# iSTEM – Computer-aided design (CAD) sample assessment package

**Practical task**



Contents

[Advice to teachers 2](#_Toc134080911)

[Task 2](#_Toc134080912)

[Evidence of learning 3](#_Toc134080913)

[Assessment type 3](#_Toc134080914)

[Duration 3](#_Toc134080915)

[Scheduling and weighting 4](#_Toc134080916)

[Inclusion and wellbeing 4](#_Toc134080917)

[Advice to students 5](#_Toc134080918)

[Task details 5](#_Toc134080919)

[Creating your drawings 6](#_Toc134080920)

[Marking rubric 7](#_Toc134080921)

[Additional information 13](#_Toc134080922)

[Rationale 13](#_Toc134080923)

[Aim 14](#_Toc134080924)

[Purpose and audience 14](#_Toc134080925)

[When and how to use this document 15](#_Toc134080926)

[Assessment for learning 15](#_Toc134080927)

[Differentiation 16](#_Toc134080928)

[About this resource 17](#_Toc134080929)

[References 20](#_Toc134080930)

## Advice to teachers

**Note:** the examples in this package are provided so that schools and teachers may choose relevant information and adjust for their contexts and their school-based practices. Relevant information should be transferred into the school’s assessment task template.

The computer-aided design (CAD) elective focuses on developing knowledge and skills required to use CAD software tools efficiently and effectively. Students learn to create functional and accurate design representations which comply with AS1100 drawing standards.

Students develop an understanding of the software capabilities and the required techniques to create functional three-dimensional (3D) models to the level required so that they could be then transformed into physical objects with rapid prototyping tools.

### Task

Students will create digital (3D) models of a selected physical object. The selected object should be composed of at least 2 individual parts which can be separated from each other and individually modelled. The number of individual parts students are required to draw can be adjusted. The task can be further differentiated by selecting physical objects that are appropriate for the skill development of the individual student. If a suitable physical object has more than 2 parts, some minor part drawing files could be provided to students to use in their assembly drawing.

More complex items could be drawn by getting students to draw assigned parts and then share them for assembly. Students could also be asked to create sub-assemblies which are then shared for each student to do the final assembly. Following this option will require having ‘backup’ completed part drawing files and/or sub-assemblies available to give students to ensure the assembly drawing can be achieved independent of successful completion of part drawings.

The dimensions of the object parts can be provided on orthographic drawings or by organising students to take measurements of a physical object to be modelled.

Students will create individual drawings of each part and a combined assembly drawing. Each drawing will be in the form of orthogonal drawings with multiple views using third angle projection and include a matching inset isometric projection. Where necessary, drawings should include hidden detail as per AS1100 specifications.

### Evidence of learning

Students will demonstrate their proficiency in using CAD software and specifically their understanding and appropriate use of various CAD drawing tools to create accurate 3D models of a selected physical object. This will be demonstrated by:

* drawings that are complete, including a title block, notes
* drawing files that are properly named and stored in an organised folder structure
* drawings that are to scale and with the proper coordinate system used.

### Assessment type

This task is intended to directly contribute to the final course assessment, either formative when developing student skills and knowledge, or summative when determining student’s achievement of outcomes for this learning sequence.

Formative assessment is an active learning process that enables teachers to continuously gather evidence of learning and respond to student learning with the goal of improving student achievement (Cowie and Bell 2010). It is an interactive process that monitors student learning to provide ongoing feedback that can be used by teachers to improve their teaching and by students to improve their understanding.

### Duration

Assessment advice and due dates should be informed by school assessment policy and assessment schedules.

Three lessons of class time can be assigned to complete the practical task.

### Scheduling and weighting

Skills developed in the CAD topic are transferable to subsequent project-based units of work and especially some specialised topics. Delivering the CAD elective early in the iSTEM course will enable students to better design prototypes for working models in other topics.

This task is designed as a midterm consolidation of the skills they have acquired and developed so far. It is intended to be used around week 5, as a quick, weeklong activity before they start their main project. In its current form it can provide useful data to inform further teaching, however, teachers may adapt parts of the marking rubric to move it further forward or backward depending on the needs of the school.

Weightings are a school-based decision.

