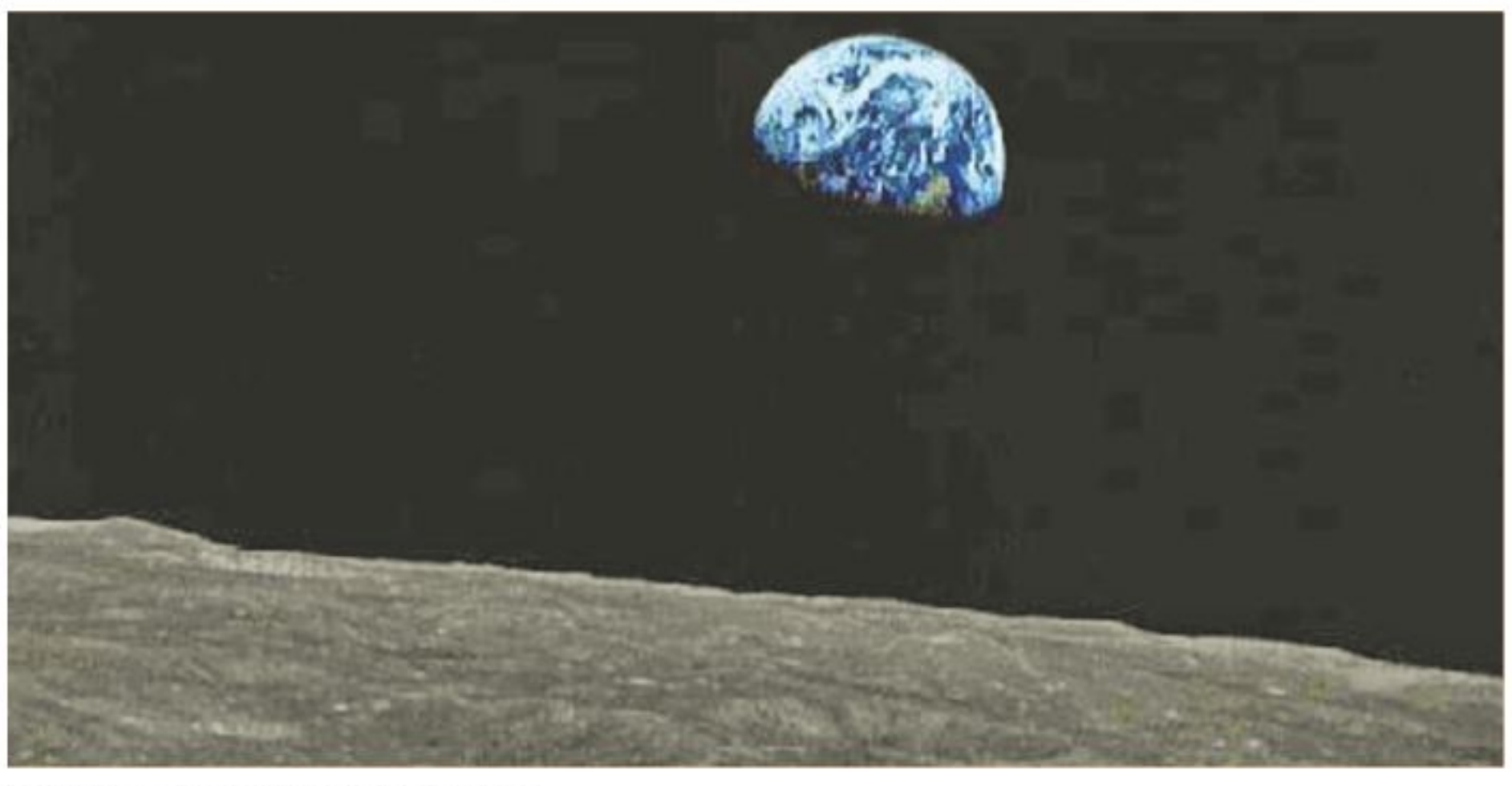


Recession of the Moon

DR. QUAMRUL HAIDER

THE gravitational force, which is the weakest of the four fundamental forces in nature, is an action-reaction force. So, just as Moon's gravitational force on Earth results in tidal friction (action) that eventually slows down Earth's rotational and orbital speeds (TDS May 21, 2013), Earth's gravitational force also exerts a frictional force (reaction) on the Moon. However, the effect of tidal friction is more drastic on Moon because of its relatively smaller size and mass. The Moon being a solid body undergoes deformation of its surface only, a phenomenon known as solid tide. Its shape becomes slightly elongated along the line toward the Earth.

Tidal friction has slowed the rotational and orbital speeds of the Moon long ago to the extent that it takes the same time to spin once on its axis as it takes to go around the Earth, i.e. lunar month and day are equal – 29.53 days. This is known as synchronous rotation and is similar to the situation with communication satellites placed in Earth's orbit with 24-hour period. The Moon, therefore, keeps only one side, the "near side," facing the Earth. Does this mean that the "far side", also known as dark side, is perpetually dark? No. It is illuminated as often as the near side. When there's a full moon the



Earth as viewed from the Moon.

far side is the dark side, but when it's a new moon the far side is the illuminated side. The Earth, as viewed from the Moon by the Apollo astronauts, always remained in the exact same position in the sky. Eventually we will also be in same situation as the Moon, probably after billions of years from now. It happened to the Moon much earlier because Earth's tidal force is stronger. Most of the natural satellites in the solar system are in synchronous rotation because of the tidal effects of their parent planets. As Earth slows down it loses rotational

kinetic energy. Energy conservation requires that Moon gain energy. In other words, Earth transfers energy to Moon through the tidal bulge and gravity. This extra energy gained by the Moon causes it to speed up and move farther away from us. Current estimates show that the Moon is receding from us at a rate of 3.8 cm per year. This rate has been determined by a technique known as Lunar Laser Ranging, which uses "corner mirrors" installed on the Moon by the Apollo astronauts in the 1960s. Planetary models indicate that the closest

distance between Earth and the Moon was 18,400 km. It took only 1.37 billion years for the Moon to reach its present distance of 384,400 km. As the Moon grows more distant, its orbital period about the Earth increases adding about 0.014 seconds per century to the lunar month.

