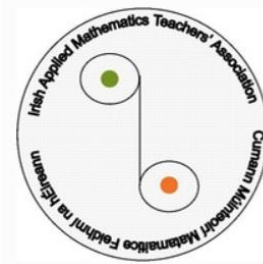


## IAMTA Junior Problem Solving

### Regional Competition 2016

#### Answer each Question

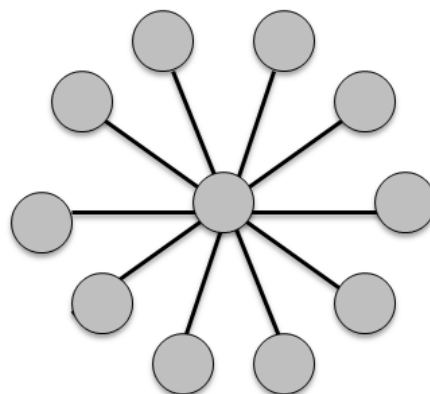


[Acceleration due to gravity on earth =  $10 \text{ ms}^{-2}$ ]

#### ROUND 1

##### Q1

Fit the numbers 1 to 11 into the circles so that when the numbers along any straight line are added together, the total is always the same. 1 2 3 4 5 6 7 8 9 10 11  
From your answer, calculate the total of any straight line.



##### Q2

A man has a mass of 95 Kg on earth.

If the acceleration due to gravity on earth =  $10 \text{ ms}^{-2}$  and acceleration due to gravity on the mars =  $3.71 \text{ ms}^{-2}$ , then

What percentage lighter will this man weigh on mars. Leave answer to nearest natural number.

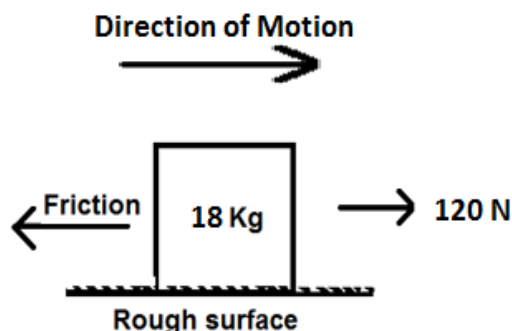
##### Q3

A swimming pool of width 9.0 m and length 24.0 m is filled with water to a depth of 3.0 m. Calculate pressure on the bottom of the pool due to the water.

##### Q4

“Friction is a force which opposes motion”

Calculate the frictional force per Kg, correct to one decimal place, if the net acceleration for the 18 Kg block is  $3.5 \text{ ms}^{-2}$  in the direction of motion.



## ROUND 2

### Q1

A dog that is tied to a 7 metre rope in and travels three full revolutions in 4.5 seconds. Calculate the dog's average speed, in S.I. units correct to one decimal place.

### Q2

A man walks 7 km East in 2 hours and then 2.5 km West in 1 hour. What is the difference between his average speed and average velocity for the whole journey in S.I. units correct to one decimal place.

### Q3

A sprinter can leave the starting blocks at  $3\text{ms}^{-1}$  and can accelerate at  $2a\text{ms}^{-2}$ . The sprinter continues at this rate and ten seconds later has a speed of  $9\text{ms}^{-1}$ . Using the graph, or otherwise, calculate the value of  $a$ .

### Q4

A ball is dropped from a height,  $3h$ , onto a smooth hard surface. Each time the ball strikes the ground it rebounds to  $\frac{2}{3}$  of the height from which it fell. If the difference in rebound heights between the second and fourth bounce is 30cm, calculate the height from which it fell, correct to one decimal place.

### ROUND 3

#### Q1.

Calculate the maximum point of the quadratic graph, whose roots are -3 and 5.

#### Q2.

A man sitting in a car is parked midway up a very steep hill of length 400m. When he takes off the handbrake and starts to drive the car up the hill, he notices that the velocity of the car changes proportionally with time. It eventually comes to a halt.

The man describes the velocity of the car,  $V$ , as a function of **time**.

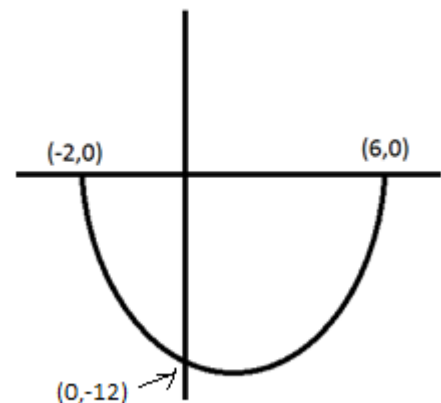
$$V(t) = 16 - 2t \text{ ms}^{-1}$$

How far will the car have travelled by the time it comes to a stop ?



