Institute of Actuaries of India

ACET March 2021 Solutions

Mathematics

1. C. It is seen that $f(1) = f(2) = 2$; $f(x) \neq 2$ for any $x \in R\backslash\{1,2\}$ since a quadratic equation cannot have more than two solutions.
Hence the pre-image of {2} is {1,2}.

2. D. Given that $f(n) - f(n-1) = \frac{1}{2}$. Summing both sides of these equations from $n = 2$ to 51, we have $f(51) - f(1) = \frac{50}{2} = 25$. Since $f(1) = 2$, we can conclude $f(51) = 25 + 2 = 27$.
(Alternatively, the sequence $f(n)$ can also be seen as an AP with common difference $\frac{1}{2}$ and first term 2. The 51st term turns out to be 27.)

3. C. $\cos^{-1}\left(\frac{1}{2}\right) + 2\sin^{-1}\left(\frac{1}{2}\right) = \frac{\pi}{3} + 2\frac{\pi}{6} = \frac{2\pi}{3}$.

4. B. Given that $4x^2 + x - 3 > 0$, we have $4x(x+1) - 3(x+1) > 0$. Therefore,
$(x+1)(4x-3) > 0 \Rightarrow (x+1)$ and $(4x-3) > 0$ *or* $(x+1)$ and $(4x-3) < 0$
$$\Rightarrow x > -1 \text{ and } x > \frac{3}{4} \text{ or } x < -1 \text{ and } x < \frac{3}{4} \Rightarrow x > \frac{3}{4} \text{ or } x < -1.$$

5. B. $\log_{15} 81 = \log_{15} 3^4 = 4\log_{15} 3 = 4\log_{15}\frac{15}{5} = 4(\log_{15} 15 - \log_{15} 5) = 4(1-a)$.

6. D. After resolving the summand into partial fractions, the limit simplifies as follows.
$$\lim_{n\to\infty}\sum_{k=1}^{n}\frac{1}{k(k+2)} = \lim_{n\to\infty}\sum_{k=1}^{n}\left[\frac{1}{2k} - \frac{1}{2(k+2)}\right]$$
$$= \lim_{n\to\infty}\left[\left(\frac{1}{2} + \frac{1}{4} + \frac{1}{6} + \cdots + \frac{1}{2n}\right) - \left(\frac{1}{6} + \frac{1}{8} + \cdots + \frac{1}{2((n-1)+2)} + \frac{1}{2(n+2)}\right)\right]$$
$$= \lim_{n\to\infty}\left[\left(\frac{1}{2} + \frac{1}{4}\right) - \left(\frac{1}{2((n-1)+2)} + \frac{1}{2(n+2)}\right)\right] = \frac{3}{4}.$$

7. A. Given that α and β are the roots of the equation $3x^2 - 6x + 1 = 0$,
$\alpha + \beta = 2$; $\alpha\beta = \frac{1}{3}$. Now $\frac{1}{\alpha^2} + \frac{1}{\beta^2} = \frac{\alpha^2+\beta^2}{\alpha^2\beta^2} = \frac{(\alpha+\beta)^2 - 2\alpha\beta}{(\alpha\beta)^2} = \frac{4-\frac{2}{3}}{\frac{1}{9}} = \frac{10}{3} \times 9 = 30$,
and $\frac{1}{\alpha^2} \times \frac{1}{\beta^2} = \frac{1}{\alpha^2\beta^2} = \frac{1}{(\alpha\beta)^2} = 9$. The required equation is: $x^2 - (\text{sum of the roots})x + \text{product of the roots} = 0$, i.e., $x^2 - 30x + 9 = 0$.

8. C. General term: $T_{r+1} = \binom{n}{r} x^r; r = 0,1,2, \dots, n$.

Fifth term: $T_5 = \binom{n}{4} x^4$; Fourth term: $T_4 = \binom{n}{3} x^3$; Third term: $T_3 = \binom{n}{2} x^2$.

