2008 – 09 New Zealand International Biology Olympiad Programme

NATIONAL ENTRANCE EXAMINATION – August 2008

Examination Date: Wednesday 6 August 2007

Total Time allowed: 2 hours.

This examination consists of 80 questions. Students are advised to allocate equal time to each question (1 ½ minutes per question). Marks will not be deducted for incorrect answers.

Completed answer sheets must be sent with the exam papers to:

Dr Heather Meikle
Secretary, NZIBO
c/PNGHS
Fitzherbert Avenue
PALMERSTON NORTH

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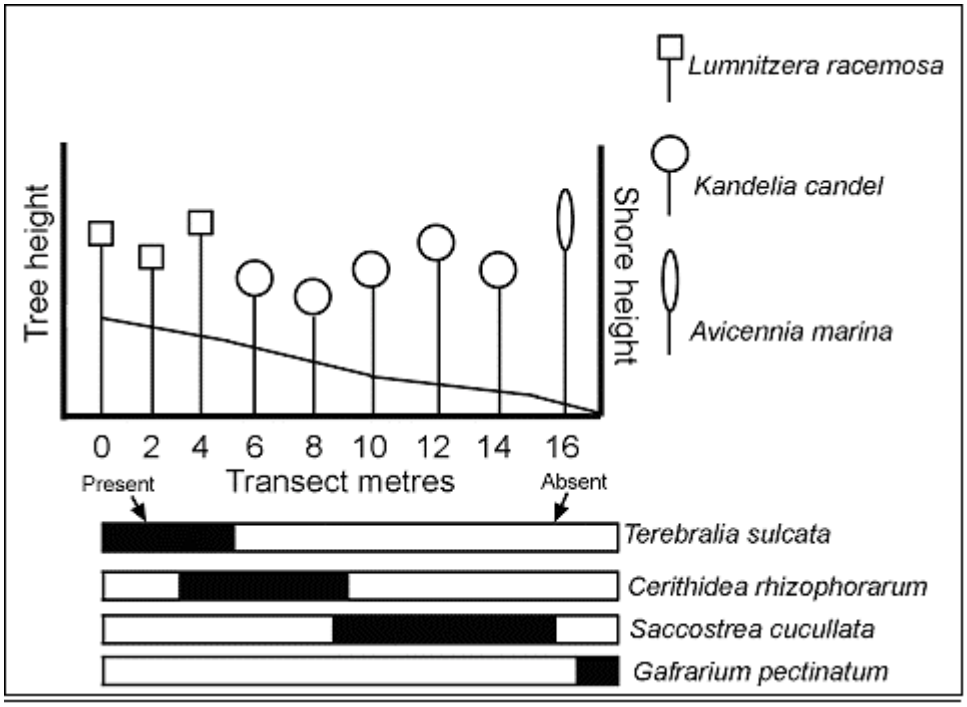
Question 1

The net increase of a population could be found by adding

A. Births and deaths and subtracting emigration and immigration.
B. Births and immigration and subtracting deaths and emigration.
C. Births and emigration and subtracting deaths and immigration.
D. Deaths and immigration and subtracting births and emigration.

The following information applies to Questions 2 – 3

A group of students examined the distribution patterns of mangrove organisms on a shore in Hong Kong by conducting transect surveys, collecting species distribution data and plotting these results. The figure below is a plot of the tree height and tree species distribution along a transect. The Y-axis is tree height, and the X-axis is the distance along the transect in metres. The shore profile along the transect is overlaid. The distribution pattern (the presence and absence) of the mangrove animals is plotted as horizontal bar charts under the graph.



Question 2

Salinity tolerance sets the zonation pattern of mangrove plants in Hong Kong. Considering the information given, which species of mangrove is likely to be the most salt-tolerant?

A. *Lumnitzera racemosa*
B. *Kandelia candel*
C. *Avicennia marina*
D. None of the above, as insufficient evidence is given to determine this.

Question 3

C. rhizophorarum is a hornshell (Class Gastropoda) that feeds on detritus and microalgae. *S. cucullata* is the hooded oyster (Class Bivalvia) and is a filter feeder. What is the most likely reason that the distribution of these two species is non-overlapping?