### Inclusion and wellbeing

This assessment package has been prepared by the NSW Department of Education. It has been developed as a model for teachers, to assist in the development of an assessment task that can be contextualised to an individual school's needs.

Plan assessment tasks that are inclusive and accommodate the needs of all students in your classroom. Some students may require more specific adjustments and enhancements to allow them to participate on the same basis. The iSTEM [learning sequences](https://education.nsw.gov.au/teaching-and-learning/curriculum/department-approved-courses/istem#/asset4) have example adjustments and enhancements. For further advice, see [Inclusive practice resources for secondary school](https://education.nsw.gov.au/campaigns/inclusive-practice-hub/secondary-school).

Outcomes referred to in this document are from the [iSTEM course document](https://education.nsw.gov.au/teaching-and-learning/curriculum/department-approved-courses/istem#/asset2) © NSW Department of Education for and on behalf of the Crown in the State of New South Wales (2021).

## Advice to students

Teachers should include their details of due date, weighting, and submission guidelines as per their school practice.

### Task details

**Type of task:** CAD drawings – parts and assembly

**Format:** practical task

**Weighting:** school-based decision

**Submission:** students work individually to complete task

**Description:** using CAD software create 2 parts drawings and an assembly drawing of a provided physical object. Submit CAD drawing files on completion of task and provide your teacher with shared access to your task work folder. If more than 2 parts exist in the physical object, these may be provided by the teacher for use in the assembly drawing.

**Outcomes assessed:**

* **ST5-4** works independently and collaboratively to produce practical solutions to real-world scenarios
* **ST5-8** uses a range of techniques and technologies, to communicate design solutions and technical information for a range of audiences

### Creating your drawings

**You will need to complete the following:**

* 3D drawings of each of the parts
* an assembly of the parts created and any extra parts provided by your teacher
* an orthogonal drawing of each of the parts, including an inset isometric projection at a suitable scale
* an orthogonal drawing of the assembly, including an inset isometric projection at a suitable scale.

**Things to check:**

* all drawing files are properly named and stored in an organised folder structure
* 3D drawings and assembly have suitable constraints and mates applied where appropriate
* orthogonal drawings include a title block and appropriate information with a suitable scale selected
* orthogonal drawings are drawn in third angle projection with views correctly aligned to each other
* orthogonal drawings indicate all features of the parts or assembly including all dimensions and symbols according to AS1100 standard.

**What to submit:**

* exported PDF versions of all orthogonal drawings (or in an appropriate format as determined by your teacher)
* shared access to all of the relevant CAD files drawn and generated as part of this task.

## Marking rubric

**Note:** the criteria and outcomes presented in this table are not mandatory for assessing the task. Teachers are encouraged to select and/or adjust criteria based on their students’ needs and the assessment and reporting requirements of their school.