The condition $T_5 = 4T_4$ implies $\binom{n}{4} x^4 = 4\binom{n}{3} x^3$

and $T_4 = 6T_3$ implies $\binom{n}{3} x^3 = 6\binom{n}{2} x^2$.

Thus, we have $\frac{\binom{n}{4}}{\binom{n}{3}} = \frac{4}{6}\frac{\binom{n}{3}}{\binom{n}{2}} \Rightarrow \frac{n-3}{4} = \frac{2}{3}\frac{n-2}{3} \Rightarrow 9n - 27 = 8n - 16 \Rightarrow n = 11$.

9. A.

x	$f(x)$	First order	Second order	Third order
2	4	$\frac{56-4}{4-2} = 26$	$\frac{131-26}{9-2} = 15$	$\frac{23-15}{10-2} = 1$
4	56	$\frac{711-56}{9-4} = 131$	$\frac{269-131}{10-4} = 23$	
9	711	$\frac{980-711}{10-9} = 269$		
10	980			

10. D. Given that: $f(x) = \frac{1}{1+X}$; $h = \frac{1}{2}$.

x	0	1/2	1
$f(x)$	1	2/3	1/2

The value of the integral using Simpson's one-third rule:

$$I = \frac{h}{3}\left[f(0) + f(1) + 4f\left(\frac{1}{2}\right)\right] = \frac{1}{6}\left[1 + \frac{1}{2} + 4\left(\frac{2}{3}\right)\right] = \frac{25}{36}.$$

11. C. The maximum value of $\sin x$ is 1 and hence the maximum value of $f(x) = 4\,\sin x + 3\cos x = 5\sin(x + \theta)$, where $\theta = \cos^{-1}\frac{4}{5}$, is 5.

12. D. The curve $y = ax^3 + bx^2 + cx + d$ has an inflexion point at $x = 1$ implies $\frac{d^2y}{dx^2} = 0$ at $x = 1$.

$\frac{dy}{dx} = 3a\,x^2 + 2bx + c$ and $\frac{d^2y}{dx^2} = 6ax + 2b = 0\ at\ x = 1$ implies $3a + b = 0$.

13. A. Let $y = \log(x + \sin x)$ and $t = x + \cos x$. Then,

$\frac{dy}{dx} = \frac{1}{x+\sin x}\ (1+\cos x)$ and $1 = \frac{dx}{dt} - \sin x \frac{dx}{dt}$.
Hence, $\frac{dy}{dt} = \frac{dy}{dx} \cdot \frac{dx}{dt} = \frac{1+\cos x}{(x+\sin x)} \times \frac{1}{(1-\sin x)}$.

14. B.

$$\int x \log 2x \ dx = \int \log 2x \, d\left(\frac{x^2}{2}\right) = \frac{x^2}{2}\log 2x - \int \frac{x^2}{2} d(\log 2x)$$
$$= \frac{x^2}{2}\log 2x - \int \frac{x^2}{2}\frac{2}{2x} dx = \frac{x^2}{2}\log 2x - \frac{x^2}{4} + \text{constant.}$$

15. A. Let $f(x) = \log\left(\frac{5-x}{5+x}\right)$. Then $f(-x) = \log\left(\frac{5+x}{5-x}\right) = \log(5+x) - \log(5-x) = -[\log(5-x) - \log(5+x)] = -\log\left(\frac{5-x}{5+x}\right) = -f(x)$.
The integrand is an odd function. The value of the integral is 0.

16. C.
Put $\tan^{-1} x = t \Rightarrow \frac{1}{1+x^2} dx = dt$. When $x = 0, t = 0$ and $x = 1, t = \frac{\pi}{4}$. Hence,
$\int_0^1 \frac{\tan^{-1} x}{1+x^2} dx = \int_0^{\pi/4} t dt = \left.\frac{t^2}{2}\right|_0^{\pi/4} = \frac{\pi^2}{32}$.

