

# PISA LIKE TEST ITEMS

## MATHEMATICAL LITERACY

### - ANSWERS

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### **01. OLD WOMAN'S WILL**

**Answers:**

1. The aunt added one camel to the total
2. Daughter 1 – 10  
Daughter 2 – 5  
Daughter 3 – 4
3. Before division 0 and after division 10:5:4
4. Yes.
5.  $19/20$  is less than 1 the old gave 1 camel actually  $1/20$  fraction and after that she divided the camels among the daughters ( $19/20 + 1/20 = 1$ )
6. Daughter 1 = 32sq. cm  
Daughter 2 = 17sq. cm  
Daughter 3 = 14sq. cm

### **02. BADMINTON TOURNAMENT**

**Answers:**

Round	Practice Table-1	Practice Table-2
1	Rajesh - Nisha	Nisha - Meena
2	Rajesh - Meena	Meena - Yash
3	Rajesh - Yash	Yash - Nisha

### **03. BIKE PUZZLE**

**NO ANSWERS AVAILABLE**

### **04. CAR JACK**

**Answers:**

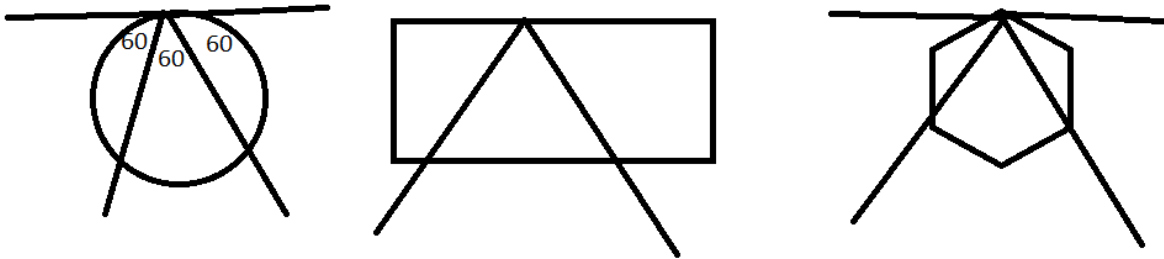
1. To lift up a heavy load (like car etc.). It is also used to lower the heavy weight safely.
2. The height (or linear distance) covered by screw in one rotation.
3. If we lift a car (or heavy weight) without using a jack up to a height 'h' than we do whole work in small interval of time. While using a jack, we lift the load in long time by dividing the height in many steps, but the whole work is same. Therefore due to long time, the less power is required using jack.
4. More effort is required.
5. Less effort will be required because the time of lifting will increase.
6. More effort will be required.

## 05. CLOSED CIRCUIT CAMERAS

### Answers:

- a] 8 cameras we need  
b] 3 for each circular room 3 for each rectangle and square room 3 for each hexagonal room  
total 24  
c] 4 for each shape and we need 32 cameras
- Type A
- Type A for 10 years purchase  $(8 \times 100) + \text{maintenance } (10 \times 50 \times 8) = 4800$   
Type B for 10 year purchase  $(24 \times 100) + \text{maintenance } (24 \times 10 \times 10) = 4800$   
Type C for 10 years purchase  $(32 \times 30) + \text{maintenance } (32 \times 10 \times 10) = 4160$

Type C is economical.



