SCIENCE AND TECHNOLOGY GS PAPER III

Black Hole Triple System

For the first time, scientists have discovered **a rare "black hole triple" system** located around 8,000 light years away in the constellation of Cygnus. This unique configuration comprises a black hole consuming a nearby star, with another distant star orbiting the system.

About Black Hole Triple

- **Definition:** A "black hole triple" system consists of a black hole with two companion stars. In the discovered system, one star orbits the black hole closely, while the second star is positioned at a far greater distance, orbiting every 70,000 years.
- **Discovery:**
  - The black hole, named **V404 Cygni**, was identified by researchers while examining a repository of astronomical observations.
  - Located in the **constellation Cygnus**, V404 Cygni has a mass approximately nine times that of the Sun.
  - The presence of gravitational interactions among the two stars confirmed the system's triple configuration.
- **Significance:**
  - **Challenges traditional theories:** The discovery questions the conventional understanding of black hole formation, which typically involves a supernova explosion that ejects nearby stars.
  - **Direct collapse formation:** V404 Cygni is thought to have formed through a "direct collapse" or "failed supernova," where the star collapsed into a black hole without an explosive event.
  - **Retention of nearby stars:** This gentler formation process enabled the black hole to retain its nearby stars, which would have been ejected in a supernova scenario.
  - **Implications for binary systems:** This finding suggests that some known binary black hole systems could have originally been triple systems, with the black hole later consuming one of its companions.

CLIMATE CHANGE GS PAPER III

1.5°C Goal & Climate Crisis

As world leaders prepare for the annual climate conference in Baku, a renewed focus on climate finance and stringent emission reduction is crucial to prevent severe climate repercussions.

Unabated rise of emissions:

- **Current emissions:** In 2023, global emissions reached 57.1 billion tonnes of CO_2 equivalent, marking a 1.3% increase from 2022.
- **Historical trend:** Emissions have increased yearly except in 2020, when the COVID-19 pandemic briefly reduced global activity.
- **Necessary target:** To meet the Paris Agreement's 1.5°C goal, emissions must peak by 2025 and steadily decline by at least 43% from 2019 levels by 2030. Current projections fall significantly short of this target.

Why there is no quick relief from warming?

- **Accumulated greenhouse gases**: Global warming is driven by accumulated CO_2 in the atmosphere, which can persist for hundreds of years.
  - **Data point:** Carbon dioxide concentrations reached 420 ppm in 2023, over 150% higher than pre-industrial levels.
- **Slow impact of reducing emissions:** Even if emissions peak and decline, the impact on warming will be gradual due to the long atmospheric lifespan of pollutants.
- **Methane and nitrous oxide levels:** Other gases like methane and nitrous oxide have also reached record concentrations, further intensifying warming.

Missing the targets:

- **Temperature threshold breach:** In 2023, the global temperature was 1.45°C above pre-industrial levels, the highest on record.

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  - **WMO projection:** Average annual global temperatures could breach the 1.5°C threshold within the next few years.
- **2030 Milestone:** The IPCC recommends a 43% reduction in emissions by 2030 from 2019 levels; however, current projections show only a 2.6% reduction, far from the required target.
- **Decadal average:** Between 2014-2023, global temperatures averaged 1.2°C above pre-industrial levels, pushing closer to the 1.5°C threshold.

Way Ahead

- **Accelerated clean energy transition:** Countries must expedite the shift to renewable energy sources to reduce dependence on fossil fuels.
- **Climate finance agreement:** The upcoming Baku climate conference should finalize a global finance deal to support ambitious climate actions, especially in developing nations.
- **Enhanced carbon reduction commitments:** Nations should revise their 2030 emissions targets with more stringent reductions to approach the 43% goal.
- **Invest in carbon capture:** Technologies like carbon capture and storage should be scaled up to address the excess greenhouse gases in the atmosphere.
- **Focus on methane reductions:** Reducing non-CO_2 emissions, especially methane, can have immediate benefits in slowing warming rates.

Conclusion:

Without drastic and immediate action, the 1.5°C target will likely remain out of reach. As UN Secretary-General António Guterres said, **"The climate crisis is a code red for humanity."** Achieving meaningful progress requires unwavering global commitment, substantial financial resources, and enhanced climate policies across all nations.