If the present rate of recession continues, sometime in the distant future Moon will be so far away that its shadow will no longer reach Earth and total solar eclipse will cease to exist. Different planetary models predict that when both solar day and lunar month will become equal to 47 of our present days, tidal friction will cease. The Earth and Moon will then be tidally locked to each other and Earth will rotate synchronously with Moon and no further recession will occur. Each will perpetually keep the same face turned toward each other and Moon will be visible from one side of Earth only. In other words, Moon as viewed from Earth will appear suspended in the sky. It is estimated that this will happen when Moon will be approximately 645,000 km away from Earth.

Within the solar system, Pluto and its Moon Charon are already in synchronous rotation. Outside the solar system, many binary stars (similar to the Earth-Moon system) are also in synchronous rotation.

The writer is a Professor in the Department of Physics & Engineering Physics, Fordham University, New York



FOOD

Feeding nine billion people

AN international team of scientists has developed crop models to better forecast food production to feed a growing population -- projected to reach 9 billion by mid-century -- in the face of climate change.

In a paper appearing in Nature Climate Change, members of the Agricultural Model Intercomparison and Improvement Project unveiled an all-encompassing modeling system that integrates multiple crop simulations with improved climate change models. AgMIP's effort has produced new knowledge that better predicts global wheat yields while reducing political and socio-economic influences that can skew data and planning efforts, said Bruno Basso, Michigan State University ecosystem scientist and AgMIP member.

"Quantifying uncertainties is an important step to build confidence in future yield forecasts produced by crop models," said Basso, with MSU's geological sciences department and Kellogg Biological Station. "By using an ensemble of crop and climate models, we can understand how increased greenhouse gases in the atmosphere, along with temperature increases and precipitation changes, will affect wheat yield globally."

The improved crop models can help guide the world's developed and developing countries as they adapt to changing climate and create policies to improve food security and feed more people, he added.

Source : Science Daily

ACROSS

1 Item on stage

5 Relaxation

9 "Help!"

12 Emanation

13 Picture of health?

14 Demonic type

15 Dance lesson

16 Green land

17 Grazing area

18 Loafer, e.g.

19 Wrestling surface

20 Small horse

21 Tear

23 Eggs

25 Ought not

28 Plunder

32 Jellyed dish

33 Flat

34 Neptune or Poseidon

36 Makes baby food, maybe

DOWN

1 Just say no

2 Naomi's daughter-in-law

3 Sandwich treat

4 Empty threat

5 Free from a duty

6 Met there, done that

7 Tailor, humorously

8 Storm center

9 Missile shelter

10 Portent

11 Fix, in a sense

20 Evidence of white-trump

40 Pre-swam

41 Portrayal

43 Ian or Celeste

45 Jessica of "Fantastic Four"

46 Prepared to drive

47 Alluring

49 Lemieux milieu

Solution time: 27 mins.

Yesterday's answer 5-4

CRYPTOQUIP

Y J F J P F E Y A H K F O I N D Y N P

A E M W N J J B M W N J N K J A H X E .

P H W A K E J F K D N , Y N H K I B

O X B E G N E A R K N W I F G I N E .

Yesterday's Cryptoquip: IF YOU SPILLED A WHOLE CUP OF PEKOE ON YOURSELF, I RECKON YOU'D END UP WEARING A TEA SHIRT.

Today's Cryptoquip Clue: Y equals H

BEETLE BAILY

by Mort Walker

WE'RE HAVING A BLOOD DRIVE TODAY. GET OVER THERE

I DON'T FEEL LIKE IT TODAY

10-17

HENRY

by Don Trachte

SALE! WHITEWALL TIRES

10-17

QUOTABLE Quotes

"One of the penalties of refusing to participate in politics is that you end up being governed by your inferiors."

Plato

The Daily Star

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Head of Import, Trade Services

Job Description

- Ensuring Trade services without any error
- Increasing team's efficiency, productivity and ensuring error free timely output to achieve customer delight.
- Continual Improvement of QMS
- Lead the team independently.
- All customer communication & troubleshooting
- Creating a suitable and balanced work environment for the team.
- Capacity Building by means of trainings, counseling, assessments at individual levels.
- Maintaining the service standard & Compliances, mitigating risks.
- Designating specific assignments to team members besides desk job.
- Ensuring a coordinated effort with other units to reach the organizational goals.

Key Responsibilities

- Effective Planning for the activities of the department.
- Efficient management of available resources for effective and smooth processing.
- Enhance team capacity through training, assessment, counseling and motivation.
- Lead and manage all activities of the department, build a team concept.
- Monitor and follow up outstanding, overdue and reconciliation issues on planned interval.
- Provide periodical feedback on outstanding issues, process and compliance breaches to department Head.
- Timely response, follow up and compliance to all regulatory issues / requirements.
- Arrange approvals, deferrals and legal opinions in case of need
- Involve team members in cross functional issues.
- Ensure continual Improvement of TSD QMS to

achieve sustainable growth.

Job Nature: Full-time

Educational Requirements

Minimum Graduation in Marketing/Finance/Accounting; Preferably MBA/M.Com from reputed universities with CGPA 3.25 and CDCS.

Experience Requirement: 8- 10 years

Head of Export, Trade Services

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