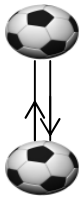
2010 APPLIED MATHS QUIZ

Note : For all questions in this quiz, take g = 10 m/s^2

Round One

1. A football is kicked vertically upwards. It takes 4.9 seconds to return to its original position. Find the speed of projection of the ball. (g = 10 m/s^2)



2. A car is travelling at 25 m/s and is breaking the speed limit for that stretch of road. It passes a stationary Garda motor cyclist who sets off in pursuit 2 seconds later. The Garda's bike accelerates uniformly and draws level with the car after a further 10 seconds. Find the acceleration of the Garda's bike.

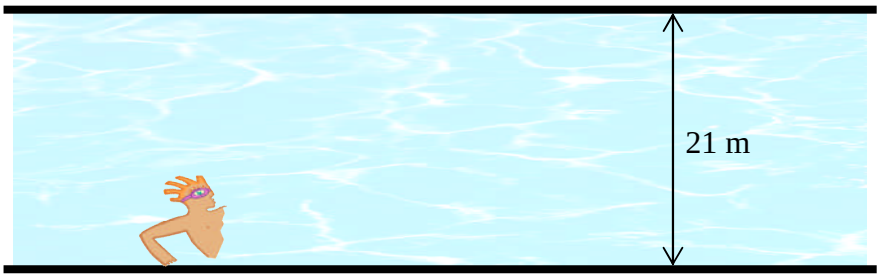
3. What is the largest number of Sundays that there can be in any one year?

A. 50 B. 51 C. 52 D. 53 E. 54

Round Two

1. To the pilot of a plane flying with velocity $45\vec{i}+11\vec{j}$ m/s the velocity of a helicopter appears to be $18\vec{i}+5\vec{j}$. Find the speed of the helicopter.

2. A river is 21 metres wide and has a current flowing at $\frac{2}{3}$ m/s parallel to its banks. A man, whose top speed is $\frac{3}{7}$ m/s in still water, crosses the river in the shortest time possible. How far downstream from his starting point does he land, to the nearest metre?

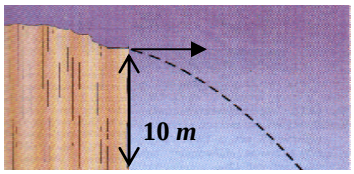


3. Peri the winkle starts at the point (1,1). Each day Peri crawls from the point (x,y) to the point (y, x+y), so that at the end of the first day Peri has reached (1,2). Where is Peri at the end of the sixth day?

A. (6,7) B. (6,12) C. (13,21) D. (21,34) E. (144,233)

Round Three

1. A stone is thrown horizontally from the top of a cliff 10 m high. The stone hits the water after t seconds. Find the value of t in surd form (using $g = 10$ m/s^2).



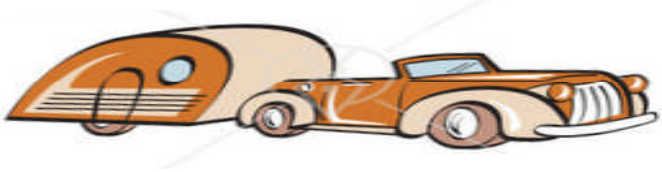
2. A javelin is thrown at 20 m/s at an angle of 40° to the horizontal ground. Taking $g = 10$ m/s^2 find the greatest height reached by the javelin, to the nearest metre.

3. A furlong is 220 yards and a yard is 36 inches. A chain is 44 cubits and a cubit is 54 barleycorns. There are 10 chains in a furlong. How many barleycorns are there in one inch?

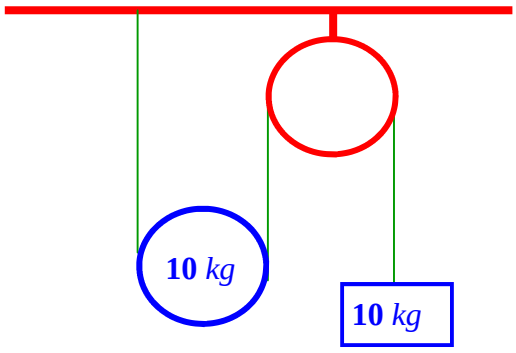
A. 6 B. 5 C. 4 D. 3 E. 2

Round Four

1. A car of mass 800 kg pulls a trailer of mass 200 kg. The force produced by the engine is 4000 N. The resistances acting on the car and the trailer are 600 N and 300 N, respectively. Calculate the common acceleration of the car and trailer.