A. The two species have similar niches and therefore compete strongly.
B. *C. rhizophorarum* is associated with the mangrove, *K. candel*.
C. *S. cucullata* has adaptations that enable it to tolerate long periods of exposure when the tide it out.
D. *S. cucullata* has adaptations to enable it to tolerate high salinities.

Question 4

In the growth of a population of cells by binary fission, starting with one cell, after *n* generations the number of cells would be

A. *n*
B. 2 x *n*
C. 2^n
D. 1 + *n*

Question 5

One cm^3 of a sample of pond water is diluted by adding 99 cm^3 of sterile water. If one cm^3 of the diluted pond water sample is found to contain on average 3 bacteria, how many bacteria should be present in 10 cm^3 of the undiluted pond water?

A. 33
B. 307
C. 3,000
D. 3,000,000

Question 6

Which of the following sequences illustrates a decrease in complexity?

A. community, individual, tissue, cell
B. community, tissue, individual, cell
C. individual, tissue, community, cell
D. individual, community, cell, tissue

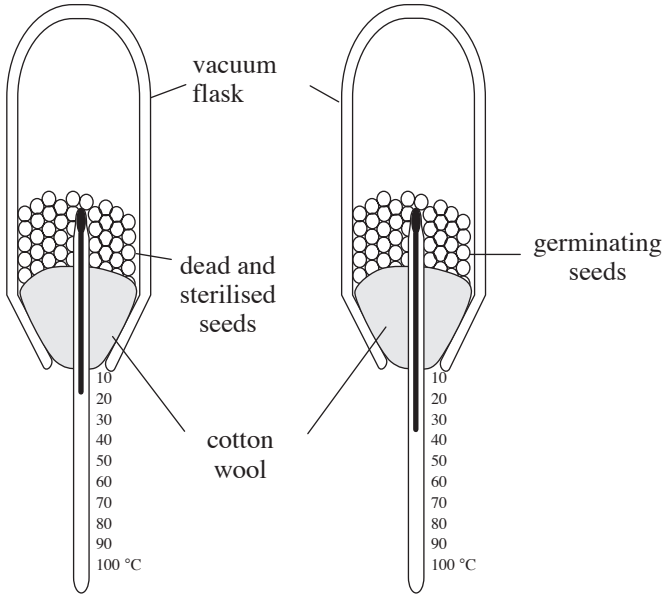
Question 7

The body mass and daily energy requirements are given for several people. Which person has the highest rate of metabolism?

		Daily energy needs (kJ)
A.	5 kg baby	4 000
B.	80 kg footballer	20 000
C.	60 kg typist	15 000
D.	50 kg teenage boy	14 000

Question 8

Two vacuum flasks were set up, one containing germinating seeds, the other containing dead and sterilised seeds, as shown in the diagram.

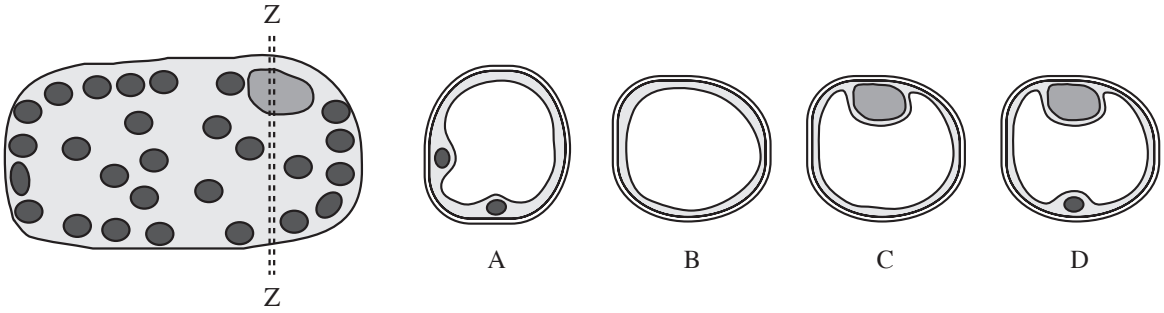


Which of the following would ***prove*** that germinating seeds produce heat?

A. The temperature of the flask containing the germinating seeds was higher on the third day than on the second day.
B. Two days after setting up the apparatus, the temperature of the flask containing the germinating seeds was 2° C above room temperature.
C. The temperature of the flask containing the sterilised seeds fell during the first two days of the experiment.
D. The temperature of the flask containing the germinating seeds was always several degrees above the temperature of the flask containing the sterilised seeds.
E. The temperature of the flask containing the germinating seeds rose steadily during the first three days of the experiment.