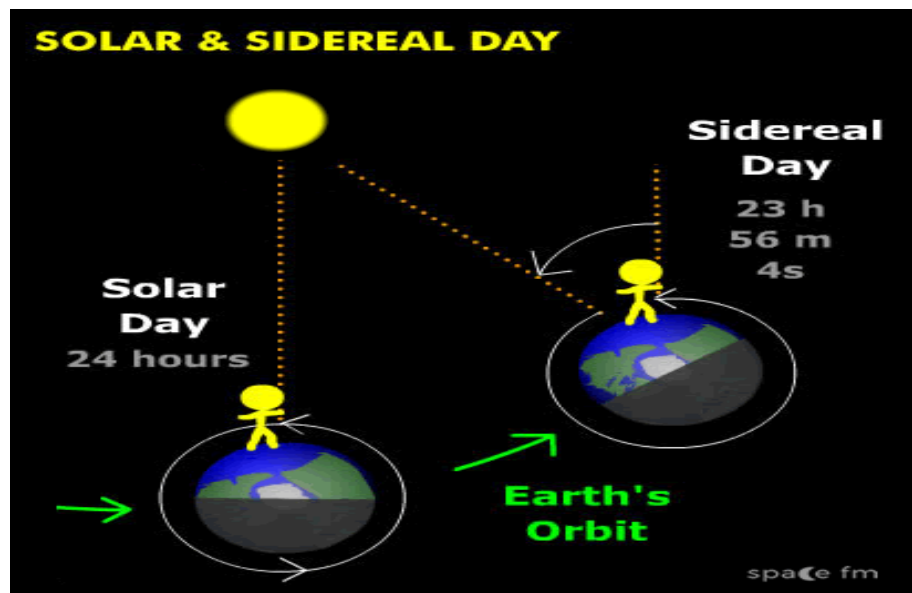
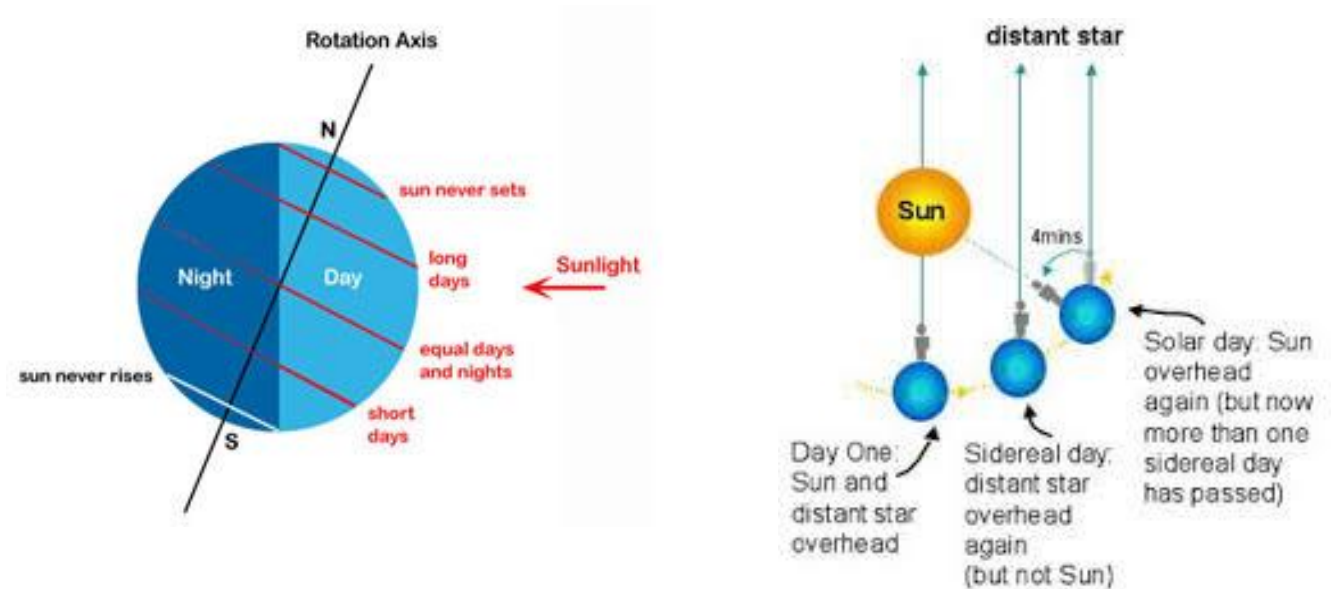
The distance range of all cameras being same the problem effectively reduces to the number of cameras required to cover  $180^\circ$ . Pupils may try positioning cameras differently. But answer remains same.

## 06. DIGITAL VERSATILE COMPACT (DVD)

- Find the range of the space of all films songs.  
Answer: Highest Space = 275 MB  
Lowest Space = 75 MB  
Range = Highest Space – Lowest Space =  $275 - 75 = 200$  MB  
  
Answer: (C)
- What is the average of space of all film songs?  
Answer: Total Space =  $100 + 150 + 125 + 275 + 150 + 225 + 100 + 75 = 1200$  MB  
Average Space =  $1200/8 = 150$  MB

## 07. DAYS AND NIGHTS

### REASON OF DAY & NIGHT ON EARTH



It spins on its axis which is an imaginary line passing through North Pole and South Pole. At any time the part of the earth that faces the sun has day (day light). The other half of the earth facing away from the sun receives no light. In summer days are longer than nights. In winter nights are longer than days.