17. D. In order that $\vec{a}$ and $\vec{b}$ are perpendicular to each other, $\vec{a} \circ \vec{b} = 0$.
That is, $(2\vec{\imath} + 3\vec{\jmath} + 4\vec{k})\circ(3\vec{\imath} + 2\vec{\jmath} - \mu\vec{k}) = 0$
$\Rightarrow (2 \times 3) + (3 \times 2) + (4 \times (-\mu)) = 0 \Rightarrow 4\mu = 12 \ \Rightarrow \ \mu = 3$.

18. D. If the three vectors are coplanar, then there must be a nontrivial vector that is perpendicular to all three of them. Let such a vector be $\alpha\vec{\imath} + \beta\vec{\jmath} + \gamma\vec{k}$. The given condition implies $a\alpha + \beta + \gamma = \alpha + b\beta + \gamma = \alpha + \beta + c\gamma = 0$. By subtracting the first expression from the second, we have $(1-a)\alpha + (b-1)\beta = 0$, i.e., $(1-a)\alpha = (1-b)\beta$. Likewise, from another pair of expressions we obtain the condition $(1-a)\alpha = (1-b)\beta = (1-c)\gamma$. Thus, α, β and γ must be in proportion with $\frac{1}{1-a}, \frac{1}{1-b}$ and $\frac{1}{1-c}$, respectively.

19. A.
Given that the matrix $A = \begin{bmatrix} a & 0 & 0 \\ 0 & b & 0 \\ 0 & 0 & c \end{bmatrix}$ $(a, b, c \neq 0)$.
Now, $\det A = abc$. The cofactors: $A_{11} = bc \quad A_{12} = 0 \quad A_{13} = 0$
$A_{21} = 0 \quad A_{22} = ac \quad A_{23} = 0$
$A_{31} = 0 \quad A_{32} = 0 \quad A_{33} = ab.$

$$Adj\ A = \begin{bmatrix} bc & 0 & 0 \\ 0 & ac & 0 \\ 0 & 0 & ab \end{bmatrix}.$$

Hence, $A^{-1} = \frac{1}{abc}\begin{bmatrix} bc & 0 & 0 \\ 0 & ac & 0 \\ 0 & 0 & ab \end{bmatrix} = \begin{bmatrix} a^{-1} & 0 & 0 \\ 0 & b^{-1} & 0 \\ 0 & 0 & c^{-1} \end{bmatrix}$.

20. B. Given matrix is $A = \begin{bmatrix} 1 & 2 & 3 \\ 1 & 4 & 2 \\ 2 & 6 & 5 \end{bmatrix}$; $\det A = 0$.

But every minor of order 2 is not zero. Hence, the rank of A is 2.

Statistics

21. A. Five digit numbers can be formed using digits 0, 2, 3, 4, 6 or by using digits 0, 3, 4, 6, 8 since sum of digits in these cases is divisible by 3.
Number of 5 digit numbers that can be formed using 0, 2, 3, 4, 6 $= 4 \times 4! = 96$.
Number of 5 digit numbers that can be formed using 0, 3, 4, 6, 8 $= 4 \times 4! = 96$.
Total number of numbers = 96+96 = 192.

22. C. If she answer 3 questions of the first 4 questions, then she can choose these 3 questions in $\binom{4}{3} = 4$ ways and she can choose other 3 questions from the remaining 4 questions in 4 ways. So she can choose the 6 questions in $4 \times 4 = 16$ ways.
If she answers all the first 4 questions, then she can choose the other 2 question from the last 4 questions in $\binom{4}{2} = 6$ ways.
So she has a total of 16+6 = 22 ways.

