1. $5\frac{1}{2} \div 2\frac{1}{2} =
(a) 2\frac{1}{2} 
(b) 2\frac{1}{2} 
(c) 2\frac{2}{3} 
(d) 13\frac{1}{2}$

2. 60% of 7% is
(a) 0.42% 
(b) 4.2% 
(c) 42% 
(d) 420%

3. 45 km per hour in metres per second is
(a) 12.5 
(b) 66 
(c) 75 
(d) 750

4. The volume in cm³ of a hemisphere of radius $\frac{1}{2}$ cm is
(a) $\frac{4\pi}{3}$ 
(b) $\frac{2\pi}{3}$ 
(c) $\frac{\pi}{4}$ 
(d) $\frac{\pi}{3}$

5. The fraction of the area of the rectangle taken up by the areas of the two circles is
(a) $\frac{1}{8}$ 
(b) $\frac{1}{4}$ 
(c) $\frac{1}{2}$ 
(d) $\frac{1}{3}$

6. If $(p, q) \neq (r, s)$, which one of the following is false?
(a) $(p, q) \in \mathbb{R}$ 
(b) $\vec{r} = q\vec{p}$ 
(c) $\vec{p} \neq q\vec{r}$ 
(d) $\vec{p} \neq q\vec{r}$

7. The lines $P, R, T, V$ form a square. Which one of the following compositions of axial symmetries maps the square on itself?
(a) $S_Q \circ S_V$ 
(b) $S_Q \circ S_U$ 
(c) $S_Q \circ S_T$ 
(d) $S_Q \circ S_P$

8. The composition of two central symmetries is
(a) a translation 
(b) a central symmetry 
(c) an axial symmetry 
(d) a projection

9. If $S_P \circ S_T \circ S_q = S_r$, which one of the following positions of $r$ is impossible?
(a) $r$ 
(b) $p$ 
(c) $q$ 
(d) $t$

10. The diagonals of a square meet at $k$ so that $S_k$, the central symmetry in $k$, maps the square onto itself. The domain of $S_k$ is
(a) the square itself 
(b) the square and its diagonals 
(c) the plane 
(d) all the couples having $k$ as centre
11. The point of concurrency of the perpendicular bisectors of the sides of any triangle is called the
   (a) centroid (b) incentre (c) circumcentre (d) orthocentre

12. q and r are fixed points and the locus of x is the circle of centre q and of radius 10. The length |xq| cannot be
   (a) 1 (b) 3 (c) $\sqrt{149}$ (d) 17

13. k is the centre of the circle of radius 7. If |kp| = x, then x is
   (a) $\sqrt{19}$ (b) $\sqrt{29}$ (c) $\sqrt{33}$ (d) $\sqrt{41}$

14. If $A \parallel B$, then 5 : 2 =
   (a) $(8 - x) : 8$ (b) $(8 + x) : 8$
   (c) $8 : (x - 8)$ (d) $8 : (8 - x)$

15. Which one of the following lines is perpendicular to $2x - 5y + 7 = 0$?
   (a) $2x + 5y + 7 = 0$ (b) $5x - 2y - 7 = 0$
   (c) $2x - 5y - 7 = 0$ (d) $5x + 2y + 7 = 0$

16. The image of the line $2y = 5 - 3x$ under the axial symmetry in the y-axis is
   (a) $3y = 2x - 5$ (b) $3y = 5 - 2x$
   (c) $2y = -5 - 3x$ (d) $2y = 5 + 3x$

17. p(-1, -5), q(-2, 1), r(2, 5), and s form the parallelogram pqrst. The coordinates of s are
   (a) (3, 0) (b) (3, -1) (c) (4, 0) (d) (4, 1)

18. The two lines $2y = x + 1$ and $3y - 2(x + 1) = 0$ meet on the x-axis where x is
   (a) 0 (b) $\frac{1}{2}$ (c) $\frac{1}{3}$ (d) -1

