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MARKSCHEME

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INFORMATION TECHNOLOGY IN A GLOBAL SOCIETY

Standard Level

Paper 2

21 pages

Examiners should be aware that in some cases, candidates may take a different approach, which if appropriate should be rewarded. If in doubt check with your Team Leader.

In the case of an "identify" question read all answers and mark positively up to the maximum marks. Disregard incorrect answers. In the case of a "describe" question, which asks for a certain number of facts *e.g.* "describe two kinds", mark the **first two** correct answers. This could include two descriptions, one description and one identification, or two identifications.

"ITGS terminology refers to both the IT technical terminology and to the terminology related to social and ethical impacts."

SECTION A

Area of impact: Business and employment

2. (a) For the following URL: http://www.richmondtaylor.co.uk/images/photo27.jpg

(i) identify the domain name ***[1 mark]***

www.richmondtaylor.co.uk or richmondtaylor.co.uk

N.B. Answer must NOT contain http:// or any other part of the URL.

*Award **[1 mark]** for the correct response.*

(ii) identify the file name. ***[1 mark]***

photo27.jpg or photo27

*Award **[1 mark]** for the correct response.*

(b) (i) Describe *one* way a new company can register a new domain name. ***[2 marks]***

- register with an accredited domain name/Internet registrar/purchase a domain name through an official site – check the domain name is free/pay an annual subscription (accept also: "register with the domain name server")
- contact your web-hosting company *ISP* who has a relationship with a particular registrar that allows you to purchase your web-hosting account and domain name with one transaction
- select a domain name on a web site that is already registered (*e.g.* wikispaces) but the web site name may be a part of the domain name
- purchase a domain name – this could be done via an online trading place/auction and is necessary if the desired name is already in use.

*Award **[1 mark]** for only identifying one way a company can register a new domain name.*
*Award up to a maximum of **[2 marks]** for a description of one way a company can register a new domain name.*

(ii) Describe why a company would prefer to use a domain name for its web site rather than an IP address. ***[2 marks]***

- easy to remember – for example users would have to remember the numbers which have no special meaning to them but a company name *e.g. ToysRus* will be easy to relate to the company
- easy to type – for example a set of numbers is easy to mistype but a name can have meaning so errors are less likely
- domain names can give users some information about the site they will be visiting – this information can help attract customers/an IP address says nothing about the content of the site they will be visiting.

*Award **[1 mark]** for identifying a reason why a company would prefer to use a domain than an IP address.*
*Award up to a maximum of **[2 marks]** for a description of the reason.*

(c) Explain *two* technical issues that must be addressed to enable a company to introduce teleworking for its employees. ***[4 marks]***

Technical issues may include providing:

- Remote access for the employee to company servers – *e.g.* VPN provides secure access enabling employees to safely share/access files.
- Software and communications services for the employee in order for them to be able to telework. Software may include electronic mail, FTP, fax, Internet browser, encryption, remote access, video conference, Internet phone and possible own data transfer software in addition to applications used in the company.
- Hardware for employees to use outside the office – *e.g.* laptop to access the office from any place/web cam, microphone, speakers to enable collaboration.
- Online technical support for employees – may use remote access software to resolve help desk queries/phone help desk support.
- Services for maintenance and repair for employees – replacement computers/onsite visit to employee's home.
- Software licences for use by employees who are teleworking – additional licences will need to be purchased for home computers or a site licence that extends to workers at home.
- Training for the employee in order to be able to use IT systems for teleworking – this could include a workshop on using the web cam, microphone, setting up the VPN.
- Security measures for both the company and teleworkers' IT systems (*i.e.* backup, virus checkers, encryption) – *e.g.* a company could use a VPN to provide security for data during transmission.
- Authentication – *e.g.* logins and passwords.
- Ensuring compatibility of software between home and office – *e.g.* same versions of the word processor so files from the company server can be downloaded and edited.
- Ensuring workers have appropriate Internet access from home (secure connection, appropriate bandwidth, spyware checks).

