TSSM
Creating VCE Success

2024 Trial Examination

Letter

STUDENT NUMBER

GENERAL MATHEMATICS
Units 3 & 4 – Written examination 1

Reading time: 15 minutes
Writing time: 1 hour and 30 minutes

MULTIPLE-CHOICE QUESTION BOOK

Number of questions	Number of questions to be answered	Number of marks
40	40	40
		Total 40

- Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners and rulers, one bound reference, one approved graphics calculator or approved CAS calculator or CAS software and, if desired, one scientific calculator.
- Students are NOT permitted to bring into the examination room: blank sheets of paper and/or white out liquid/tape.

Materials supplied
- Question book of 20 pages.
- Multiple Choice answer sheet

Instructions
- Print your name in the space provided on the top of this page.
- All written responses must be in English.

Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic communication devices into the examination room.

SECTION A – Data analysis & Recursion and financial modelling

Instructions
Answer **all** questions in pencil on the answer sheet provided for multiple-choice questions.
Choose the response that is **correct** for the question.
A correct answer scores 1; an incorrect answer scores 0.
Marks will **not** be deducted for incorrect answers.
No marks will be given if more than one answer is completed for any question.
Unless otherwise indicated, the diagrams in this book are **not** drawn to scale.

Data analysis

Question 1

A relationship between two variables is displayed using a parallel box plot.

One of the variables is *month of the year* (January, February, March,…).

The other variable could be

A. *daily UV index* (high, medium, low)

B. *monthly rainfall* (in centimetres)

C. *daily rainfall* (low, medium, high)

D. *daily sunlight hours* (in hours)

E. *daily moon type* (waning crescent, waxing gibbous,…)

Question 2

The mean *weekly sales* of a company, for a particular year, is found to be $240 000.

The sales for a particular week in this year is $180 000 and the standardised sales for this chosen week is -0.85.

The standard deviation of weekly sales for this year is closest to

A. $200 000

B. $70 588

C. $20 600

D. $15 680

E. $60 000

Question 3

The following information relates to the variable *test scores* (in %) of a large cohort of students.

$Median = 57\%, \ Q_1 = 31\%, \ Q_3 = 58\%, \ Maximum = 99\%$

Which of the following is not true about *test scores* (in %)?

A. A score of 99% in this test is considered to be an outlier.

B. There are 50% students with a tests core below 57%.

C. At least 75% of students achieved a score of at least 31%.

D. The minimum score in this test must be less than 31%.

E. 25% of students scored between 58% and 99% in this test.

Use the following information to answer Questions 4 and 5

The dot plot below shows the number of practice tests completed by 30 students before the exam.
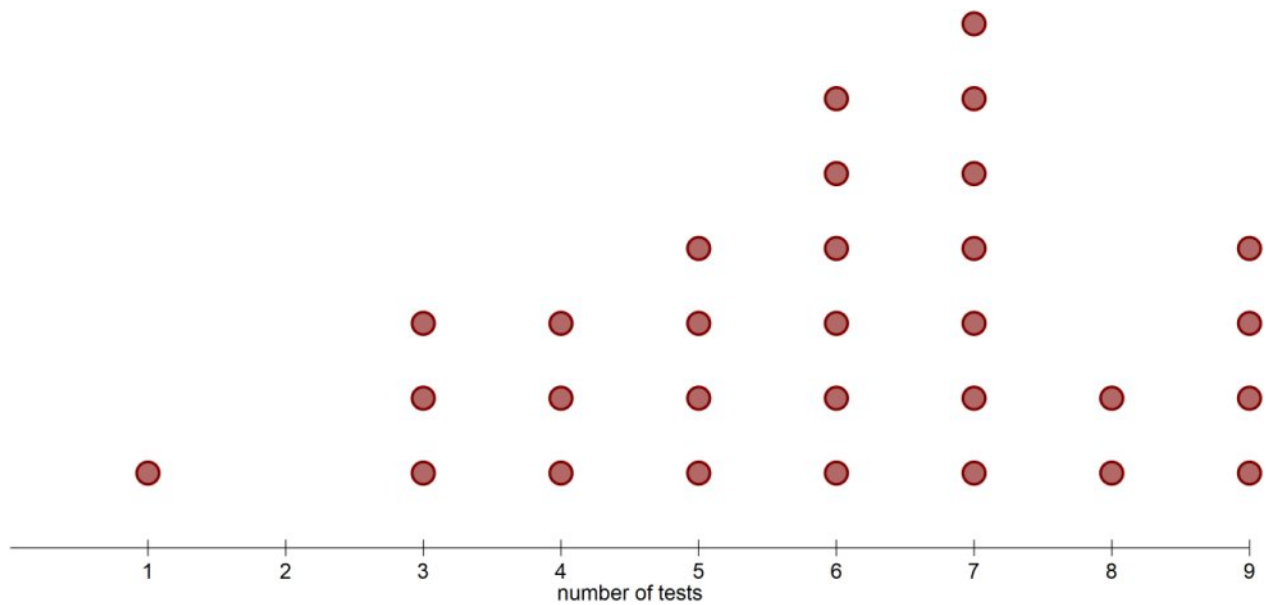
Question 4