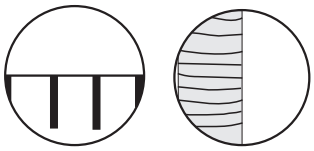
Question 9

The diagram shows an entire plant cell as it might be seen down the microscope. Imagine that a thin section (slice) of this cell were to be cut along the dotted lines Z ----- Z. Which (if any,) of the drawings A - D would show the appearance of the cell cut along this line?



Question 10

A ruler was placed under the low power of a microscope and the mm scale appeared as in the left of the diagram. When a human hair was viewed under the high power of the same microscope, it appeared as on the right.

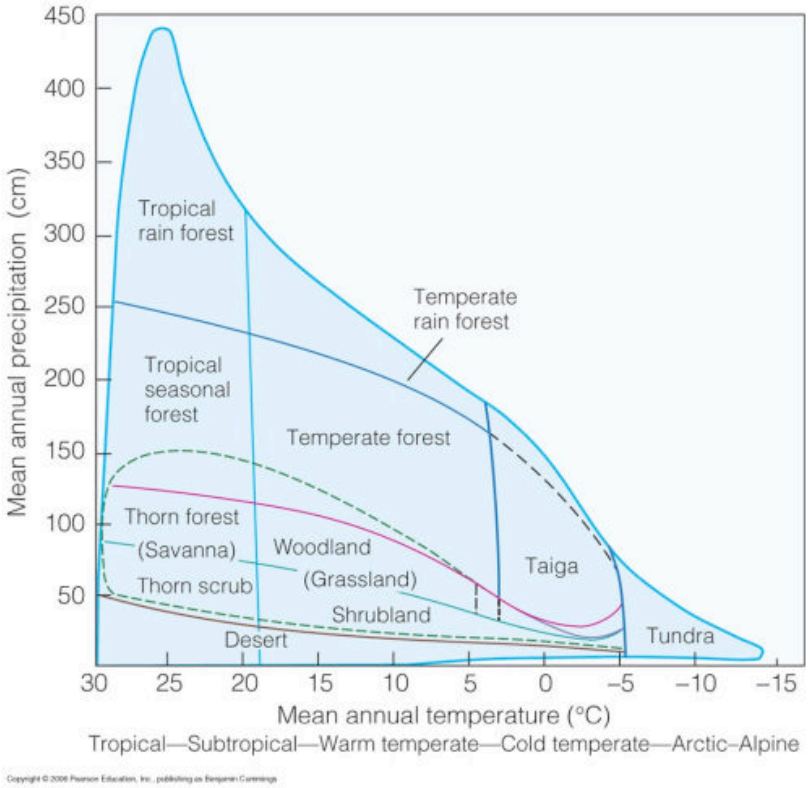


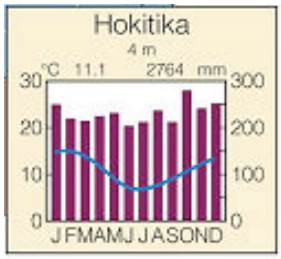
If the low power objective magnifies 4x and the high power magnifies 40x, the thickness of the hair is

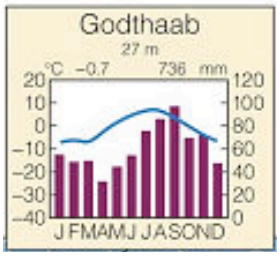
A. 0.1 mm
B. 0.15 mm
C. 0.25 mm
D. 0.3 mm

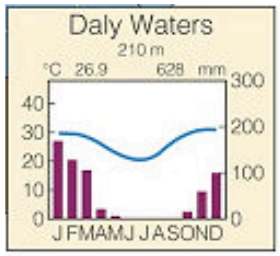
The following information applies to Questions 11 – 12

The graphs below shows the annual temperature and rainfall data for different terrestrial biomes and three specific places; Hokitika, Godthaab and Daly Waters (rainfall in mm, on right axis, temperature in °C on left).









Question 11

To what terrestrial biomes do Hokitika, Godthaab and Daly Waters belong?