*Award **[1 mark]** for each technical issue identified. Award an additional **[1 mark]** for the explanation of that technical issue up to a maximum of **[2 marks]**. Mark the first two correct technical issues identified.*

(d) To what extent has the change to teleworking been beneficial to both employers and employees? ***[10 marks]***

Benefits for employers

- cost savings (*i.e.* premises costs, office overheads and reduced recruitment costs)
- increased productivity (*i.e.* teleworkers avoid travel time, none of the interruptions of an office environment) – but cannot monitor employees to see if they are working
- improved motivation for employees – but loss of motivation generated in a workplace environment
- employees who might otherwise leave can remain in their jobs
- employees on maternity leave can continue to work and require less re-training when they return to work
- organization flexibility (*i.e.* teams representing the best skills and experience for a particular project can be created, regardless of geography and time differences; part-time workers can be on stand-by when more work is available)
- no disruption in the event of problems (*i.e.* transport strikes, severe weather, natural disasters)
- enhanced customer service extended beyond the working day or the working week without the costs of overtime payments or the need for staff to work (and travel) at unsocial hours – but this could negatively affect employees who cannot get away from work
- may have access to wider diversity of employees as the company can hire from around the world.

Benefits for employees

- reduced travel time and costs – but cost to set up hardware if employer doesn't pay for a home system
- improved work opportunities (*i.e.* job not confined to a specific commuting distance)
- less disruption to family life (*i.e.* no need to move due to job change)
- better balance of work and family life (*i.e.* be with the family and participate in home responsibilities such as transporting children, shopping) – but may be hard to separate work and home
- participation in the local community (*i.e.* be involved in local clubs at a time when commuters are still *en route*) – but less interaction with work colleagues
- flexible hours (*i.e.* individual freedom to stop and start work according to what is best) – but home distractions may interfere with work.

In part (d) of this question it is acceptable if there is more emphasis on the ITGS terminology related to social and ethical impacts and less on IT technical terminology.

Please see generic markband information sheet on page 21.

SECTION B

Area of impact: Education

2. (a) Define the term *search engine*. ***[2 marks]***

- a program that searches documents for specified keywords and returns a list of the documents where the key words were found
- a program that uses a "spider" (also called a "crawler" or a "bot") that goes to representative pages on every web site that wants to be searchable and reads it
- very large databases of web sites that are automatically built by robots ("spiders") that seek out and index the words on web pages.

[1 mark]
There is an attempt to define a search engine but it may not be complete.

[2 marks]
A search engine is accurately defined, possibly with a relevant example.

(b) Describe *two* ways in which search engines make decisions about the rank order of the links that they display in response to an enquiry. ***[4 marks]***

- direct purchasing (available on many search engines) for placement
- use a ranking algorithm:
  - the search engine interprets a link from page A to page B as a vote, by page A, for page B
  - an equation that calculates a page's PageRank
- PageRank does not rank web sites as a whole, but is determined for each page individually
- factors are used such as:
  - site age
  - content
  - inbound links
  - tags
  - link popularity
  - key words
  - link relevance and quality.

*Award **[1 mark]** for each way identified. Award an additional **[1 mark]** for the development of that idea up to a maximum of **[2 marks]**. Mark the first two correct ways described.*

(c) Explain how students could carry out the most effective search for the *International Baccalaureate* using a search engine. ***[4 marks]***

- use a Boolean search "AND" such as International AND Baccalaureate that will retrieve records in which BOTH of the search terms are present (words may not be found consecutively on the page)
- use an Implied Boolean search "+" such as International+Baccalaureate that will retrieve records in which BOTH of the search terms are present (words may not be found consecutively on the page)
- use the term in quotation marks "International Baccalaureate" that will retrieve records in which BOTH of the search terms are present (words will be found consecutively on the page)
- use the "=" symbol to get an exact match such as =International Baccalaureate.

[1 mark]
A limited response that indicates very little understanding of the topic.

[2–3 marks]
A reasonable description of search techniques, although the answer may be lacking details or reasons.

[4 marks]
A clear, detailed description of search techniques.

(d) Some educational organizations have decided not to allow students to quote public information web sites such as *Wikipedia* as references for their research work. To what extent is this decision justified? ***[10 marks]***

- written by volunteers therefore subject to mistakes or deliberate falsehoods
- lack of accuracy or completeness of entries because entries are not formally edited
- students should use quality information, not just convenient, therefore should be using primary sources, not encyclopedias (this is true for offline encyclopedias as well)
- educational organizations are allowing students to use it for initial probing, but are stating students should not quote from it
- students argue freedom of access, but verification of sources is still essential
- limits research skills of students
- dependent on technology working; if the Internet connection fails research can be seriously affected.