ECONOMICS GS PAPER III

Unpaid Labor

The paper **"Valuation of Unpaid Household Activities in India"** by Sahoo, Sarkar, and Kumar sheds light on the economic significance of unpaid household work, particularly the disproportionate burden borne by women.

Unpaid work and India's status:

- **High burden on women:** Indian women spend an average of 36 hours per week on unpaid domestic work, compared to 16 hours for men.
- **Major contributor to economy:** Unpaid work in India contributes approximately Rs.22.7 lakh crore, around 7.5% of GDP.
- **Labor force gap:** Women outside the labor force spend over seven hours daily on unpaid work, limiting their ability to participate in paid employment.

Comparison with global trends:

- **Global perspective:** Unpaid work accounts for between 10% to 60% of GDP worldwide, varying significantly across countries.
- **Examples:** APEC member economies estimate unpaid work at 9% of GDP; in Australia, it represents up to 41.3%, while it is only 5.5% in Thailand.
- **SDG integration:** Recognizing unpaid labor aligns with UN SDG 5, which promotes gender equality and values unpaid care and domestic work.

Economic value of unpaid work in India:

- **Monetary valuation:** Estimated at Rs.49.5 lakh crore (24.6% of GDP) using the Gross Opportunity Cost method and Rs.65.1 lakh crore (32.4% of GDP) using the Replacement Cost method for 2019–20.
- **Pandemic impact:** During COVID-19, the value rose to 27.2% (GOC) and 42.3% (RCM) of GDP, reflecting increased household contributions

Consequences of unpaid work:

- **Gender inequality:** Disproportionate unpaid work for women perpetuates gender disparity, restricting women's financial independence and professional growth.
- **Economic underutilization:** Excluding unpaid work from GDP undervalues substantial economic contributions, leading to an incomplete view of national productivity.

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- **Reduced workforce participation:** High unpaid workload limits women's entry into the formal labor market, affecting overall labor force productivity and economic growth.
- **Mental and physical health impact:** The burden of unpaid work can lead to stress, burnout, and negative health outcomes for those disproportionately responsible for it.
- **Policy blind spot:** Without quantification, unpaid work remains unaddressed in policy-making, leaving a significant economic and social issue unresolved.

New Zealand's Wellbeing Budget Case Study: New Zealand's 2019 Wellbeing Budget emphasizes citizen well-being alongside economic growth, targeting mental health, child welfare, and gender equity. By accounting for unpaid and domestic labor in policy, it promotes a holistic approach to development, balancing economic and social welfare

Way ahead:

- **Policy recognition and inclusion:** Develop frameworks to recognize and account for unpaid work in national economic indicators, acknowledging its economic value.
- **Redistribution of domestic labor:** Encourage shared domestic responsibilities to address gender disparities, supported by public awareness and educational initiatives.
- **Enhanced data collection:** Conduct frequent and comprehensive Time Use Surveys to obtain accurate data on unpaid labor and support evidence-based policymaking.
- **Supportive services:** Introduce affordable childcare, eldercare, and family support services to ease the unpaid workload on primary caregivers, mostly women.
- **Financial support mechanisms:** Consider direct or indirect support, such as tax credits or social security benefits for primary caregivers, to offset unpaid work contributions.

Conclusion:

Integrating unpaid labor into economic assessments would not only highlight the economic value of women's contributions but also foster more equitable policies, supporting India's growth and aligning with global goals for sustainable development.

PRELIM FACTS

1.Electronic Voting Machine

During the Haryana Assembly elections, Congress raised concerns about EVM battery life discrepancies, questioning why some EVMs showed 99% charge after polling

About Electronic Voting Machine (EVM):

- **Purpose:** Portable device for conducting elections to the Parliament, State Legislatures, and local bodies, enabling electronic voting over traditional paper ballots.
- **Key Features:**
  - **Voting capacity:** Records up to 2,000 votes for efficient election handling.
  - **Secure storage:** Encrypted memory ensures confidentiality of votes.
  - **Backup power:** Alkaline batteries enable use in remote areas without electricity.
  - **Multilingual options:** Supports multiple languages for voter accessibility.
  - **Audit trail (VVPAT):** Voters can verify their votes with a paper trail for audit purposes.
- **Development:** Designed by the Election Commission's Technical Experts Committee, manufactured by **Bharat Electronics Limited (BEL)** and **Electronics Corporation of India Limited (ECIL),** both Indian PSUs.