In general when we talk about a day, as how many days are in a week or in a month, we mean the day as the time duration between two consecutive noons (when the sun is overhead).

We can also define the day duration as the time interval between two consecutive days on which we see the sun at the same point (as above or behind the same tree). We know that a day has 24 hours.

Now we will discuss whether a day has exactly 24 hours.

Factors on which duration of a day depends:

1. Rotation of earth on its axis.
2. Revolution of sun around the sun.
3. Tilt of axis of earth.
4. Position of the place with respect to equator.

The earth spins on its axis in anticlockwise direction and takes 23 hours 56 minutes in one complete rotation. This happens as the earth is also moving around the sun. The sun should appear at the same place in the sky on the next day after 24 hours. For this the earth rotates  $361^\circ$ , while in one complete rotation it spins through  $360^\circ$ . This time (24 hours) is called a solar day. Day duration for distant stars is 23 hours 56 minutes. This day is called sidereal day.

### Effect of tilt of the earth's axis

#### Answers:

1. The axis of rotation is tilted at an angle of 23.5 degrees relative to our orbital plane – the plane of Earth's orbit around the sun.
2. A **solar day** is the time it takes for the Earth to rotate about its axis so that the Sun appears in the same position in the sky. The duration of a solar day is 24 hours.  
The **sidereal day** is ~4 minutes shorter than the solar day i.e. **23 hours 56 minutes (approx)**. The **sidereal day** is the time it takes for the Earth to complete one rotation about its axis with respect to the 'fixed' stars.
3. Due to the tilt of the earth's axis the sun never sets for several days on one of the polar regions. Similarly on the other polar region nights will be for several days.
4. It increases by ~4 minutes.
5. As given above in the passage
6. The duration of the day will become 23 hours 56 minutes.
7. Earth would now take a whole year to do what it pulls off in a day: cycle from night to day and back. Cities would spend half the year in darkness and half the year in full sunlight, just like the North and South Poles do today.

## **08. DECISION MAKING**

#### Answers:

1. Answer: Disease C as it is effecting around 66% of population.
2. Answer: Disease B as it is accounting for 55% of deaths by illness.
3. Answer: Disease C since it is causing permanent disability.
4. Answer: C
5. Answer: Disease B as it is causing more number of deaths.

## 09. DO BIGHA JAMEEN

NO ANSWERS AVAILABLE

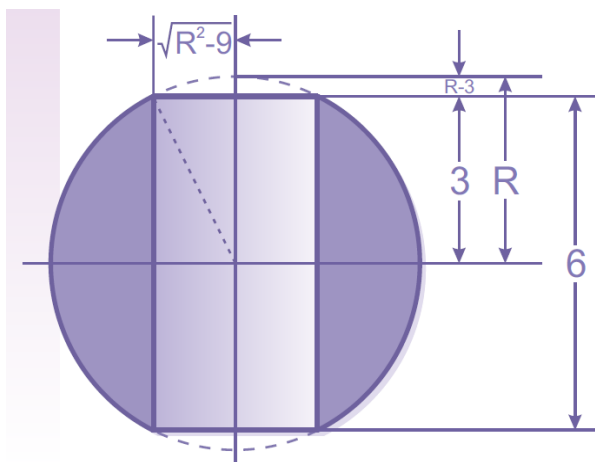
## 10. DRILLING A SPHERE

Answers:

CASE 1—IF THE DIAMETER OF THE BALL IS LESS THAN 6 INCHES.

It is not possible to drill a 6 inches hole through a sphere whose diameter is less than 6 inches.

CASE 2 – IF THE DIAMETER OF THE BALL IS GREATER THAN OR EQUAL TO 6 INCHES.



$R \rightarrow$  Radius of the sphere

$H \rightarrow$  height of the cylinder

Therefore radius of the cylindrical hole =  $\sqrt{R^2 - 9}$

Required volume= Volume of sphere – {Volume of the cylinder + 2(Volume of spherical cap)}

$$= \frac{\pi}{6} 63 = 36 \pi \text{ cubic units.}$$

Logical reasoning:

Suppose the hole is of zero diameter and length of the hole is 6 inches long, then the diameter of the sphere is 6 inches, then the volume of the remaining is equal to the volume of the sphere, which is  $36 \pi$  cubic units.