23. D. $P(A^c|B^c) = \frac{P(A^c \cap B^c)}{P(B^c)}$. $P(A^c \cap B^c) = P((A \cup B)^c) = 1 - P(A \cup B)$.
$P(A \cup B) = P(A) + P(B) - P(A \cup B) = \frac{1}{2} + \frac{1}{3} - \frac{1}{4} = \frac{7}{12}$.
$P(A^c \cap B^c) = 1 - \frac{7}{12} = \frac{5}{12}$, $\quad P(B^c) = 1 - \frac{1}{3} = \frac{2}{3}$. $P(A^c|B^c) = \frac{5}{12} \times \frac{3}{2} = \frac{5}{8}$.

24. B. Let A be the event that a new worker will meet the production quota, and B be the event that a new worker has attended the training programme.
Given that $P(A|B) = 0.8$, $P(A|B^c) = 0.5$, $P(B) = 2/3$,
$P(A) = P(A|B)P(B) + P(A|B^c)P(B^c) = 0.8 \times \frac{2}{3} + 0.5 \times \frac{1}{3} = 0.7$.

25. B. Let the two numbers be a and b ($> a$).
Mean $= \frac{a+b}{2}$. Second central moment $= \frac{1}{2}\left[\left(a - \frac{a+b}{2}\right)^2 + \left(b - \frac{a+b}{2}\right)^2\right] = \frac{(a-b)^2}{4}$.
So $\frac{a+b}{2} = 8$ and $\frac{b-a}{2} = 2$. This implies $a = 6$ and $b = 10$.

26. D. A. Coefficient of variation (CV) $= 100 \times \frac{s}{\bar{x}}$. $CV_A = 100 \times \frac{s}{\bar{x}_A}$ and $CV_B = 100 \times \frac{s}{\bar{x}_B}$.
Given that $\bar{x}_A < \bar{x}_B$. So $CV_A > CV_B$
B. $Q_3 = 130$ and $Q_2 = 112$. Since the distribution is symmetric, Median $= \frac{Q_3+Q_1}{2}$
So $Q_1 = 2 \times 112 - 130 = 94$. Interquartile range $= Q_3 - Q_1 = 130 - 94 = 36$.
C. If $y = a + bx$, then $sd(y) = |b|.sd(x)$
D. The highest value 68.2 is changed to 168.2
$\bar{x}_{new} = \frac{\bar{x}_{old} \times 50 + (168.2 - 68.2)}{50} = \bar{x}_{old} + \frac{100}{50}$, Mean increases by 2.

27. B. Mean = $(0 \times 1 + 1 \times \binom{n}{1} + 2 \times \binom{n}{2} + \cdots + n \times \binom{n}{n})/N$.
$N = 1 + \binom{n}{1} + \binom{n}{2} + \cdots + \binom{n}{n} = 2^n$.
$1 \times \binom{n}{1} + 2 \times \binom{n}{2} + \cdots + n \times \binom{n}{n} = n2^{n-1}$.
Mean = $\frac{n2^{n-1}}{2^n} = \frac{n}{2}$.

28. A. Mean of the numbers = $\frac{\left(a+b+\frac{(n-2)(a+b)}{2}\right)}{n} = \frac{a+b}{2}$.
Mean deviation about mean = $\frac{1}{n}\left(\left|a - \frac{a+b}{2}\right| + \left|b - \frac{a+b}{2}\right| + (n-2)\left|\frac{a+b}{2} - \frac{a+b}{2}\right|\right) = \frac{|a-b|}{n}$.

29. D. $P(H) = 2P(T)$. $P(H) + P(T) = 1$ implies $P(H) = 2/3$ and $P(T) = 1/3$.
$X \sim Binomial\left(3, \frac{2}{3}\right)$.
$P(1 < X \leq 3) = P(X = 2) + P(X = 3) = \binom{3}{2} \times \left(\frac{2}{3}\right)^2 \times \frac{1}{3} + \binom{3}{3} \times \left(\frac{2}{3}\right)^3 = \frac{20}{27}$.