About EVM batteries:

- **Battery type:** EVMs and VVPATs use non-rechargeable alkaline batteries chosen for reliability and a five-year shelf life.
- **Voltage display:** The 99% indicator reflects a voltage range (8.2V to 7.4V) rather than exact charge. Actual percentage only appears below 7.4V.
- **Choice rationale:** Alkaline batteries were selected for their stable performance in extreme temperatures and gradual power decline, ensuring uninterrupted function.
- **Power use:** EVMs consume minimal power, remaining disconnected from networks, unlike mobile phones, which ensures battery longevity.

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2.Namo Drone Didi

The Government of India has launched the "Namo Drone Didi" scheme to empower women Self-Help Groups (SHGs) under the Deendayal Antyodaya Yojana – National Rural Livelihood Mission (DAY-NRLM).

About Namo Drone Didi Scheme:

- **Origin:** Launched by the Government of India under the DAY-NRLM initiative.
- **Aim:** To provide women SHGs with drones for agriculture-related services, empowering them with new income sources while enhancing farming efficiency.
- **Ministry:** Administered by the Department of Agriculture & Farmers' Welfare, Ministry of Agriculture, in partnership with the Ministry of Rural Development.
- **Features:**
  - **Financial Support:** Central Financial Assistance covering 80% of the drone cost, capped at Rs.8 lakh per drone.
  - **Loan Assistance:** SHGs can secure loans for the remaining cost through the National Agriculture Infrastructure Fund (AIF) with 3% interest subvention.
  - **Drone Package:** Includes drones with spray systems, additional battery sets, training for a pilot and drone assistant, a one-year warranty, two years of maintenance, and insurance.
  - **Training and Support:** SHG members receive 15-day training for drone operation, maintenance, and agricultural use.
  - **Implementation:** State-level Lead Fertilizer Companies (LFCs) and State Departments manage implementation, with drones allocated to SHG clusters.
  - **Monitoring:** An IT-based Management Information System (MIS) Drone Portal will monitor drone operations and service delivery.

3.Analog Space Mission

The Indian Space Research Organisation (ISRO) has launched India's first analog space mission in Leh, Ladakh.

About Analog Space Mission:

- **Objective:** Simulate interplanetary habitat conditions to assess the feasibility of a sustainable extraterrestrial base.
- **Significance of location:** Ladakh's isolation, dry climate, and high-altitude, barren terrain provide Mars- and Moon-like conditions, making it ideal for analog simulations.
- **Collaborative effort:** Led by ISRO's Human Spaceflight Centre with partners including AAKA Space Studio, the University of Ladakh, and IIT Bombay.
- **Key benefits:** Supports Gaganyaan and other future space missions by testing life-support technologies, habitat feasibility, communication systems, and behavior in isolated conditions.
- **International context:** Analog missions, also conducted by NASA, simulate space conditions on Earth to evaluate human and robotic responses, technology, and operational dynamics essential for deep-space missions.

4.Military Exercises

India participated in two notable joint exercises involving its Special Forces: **Exercise VAJRA PRAHAR** with the United States and **Exercise GARUD SHAKTI** with Indonesia.

About Exercise VAJRA PRAHAR:

- **Participants:** Indian Army Special Forces and the US Army Green Berets.
- **Location:** Orchard Combat Training Centre, Idaho, USA
- **Purpose:** To enhance cooperation, joint operations capability, and interoperability between Indian and US Special Forces.
- **Training Focus:**
  - Execution of joint missions in desert and semi-desert conditions.
  - Tactics, including joint planning, reconnaissance missions, use of Unmanned Aerial Systems, and psychological warfare.

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About Exercise GARUD SHAKTI:

- **Participants:** Indian Parachute Regiment (Special Forces) and Indonesia's Special Forces, Kopassus.
- **Location:** Cijantung, Jakarta, Indonesia.
- **Purpose:** To boost cooperation, enhance tactical knowledge, and improve interoperability between Indian and Indonesian Special Forces.
- **Training Focus:**
  - Special operations in jungle terrain, strikes on terrorist camps, and tactical drills.
  - Sharing information on weapon systems, equipment, and specialized techniques.