The median number of practice tests of these 30 students is

A. 4

B. 5

C. 6

D. 7

E. 9

TURN OVER

Question 5

The shape of this distribution is best described as

A. positively skewed with an outlier.

B. negatively skewed.

C. negatively skewed with an outlier.

D. approximately symmetric.

E. approximately symmetric with an outlier.

Question 6

The time spent by students at a career expo is approximately normally distributed with a mean of 180 minutes and standard deviation of 24 minutes.

1800 students are expected to visit the expo.

Using the 68-95-99.7% rule, the number of these students who are expected to spend between 132 and 228 minutes is

A. 1224

B. 1467

**C.** 1509

D. 1710

E. 1795

Question 7

The mean number of milk bottles sold at a milk store from Monday to Saturday is 24.

How many bottles of milk are sold on Sunday so that the mean number of milk bottles sold over seven days is 25?

A. 25

B. 31

C. 32

D. 33

E. 34

Question 8

The histogram below displays the distribution of sales, in hundreds of dollars, of a clothing store.

The histogram is drawn on a logarithmic (base 10) scale.
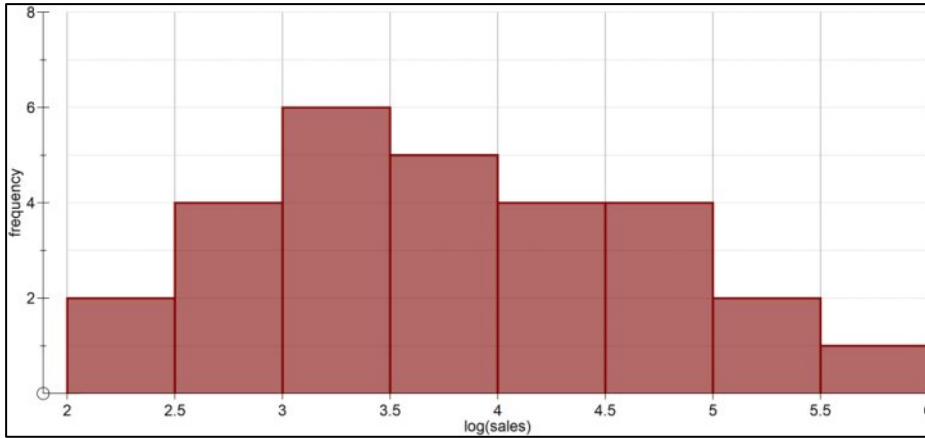
The modal class interval of the sales at this store is closest to

A. $100000 − $316228

B. $1000000 − $316228

C. $100000 − $1000000

D. $300 − $350

E. $3000 − $3500

Use the following information to answer Questions 9 and 10

A least squares regression line has been fitted to the data involving the variables *volume of sand* (in m^3) and *height of sand fill in container* (in m).

The equation of the line is

$$height = 0.1203 + 0.4316 \times volume$$

Question 9

Which of the following statements is evident from the equation of the line above?

A. There is a strong association between *height* and *volume*.

B. On average, the height increases by 0.4316m with each additional m^3 of volume.

C. The intercept of the line correct to three significant figures is 0.12.

D. Predicting the height given the volume of the container is 5m^3 is an example of interpolation.

E. The coefficient of correlation, *r*, for this association is such that $0 \leq r \leq 1$.

TURN OVER

Question 10

It is also known that the height of the container when the volume is $2.1m^3$ is 1.03m.