2. A light inextensible string is attached to the ceiling. It passes under a smooth movable pulley of mass 10 kg, then over a fixed pulley and its other end is attached to a particle of mass 10 kg which hangs freely. When the system is released from rest, find the acceleration of the particle. [All strings are vertical except when in contact with pulleys. $g = 10$ m/s^2]

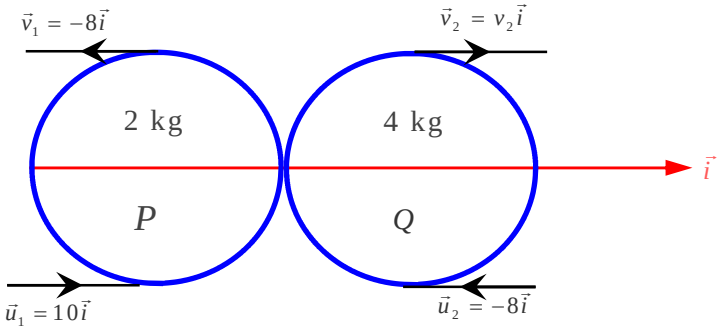


3. Annakin Skywalker and Obi-Wan Kenobi each has some coins in his pocket. If Annakin gave Obi-Wan Kenobi one coin then Obi-Wan Kenobi would have twice as many coins as Annakin, but if Obi-Wan Kenobi gave Annakin one coin, they would each have the same number of coins. Altogether, how many coins do they have?

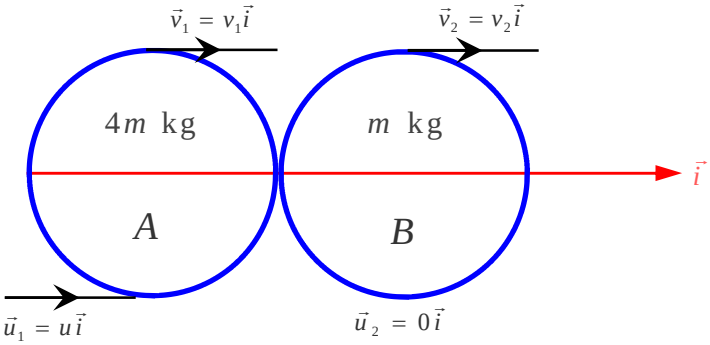
A. 8 B. 10 C. 12 D. 14 E. 16

Round Five

1. A smooth sphere P has mass 2 kg moving with a speed of 10 m/s collides directly with a second smooth sphere Q of mass 4 kg moving in the opposite direction with a speed of 8 m/s. Due to the collision the speed of P is reversed and reduced to 8 m/s. Find the value of the coefficient of restitution.



2. A smooth sphere A of mass $4m$ *kg* which is travelling with speed u *m/s* collides directly with a stationary smooth sphere B of mass m *kg*. The coefficient of restitution between the two spheres is e. Find the minimum possible speed of sphere A after the collision, in terms of u.



3. Last year Rachel took part in a swimathon. Every day for 9 weeks she swam the same number of lengths, either in a 25 m indoor pool or a 20 m outdoor pool. Later she discovered that she had swum the same total distance in each pool. On how many days did Rachel swim in the indoor pool?

A. 45 B. 42 C. 35 D. 32 E. 28

Round Six

1. A cage descends 720 m vertically down a mine-shaft in 60 seconds, starting from rest and ending at rest. It travels the first quarter of the journey under uniform acceleration and the last quarter under uniform deceleration, the acceleration and deceleration being equal. It travels the middle section of the journey at uniform velocity v. Find v.

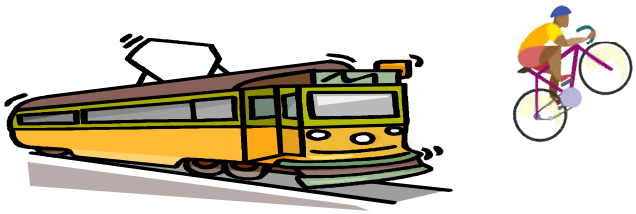
2. A balloon is rising vertically with speed 12 m/s, when a stone is dropped from the balloon. The stone reaches the ground in 6 seconds. From what height was the stone dropped? [g = 10 m/s^2]

3. Mary's height increased by 30% between her 5th and 10th birthdays. It increased by 20% between her 10th and 15th birthdays. By how much did her height increase between her 5th and 15th birthdays?

A. 50% B. 52% C. 54% D. 56% E. 60%

Round Seven

1. A passenger on a train which is travelling northwards at 20 m/s observes a cyclist who is travelling westwards at 3 m/s. During the period of observation the shortest distance between the train and the cyclist is 30 m. If visibility is 50 m, find the time span during which the passenger can observe the cyclist, to the nearest second.