A. Temperate rain forest, Taiga, and Thorn Scrub respectively.
B. Temperate forest, Taiga and Savanna respectively.
C. Temperate rain forest, Tundra and Thorn Forest respectively.
D. Temperate forest, Taiga and Thorn Forest respectively.

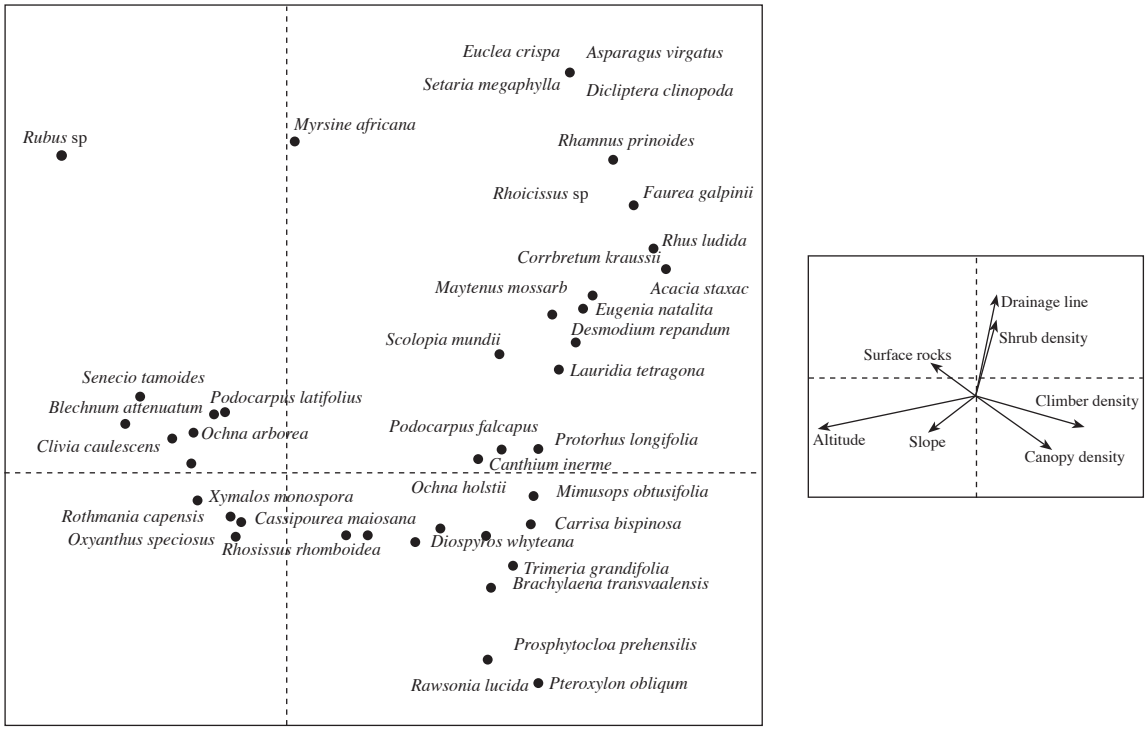
Question 12

In which hemisphere are Godthaab and Daly Waters found?

A. Southern, and Northern hemispheres respectively.
B. Both are found in the Southern hemisphere.
C. Northern and Southern hemispheres respectively.
D. Both are found in the Northern Hemisphere.

Question 13

Mixed evergreen forests form the smallest, most widely distributed and fragmented biome in southern Africa. Within South Africa, 44% of this vegetation type has been transformed, primarily by human activities. Researchers studied the floristic composition of the forest biome in the Blyde River Canyon Nature Reserve (BRCNR) along environmental gradients. Some of these data are shown in the graphs below.

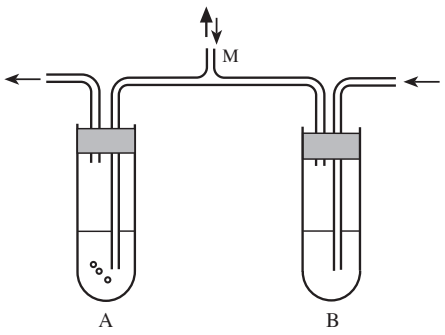


Name three species that are found in areas almost devoid of rocks and boulders.