When the least squares line is used to predict the height with a volume of $2.1m^3$, the residual, in metres, is closest to

A. 0.003

B. -0.003

C. 1.07

D. -1.07

E. 0.465

Use the following information to answer Questions 11 and 12

The data in the table below was collected in a study of the association between having symptoms of skin disease (yes, no) and level of exposure to sun (none, limited, high) that is expected to cause skin problems to trade workers in a company.

Five hundred people were surveyed.

Symptoms	Level of exposure		
	Low	**Medium**	**High**
yes	15	34	181
no	70	82	118

Question 11

The percentage of the workers with *symptoms* of skin disease in this study is

A. 0%

B. 17%

C. 46%

D. 56%

E. 83%

Question 12

Which of the following statements supports the contention that increasing exposure of workers to sun is associated with having *symptoms* of skin disease?

A. 78.7% of those with *symptoms* had a high level of exposure to sun.

B. 14.8% of those with *symptoms* had a low level of exposure to sun.

C. 25.9% of those without *symptoms* had low exposure to sun.

D. The percentage of workers with *symptoms* increased from 6.5% to 14.8% to 78.7% as the level of exposure increased from low, to medium, to high.

E. The percentage of workers with *symptoms* increased from 25.9% to 30.4% to 43.7% as the level of exposure increased from low, to medium, to high.

Question 13

The scatterplot displaying *age*, in years, and *weight*, in kg, of 12 koalas is found to be non-linear.

The scatterplot is linearised using a logarithmic (base 10) transformation applied to the variable *age*.

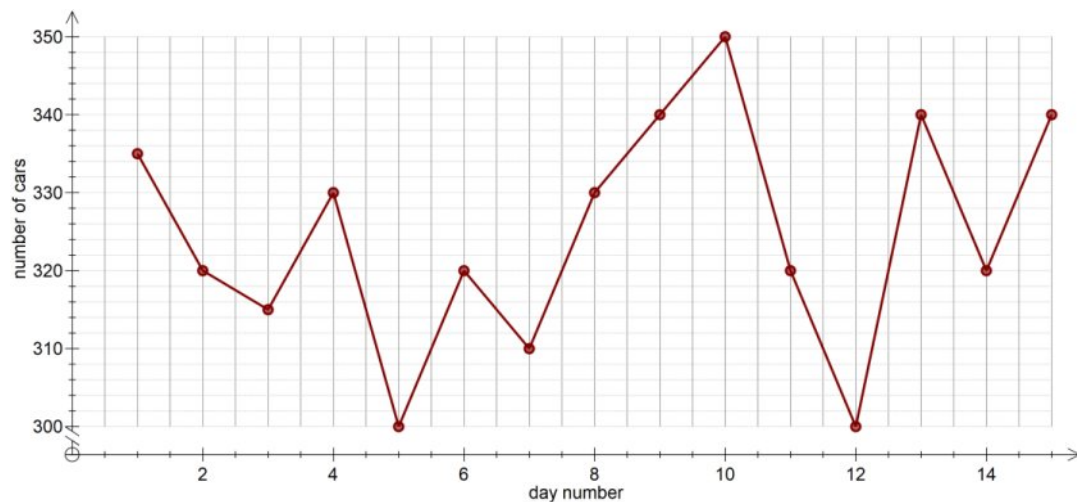The equation of the least squares line is

$$weight = -2.7 + 15.6 \times log_{10}(age)$$

Using this equation, the *age*, in years, of a koala with a weight of 11.2kg is closest to

A. 7.8

B. 74

C. 173

D. 180

E. 184

Use the following information to answer Questions 14 and 15

The following graph shows the number of cars parked each day in a parking lot for 15 consecutive days.

Question 14

The time series is smoothed using seven- median smoothing.

The smoothed value for day number 7 is

A. 310

B. 320

C. 330

D. 340

E. 350

TURN OVER

Question 15

The median number of cars parked over the 15-day period is

A. 310

B. 320

C. 330

D. 340

E. 350

Question 16

The number of visitors each month to a theme park is seasonal.

To correct the number of visitors in February for seasonality, the actual number of visitors is increased by 33%.