#### Q3.

Find the point(s) where the quadratic shown in the diagram, intersects with the line  $y = -4x - 11$



#### Q4.

Find the average speed of an airplane with good and bad weather.

Mae took a non-stop flight to visit her grandmother. The 750-mile trip took three hours and 45 minutes. Because of the bad weather, the return trip took four hours and 45 minutes. What was her average speed for the round trip in miles per hour, correct to one place of decimal?

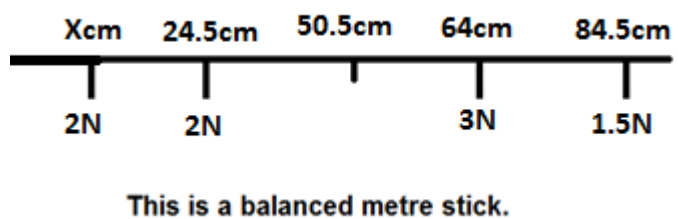
## ROUND 4

### Q1

If a team wins 60 percent of its games in the first third of a season, what percentage of the remaining games must it win to finish the season having won 80 percent of the games?

### Q2

This metre stick is found to have its centre of gravity at the 50.5cm mark. It is balanced by hanging 3N, 1.5N, 2N and 2N weights at positions indicated in the diagram. Calculate the value of X, correct to 2 places of decimal.



### Q3

If the shadow of a building increases by 10 meters when the angle of elevation of the sun rays decreases from  $70^\circ$  to  $60^\circ$ , what is the height of the building, correct to one decimal place?

### Q4

From the top of a 200 meters high building, the angle of depression to the bottom of a second building is 20 degrees. From the same point, the angle of elevation to the top of the second building is 10 degrees. Calculate the height of the second building. To the nearest metre.

ROUND 5

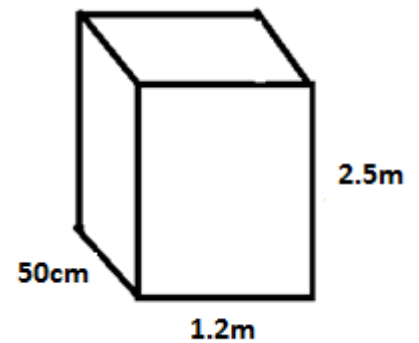
[Acceleration due to gravity on earth =  $10 \text{ ms}^{-2}$ ]

Q1

Evaluate  $\frac{X^2 - 3X - 10}{X^3 - 4X}$  when  $X = -2$

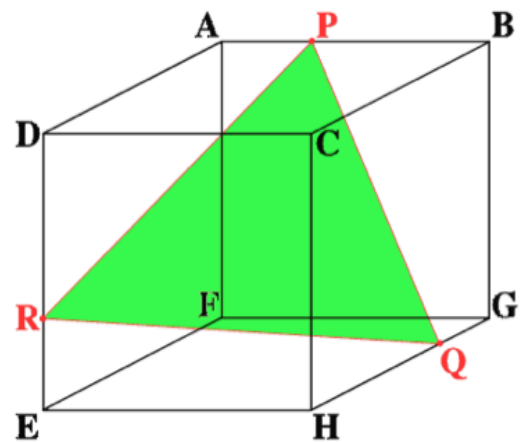
Q2

Find the density of the solid rectangular block of weight 150 N, as shown in the diagram, correct to one decimal place.



Q3

ABCDEFGH is a 3cm by 3cm by 3cm cube. Point P is  $\frac{1}{3}$  along AB, point Q is  $\frac{1}{3}$  along GH, and point R is  $\frac{1}{3}$  along ED.



What is the area of triangle PQR?

Q4

The volume of a lead sphere has a value equal to its surface area. If this sphere is to be melted down and re-cast into a hemisphere, calculate the radius of the hemisphere, correct to one decimal place.

