^{-1}}$, collides directly with a smooth sphere $\boldsymbol{Q}$, of mass $\mathbf{2\ kg}$, which is moving in the same direction with speed $\mathbf{2\ m\ s^{-1}}$. After the collision $\boldsymbol{Q}$ travels with a speed $\mathbf{3\ m\ s^{-1}}$ in the same direction. Calculate the coefficient of restitution between the spheres.



Q2 Three **equal** spheres $\boldsymbol{A}$, $\boldsymbol{B}$ and $\boldsymbol{C}$ lie at rest on a smooth table. $\boldsymbol{A}$ is then projected towards $\boldsymbol{B}$ with speed $\mathbf{3\ m\ s^{-1}}$ which in turn collides with $\boldsymbol{C}$. All of the collisions are **perfectly elastic**. After impact with $\boldsymbol{B}$, sphere $\boldsymbol{C}$ travels for $\mathbf{0 \cdot 6\ seconds}$ before striking a vertical wall. What is the distance between sphere $\boldsymbol{C}$ and the wall?



Q3 A group of thirteen people paid a total of €**60** to enter a school concert. It included adults at €**10** per ticket, senior citizens at €**5** per ticket and €**2** for a student.
How many adults were in the group?

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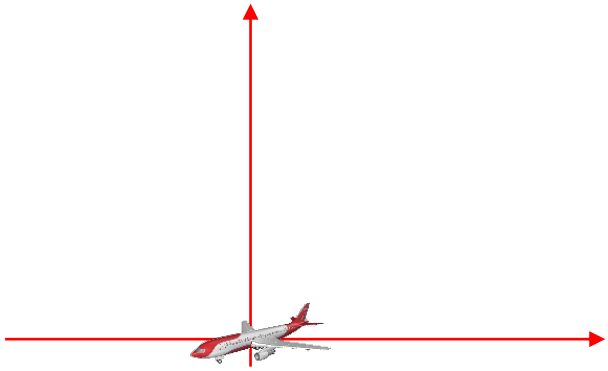
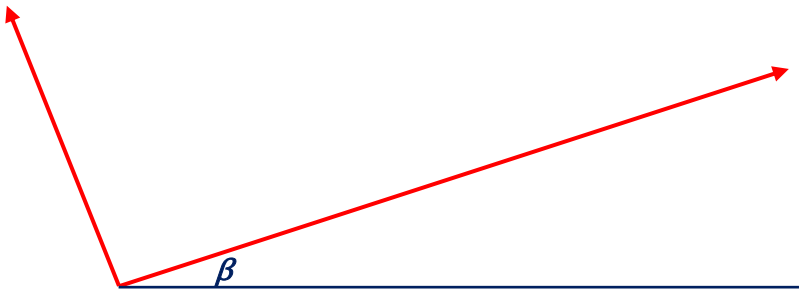
ROUND 6 – 8 Minutes

Marks may be lost for omission of correct units

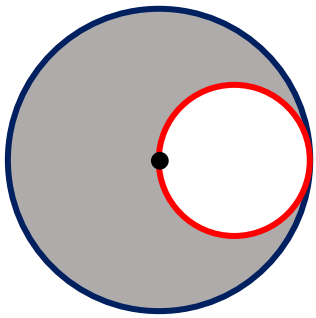
Q1 An aeroplane undergoes two consecutive displacements parallel to the ground. The first is **100 km 10° West of North** followed by **120 km 50° East of North**. What is the magnitude of the aeroplane's resultant displacement? Give your answer to the nearest km.



Q2 A particle is projected up an inclined plane with an initial speed $\mathbf{50\ m\ s^{-1}}$ at an angle $\mathbf{\tan^{-1}\left(\frac{1}{2}\right)}$ to the inclined plane. The plane is inclined at an angle $\boldsymbol{\beta}$ to the horizontal If the particle strikes the plane at right angles, find the time of flight. Give your answer correct to one decimal place. $[\mathbf{Use}\ \ g = 9 \cdot 8\ \mathbf{m\ s^{-2}}]$.