Since the size of the sphere is more than the length of the hole, for any radius of the hole the volume will be equal to the volume of the sphere.

The same can be extended to the earth also. Even if the sphere is the size of the Earth, and if a hole of 6 inches long is drilled then the volume will remain same.

Inference –

The length of the hole drilled will be equal to the diameter of the sphere.

The remaining volume does not depend on the size of the sphere or of the hole.

Let us assume that the length of the hole is greater than the diameter of the sphere. Then the hole will not be a hole. Means our assumption is wrong which implies that the length of the hole is equal to the diameter of the sphere.

### **PISA QUESTIONS BASED ON THIS ACTIVITY**

#### **Answers:**

Q.1 – Y/N/N/N

Q.2 – SOLID SPHERE

Q.3 – ONE

Q.4 –  $4\pi R^2$

Q.5 – SPHERICAL. WHEN THE OBJECT IS A SPHERE, SURFACE AREA IS MINIMUM FOR GIVEN VOLUME.

Q.6 – WHEN A HOLE IS DRILLED THROUGH THE CENTRE OF THE BALL.

Q.7 – CHORD/TANGENT

Q.8 –  $12\pi$  CUBIC INCHES

Q.9 – NO. DIAMETER OF THE SPHERE IS LESS THAN THE LENGTH OF THE HOLE. SO NOT POSSIBLE.

Q.10 –  $36\pi$  CUBIC UNITS

Q.11 – YES.

### **11. FRACTION**

#### **PICTURES CAN MAKE THE FRACTIONS EASIER!**

**Answers: -**

**(a) (i)** If the numerators of any two fractions are equal, the fraction with smaller denominator is always greater. On this basis, Anushka claimed that Village 'A' had more number of literate people.

**(ii) Pictorially:-**

Given fractions are:-

LITERACY VILLAGE A :  $3/4$

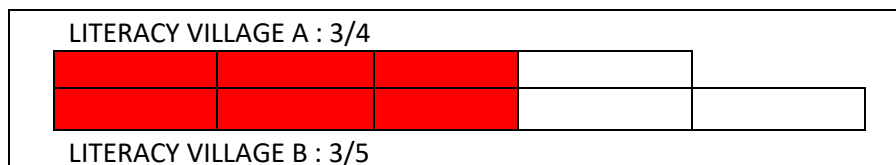


**&**

LITERACY VILLAGE B :  $3/5$



Since they are numerically same, so we have to equate them





Now, on equating them, we find 9 parts out of which 6 are shaded i.e. fraction of people who are literate in both the villages altogether is  $\frac{6}{9}$  or  $\frac{2}{3}$  and fraction of people who are illiterate in both the villages altogether is  $\frac{3}{9}$  or  $\frac{1}{3}$ .

**(iii) Algebraically:** Let the population of Village 'A' be  $x$  and Village 'B' be  $y$ .

Now, number of literate people in villages A and B are  $\frac{3x}{4}$  and  $\frac{3y}{5}$  respectively.

**ACCORDING TO THE SITUATION:**

$$\frac{3x}{4} = \frac{3y}{5} \text{ or } y = \frac{5x}{4}$$

Now fraction of literate people out of population of both the villages' altogether

$$= \frac{\left[\left(\frac{3x}{4}\right) + \left(\frac{3y}{5}\right)\right]}{x+y} = \frac{\left[\left(\frac{3x}{4}\right) + \left(\frac{3x}{4}\right)\right]}{x + \left(\frac{5x}{4}\right)} = \frac{\left(\frac{6x}{4}\right)}{\left(\frac{9x}{4}\right)} = \frac{2}{3}$$

So, fraction of illiterate people out of population of both the villages altogether =  $1 - \frac{2}{3} = \frac{1}{3}$  (Ans.)

**(b) (i)** Given fractions are:-

AGE GROUP: (0-25 YRS.)