In part (d) of this question it is acceptable if there is more emphasis on the ITGS terminology related to social and ethical impacts and less on IT technical terminology.

Please see generic markband information sheet on page 21.

Area of impact: Health

3. (a) Identify *two* limitations of the Wii as a simulation. ***[2 marks]***

- cannot be modified to suit individuals
- real world is unpredictable and complex unlike the Wii simulations
- range of sensors and remotes is limited
- simulation is 2D not 3D, which may affect depth visualizations.

*Award **[1 mark]** for each point up to a maximum of **[2 marks]**.*

(b) Describe *two* other potential uses of the technology incorporated within the Wii video game console. ***[4 marks]***

- military training using motion sensors to simulate situations
- educational programs which enhance learning and challenge students, as well as games where students may challenge other students or the computer
- online communication over the Internet with other individuals.

Examiners should be aware that candidates may take a different approach, which, if appropriate, should be rewarded.

*Award **[1 mark]** for each potential use identified. Award an additional **[1 mark]** for each relevant description up to a maximum of **[2 marks]**. Mark the first two correct potential uses identified.*

(c) Explain how *two* devices that are not physically connected can communicate with each other. ***[4 marks]***

Answers may include **two** devices that use:

- **Wi-Fi (wireless network)**
  - also known as 802.11 uses radio waves to communicate across a wireless network, similar to a two-way radio communication
  - a computer's wireless adapter translates data into a radio signal and transmits it using an antenna
  - a wireless router receives the signal, decodes it and then sends the information to the Internet using a physical, wired Ethernet connection
  - they transmit at frequencies of 2.4 gigahertz (GHz) (802.11b, (802.11g)) or 5GHz (802.11a).

- **WiMax (worldwide interoperability for microwave access)**
  - also known as 802.16, has the benefits of broadband and wireless and can provide high-speed wireless Internet over very long distances (unlike typical Wi-Fi).

- **Bluetooth**
  - Bluetooth is essentially a short-range radio or short-range wireless communication
  - the Bluetooth RF transceiver operates at 2.4 GHz (the same range of frequencies used by microwaves and Wi-Fi)
  - uses frequency hopping to combat interference that are designed to operate in noisy radio frequency environments
  - avoids interference from other signals by hopping to a new frequency after transmitting or receiving information.

- **Infrared**
  - allows computing devices to communicate via short-range wireless signals and transfer files and other digital data bidirectionally – the infrared transmission technology used in computers is similar to that used in consumer product remote control units
  - wireless infrared communication is the propagation of light waves in the near infrared band as a transmission medium
  - the communication can be between one portable communication device and another or between a portable device and a tethered device, called an access point or base station
  - typical portable devices include laptop computers, PDAs, and portable telephones, while the base stations are usually connected to a computer with other networked connections
  - infrared technology used in local networks exists in three different forms, IrDA-SIR (slow speed), IrDA-MIR (medium speed), IrDA-FIR (fast speed).

[1 mark]
A limited response that indicates very little understanding of the topic.

[2–3 marks]
A reasonable description of devices, although the answer may lack how device communicates.

[4 marks]
A clear, detailed explanation of devices with clear understanding of how each device works.

(d) Evaluate the role of video game consoles in the healthcare of the elderly. ***[10 marks]***

- involves a pleasing combination of mental and physical exercise, along with positive social interaction
- because of the video game system, technology-savvy residents are now interested in other technologies such as reading the local newspaper online
- good physical exercise
- mental improvements
  - exercises the brain
  - improves concentration
  - having fun while keeping active
  - not bored, "don't know that they're doing" therapy
- socialization
  - tournaments – great interaction with others
  - clapping and cheering fans
  - cross-generational, kids can play with grandparents
- physical improvements
  - range of motion
  - standing and balancing
  - endurance
  - posture
  - hand-eye coordination
  - arm movement
  - dexterity.

In part (d) of this question it is acceptable if there is more emphasis on the ITGS terminology related to social and ethical impacts and less on IT technical terminology.

Please see generic markband information sheet on page 21.