Q3 In the diagram, the smaller circle touches the larger circle and also passes through its centre. What fraction of the area of the larger circle is outside the smaller circle?

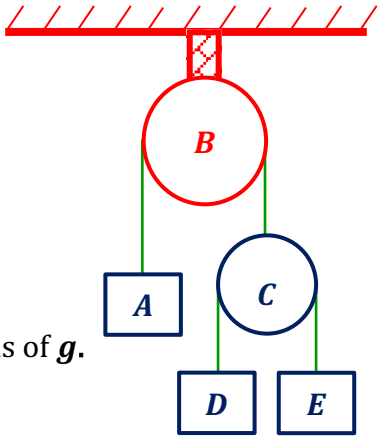


2016 SENIOR APPLIED MATHS QUIZ - 3RD MARCH 2016

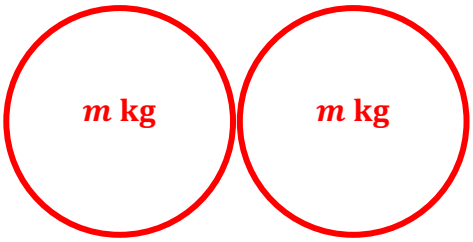
ROUND 7 – 8 Minutes

Marks may be lost for omission of correct units

Q1 The diagram shows a light inelastic string passing over a fixed pulley ***B*** connecting a particle ***A*** of mass **3 kg** to a light movable pulley ***C***. Over this pulley passes a second light inelastic string to the ends of which are attached particles ***D*** and ***E*** of masses **2 kg** and **1 kg** respectively.
The system is released from rest.
Find the **magnitude of the acceleration** of particle ***A*** in terms of ***g***.



Q2 Two identical smooth spheres each of mass ***m*** **kg** and moving in the same direction collide directly. The coefficient of restitution between the spheres is ***e***.
The magnitude of the relative velocity between the spheres before impact is $2u$.
After the collision one sphere moves at a greater speed than the other sphere.
Calculate the speed of the faster sphere in terms of ***e*** and ***u***.



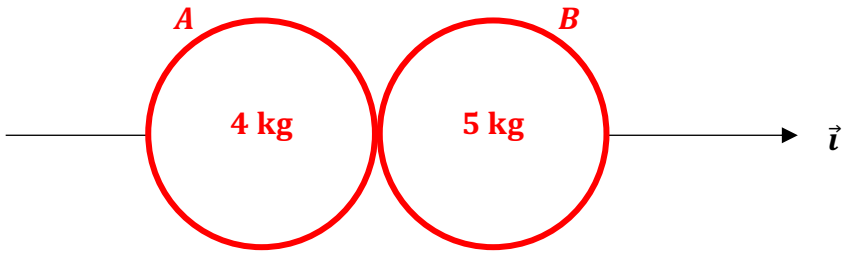
Q3 Conor is baking a cake today, Thursday. He bakes a cake every fifth day.
How many days will it be before he next bakes a cake on a Thursday?

2016 SENIOR APPLIED MATHS QUIZ - 3RD MARCH 2016

ROUND 8 – 8 Minutes

Marks may be lost for omission of correct units

Q1 Two smooth spheres $\boldsymbol{A}$ of mass **4 kg** and $\boldsymbol{B}$ of mass **5 kg** collide. The velocity of $\boldsymbol{A}$ before the collision is $2\vec{\imath} + 5\vec{\jmath}$ and the velocity of $\boldsymbol{B}$ before the collision is $u\vec{\imath} - 2\vec{\jmath}$ where $\vec{\imath}$ is along the line of the centres of the spheres at impact.
The velocity of $\boldsymbol{A}$ after the collision is $-v\vec{\imath} + v\vec{\jmath}$.
If the coefficient of restitution is $0 \cdot 8$, find the value of u.