30. B. $P(X = -1) + P(X = 0) + P(X = 1) = 1$
$\Rightarrow P(X = -1) + P(X = 1) = 1 - P(X = 0) = 1 - \frac{1}{4} = \frac{3}{4}$.
$E(X) = -1 \times P(X = 0) + 0 \times P(X = 0) + 1 \times P(X = 1) = - P(X = -1) + P(X = 1) = \frac{1}{4}$.
Solving we get, $P(X = -1) = \frac{1}{4}$ and $P(X = 1) = \frac{1}{2}$.
$E(X^2) = (-1)^2 \times \frac{1}{4} + 0 \times \frac{1}{4} + 1^2 \times \frac{1}{2} = \frac{1}{4} + \frac{1}{2} = \frac{3}{4}$.
Var$(X) = E(X^2) - \left(E(X)\right)^2 = \frac{3}{4} - \left(\frac{1}{4}\right)^2 = \frac{11}{16}$.

31. D. Let X denote the number of defects in a 10-square-foot sheet of the metal.
$X \sim$ Poisson(λ), where $\lambda = \frac{2}{5} \times 10 = 4$. Find $P(X \leq 2)$.
$P(X \leq 2) = P(X = 0) + P(X = 1) + P(X = 2) = e^{-4} + 4.e^{-4} + \frac{4^2}{2!}e^{-4} = 13e^{-4}$.

32. D. A. $P(X = x) = \frac{1}{6}$, for $x = 1, 2, \ldots, 6$.
$E(X) = \frac{1}{6}(1 + 2 + 3 + 4 + 5 + 6) = \frac{7}{2} = 3.5$.
B. $E\left(X - E(X)\right)^2 \geq 0$. $E\left(X - E(X)\right)^2 = E(X^2) - \left(E(X)\right)^2$.
So $E(X^2) \geq \left(E(X)\right)^2$.
C. $E(X - a)^2 = E(X^2) - 2aE(X) + a^2$. Therefore, $\frac{d}{da}E(X - a)^2 = -2E(X) + 2a = 0 \Rightarrow a = E(X)$. But this is a minima, since the second derivative is 2 (>0).

D. $P(X = x) = \frac{1}{6}, x = 2, 3, 5, 7, 9, 10$. $P(|X - 8| < 4) = P(-4 < X - 8 < 4) = P(4 < X < 12) = P(X = 5) + P(X = 7) + P(X = 9) + P(X = 10) = \frac{4}{6} = \frac{2}{3}$.

33. B. Cumulative distribution function $F(x) = 1 - e^{-x} - xe^{-x}$.
Probability density function $f(x) = xe^{-x}$.
$f'(x) = e^{-x} - xe^{-x}$, $f'(x) = 0 \Rightarrow x = 1$.
$f''(x) = -2e^{-x} + xe^{-x}$ $\quad f''(1) = -e^{-1} < 0$. Mode is 1.

34. C. $X \sim N(\mu, \sigma^2)$.
$P(\mu - 2\sigma < X < \mu + 2\,\sigma) = P\left(\frac{\mu-2\sigma-\mu}{\sigma} < \frac{(X-\mu)}{\sigma} < \frac{\mu+2\,\sigma-\mu}{\sigma}\right) = P(-2 < Z < 2)$, $Z \sim N(0, 1)$. So $P(\mu - 2\sigma < X < \mu + 2\,\sigma)$ does not depend on the values of μ and σ.
$P(\mu < X < \mu + 2\sigma) = P(0 < Z < 2)$ – does not depend on the values of μ and σ.

35. A. The area of the rectangle = $X(1 - X)$.
Expected area of the triangle = $E\big(X(1 - X)\big) = E(X) - E(X^2)$.
$E(X) = \int_0^1 x.3x^2\,dx = \frac{3}{4}$=0.75 and $E(X^2) = \int_0^1 x^2.3x^2 dx = \frac{3}{5} = 0.6$.
So expected area of the rectangle = 0.75-0.6 = 0.15.