Area of impact: Arts, entertainment and leisure

4. (a) Identify *two* kinds of information that are stored in an online video broadcasting database about each of the videos. ***[2 marks]***

- online name of the person/personal details of the person who uploaded the video
- date the video was uploaded
- name of the video
- URL of the video
- embedded code for the video
- description for the video
- tags for the video
- length/duration of the video
- Video format (mp4, flv, *etc.*)
- if there is an age restriction *i.e.* over 18
- file size.

*Award **[1 mark]** for each appropriate kind of information identified up to a maximum of **[2 marks]**.*

(b) Describe *two* reasons why there is a requirement to use a captcha when setting up an account. ***[4 marks]***

- demonstrate that a human is entering the information – because machines cannot read the graphic
- avoid automated systems for completing the forms with bogus information, which could lead to abuse of the service
- stop automated postings to blogs, forums and wikis, whether as a result of commercial promotion, harassment or vandalism
- captcha – can be deployed to protect systems vulnerable to e-mail spam, such as the web mail services
- protect e-mail addresses from spammers who crawl the World Wide Web in search of e-mail addresses posted in clear text – require users to solve a CAPTCHA before showing their e-mail address.

*Award **[1 mark]** for each reason identified. Award an additional **[1 mark]** for the development of that reason up to a maximum of **[2 marks]**. Mark the first two correct reasons identified.*

(c) Explain *two* ways video services such as *YouTube* can ensure that the videos uploaded by members comply with copyright laws. ***[4 marks]***

- users must agree to online policies indicating copyright must be observed
- explanation is provided online about what is copyrighted on its web site
- the company could manually check all the videos that have been uploaded/random checks could be made on uploaded videos – videos are made available after checking
- automatically check uploaded videos against a database of copyrighted videos
- videos violating copyright are removed from the online video broadcasting service – offenders are removed as members
- complaints from customers are followed up by the online video broadcasting service.

*Award **[1 mark]** for identifying how videos uploaded can comply with copyright laws. Award an additional **[1 mark]** for the development of the initial point up to **[2 marks]**. Mark the first two correct ways identified.*

(d) To what extent have web sites such as *YouTube* been used for more purposes than leisure and entertainment? ***[10 marks]***

- amateurs posting videos of current news happenings to online video broadcasting services
- software companies and trainers posting training videos to online video broadcasting services
- political speeches for campaigning for elections
- educational lectures (*e.g.* what is web 2.0, physics) – a source of free resources for under-resourced schools/there is an ability to post questions
- demonstration of how to perform a particular task (*e.g.* particular technique in photography, how to set up a wireless network)
- presentation of new IT technology (*e.g.* particular hardware/software)
- terrorism – used as advertising, used to "indoctrinate", used to teach how to create bombs
- many news channels post videos of news on these services and allow users worldwide access to latest news
- health campaigns for disease prevention/health care
- individuals posting their CV to attract employers who may offer them a job
- businesses marketing products – *e.g.* clothing manufacturers preparing a video of new products/musical groups uploading video clips of latest songs to promote a CD.

Some negatives that may be considered in analysis of non-leisure use:

- videos used in education and training need to be used with caution as anybody can post a video and the content may not be accurate
- news stories should be checked for accuracy
- individuals posting personal information (*e.g.* CV) should be aware of privacy issues – who is downloading their personal details?
- political speeches should be checked as many fake videos have been posted to discredit politicians
- bandwidth could be a limitation *e.g.* for educational use
- limitations on size of upload – users compress videos which could impact on quality and information *e.g.* in medical training.

In part (d) of this question it is expected that there will be a balance in the ITGS terminology between IT technical terminology and the terminology related to the social and ethical impacts.

Please see generic markband information sheet on page 21.

Area of Impact: Science and the environment

1. (a) Define the term *relational database*. ***[2 marks]***

- collection of data items organized in tables
- key fields are used to link data between the tables
- organization of data in tables reduces data redundancy
- changes in one table are reflected in other tables automatically.

*Award **[1 mark]** for any of the above points up to a maximum of **[2 marks]**.*

(b) Describe the process of how a particular person's DNA could be checked against data in the national DNA database to see if their DNA data has been stored. ***[4 marks]***

- DNA sample is collected from the evidence found from the crime being investigated/person submits DNA sample
- DNA data is converted into digital code
- a program is used that compares the DNA digital code to the DNA codes that have been collected and stored in a database from persons committing previous crimes
- when a match is found, the name of the criminal suspect is retrieved from the database/the person is identified as a suspect in the database.