Q2 A small ball is released and falls on to a horizontal platform which is descending vertically at a constant speed of $5\ \mathrm{m\ s^{-1}}$. If the ball is **10 metres** above the platform at instant of release, calculate the time that elapses before the ball hits the platform.
[**Use** $g = 10\ \mathrm{m\ s^{-2}}$]

Q3 In July 2014, a test on a leopard tortoise called Bertie measured its speed along a **5. 5 metre** long track which it covered in **19. 6 seconds** . Amazingly fast!
What was Bertie's speed in **km per hour** ? Give your answer to 2 decimal places.

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Rules for Tie Breakers

1. A maximum of 6 minutes to be allowed per tie break round.
2. Teams may submit their answer before the final signal.
3. If two or more teams are still tied on their scores after this round, then the tying team which submitted its answer paper first will be deemed to have won, and so on.
   (Note: The score is the primary criterion).
4. Should a tie still remain after all tie-break questions have been used, then the adjudicator, at his or her discretion, will decide how the matter is to be resolved.

TIE BREAKER – 6 Minutes per Question

Q1 Colm has a mass of **72 kg.** He is ascending in a lift at a constant speed of 2 $\mathbf{m\ s^{-1}}$
Mary has a mass of **60 kg** and she is ascending in a lift which is accelerating upwards at $\mathbf{2\ m\ s^{-2}}$. What is the difference in their weights during their time in the lifts?
[**Use** $g = \mathbf{10\ m\ s^{-2}}$].

Q2 The buffers at the end of a railway line can stop a train which is travelling at $\mathbf{10\ m\ s^{-1}}$ by being compressed through **10 cm**. How many seconds does the uniform deceleration require?

Q3 December 31st 2015 was a Thursday. How many Thursdays were there in 2015.

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	4 s	[Unit required for 2 marks – if unit is omitted award 1 mark]
Q2	$1 \cdot 5$ s	[Unit required for 2 marks – if unit is omitted award 1 mark]
Q3	21	[No unit required]

Round 2

Q1	64 s	[Unit required for 2 marks – if unit is omitted award 1 mark]
Q2	81 m	[Unit required for 2 marks – if unit is omitted award 1 mark]
Q3	0	[Allow 1 mark if ± 5 is given as the answer]

Round 3

Q1	3 s	[Unit required for 2 marks – award 1 mark if 1 s is given as the answer]
Q2	$71°$	[No unit required - allow 1 mark if $19°$ is given as the answer]
Q3	€150	[No unit required]

Round 4

Q1	$\frac{3g}{10}$ m	[Unit required for 2 marks – allow 1 mark if $2 \cdot 94$ m is given as the answer]
Q2	$0 \cdot 59$	[No unit required – allow 1 mark if $\frac{25\sqrt{3}}{73}$ is given as the answer]
Q3	A	[No unit required]

Round 5

Q1	$0 \cdot 5$	[No unit required]
Q2	$1 \cdot 8$ m	[Unit required for 2 marks – if unit is omitted award 1 mark]
Q3	2	[No unit required]

Round 6

Q1	191 km	[Unit required for 2 marks – allow 1 mark if $20\sqrt{91}$ km is given as the answer]
Q2	$6 \cdot 5$ s	[Unit required for 2 marks – allow 1 mark if $\frac{20\sqrt{10}}{g}$ s is given as answer]
Q3	$\frac{3}{4}$	[No unit required]

Round 7

Q1	$\frac{g}{17}$ m s^{-2}	[Allow 1 mark if answer given $= -\frac{g}{17}$ m s^{-2} or $\pm 0 \cdot 58$ m s^{-2} or unit omitted]
Q2	$u(1+e)$	[No unit required]
Q3	35	[No unit required]

Round 8

Q1	-5	[No unit required]
Q2	2 s	[Unit required for 2 marks – if unit is omitted award 1 mark]
Q3	$1 \cdot 01$ km hr^{-1}	[Unit required for 2 marks – if unit is omitted award 1 mark]

TIE BREAKER

Q1	0	[No unit required]
Q2	$0 \cdot 02$ s	[Unit required for 2 marks – if unit is omitted award 1 mark]
Q3	53	[No unit required]