The seasonal index for that month is closest to

A. 0.54

B. 0.61

C. 0.65

D. 0.75

E. 0.80

Recursion and financial modelling

Question 17

A sequence of numbers is generated by the recurrence relation shown below.

$$K_0 = 6, \qquad K_{n+1} = 1 - K_n$$

The value of K_2 is

A. -6
B. -5
C. -4
D. 5
E. 6

Use the following information to answer Questions 18 and 19

Nysa purchases a water dispensing machine for $8000 and depreciates its value using the unit cost method.

The rate of depreciation is $0.02 per cup of water dispensed.

A recurrence relation that models the year-to-year value D_n, in dollars, of the machine is

$$D_0 = 8\ 000, \qquad D_{n+1} = D_n - 48$$

Question 18

The number of cups dispensed by the per year is

is

A. 160
B. 2400
C. 4800
D. 7952
E. 16 000

Question 19

A rule for D_n, the value of the machine after n years is

A. $D_n = 8000 - 48n$
B. $D_n = 8000 + 0.02n$
C. $D_n = 8000 - 0.02n$
D. $D_n = 48 - 0.02n$
E. $D_n = 48 + 0.02n$

TURN OVER

Use the following information to answer Questions 20 and 21

For taxation purposes, Danny depreciates the value of her $45 000 car over an eight-year period. At the end of eight years, the value of the car is $9 000.

Question 20

Using the flat rate depreciation model, the depreciation rate, per annum is

A. 8%

B. 10%

C. 25%

D. 33%

E. 36%

Question 21

The value of the car after six years, using the reducing balance depreciation model is closest to

A. $6000

B. $13 462

C. $19 371

D. $23 915

E. $27 000

Use the following information to answer Questions 22 and 23

Question 22

Manu took out a loan of $30 000, with interest compounding quarterly. The recurrence relation below shows the balance, V_n, of the loan after n quarters.

$$V_0 = 30\,000, \qquad V_{n+1} = 1.0115V_n - 758.35$$

The effective interest rate for Manu's loan is

A. 3.69%

B. 4.60%

C. 4.68%

D. 4.70%

E. 4.98%

Question 23

A final repayment that will fully repay the loan, to the nearest cent, is

A. $703.75

B. $758.35

C. $808.95

D. $812.95

E. $1501.57

Question 24

The following recurrence relation models the value, P_n , of a perpetuity after n time periods.

$$P_0 = a, \qquad P_{n+1} = 1.08P_n - 1200$$

The value of a is

A. $10 000

B. $12 000

C. $15 000

D. $15 800

E. $16 200

TURN OVER

Matrices

Use the following information to answer Questions 25 and 26

The daily number of visitors in a local library for two weeks is displayed in the table below.

	Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**
Week 1	85	102	130	87	98	56
Week 2	92	96	126	102	116	62

This information can also be represented by matrix *V*, shown below.

$$V = \begin{bmatrix} 85 & 102 & 130 & 87 & 98 & 56 \\ 92 & 96 & 126 & 102 & 116 & 62 \end{bmatrix}$$

Question 25

Element v_{21} indicates that

A. there were 92 visitors on Monday in week 2.

B. there were 102 visitors on Tuesday in week 1.

C. the total number of visitors in week 1were 558.

D. there were 7 more visitors on Monday in week 2 as compared to week 1.

E. the least number of visitors in both weeks was on Tuesday.

Question 26

The matrix multiplication that calculates the total number of visitors each week is

A. $\begin{bmatrix} 1 \\ 1 \end{bmatrix} V$

B. $V \begin{bmatrix} 1 \\ 1 \end{bmatrix}$

C. $\begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \end{bmatrix} V$

D. $V \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \end{bmatrix}$

E. $V \begin{bmatrix} 1 & 1 & 1 & 1 & 1 & 1 \end{bmatrix}$

Question 27

Matrix P is a permutation matrix and matrix Q is a column matrix.

$$P = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 1 & 0 \end{bmatrix} \qquad Q = \begin{bmatrix} g \\ r \\ o \\ u \\ p \\ s \end{bmatrix}$$

When Q is multiplied by P, which letters do not change position?