19. If $\cos A = 0.8841$ and $0 \leq A \leq 90^\circ$, then $A$ is
   (a) $27^\circ52'$ (b) $62^\circ8'$ (c) $27^\circ56'$ (d) $27^\circ4'$

20. $x =$
   (a) $\frac{5 \sin 70^\circ}{\sin 30^\circ}$ (b) $\frac{5 \sin 70^\circ}{\sin 80^\circ}$
   (c) $\frac{8 \sin 70^\circ}{\sin 30^\circ}$ (d) $\frac{5 \sin 70^\circ}{\sin 30^\circ}$
1. (a) Two cars $P$ and $Q$ were bought for £3950 and £3550, respectively. Car $P$ was sold at a profit of 14% while car $Q$ was sold at a loss of 12%. Calculate the overall percentage profit or loss.

(b) A solid cylinder of height $h$ is cut from a solid hemisphere of radius $r$. If the radius of the hemisphere is three times the radius of the base of the cylinder, find how many times is the volume of the hemisphere greater than the volume of the cylinder. Give your answer correct to the nearest integer.

2. $abc$ is an isosceles triangle in which $|ab| = |ac|$. Prove that $|Labc| = |Lacb|$. $d$ is a point in $[bc]$ such that $ad \perp bc$. Prove that $d$ is equidistant from $ab$ and $ac$.

Taking the axial symmetry in the bisector of $Lbad$, or otherwise, show, with proof, how to construct a point $q$ in $ab$ such that the distance of $q$ from $ad$ is the same as the distance of $d$ from $ab$.

3. Prove that the composition of two axial symmetries in perpendicular axes is a central symmetry.

The lines $L, M, N$ form an isosceles right angled triangle $pqr$.

Construct the image of $\Delta pqr$ under the composition of axial symmetries

$S_N \circ S_M \circ S_L$

and prove that the image of $q$ is the distance $|pr|$ from $q$.

4. Prove that the image of a circle under the axial symmetry in a line through its centre is the same circle.

From a point $k$ outside a circle of centre $c$ two tangents $kt_1$ and $kt_2$ are drawn to touch the circle at $t_1$ and $t_2$. Say why $c$ is on the bisector of the $\angle t_1kt_2$ and hence, or otherwise, prove that $t_1$ is the image of $t_2$ under the axial symmetry in $kc$.

OVER →
5. In a triangle $abc$, $\angle bac = 90^\circ$, $ad \perp bc$ and $d$ is a point in $[bc]$.
Prove $\angle dab = \angle dca$
and hence deduce that the triangles $abd$ and $abc$ are similar.
Prove that $|bd| \cdot |bc| = |ba|^2$ and deduce the Theorem of Pythagoras.

If $\angle pqr = 90^\circ$, as in the diagram,
show how to construct a rectangle $prxy$
which is equal in area to the square on $[pq]$.

6. $a(3, 4), b(-2, 1), c(5, -1)$ are three points.

(i) Find the slope of $ab$.
(ii) Find the equation of the line through $c$ which is parallel to $ab$.
(iii) Show that $\frac{9}{2}$ is the area of the triangle enclosed between the line
in (ii) and the two axes.
(iv) Find the coordinates of a point $p$ on the $y$-axis for which the area of
$\triangle apb$ is equal to the area in (iii).
(v) Let $ab$ cut the $y$-axis at $h$ and let $q$ be the image of $p$ under the
central symmetry in $h$. Prove that $\frac{40}{3}$ is also the area of the $\triangle apb$.

7. (a) Prove that the area of a triangle is
$$\frac{1}{2} \cdot a \cdot b \cdot \sin C$$
where $a, b, C$ have their usual meanings.

(b) 20 identical triangles are drawn in a circle
of centre $k$. Some of these triangles
are shown in the diagram. Calculate the
percentage of the area of the circle
occupied by the 20 triangles, giving your
answer correct to the nearest integer and
taking $\pi = 3.14$.

(c) The $\triangle pqr$ indicates the course sailed
by boats in a race.
Calculate, to the nearest integer, the
length of the course beginning and
ending at $p$. 

\[ \text{Diagram:} \]