5.Ultra-Enforcement Concrete

The Government is working to reduce the cost of the construction of bridges and metros by 25 percent with the use of ultra-enforcement concrete, a technology adapted from Malaysia.

About Ultra-Enforcement Concrete (UEC):

- **Definition:** High-performance concrete offering enhanced strength, durability, and cost-efficiency.
- **Source:** Adapted from Malaysian technology, aimed at reducing construction costs in India.
- **Key Feature:** Reduces material usage while maintaining strength, with potential cost savings up to 25% in large infrastructure projects like bridges and metros.

Usage in UPSC Syllabus:

- **Infrastructure:** Relevant to GS Paper 3, focusing on Economic Development and Infrastructure (highways, railways, ports).
- **Technology and Innovation:** Links to technological advancements in sustainable construction.
- **Environmental Impact:** Aligns with sustainable development goals by reducing carbon footprints in construction projects.

6.Luminescent Nanomaterials

To combat the increasing issue of counterfeiting, scientists at the **Institute of Nano Science and Technology (INST)** have developed a novel security ink based on luminescent nanomaterials.

About Luminescent Nanomaterials:

- **Unique properties:** These materials, doped with rare earth ions, exhibit luminescence that varies based on the wavelength of light they're exposed to.
- **Multi-color display:** The ink shows vibrant blue under 365 nm UV light, pink under 395 nm, and orange-red under 980 nm near-infrared light, enhancing its security features.
- **Durability:** Remains effective under a wide range of light, temperature, and humidity conditions, making it ideal for long-term use.

Counterfeiting in Currency and Other Goods:

- **Advanced security feature:** Traditional covert tags are only visible under UV light and are easily duplicated. This new ink offers enhanced security with multi-wavelength color changes.
- **Applications:** Can be applied to various items to ensure authenticity, including currency, certificates, branded goods, and medicines.
- **Ease of verification:** Enables consumers and manufacturers to verify authenticity easily, offering a practical solution to counterfeiting.

7.Sanjay Dubri Tiger Reserve

A resort and a conference hall built within tiger reserve corridors at Madhya Pradesh's Sanjay Dubri and Bandhavgarh have emerged as a point of contention between the state's Wildlife and Tourism departments.

About Sanjay Dubri Tiger Reserve:

- **Location:** Situated in the Sidhi district of northeastern Madhya Pradesh, bordering Guru Ghasidas National Park to the south.
- **Composition:** Encompasses Sanjay National Park and Dubri Sanctuary, along with buffer zones from Sidhi and Shahdol districts.
- **Ecological corridor:** Part of the Bandhavgarh-Sanjay-Guru Ghasidas-Palamau landscape, forming a vital wildlife corridor between Bandhavgarh and Palamau Tiger Reserves.
- **Rivers:** Key rivers include Banas, Gopad, Mawai, Mahan, Kodmar, and Umrari.

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- **Flora:** Dominated by moist deciduous and dry deciduous sal forests, with some areas featuring open sal forests and bamboo remnants.
- **Fauna:** Home to diverse species like tigers, leopards, sloth bears, chital, nilgai, wild dogs, jungle cats, and the Indian python.

About About Bandhavgarh Tiger Reserve:

- **Location:** Situated between the Vindhyan and Satpura ranges in Umaria district, Madhya Pradesh.
- **Status:** Designated a national park in 1968, it gained Tiger Reserve status in 1993.
- **Topography:** Known for valleys, hills, and plains with the historic Bandhavgarh Fort, associated with Lord Rama and his brother Lakshmana, prominently located.
- **Vegetation:** Features tropical moist deciduous forests, including sal, mixed forests, and grasslands, with bamboo on the lower slopes.
- **Flora:** Includes notable species like Saj (Terminalia tomentosa), Dhaora (Anogeissus latifolia), Arjun (Terminalia arjuna), and Amla (Emblica officinalis).
- **Fauna:** Hosts the Royal Bengal Tiger noted for the highest density of tiger population in India and globally.