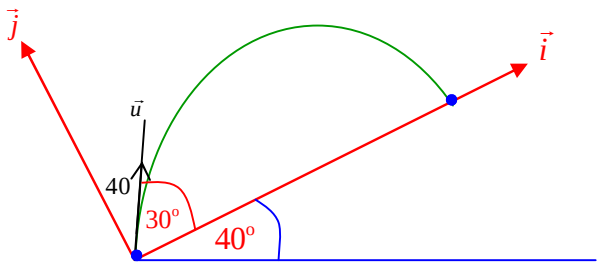
2. A woman travelling due West at 10 m/s considers that the wind appears to blow from the North. Increasing her speed Westwards to 20 m/s, the wind appears to blow from the North-West. Find the speed of the wind to the nearest m/s.

3. Two numbers differ by 9 and have sum 99. What is the ratio of the larger number to the smaller?

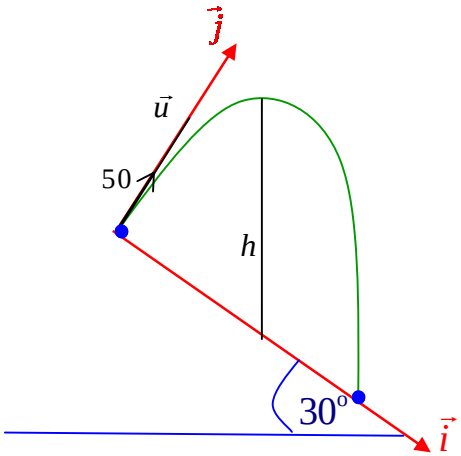
A. 5 : 4 B. 6 : 5 C. 7 : 6 D. 8 : 7 E. 9 : 8

Round Eight

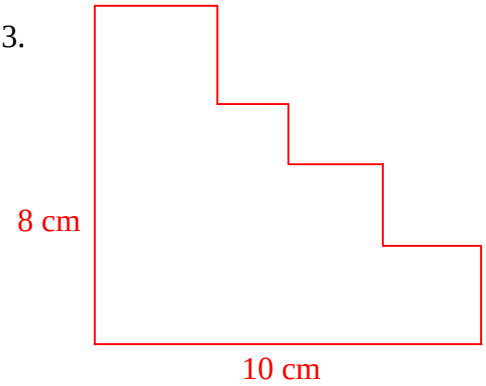
1. A particle is projected up a plane which is inclined at $40°$ to the horizontal. The particle is launched at 40 m/s at an angle of $30°$ to the inclined plane. Find the time (to the nearest second) that elapses before the particle strikes the plane. [g = 10 m/s^2]



2. A particle is projected with initial speed 50 m/s down a plane which is inclined at an angle $30°$ to the horizontal. The direction of projection is perpendicular to the plane. Find h, the vertical height (to the nearest metre) of the particle above the plane after 3 seconds, using g = 10 m/s^2.



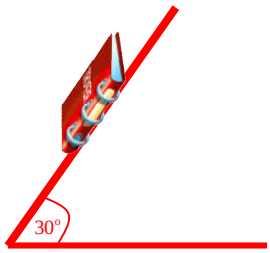
3. In the figure shown, all lines are horizontal or vertical. What is the perimeter of the figure?



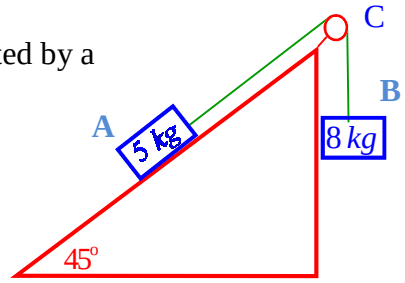
A. 80 cm B. 40 cm C. 36 cm D. 26 cm E. Not enough information given

Round Nine

1. A book of mass 0.5 kg is placed at rest on a rough plane inclined at $30°$ to the horizontal. The book is just on the point of moving down the plane. Calculate the value of the coefficient of friction, correct to one decimal place.



2. Particles A and B of mass 5 kg and 8 kg respectively are connected by a light inextensible string passing over a smooth light pulley C as shown. Particle A moves up the rough inclined plane and the coefficient of friction between A and the slope is $\frac{1}{2}$. The plane is inclined at $45°$ to the horizontal. Find, to the nearest m/s^2, the common acceleration of A and B.

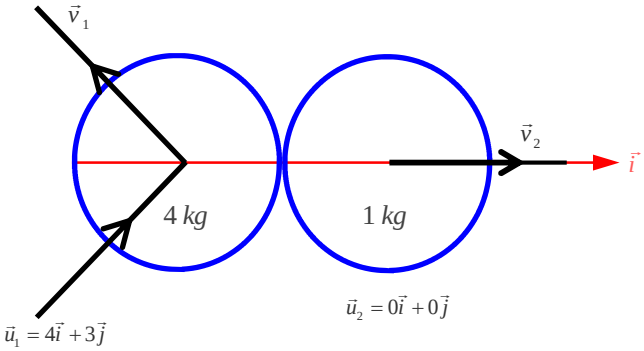


3. A tennis club has *n* left-handed players and 2*n* right-handed players. In total there are fewer than 20 players. At last summer's tournament, in which every player in the club played every other member exactly once, no matches were drawn and the ratio of the number of matches won by left-handers to the number won by right-handers was 3 : 4. What is the value of *n*.