LITERACY VILLAGE B



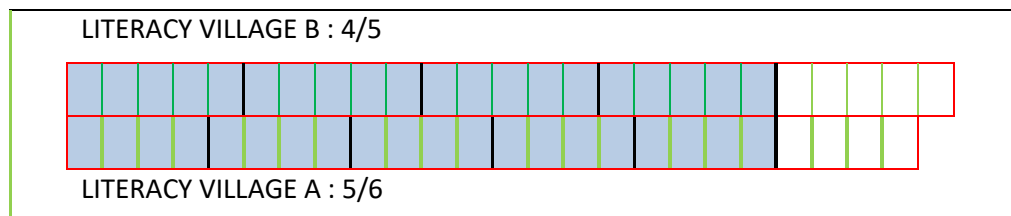
AGE GROUP: (0-25 YRS.)

LITERACY VILLAGE A



&

Since they are numerically same, so we have to equate them



To make them equal first we have to divide each box of  $\frac{4}{5}$  representation into 5 parts then we have to take 5 parts of 2<sup>nd</sup> representation coincided with them. Obviously each part of  $\frac{5}{6}$  representation is divided into 4 parts. So the 6<sup>th</sup> part will also have 4 parts.

In this way, altogether 49 parts are there, out of which 40 are shaded.

So, fraction of people who are literate in both the villages' altogether is  $\frac{40}{49}$  and fraction of people who are illiterate in both the villages' altogether is  $\frac{9}{49}$  in the age group 0-25 years.

**(ii) Algebraically:** Let the population of Village 'A' be  $x$  and Village 'B' be  $y$ .

Now, number of literate people in villages A and B are  $\frac{3x}{4}$  and  $\frac{3y}{5}$  respectively.

**ACCORDING TO THE SITUATION:**

$$\frac{5x}{6} = \frac{4y}{5} \text{ or } y = \frac{25x}{24}$$

Now fraction of literate people out of population of both the villages' altogether

$$= \frac{\left[\left(\frac{5x}{6}\right) + \left(\frac{4y}{5}\right)\right]}{x+y} = \frac{\left[\left(\frac{5x}{6}\right) + \left(\frac{5x}{6}\right)\right]}{x + \left(\frac{25x}{24}\right)} = \frac{\left(\frac{10x}{6}\right)}{\left(\frac{49x}{24}\right)} = \frac{40}{49}$$

So, fraction of illiterate people out of population of both the villages altogether =  $1 - \frac{40}{49} = \frac{9}{49}$  (Ans.)

(c) (i) It can't be decided because individual sample size is not given.

(d)

POPULATION	VILLAGE A				
	TOTAL	LITERATE	FRACTION	ILLETERATE	FRACTION
0-25 YEARS	480	400	5/6	80	1/6
25-50 YEARS	320	240	3/4	80	1/4
50 & ABOVE	200	110	11/20	90	9/20
<b>TOTAL</b>	<b>1000</b>	<b>750</b>	<b>3/4</b>	<b>250</b>	<b>1/4</b>
POPULATION	VILLAGE B				
	TOTAL	LITERATE	FRACTION	ILLETERATE	FRACTION
0-25 YEARS	500	400	4/5	100	1/5
25-50 YEARS	500	200	2/5	300	3/5
50 & ABOVE	250	150	3/5	100	2/5
<b>TOTAL</b>	<b>1250</b>	<b>750</b>	<b>3/5</b>	<b>500</b>	<b>2/5</b>
<b>TOTAL (VILL A+B)</b>	<b>2250</b>	<b>1500</b>	<b>2/3</b>	<b>750</b>	<b>1/3</b>

## 12. GOLDEN RATIO

### FIBONACCI'S RABBITS AND GOLDEN RATIO

**Answers:**

1. 3,5,8,13,21,34,55.
2. 8
3. 1, 1, 2, 3, 5, 8, 13, 21, 34,55
4. (a)
5. 1.618

Explanation:  $1/1 = 1$ ,  $2/1 = 2$ ,  $3/2 = 1.5$ ,  $5/3 = 1.666...$ ,  $8/5 = 1.6$ ,  $13/8 = 1.625$ ,  $21/13 = 1.61538$ ,  $34/21 = 1.619$ ,  $55/34 = 1.617$