A. *Rubus* sp. *M. africans,* and *S. megaphylla*.
B. *E. crispa*, *A. virgatus*, and *S. megaphylla*.
C. *C. caulescens*, *O. arborea*, and *P latifolius*.
D. *P. prehensilis*, *R. lucida*, and *P obliquum*.

Question 14

The apparatus shows an experiment to compare the carbon dioxide content of exhaled and inhaled air. Placing his mouth over M, Bill blew gently for 30 seconds and then inhaled for the same time. The liquid in Tube A turned milky but the liquid in Tube B remained clear.

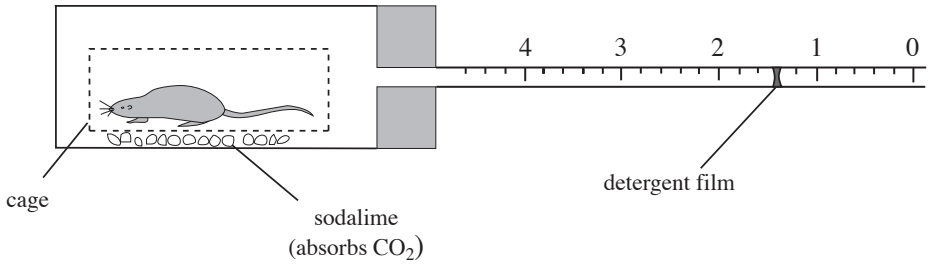


Which of the following statements (if any) would be justified from these results?

A. Exhaled air contains carbon dioxide.
B. Exhaled air contains less oxygen than inhaled air.
C. The body exchanges oxygen for carbon dioxide
D. Inhaled air contains no carbon dioxide.
E. None of these

Question 15

The apparatus shown is used to measure the oxygen uptake by small animals.

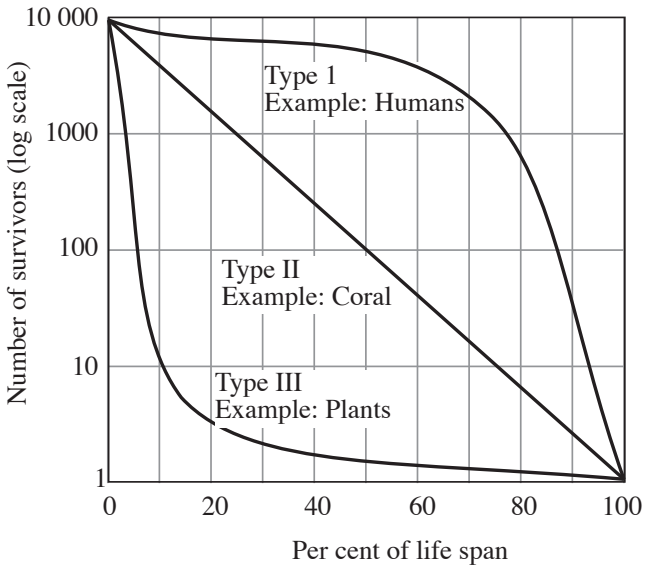


A mouse was introduced into the apparatus and after a few minutes, a thin film of detergent was introduced into the tube, as shown. During a 5-minute period the detergent film moved inwards (i.e. towards the mouse) from 0.1 cm^3 to 2.3 cm^3. In the same 5-minute period, a detergent film in a control apparatus (without a mouse) moved in the same direction from 0.4 cm^3 to 0.6 cm^3.

The rate of oxygen uptake by the mouse was

A. 2.2 cm^3 per minute
B. 0.4 cm^3 per minute
C. 2.4 cm^3
D. 2.0 cm^3

Question 16



Survivorship curves tell us something about how long individuals survive in a population. There are basically three types of survivorship curves:

Type I survivorship curves are for species that have a high survival rate of the young, live out most of their expected life span and die in old age, for example humans.

Type II survivorship curves are for species that have a relatively constant death rate throughout their life span. An example of species exhibiting a Type II survivorship curve is coral.

Type III survivorship curves are found in species that have many young, most of which die very early in their life. Many plants and marine invertebrates have Type III survivorship curves.

Below is a life table for the grass, *Poa annua*.