*Award **[1 mark]** for each of the steps up to a maximum of **[4 marks]**.*

(c) Explain *two* security measures that would need to be implemented by a government before a national DNA database can be introduced. ***[4 marks]***

Security measure and reason:

- levels access for different users of the database
- use of passwords/biometrics need to be implemented for secure access
- exporting data from the database has been blocked to prevent misuse
- virus checking software has been implemented on the server so that the database is not corrupted
- firewall has been set up, blocking unauthorized access
- laws regarding access, use and/or storage of the DNA database to ensure proper use
- encryption of DNA data – encryption of data on central database so hackers who gain access cannot read the data without being able to decode it
- encryption of data during transfer – in order to protect data from unauthorized access when it is sent to the central database
- backing up data so records are not lost – a backup routine needs to be instigated/backups need to be stored off site
- physical security of hardware – *e.g.* locked room with keycards/biometric identification to enter.

*Award **[1 mark]** for each security measure identified. Award an additional **[1 mark]** for the development of that measure up to a maximum of **[2 marks]**. Mark the first two correct security measures identified.*

(d) Evaluate the possible impacts on UK citizens of collecting DNA data from children at birth. ***[10 marks]***

Positive and negative impacts of the following may be evaluated:

Negative impacts

- the DNA database may be shared with other government agencies for purposes that are different from the original intention
- if data is leaked then health insurance companies could deny insurance cover
- if data is not secure then unauthorized access could lead to blackmail/identity theft/loss of data integrity
- UK citizens could be falsely accused of a crime because a small DNA sample is found from the person at the scene of a crime/due to errors entering personal information
- invasion of privacy impacts because the DNA database could reveal additional information (*e.g.* health risks, race, potential psychiatric disorders, paternity) – some people do not want to know if they are susceptible to diseases
- possible to assemble biometric profiles of UK residents
- police will have more information about offenders than ever before (e.g. DNA could be traced and family relatives could be unfairly targeted by police)
- DNA database could be used in data matching with other government databases.
- there will be costs involved and these could be offset by taxes to UK citizens.

Positive impacts

- early detection of diseases could lead to a cure
- DNA database could reveal additional information and this may help medical research into disease prevention
- if the tissue samples are also stored, the human cells could be re-tested in the future for more information as DNA analysis becomes more advanced
- DNA matching could help crime prevention/identify bodies in a disaster.

In part (d) of this question it is acceptable if there is more emphasis on the ITGS terminology related to social and ethical impacts and less on IT technical terminology.

Please see generic markband information sheet on page 21.

Area of impact: Politics and government

6. (a) Identify *two* possible ways in which a person could cast an e-vote. ***[2 marks]***

- direct recording electronic (DRE) – touch screens
- ballot scanners
- optical scan
- punch key machines – use a keypad for making selections on an electronic ballot
- wheel machines – require voters to rotate a wheel and press a button
- can also involve transmission of ballots and votes via telephones, private networks, or the Internet
- paper-based – punch card voting, marksense and digital pen voting systems
- public network DRE voting system.

*Award **[1 mark]** for each point up to a maximum of **[2 marks]**.*

(b) Describe *two* reasons why governments would encourage e-voting. ***[4 marks]***

- increase of participation (voter turnout), particularly through the use of Internet voting
- electronic voting machines can be made fully accessible for persons with disabilities
- younger generation will be more likely to vote
- it will provide a more accurate count
- it will reduce tabulation times
- it can be more secure when administered correctly
- electronic voting machines detect votes that paper-based machines would miss
- electronic voting systems can offer solutions that allow voters to verify their vote is recorded and tabulated with mathematical calculations; these systems can alleviate concerns of incorrectly recorded votes
- electronic voting machines are able to provide immediate feedback to the voter detecting such possible problems as under-voting and over-voting which may result in a spoiled ballot.