So, we will find next ratio, it become closer to 1.618

### **13. GUESSING THE DAY**

#### **ZELLER'S RULE: FIND THE DAY FOR GIVEN DATE QUICKLY**

##### **Answer 1:**

The formula is  $F = K + [(13 \times M - 1)/5] + D + [D/4] + [C/4] - 2C$

Here,  $K = 15$ ,  $M = 6$ ,  $D = 47$ ,  $C = 19$

$$\begin{aligned}\text{So, } F &= 15 + [(13 \times 6 - 1)/5] + 47 + [47/4] + [19/4] - 2 \times 19 \\ &= 15 + 77/5 + 47 + 11.75 + 4.75 - 38 \\ &= 15 + 15.4 + 47 + 11.75 + 4.75 - 38 \\ &= 15 + 15 + 47 + 11 + 4 - 38 \\ &= 54\end{aligned}$$

Now divide the number by 7 which gives remainder 5.

Hence, 5 represents Friday

##### **Answer 2:**

The formula is  $F = K + [(13 \times M - 1)/5] + D + [D/4] + [C/4] - 2C$

Here,  $K = 26$ ,  $M = 11$ ,  $D = 50$ ,  $C = 19$

$$\begin{aligned}\text{So, } F &= 26 + [(13 \times 11 - 1)/5] + 50 + [50/4] + [19/4] - 2 \times 19 \\ &= 26 + 142/5 + 50 + 12.5 + 4.75 - 38 \\ &= 26 + 28.4 + 50 + 12 + 4.75 - 38 \\ &= 26 + 28 + 50 + 11 + 4 - 38 \\ &= 81\end{aligned}$$

Now divide the number by 7 which gives remainder 4.

Hence, 5 represents Thursday

### **14. HOW MANY ROUNDS**

##### **Answer:**

1.  $r_1 = 2r_2$ .
2. Circumference  $= 2\pi r$
3. Moving circle will have to complete two revolutions.
4. Centre of two circles.
5. Three (Common Tangents)

## **15. GREAT MATHEMATICIAN**

### **Answers:**

1. Bhāskara
2. Shakuntala Devi
3. Hemachandra
4. Brahmagupta
5. Bhaskara II

## **16. INTERNET RELAY CHAT**

### **NO ANSWERS AVAILABLE FOR QUESTION NO. 1**

### **Answer 2:**

Any time or interval of time satisfying the 9 hours time difference and taken from one of these intervals:

Sydney: 4:30 PM – 6:00 PM; Berlin: 7:30 AM – 9:00 AM OR

Sydney: 7:00 AM – 8:00 AM; Berlin: 10:00 PM – 11:00 PM

Sydney 17:00, Berlin 8:00.

### **NOTE**

If an interval is given, the entire interval must satisfy the constraints. Also, if morning (AM) or evening (PM) is not specified, but the times could otherwise be regarded as correct, the response should be given the benefit of the doubt, and coded as correct.

Other responses, including one time correct, but corresponding time incorrect.

Sydney 8 am, Berlin 10pm.

## **17. INVESTMENT**

### **Answer:**

1.  $A = P\left(1 + \frac{R}{100}\right)^N$
2. Let principal of 1<sup>st</sup> scheme be  $x$  and 2<sup>nd</sup> scheme be  $y$   
So accordingly  
 $8x + 9y = 186000$   
 $9x + 8y = 188000$   
Solving  $x = 12000$   
 $y = 10000$

3. Here  $P=22000$ ,  $R= 8.5\%$  ,  $T= 1$   
 $I= \text{Rs } 1870$

Hence 2<sup>nd</sup> scheme is better

### **18. JUICY WATERMELONS**

**Answers:**

- Both would occupy same space. When the spherical melons are stacked the gaps in between is wasted and the space is equivalent to the space occupied by a cubic melon of side equal to its diameter.
- Volume of the cubic watermelon =  $(\text{side})^3$   
 $= 15^3 = 3375 \text{ cu.cm}$   
Volume of water in the watermelon = 90% of 3375  
 $= 3037.5 \text{ cu.cm}$

### **19. KUTTY'S TILING PROBLEM**

**Answers:**

- 24 tiles
- 4
- 3
- 3mx3m
- 6

### **20. LARGEST EQUILATERAL TRIANGLE FROM A SQUARE**

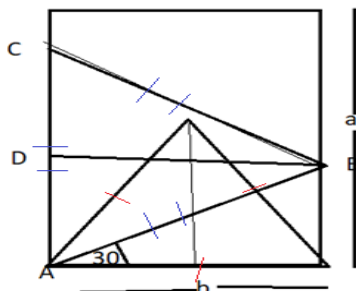
**Answers:**

- Equilateral triangle,  $60^\circ$
- $144\text{cm}^2$
- $36\sqrt{3}\text{cm}^2$
- $4/\sqrt{3}$
- Decrease
- Increase