A. g, r

B. g, u

C. g, s

D. r, s

E. r, p

Question 28

The following transition matrix, T, models the movement of trucks around three different locations, B, C and D from one week to the next.

$$\begin{array}{c} \textit{this week} \\ \begin{array}{ccc} B & C & D \end{array} \\ \begin{bmatrix} \frac{1}{2} & 0 & \frac{4}{5} \\ \frac{1}{4} & \frac{1}{2} & 0 \\ \frac{1}{4} & \frac{1}{2} & \frac{1}{5} \end{bmatrix} \begin{array}{l} B \\ C \quad \textit{next week} \\ D \end{array} \end{array}$$

Which one of the following statements is **not** true?

A. Half the trucks that are in location B one week remain in location B the following week.

B. The number of trucks at location B the following week, had no trucks parked at location C the previous week.

C. In the long term, there will always be a smaller number of trucks parked in location D as compared to B and C.

D. In the long term, most trucks will be parked at location B.

E. No truck parked at location D in a particular week will be parked at location C the following week.

TURN OVER

Question 29

Matrix R is a 2×3 matrix.

The elements of R are determined by the rule $r_{ij} = i - j^2$.

Matrix R is

A. $\begin{bmatrix} 0 & 1 \\ 3 & 2 \\ 8 & 7 \end{bmatrix}$

B. $\begin{bmatrix} 0 & 1 \\ -3 & -2 \\ -8 & -7 \end{bmatrix}$

C. $\begin{bmatrix} 0 & -3 & -8 \\ 1 & 2 & -7 \end{bmatrix}$

D. $\begin{bmatrix} 0 & -3 & 8 \\ 1 & -2 & 7 \end{bmatrix}$

E. $\begin{bmatrix} 0 & -3 & -8 \\ 1 & -2 & -7 \end{bmatrix}$

Question 30

Let F be a square matrix of order 4×4.

Which of the following is true?

A. F^{-1} will exist only if $\det(F)$ is not equal to zero.

B. F will always have an inverse.

C. Pre-multiplying F by an identity matrix of order 4×4 will result in the identity matrix.

D. Transpose of F will always be equal to F.

E. F can be added to any matrix.

Question 31

The following Leslie matrix, L, can be used to model how a population of female animals of three age groups changes over time.

$$L = \begin{bmatrix} 0 & 5 & 4 \\ 0.3 & 0 & 0 \\ 0 & 0.4 & 0 \end{bmatrix}$$

The element in the second row, first column states that on average 30% of this population will

A. be female.

B. not reproduce.

C. not survive.

D. survive into second age group.

E. survive for the entire life span.

Question 32

For one particular week in a school year, students are allowed to attend different universities for a whole day.

Students stay at the same location for the whole day.

The transition diagram below shows the proportion of students who change location from one day to the next.
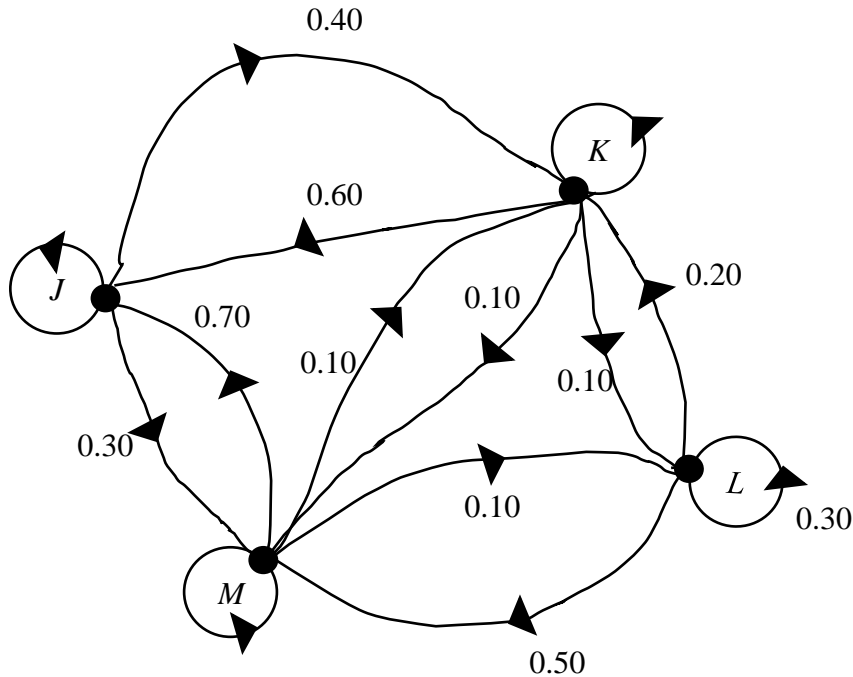
On Monday, 80 students attended University J, 55 students attended University K, 45 students attended University L and 60 students attended University M.