*Award **[1 mark]** for each reason identified. Award an additional **[1 mark]** for the development of that reason up to a maximum of **[2 marks]**. Mark the first two correct reasons identified.*

(c) Explain *two* methods that governments can use to attempt to prevent people casting e-votes using a false identity. ***[4 marks]***

- Issue smartcards to everyone with a unique number to be used on a direct recording e-voting system.
- Software tracking to determine a person has voted and someone is trying to use their identity to cast multiple votes.
- Require voters to sign their ballots with digital signatures using a program such as PGP. Unless a voter's secret key has been compromised, it can be assured that voters are not using others' identification numbers.
- A PIN-based system whereby an identification number and a password were sent to the eligible voters in advance by means of a letter to their permanent address. PIN numbers are interrogated by the system when filling in the ballot and sending it.
- National ID cards (*e.g.* Bangladesh Voter Registration Project) with biometric fingerprints information. Fingerprint readers verify the person's identity at the e-voting location.

[Source: adapted from http://www.acm.org/crossroads/xrds2-4/voting.html, 29 May 2009]

*Award **[1 mark]** for each method identified. Award an additional **[1 mark]** for the development of that method up to a maximum of **[2 marks]**. Mark the first two correct methods identified.*

(d) Discuss policies and procedures that could be implemented in order to ensure the security and integrity of the votes before, during and after they have been cast. ***[10 marks]***

- expertise in internal control should be added to the personnel complement in election administration in order to assure implementation of applicable concepts
- auditors should be available to independently review the implementation of internal controls and report on their effectiveness
- all vote-tallying software, and all software used with it, should be reviewed for integrity, that is, for the ability to carry out its asserted function and to contain no hidden code and assurance of logical correctness
- copying of software from unaccountable sources must be forbidden
- computerized vote count should be able to be reproduced, on a re-count, with no more than a change in one vote for each ballot position in ballot quantities of up to 100 000, when machine-generated (ideal) ballots are used
- a ballot reader should be able to tolerate a wide range of punching or marking behaviour by a voter without a significant increase in error
- for hardware, recommendations concern accuracy of ballot reading, design and certification of vote-tallying systems that do not use ballots
- improved pre-election testing and partial manual re-counting of ballots are recommended in operational procedures
- if a ballot cannot be read by machine, administrative controls should be in place to permit such ballots to be counted manually; a voter's choices should not be lost because of machine failure.

In part (d) of this question it is expected that there will be a balance in the ITGS terminology between IT technical terminology and the terminology related to the social and ethical impacts.

Please see generic markband information sheet on page 21.

Markband for all extended response questions

Opinion discuss, evaluate, justify, recommend and to what extent	***0***	*No knowledge or understanding of IT issues and concepts or use of ITGS terminology.*
	1–2 marks	*A brief and generalized response with very little knowledge and understanding of IT issues and concepts with very little use of ITGS terminology.*
	3–5 marks	*A response that may include opinions, conclusions and/or judgments that are no more than unsubstantiated statements.* *The response will largely take the form of a description with a limited use of ITGS terminology and some knowledge and/or understanding of IT issues and/or concepts.* *If no reference is made to the information in the stimulus material, award up to* ***[3 marks]****.* *At the top end of this band the description is sustained.* *At the lower end of the band a tendency towards fragmentary, common sense points with very little use of ITGS terminology.*
	6–8 marks	*A response that demonstrates opinions, conclusions and/or judgments that have limited support.* *The response is a competent analysis that uses ITGS terminology appropriately. If there is no reference to ITGS terminology the candidate cannot access this markband.* *There is evidence that the response is linked to the information in the stimulus material.* *At the top end of the band the response is balanced, the response is explicitly linked to the information in the stimulus material and there may be an attempt to evaluate it in the form of largely unsubstantiated comments. There is also evidence of clear and coherent connections between the IT issues.* *At the lower end of the band the response may lack depth, be unbalanced or tend to be descriptive. There may be also implicit links to the information in the stimulus.*
	9–10 marks	*A detailed and balanced (at least one argument in favour and one against) response that demonstrates opinions, conclusions and/or judgments that are well supported and a clear understanding of the way IT facts and ideas are related.* *Thorough knowledge and understanding of IT issues and concepts.* *Appropriate use of ITGS terminology and application to specific situations throughout the response.* ***If there is no reference to ITGS terminology candidates cannot access this markband.*** *The response is explicitly linked to the information in the stimulus material.* *At the lower end of the band opinions, conclusions and/or judgment may be tentative.*

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