### **21. MAXIMUM AREA**

**Answers:**

By folding one corner of rectangle into three equal parts we will get three equal parts of  $90^\circ$  that we can use  $60^\circ$  for first triangle and  $30^\circ$  for other triangle then by overlapping of sides we will get equilateral triangles



(a) Height of this maximum area equilateral triangle  
= breadth of rectangle = b let

(b)  $\cos 30^\circ = \frac{b}{AB}$

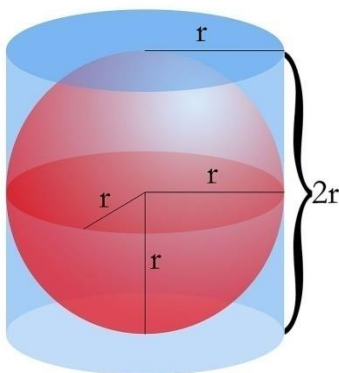
Side of maximum area equilateral triangle =  $\frac{b}{\cos 30} = \frac{2b}{\sqrt{3}} = \frac{2\sqrt{3}b}{3}$

(c) Area of maximum area equilateral triangle =  $\frac{\sqrt{3}}{4} (side)^2 = \frac{\sqrt{3}}{3} (b)^2$

(d) Ratio of first triangle to another triangle =  $\frac{\sqrt{3}}{3} (b)^2 : \frac{\sqrt{3}}{4} b^2 = 4:3$

## 22. SPHERE AND CYLINDER

Answers:



1. a)  $\frac{\text{Volume of sphere}}{\text{Volume of cylinder}} = \frac{\frac{4}{3} \pi r^3}{\pi r^2 h}$

Height of cylinder = 2r

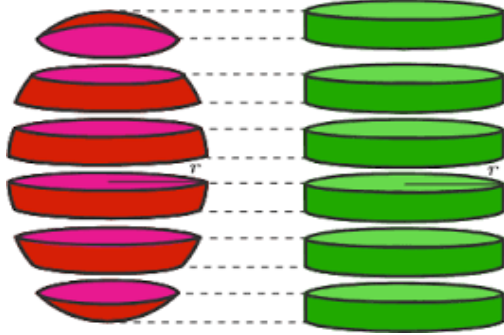
$$\frac{\text{Volume of sphere}}{\text{Volume of cylinder}} = \frac{2}{3}$$

b)  $\frac{\text{TSA of sphere}}{\text{TSA of cylinder}} = \frac{4 \pi r^2}{2 \pi r (r + h)}$

Height of cylinder = 2r

$$\frac{\text{TSA of sphere}}{\text{TSA of cylinder}} = \frac{2}{3}$$

2. a) To solve this imagine a cylinder enclosing a sphere:



Volume of each slice =  $\frac{1}{6} \times \frac{2}{3}$  volume of cylinder enclosing the sphere

$$= \frac{2}{9} \pi r^3$$

b) TSA of each slice =  $\frac{1}{6} \times \frac{2}{3}$  TSA of cylinder enclosing the sphere

$$= \frac{2}{3} \pi r^2$$

c) Given, TSA of each slice =  $6\pi$

$$\frac{2}{3} \pi r^2 = 6\pi$$

$$r = 3$$

### 23. PLOTTING AREA

	SOLUTIONS BASED ON ACTIVITY
1.	Yes
2.	Yes
3.	No
4.	7 $\triangle ABC$ $\triangle ADC$ $\triangle ADB$ $\triangle AMF$ $\triangle AMG$ $\triangle CDF$ $\triangle BEG$
5.	Area = $20\sqrt{2}$ sq. unit. So, altitude = $2(\text{area}/BC)$
6.	Area = $20\sqrt{2}$ sq. unit
7	Perimeter = altitude + base

8.	No. of lines	No. of Triangles	
	3	1	
	5	2	
	7	3	
9.	No. of triangles required= $(10 \times 10) / (20 \times 2) = 4$ triangles		