Table 1 – marking rubric

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Criteria | A | B | C | D | E |
| OrganisationST5-4, ST5-8 | Filenames created using a naming system consistent with industry practice, emphasising their function and design intent.Files are organised in a logical folder structure and in the correct format.Saved drawing files match required settings. | Filenames created using a naming system consistent with industry practice.Files are organised in a logical folder structure and in the correct format.Saved drawing files match required settings. | Filenames created in a logical mannerFiles are organised and in the correct format.Saved drawing files match required settings. | Filenames are inconsistently created.Some drawing files do not have the required settings for AS1100 standard. | Files are saved without evidence of proper file organisation.Files are saved without correct settings for AS1100 standard is shown. |
| Paper size, scale and view layoutST5-4, ST5-8 | Correct paper size selected with parts and assembly drawn to an appropriate scale.Orthographic views are properly aligned and the location and spacing provides enough space for dimensions and an isometric view to be included.Placement of aligned drawings and additional content on page is balanced with white space. | Correct paper size selected with parts and assembly drawn to an appropriate scale.Orthographic views are properly aligned and the location and spacing provides enough space for dimensions and an isometric view to be included.Placement of aligned drawings on page is balanced with white space. | Correct paper size selected with parts drawn to an appropriate scale.Orthographic views are properly aligned and the location and spacing provides enough space for dimensions and an isometric view to be included. | Some parts are drawn to an appropriate scale for the selected paper.Orthographic views are not properly aligned **or** not spaced appropriately to allow additional views and correct dimensioning. | Incorrect paper size selected and drawings are created without the correct scale.Orthographic views are not properly aligned and spaced. |
| CAD software toolsST5-4, ST5-8 | Uses extensive range of editing tools and methods, for example:* uses the array tool to pattern features
* uses constraints to avoid over dimensioning
* uses complex mates to create adjustable connections in assemblies.
 | Uses high range of editing tools and methods, for example:* uses construction lines in the generation of complex geometry
* uses the spline tool to generate complex curves
* uses the mirror tool to mirror features
* groups and/or fixes items in assemblies
* uses simple mates to create solid connections in assemblies.
 | Uses sound range of editing tools and methods, for example:* uses fillet tool to round edges
* uses chamfer tool to angle edges
* uses dimension tool to apply and modify dimensions
* uses the mirror tool to mirror parts
* uses trim tool to remove extra lines
* manipulates views using shortcut keys and mouse control.
 | Uses basic range of editing tools and methods, for example:* uses multiple workplanes
* draws basic shapes on surfaces
* manipulates views using navigation cube or similar on screen device
* uses extrude tool for additive and subtractive processes.
 | Uses limited range of editing tools and methods, for example:* draws basic shapes on workplanes
* uses extrude tool to create simple 3D forms.
 |
| Parts drawingsST5-4, ST5-8 | All individual parts drawings are complete with no errors.All features are included. | Most individual parts drawings are produced with no more than 2 minor errors. Examples of minor errors are fillets with incorrect radius and chamfers with incorrect dimensions.All features are included. | Some individual parts drawings are produced with minor errors present in either drawing, for example missing features obscured by view. | At least one part drawing is produced with major errors present.Features are not completed or missing. | No part drawings are complete. |
| DimensioningST5-4, ST5-8 | All features are correctly dimensioned.Dimensions are positioned properly according to AS1100 standard. | All features are dimensioned.No more than 2 dimensions are incorrectly positioned according to AS1100 standard. | Most features of all parts drawings are dimensioned.No more than 2 features are not dimensioned. | Some features of parts drawings are dimensioned.More than 2 dimensions are missing. | Produces a drawing without applying dimensions. |
| LabellingST5-4, ST5-8 | Components are labelled and grouped to emphasise their function.Information in legends and units are accurate, clear and concise.Accurately applies appropriate annotation and drawing symbols. | Clear and concise labelling is provided for all components.Accurate information in legends and units are provided.Applies annotation and correct drawing symbols. | All components are labelled.Information in legends and units are complete.Applies annotation and correct drawing symbols but with minor issues. | Drawings shown with incomplete labelling.Information in legends is missing.Applies annotation and drawing symbols but with multiple errors. | Drawings shown without labelling.Annotation and drawing symbols are not applied.Incorrect units used or units not evident. |
| AssemblyST5-4, ST5-8 | The assembly includes all required components with appropriate mates and constraints to control their interaction with each other.The assembly tree replicates the assembly/disassembly process. | The assembly file and the linked files are easily located, and the process can be repeated.The assembly includes all required components with mostly appropriate mates applied. | The assembly file and the linked files are located and used.The assembly includes all required components. | The assembly includes most components but requires minor modifications to complete process. | The assembly is incomplete with missing parts and major modifications required. |

## Additional information

Please complete the following [feedback form](https://forms.office.com/Pages/ResponsePage.aspx?id=muagBYpBwUecJZOHJhv5kbKo2q_ZUXlHndJMnh2Wd8NUOUk0VTIzUDVVSlVFQVM5MkdOMkJGTjVKNCQlQCN0PWcu) to help us improve our resources and support.

The information below can be used to support teachers when using this assessment package for iSTEM.

### Rationale

Australian businesses competing in a global economy will need more employees trained in science, technology, engineering, and mathematics (STEM). Research indicates that 75% of the fastest growing occupations require STEM skills. Global accounting firm PwC (formerly known as Price Waterhouse Cooper) produced a report titled ‘[A Smart Move](https://www.pwc.com.au/publications/a-smart-move.html)’ where it found that shifting just 1% of the Australian workforce into STEM roles would add $57.4 billion to the Gross Domestic Product (GDP) (net present value over 20 years).

iSTEM is a student-centred Stage 5 elective course that delivers science, technology, engineering, and mathematics education in an interdisciplinary, innovative, and integrated fashion. It was developed in direct response to industry’s urgent demand for young people skilled in science, technology, engineering, and mathematics.