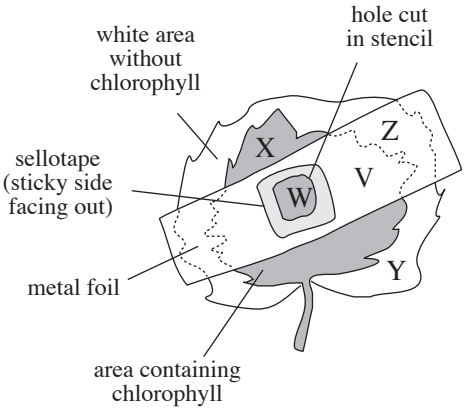
Age (month)	Number Observed Alive	Proportion Surviving	Number Dying	Mortality Rate Per Capita	Avg. Number of Seeds/Individuals
0-3	843	1,000	121	0.143	0
3-6	722	857	195	0.271	300
6-9	527	625	211	0.400	620
9-12	316	375	172	0.544	430
12-15	144	171	95	0.626	210
15-18	54	64	39	0.722	60
18-21	15	17.8	12	0.800	30
21-24	3	3.6	3	1.000	10
24	0	-	-	-	-

What type of survivorship curve does *P. annua* have?

A. Type I.
B. Type II.
C. Type III.
D. There is insufficient evidence to decide.

The following information applies to Questions 17 – 20

In an experiment to test the hypothesis that leaves need both light and chlorophyll to make starch, a stencil was fixed to both sides of a leaf of a variegated geranium plant as shown.



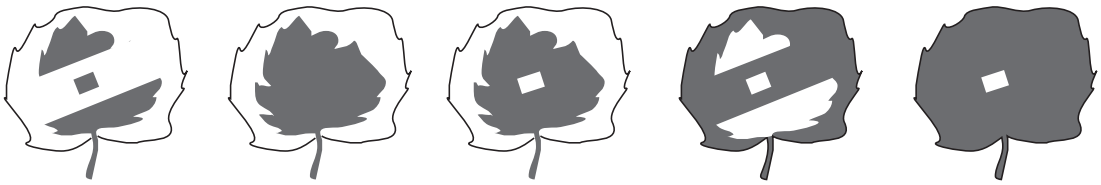
The hole cut in the stencil was covered by a small piece of transparent plastic sheeting. As a result of this treatment, the leaf had been divided into FIVE parts, the positions of which are indicated by the letters V – Z in the diagram above.

V contained chlorophyll but was in darkness.
W contained chlorophyll and was open to the light but was covered with plastic.
X contained chlorophyll and was open to the light but not covered with plastic.
Y had no chlorophyll and was open to the light.
Z had no chlorophyll and was in darkness.

The plant was then left in bright light for 48 hrs, after which the stencil was removed and the leaf tested for starch.

Question 17

Which of the diagrams A - E would indicate the appearance of the leaf after testing for starch?



A B C D E

Question 18

The purpose of the plastic covering over the hole in the stencil was to

A. protect the leaf from excessive light.
B. prevent the part of the leaf under the stencil from drying out.
C. reflect excessive light.
D. ensure that the air supply to the illuminated and darkened parts of the leaf were equal.
E. prevent too much carbon dioxide from reaching the leaf.

Question 19

After testing for starch, which two parts of the leaf would you have to compare in order to decide whether light is necessary for the leaf to make starch?

A. V and W
B. W and X
C. V and Y
D. W and Y
E. X and Y

Question 20

After testing for starch, which two parts of the leaf would you have to compare in order to decide whether chlorophyll is necessary for the leaf to make starch?

A. V and W
B. W and X
C. V and Y
D. W and Y
E. X and Y

Question 21

An 'L'-shaped area was painted on the lower side of a de-starched leaf using clear nail varnish. A few centimetres away from the 'L', a 'U' shape was painted on the upper surface of the same leaf. The leaf was then exposed to bright light for 4 hours and tested for starch. Which of the following diagrams would show the appearance of the leaf? (The leaf is shown from above).

A B C D E

Question 22

Below about 40 °C, the rate of growth of a species of bacterium doubles for every 10 °C rise in temperature. A single bacterium of this species was introduced into a culture medium maintained at 35 °C, and after 12 hours there were 4096 bacteria. Assuming that the generation time in this species of bacterium doubles for every 10 °C decrease in temperature, how many bacteria would have been present after 12 hours if the experiment had been conducted at 15 °C?

A. 8
B. 16
C. 32
D. 64