Of the students expected to attend University K on Wednesday, the percentage of these students who also attended University K on Tuesday is closest to
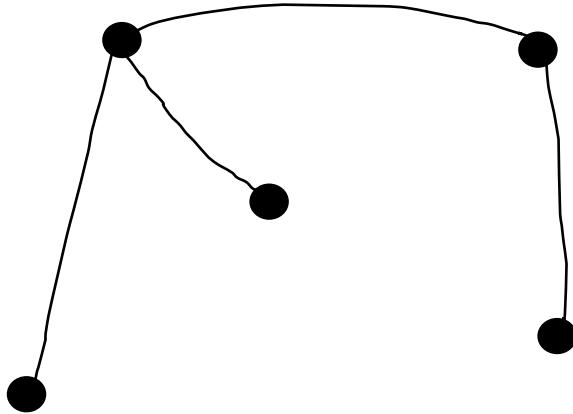
A. 19%

B. 20%

C. 30%

D. 39%

E. 43%

TURN OVER

Networks and decision mathematics

Question 33

Consider the following graph.

Which of the following is true about the graph?

- **A.** The graph contains a cycle.
- **B.** The graph contains an Eulerian path.
- **C.** The graph is planar.
- **D.** The sum of the degrees of the vertices is 6.
- **E.** There is only one bridge.

Question 34

A minimum spanning tree is used to display

- **A.** the shortest distance from one house to another.
- **B.** the path from one house to another.
- **C.** the allocation of tasks to tradespersons.
- **D.** the minimum length of cable required to connect six houses.
- **E.** the critical path of activities to be completed in building a house.

Question 35

Four employees, Jay, Kai, Lee and Mario, are each assigned a different task by the head chef.

The time taken for each employee to complete tasks 1, 2, 3 and 4, in minutes, is shown in the table below.
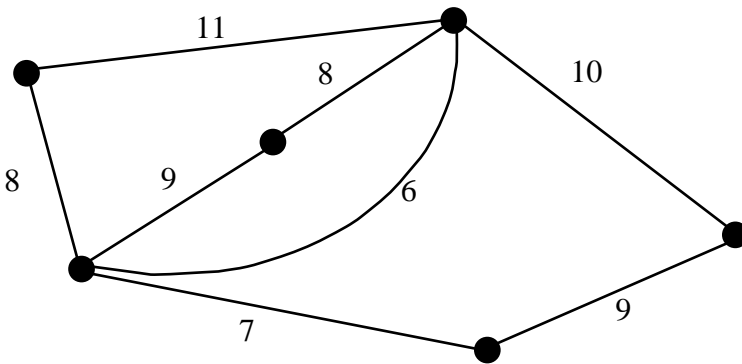
	Task 1	Task 2	Task 3	Task 4
Jay	10	6	6	8
Kai	9	8	10	7
Lee	14	10	6	10
Mario	12	9	9	9

The head chef allocates the tasks so as to minimise the total time taken to complete the four tasks. The minimum total time taken to complete the four tasks, in minutes, is

A. 29

B. 30

C. 32

D. 33

E. 34

Question 36

Consider the weighted graph shown below.

The weight of the minimum spanning tree is

A. 37

B. 38

C. 39

D. 40

E. 42

TURN OVER

Question 37

A planar graph has five vertices.

The number of edges of this graph

A. is always 4.
B. is greater than or equal to 3.
C. is two more than the number of faces.
D. is one more than the number of faces.
E. is greater than 3.

Question 38

The network below shows the one-way paths between the entry (A) and the exit (H) of a car park.

The vertices represent the intersections of the one-way paths.