36. C. $f(x) = \frac{3}{7}\exp\left(-\frac{3}{7}x\right),\ x > 0$.
$P\left[X \geq \frac{17}{5} \middle| X \geq 2\right] = \frac{P\left[X\geq\frac{17}{5},\ X\geq 2\right]}{P[X\geq 2]} = \frac{P\left[X\geq\frac{17}{5}\right]}{P[X\geq 2]} = \exp\left[-\frac{3}{7} \times \frac{17}{5}\right] / \exp\left[-\frac{3}{7} \times 2\right] = \exp\left[-\frac{3}{7}\left(\frac{17}{5} - 2\right)\right] = \exp\left(-\frac{3}{5}\right)$.

37. A. $Corr\ (X, Y) = Corr(X, X^2) = \frac{E(X^3)-E(X)E(X^2)}{\sqrt{Var(X).Var(X^2)}}$.
$X \sim N(0, 1),\ E(X) = 0,\ E(X^2) = 1, E(X^3) = 0$.
So $Corr(X, Y) = 0$.

38. A. $\sum_{x=1}^{3}\sum_{y=1}^{3} kxy = 1$. Therefore $k + 2k + 3k + 2k + 4k + 6k + 3k + 6k + 9k = 1$, i.e., $k = \frac{1}{36}$.

39. D. A. $\text{Corr}(X,\ Y) = \text{Cov}(X, Y)/\sqrt{\text{Var}(X)\text{Var}(Y)}$. $\text{Corr}(-X, -Y) = \frac{Cov(-X,-Y)}{\sqrt{Var(-X)Var(-Y)}} = \frac{Cov(X,Y)}{\sqrt{Var(X)Var(Y)}} = \text{Corr}(X,\ Y) > 0$.
B. $\text{Var}(X - Y) = \text{Var}(X) - 2\text{Cov}(X, Y) + \text{Var}(Y)$. As X and Y are independent, $\text{Cov}(X, Y) = 0$. So $\text{Var}(X - Y) = \text{Var}(X) + \text{Var}(Y)$.
C. $\text{Corr}(X, X - Y) = \text{Cov}(X, X - Y)/\sqrt{\text{Var}(X)\text{Var}(X - Y)}$. $\text{Cov}(X, Y) = 0$ as X

and Y are uncorrelated. $\text{Cov}(X, X-Y) = Var(X) - Cov(X,Y) = Var(X) = \sigma_x^2$. $\text{Var}(X-Y) = \text{Var}(X) + \text{Var}(Y) = \sigma_x^2 + \sigma_y^2$ (Since X and Y are uncorrelated). $\text{Corr}(X, X-Y) = \frac{\sigma_x^2}{\sqrt{\sigma_x^2(\sigma_x^2+\sigma_y^2)}} = \sigma_x/\sqrt{\sigma_x^2 + \sigma_y^2}$.

D. $\text{Corr}(X+Y, X-Y) = \text{Cov}(X+Y, X-Y)/\sqrt{\text{Var}(X+Y)\text{Var}(X-Y)}$. $\text{Cov}(X+Y, X-Y) = Var(X) - Cov(X,Y) + Cov(X,Y) - Var(Y)$. If $\text{Var}(X) = \text{Var}(Y)$, $\text{Cov}(X+Y, X-Y) = 0$. Then $X+Y$ and $X-Y$ are uncorrelated.

40. C. The regression lines intersect at $(\bar{x}, \bar{y})$. By solving lines $x + 4y + 3 = 0$ and $4x + 9y + 5 = 0$, we get $\bar{x} = 1$ and $\bar{y} = -1$.