ANSWER WRITING

Q. The recent incidents of work-culture-related issues in multinational corporations operating in India highlight the conflict between global business practices and local social realities. Discuss the role of state in balancing economic growth with labour welfare in the era of globalization.

In recent years, multinational corporations (MNCs) in India have faced work-culture-related challenges that highlight a conflict between global practices and local cultural norms. While MNCs bring efficiency, innovation, and economic growth, their emphasis on productivity-driven work environments often clashes with India's community-oriented social values. Addressing these issues requires understanding local sensitivities and facilitating a balanced work culture that respects both global and local perspectives.

How Recent Work-Culture Issues in MNCs Highlight Conflict Between Global Practices and Local Realities

- **Rigid Productivity Norms vs. Flexible Work Culture**: Global corporations often impose **rigid work schedules** focused on productivity, which may conflict with the more **flexible, family-oriented** Indian work culture.
- **Lack of Sensitivity to Hierarchical Structures**: Many MNCs operate with **flat hierarchies**, encouraging open dialogue, but Indian workplaces traditionally emphasise **hierarchical respect**, causing discomfort for local employees.
  For example: In tech sectors, junior Indian employees may struggle to adopt Western practices of direct communication with seniors, affecting workplace harmony.
- **Insufficient Consideration of Local Holidays**: MNCs with standardised holiday policies often overlook **important regional festivals**, creating **employee dissatisfaction** and disrupting work-life balance for local teams.
- **Differences in Work-Life Balance Expectations**: Western companies promote individualistic values around **work-life separation**, which may not align with India's **community-oriented approach** where work relationships often extend beyond office hours.
- **Varying Standards for Employee Welfare**: Many MNCs apply **universal welfare policies** that may be insufficient in India, where employees face unique **socio-economic challenges** and expect more comprehensive support.

Role of the State in Balancing Economic Growth with Labour Welfare in the Era of Globalization

- **Ensuring Fair Labour Laws Compliance**: The state must ensure MNCs adhere to labour laws that safeguard workers' rights, especially in areas like **working hours** and **wage parity**.
  For example: The Indian government's **Code on Wages, 2019** mandates fair wages, protecting workers from exploitative practices by enforcing compliance.
- **Facilitating Flexible Policy Frameworks**: States can establish flexible policies that allow MNCs to operate effectively while respecting local work cultures, especially around **work hours** and **leave policies**.

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For example: By advocating **flexible leave policies** for regional festivals, the state can foster a culturally sensitive work environment in MNCs.

- **Promoting Local Labour Welfare Programs**: States should support welfare programs tailored to local needs, including **healthcare** and **education benefits** for workers' families to balance global practices with Indian realities.
  For example: Several states provide **subsidised healthcare programs** for industrial workers, encouraging MNCs to extend similar benefits.
- **Monitoring Workplace Safety and Inclusivity**: The state must ensure that MNCs provide **safe** and **inclusive workplaces**, meeting local regulatory standards and global best practices.
- **Collaborating with MNCs on Skill Development**: Governments can work with MNCs to fund **skill development initiatives**, ensuring local employees can benefit from global growth without compromising welfare.
  For example: Programs like **Skill India** provide training partnerships with MNCs to enhance workforce capabilities while addressing job satisfaction.

Best Practices from Other Countries on Labour Welfare

- **Comprehensive Health Benefits in Germany**: Germany mandates that MNCs provide **health benefits** that include family coverage and psychological support, promoting a holistic approach to employee well-being.
- **Stringent Work Hour Regulations in France**: France's policies enforce **limits on working hours** and promote work-life balance, allowing employees the right to disconnect, which can reduce burnout in high-intensity roles.
- **Paid Family Leave in Sweden**: Swedish companies offer extensive **paid family leave** for both parents, fostering a supportive work environment that values family and personal time.
- **Labour Union Representation in the UK**: In the UK, strong **labour union representation** allows workers to voice concerns regarding work culture, enabling balanced solutions between MNCs and employees.
- **Localised Employment Standards in Japan**: Japan requires MNCs to adopt **localised employment standards**, aligning global practices with cultural norms, ensuring work-life balance and stability.