## **24. RATE OF EXCHANGE**

**Answer:**

(a) Calculation Sheet

*For Ronald*

1 USD = 69.043582 INR

So, 9000 USD =  $9000 \times 69.043582 = 621392.20$  INR

*For Joy*

1 Singapore dollar = 51.011760 INR

So, 10000 =  $10000 \times 51.011760 = 510117.60$  INR

*For Chiko*

1 Japanese Yen = 0.640227 INR

So, 580000 Japanese Yen =  $580000 \times 0.640227 = 371331.70$  INR

1. If each one purchased a travel bag of Rs. 3000, how many dollars has to be paid by Ronald?

Answer:

1 USD = 69.043582 INR

So, 3000 INR =  $3000 / 69.043582 = 43.45$  USD

2. On returning from tour, Ronald has 2500 INR left with him, Joy has 3000 INR left and Chiko has 1500 INR, how much their exchange currency they will take from their left amount?

**Answer:**

*For Ronald*

1 USD = 69.043582 INR

So, 2500 INR =  $2500 / 69.043582 = 36.21$  USD (approx.)

*For Joy*

1 Singapore dollar = 51.011760 INR

So, 3000 INR =  $3000 / 51.011760 = 58.81$  Singapore dollar (approx..)

*For Chiko*

1 Japanese Yen = 0.640227 INR

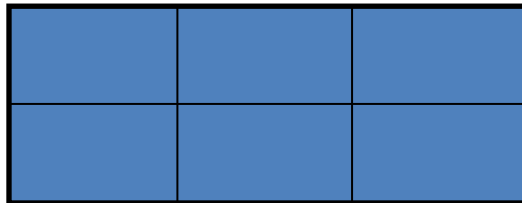
So, 1500 INR =  $1500 / 0.640227 = 2342.92$  Japanese Yen (approx..)



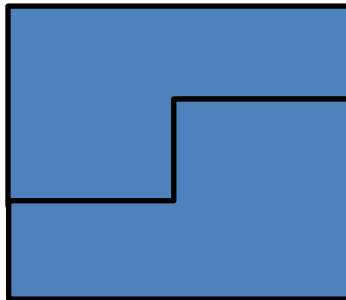
## 25. RECTANGLE ON SQUARE

### Answers:

1. Floor: Square shaped                      Carpet: Rectangular shape
2. Perimeter of Floor: 48 units              Perimeter of Carpet: 52 units
3. Area of Floor: 144 sq units              Area of carpet: 144 sq units              Areas of both are equal.
4. Yes
5. To cover the floor with carpet as there areas are same this can be done by making piece of carpet. Now to cover the floor we have to cut and join it so that length of carpet should be decrease from 18 units to 12 units and breadth should increase from 8 units to 12 units. So first mark the carpet along the length in three equal parts each of length 6 units and along the breadth in two parts each of 4 units. Now cut the carpet as per the following diagram.



Put the two pieces adjacent to each other as per following diagram.



6. Perimeter of each pieces of carpet =  $12 + 8 + 6 + 4 + 6 + 4 = 40$  units
7. Length of tape required to join two carpets =  $6 + 4 + 6 = 16$  units
8. Money required to buy the tape =  $16 \times \text{Rs } 5 = \text{Rs } 80$

Other Activity based on above:

1. If we have to cover the above floor with a rectangular carpet of length 16 units and breadth 9 units. Think and try is it possible?

## 26. REVOLVING DOOR

### Answer:

1. 120 (or Reflex angle 240)
2.  $100\pi/3$  cm
3. B
4.  $360/n$

## **27. SCOUT CAMP**

**NO ANSWERS AVAILABLE FOR QUESTION**

## **28. SPEED OF RACINGCAR**

**Answer:**

1. B. 1.5 km
2. C. at about 1.3km.
3. B. The speed of the car is increasing.
4. B

## **29. TRAVELLERS' PUZZLE**

**Answers:**

1. October and November  
(Students should be able to calculate the number of days, average, division and approximation.)
2. (c) 1700  
(Average and approximation of large numbers)
3. Time for each exhibit  $= \frac{4 \text{ hours} \times 60}{120}$   
 $= 2 \text{ min}$   
(Convert time in different units to same units and use data in practical application)

## **30. WAR PLANES**

**NO ANSWERS AVAILABLE FOR QUESTION**