The number on each edge is the maximum number of cars that are allowed to travel along that path per minute.
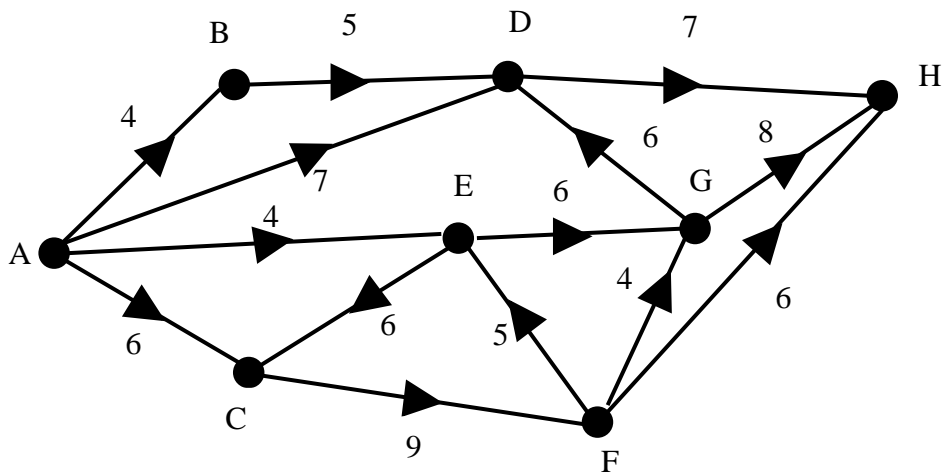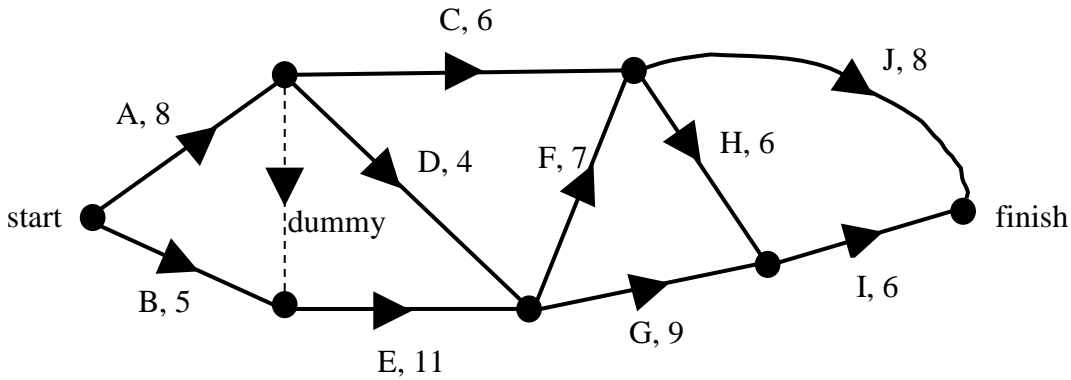

Cuts on this network are used to consider the possible flow of cars through the car park.

The capacity of the minimum cut would be

A. 16
B. 17
C. 21
D. 22
E. 23

Use the following information to answer Questions 39 and 40

A directed graph that represents a project is shown below, with activities A-J along with time, in minutes, for each activity.

Question 39

The table that represents these activities (A-J) with their immediate predecessors is

A.

Activity	Immediate predecessor(s)
A	-
B	-
C	A
D	A
E	A, B
F	D, E
G	D, E
H	C, F
I	G, H
J	C, F

B.

Activity	Immediate predecessor(s)
A	-
B	-
C	A
D	A
E	B
F	D, E
G	D, E
H	C, F
I	G, H
J	C, F

C.

Activity	Immediate predecessor(s)
A	-
B	-
C	A
D	A
E	A, B
F	D, E
G	D, E
H	C, F
I	G, H
J	C

D.

Activity	Immediate predecessor(s)
A	-
B	-
C	A
D	A
E	A, B
F	D, E
G	D
H	C, F
I	G, H
J	C, F

E.

Activity	Immediate predecessor(s)
A	-
B	-
C	A
D	A
E	A, B
F	D
G	E
H	C, F
I	G, H
J	C, F

Question 40

The minimum completion time, in minutes, for this project is

A. 34

B. 35

C. 38

D. 39

E. 42

END OF QUESTION AND ANSWER BOOK