Balancing global work practices with local realities is crucial for India as MNCs expand their footprint in the country. As Mahatma Gandhi once said, "The true measure of any society can be found in how it treats its most vulnerable members." In India's case, achieving equitable and culturally aware work environments within MNCs will strengthen employee satisfaction, promote labour welfare, and support sustainable economic growth.

MCQ

1. Recently, scientists observed the merger of giant 'blackholes' billions of light-years away from the Earth. What is the significance of this observation?
   a) 'Higgs boson particles' were detected
   b) **'Gravitational waves' were detected**.
   c) Possibility of inter-galactic space travel through 'wormhole' was confirmed.
   d) It enabled the scientists to understand 'singularity'
2. Which of the following statements about the Nikshay Poshan Yojna is/are correct?
   a) It is a centrally sponsored scheme launched in 2018 by the Ministry of Health and Family Welfare.
   b) The scheme provides a Direct Benefit Transfer (DBT) of Rs 500 per month to support the nutritional needs of every TB patient.
   c) Only TB patients receiving treatment from government health facilities are eligible.
   Select the correct answer using the code given below:
   a) 1 and 2 only b) 1 and 3 only
   c) 2 and 3 only d) 1, 2, and 3
3. Which of the following statements about 'Exercise VAJRA PRAHAR-2024' are correct?
   1. This was a joint Special Forces exercise between India and the United States.

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2. It was conducted in Idaho, USA.
3. The Indian Navy was a part of this exercise.

Select the correct answer using the code given below:

a) 1 and 2 only b) 1 and 3 only
c) 2 and 3 only d) 1, 2 and 3

4. Which of the following statements regarding the National Commission for Protection of Child Rights (NCPCR) is/are correct?
1. The NCPCR is a constitutional body constituted by the Government of India.
2. It operates under the administrative control of the Ministry of Women and Child Development.
3. The NCPCR monitors the implementation of the Protection of Children from Sexual Offences (POCSO) Act, 2012.

Select the correct answer using the code given below:

a) 1 and 2 only **b) 2 and 3 only**
c) 1 and 3 only d) 1, 2, and 3

5. Consider the following pairs:

Teachings of Buddha	Meaning
A. Sabbam Dukkam	1. Desire, ignorance, and attachment are causes of suffering
B. Dwadash Nidan	2. Suffering can be eliminated by eliminating its cause
C. Nirodha	3. The world is full of suffering
D. Ashtangika Marga	4. The Eightfold Path to end suffering

Select the correct answer using the code below:

a) A-3, B-1, C-2, D-4
b) A-1, B-2, C-3, D-4
c) A-2, B-3, C-4, D-1
d) A-3, B-4, C-1, D-2

6. Consider the following statements regarding nominal wages:
1. Nominal wages reflect the purchasing power of income.
2. Changes in nominal wages do not account for inflation.
3. Nominal wages can increase while real wages decrease.

Which of the above statements is/are correct?

a) 1 only b) 2 only
c) 2 and 3 only d) 1, 2, and 3

7. Sanjay Dubri Tiger Reserve is located in which of the following states ?
a) Odisha
b) Chhatisgarh
c) Bihar
d) Madhya Pradesh

8. Consider the following statements about Namo drone didi
1. Launched by the Government of India under the DAY-NRLM initiative
2. Administered by the Department of Agriculture & Farmers' Welfare, Ministry of Agriculture, in partnership with the Ministry of Rural Development.
3. Central Financial Assistance covering 80% of the drone cost, capped at Rs.8 lakh per drone.

Which of the following statements are correct?

a) 1 and 2 only
b) 1, 2 and 3
c) 2 and 3 only
d) None of the above

9. The Indian Space Research Organisation (ISRO) has launched India's first analog space mission in which place of india ?
a) Sriharikota
b) Bangalore
c) Abdul kalam island
d) Ladakh

10. Consider the following statements about the Konark Sun Temple:
1. The temple was constructed in the 13th century under the rule of King Narasimhadeva I of the Eastern Ganga Dynasty.
2. It is designed as a colossal chariot with seven wheels on each side, symbolizing the Sun God's chariot.
3. The temple was primarily constructed using Khondalite stones.

Which of the above statements are correct?

a) 1 only **b) 1 and 3 only**
c) 1 and 2 only d) 1, 2, and 3

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