Data Interpretation

41. A. The percentage of death is the second smallest in the year 2014.

42. A. The percentage of death less than 6% in the years 2014, 2015 and 2016.

43. B. The percentage of time intervals having more than 3 calls is $\frac{50+40+25+4}{250} \times 100 = 48$.

44. D. The highest frequency (55) is of 3. Therefore, the mode is 3.

Year	Number of Permanent workers	Percentage of total workers		Total	No. of casual workers
		Permanent	Casual		
2008	320	80	20	400	80
2009	336	80	20	420	84
2010	351	78	22	450	99
2011	345	75	25	460	115
2012	336	70	30	480	144
2013	340	68	32	500	160
2014	338	65	35	520	182
2015	377	65	35	580	203
2016	372	62	38	600	228

To answer the questions, find total number of workers and total number of casual workers in each year.

45. C. The percentage increase of total workers from 2008 to 2016 is

$$\frac{600-400}{400} \times 100 = 50\%.$$

46. C. Calculate percentages for the years from 2009 to 2016. The maximum percentage (25.22) occurred in 2012.

47. D. Calculate the difference between permanent and casual workers in each year. The minimum is 144 in the year 2016.

48. C. The percentage increase of casual workers from 2008 to 2016 is

$$\frac{228-80}{80}\times 100 = 185\%.$$

In order to answer 49, 50 and 51, we have the following information from the graph.
Tea production of C1 is just below 600 in 2010 but slightly above 600 in 2011
Tea production of C2 is slightly higher than 200 in 2010 and less than 250 in 2011
Tea production of C3 is 300 in 2010 and slightly less than 350 in 2011
Tea production of C4 is slightly more than 100 in 2010 and just more than 100 in 2011
Tea production of C5 is about 200 in 2010 and around 210 in 2011 as total is more than 400.
Tea production of C6 is slightly more than 100 in 2010 and more than 100 in 2011.
Tea production of C7 is just below 100 in 2010 and more than 100 in 2011.

49. A. The percentage increase must be minimum for C1.

50. D. Country C7 had tea production less than 100 million kg.

51. C. The total production in 2010 must be near to (600+200+300+100+200+100+100) = 1600.

English

52. C.
53. C.
54. A.
55. B.
56. C.
57. A.
58. C.
59. D.
60. A.
61. B.
62. B.

Logical reasoning

63. B. People who have come for both = 80.
People who have only for shopping: 140-80 = 60.
People who have come only for eating = 120-80 = 40.
So people who have come for atleast one = 80+60+40 = 180.
People who have come for neither = 200-180= 20.

64. C.

65. B. 8.30 = 8 hour 30 minutes =8 ½ hour = 17/2 hour.
Angle traced by hour hand in 12 hours = 360°.
Hence angle traced by hour hand in 17/2 hour =360/12×17/2 =255°.
Angle traced by minute hand in 60 minutes = 360°.
Angle traced by minute hand in 30 minutes =360/60×30=180°.
Required angle = 255- 180= 75°.

66. A. Since no cactus is a peanut, and some cactuses are almonds, these almonds cannot be peanuts. Thus, I is true.
If some cactuses had been cashew nuts, they would have been peanuts too, contradicting the second statement. Thus, II is false.

67. D. Cub, Foal and Calf are young ones of lion, horse and cow. The young one of cat is called kitten.

68. D. 2016 is a leap year. So any reusable year must be a leap year as well. So the number of years must be divisible by 4.
A four year period has, including one leap day, $4 \times 365 + 1 = 1461$ days. Divide by 7 and we get that a four year period is 208 weeks and 5 days.
After $4k$ years the calendar will be $5k$ days ahead. If 5k is a multiple of 7 (and only if 5k is a multiple of 7) the calendar will be starting on the same day.
The smallest possible (positive) value for k to be so that 5k is divisible by 7 is if $k = 7$.
So $4k = 4 \times 7 = 28$ is the shortest period before the calendar will be good again for a leap year.
So the year which had the same calendar as 2016 was 28 years back i.e, 1988.

69. B.

70. D. C, M, Z and J are females.