ROUND 6

[Acceleration due to gravity on earth =  $10 \text{ ms}^{-2}$ ]

[Density of water =  $1000 \text{ Kg/m}^3$ ]

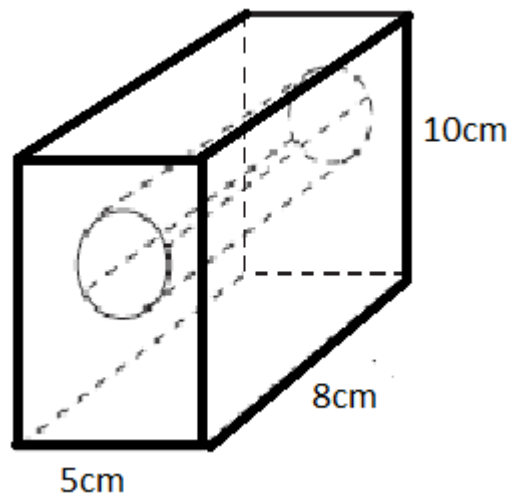
Q1

Calculate the time taken by a water pump of power 500 W to lift 2000 kg of water to a tank, which is at a height of 15 m from the ground?

Q2

The diagram shows a wooden block, of relative density 0.8, that has had a hole drilled in it. The diameter of the hole is 3 cm.

Calculate the *mass* of this solid, giving your answer correct to 2 decimal places.

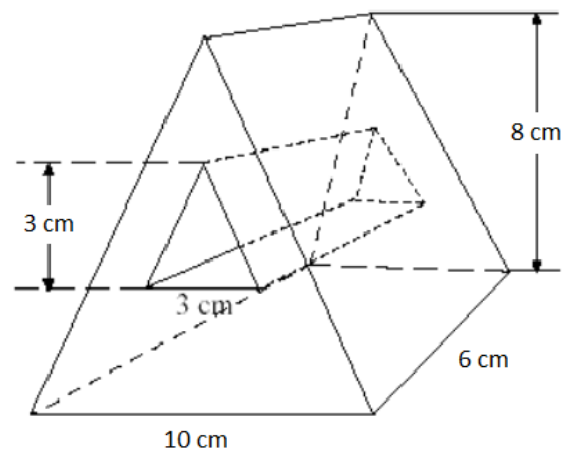


Q3

A car weighing 10 kN and travelling at 30 m/s stops at a distance of 50 m decelerating uniformly. What is the work done by the brakes?

Q4

A triangular prism has a triangular hole cut in it. Calculate the volume of the prism remaining in  $\text{m}^3$ .



## Answers

### **AWARD 2 MARKS FOR CORRECT SOLUTION.**

#### Round 1

- Q1. 22 [No unit required]  
Q2. 63% [No unit required]  
Q3. 30,000 Pa [Unit required for 2 marks – if unit omitted award 1 mark]  
Q4. 3.2 N/Kg [Unit required for 2 marks – if unit omitted award 1 mark]

#### Round 2

- Q1. 29.3 ms<sup>-1</sup> [Unit required for 2 marks – if unit omitted award 1 mark]  
Q2. 0.5 ms<sup>-1</sup> [Unit required for 2 marks – if unit omitted award 1 mark]  
Q3. 3/10 or 0.3 [No unit required]  
Q4. 2.6m [Unit required for 2 marks – if unit omitted award 1 mark]

#### Round 3

- Q1. (1, 16) [Allow 1 mark if '16' given as the answer]  
Q2. 64 m [Unit required for 2 marks – if unit omitted award 1 mark]  
Q3. {(1,-15) and (-1,-7)} [Full coordinates required – if -15 and -7 award 1 mark]  
Q4. 176 [No unit required]

#### Round 4

- Q1. 90% or 90 [No unit required]  
Q2. 19.75 [No unit required]  
Q3. 17.1m [No unit required]  
Q4. 297 [No unit required]

#### Round 5

- Q1.  $\frac{-7}{8}$  [No unit required]  
Q2. 10 kg/m<sup>3</sup> [Unit required for 2 marks – if unit omitted award 1 mark]  
Q3.  $\frac{7}{2}\sqrt{3}$  [No unit required]  
Q4. 3.8 [No unit required]

#### Round 6

- Q1. 600seconds or 10 minutes [Unit required for 2 marks – if unit omitted award 1 mark]  
Q2. 3.02 Kg [Unit required for 2 marks – if unit omitted award 1 mark]  
Q3. 9000 N or 9 kN [Unit required for 2 marks – if unit omitted award 1 mark]  
Q4. 0.000213 m<sup>3</sup> [No unit required]