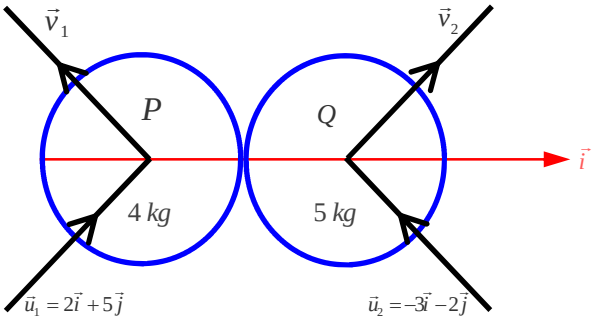
A. 3 B. 4 C. 5 D. 6 E. Not enough information given

Round Ten

1. A sphere of mass 4 kg with a velocity of $4\vec{i}+3\vec{j}$ m/s collides obliquely with a sphere of mass 1 kg which is at rest. The $\vec{i}$-axis is along the line of centres at impact. The $\vec{j}$-axis is perpendicular to the $\vec{i}$-axis. The coefficient of restitution is $\frac{1}{2}$. Calculate the velocity (in m/s) of the heavier sphere after the collision in terms of $\vec{i}$ and $\vec{j}$.



2. Sphere P and Q, of masses 4 kg and 5 kg, respectively, collide obliquely. Their velocities before impact are $2\vec{i}+5\vec{j}$ m/s and $-3\vec{i}-2\vec{j}$ m/s, respectively. If the coefficient of restitution for the collision is $\frac{4}{5}$, find the loss in kinetic energy due to the collision, to the nearest joule.
[$\vec{i}$ is along the line of centres at impact]



3. A Narcissean Number is one in which the cube of the digits add up to the number itself. For example 153 is a Narcissean Number since $1^3+5^3+3^3 = 1+125+27 = 153$.
Take the set of numbers *S* = {218, 407, 562, 1099}. Which of the following statements is true?:

A. Only one element in *S* is a Narcissean Number
B. Only two elements in *S* are Narcissean Numbers
C. All elements in *S* are Narcissean Numbers
D. All but one elements in *S* are Narcissean Numbers
E. No elements in *S* are Narcissean Numbers

Tie breakers:

Rules for tie-breaker: Give the teams just one question. The first team to hand up the correct answer (written down) wins. Maximum time per question: 5 minutes. If they all get it wrong, use another question:

1. A person sets out to drive from A to B, a distance of 200 km. She promises her friend at B that she will cover the journey at an average speed of 80 km/h. Traffic jams slow her down and when she reaches the half way point M she realises that her average speed so far is 40 m/s. At what average speed will she have to travel from M to B in order to keep her promise?
   A. 120 km/h B. 160 km/h C. 200 km/h D. 60 km/h E. Impossible

2. What is the smallest composite (non-prime) Natural number (greater than 1) which is not divisible by 2, 3, 4, 5, 6, 7, 8, 9, 10, or 11?

3. A parachutist of mass m jumps out of a plane and opens her parachute. The air resistance due to the parachute is $\frac{mv^2}{40}$, when her speed is v. The parachutist's speed tends to a terminal velocity. Find the terminal velocity. [g= 10 m/s^2]

4. A car is travelling at 35 m/s along a straight road. It is 100 m behind a bus which is travelling in the same direction at a constant 15 m/s. What is the minimum deceleration of the car which will ensure that no collision will occur?

Answers:

Round 1: 1. 24.5 m/s 2. 6 m/s^2 3. D
Round 2: 1. 65 m/s 2. 33 m 3. C
Round 3: 1. $\sqrt{2}$ s 2. 8 m 3. D
Round 4: 1. 3.1 m/s^2 2. 2 m/s^2 3. C
Round 5: 1. $e = \frac{1}{2}$ 2. $\frac{3u}{5} = 0.6u$ 3. E
Round 6: 1. 18 m/s 2. 108 m 3. D
Round 7: 1. 4 s 2. 14 m/s 3. B
Round 8: 1. 5 s 2. 128 m 3. C
Round 9: 1. 0.6 2. 2 m/s^2 3. C
Round 10: 1. $2.8\vec{i} + 3\vec{j}$ m/s 2. 10 J 3. A

Tie-breakers

1. E
2. 169
3. 20 m/s
4. 2 m/s^2 [-2 m/s^2 is an acceptable answer]