The course was developed in collaboration, and is supported by industry, business, government, and universities, ensuring that students develop future focused STEM skills. The course has a number of specialised topics, many of which are aligned with NSW State Government Priority Industries, identified in the [NSW Industry Development Framework](https://www.investment.nsw.gov.au/living-working-and-business/nsw-industry-development-framework/).

iSTEM develops enabling skills and knowledge that increasingly underpin many professions and trades, and the skills of a technologically enabled workforce. It provides students with learning opportunities to develop knowledge and skills to use the most up-to-date technologies including additive manufacturing (3D printing), laser cutters, augmented and virtual reality, drones, smart robotics and automation systems, Artificial Intelligence (AI) and a range of digital systems.

Students gain and apply knowledge, deepen their understanding, and develop collaborative, creative and critical thinking skills within authentic, real-world contexts. The course uses inquiry, problem, and project-based learning approaches to solve problems and produce practical solutions utilising engineering-design processes.

iSTEM is aligned to the concept of ‘[Industry 4.0](https://www.weforum.org/agenda/2019/01/why-companies-should-strive-for-industry-4-0/)’ which refers to a new and emerging phase in the industrial revolution that heavily focuses on interconnectivity, automation, machine learning and real-time data.

iSTEM has been developed to meet the goals of National Federation Reform Council (NFRC) Education Council’s [National STEM School Education Strategy (2016-2026)](https://www.dese.gov.au/education-ministers-meeting/resources/national-stem-school-education-strategy), and supports the NSW Government’s [NSW Industry Development Framework](https://www.investment.nsw.gov.au/living-working-and-business/nsw-industry-development-framework/) and the NSW Department of Education’s [Rural and Remote Education Strategy (2021-2024)](https://education.nsw.gov.au/about-us/strategies-and-reports/rural-and-remote-education-strategy-2021-24) and the [High Potential and Gifted Education Policy](https://education.nsw.gov.au/policy-library/policies/pd-2004-0051).

### Aim

The aim of the course is to engage and encourage student interest and skills in STEM, appreciate the scope, impact and pathways into STEM careers and learn how to work collaboratively, entrepreneurially, and innovatively to solve real-world problems.

### Purpose and audience

This assessment package provides a range of assessment strategies and supplementary material that can be used to support student achievement in the task outlined. This resource is for teachers when creating a program of assessment for the iSTEM course.

### When and how to use this document

Use the assessment package in the context that best supports your school context.

### Assessment for learning

Possible formative assessment strategies that could be included:

* Learning intentions and success criteria assist educators to articulate the purpose of a learning task to make judgements about the quality of student learning. These help students focus on the task or activity taking place and what they are learning and provide a framework for reflection and feedback. [Online tools](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/622) can assist implementation of this formative assessment strategy.
* Eliciting evidence strategies allow teachers to determine the next steps in learning and assist teachers in evaluating the impact of teaching and learning activities. Strategies that may be added to a learning sequence to elicit evidence include all student response systems, [exit tickets](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/543), mini whiteboards (actual or [digital](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/575)), [hinge questions](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/560), [Kahoot](https://kahoot.com/), [Socrative](https://www.socrative.com/), quick quizzes to ensure that individual student progress can be monitored and the lesson sequence adjusted based on formative data collected.
* Feedback is designed to close the gap between current and desired performance by informing teacher and student behaviour (AITSL). AITSL provides a [factsheet to support evidence-based feedback](https://www.aitsl.edu.au/teach/improve-practice/feedback#:~:text=FEEDBACK-,Factsheet,-A%20quick%20guide).
* [Peer feedback](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/549) is a structured process where students evaluate the work of their peers by providing valuable feedback in relation to learning intentions and success criteria. It can be supported by [online tools](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Browser?cache_id=1d29b).
* Self-regulated learning opportunities assist students in taking ownership of their own learning. A variety of strategies can be employed and some examples include reflection tasks, [Think-Pair-Share](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/645), [KWLH charts](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/562), [learning portfolios](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/583) and [learning logs](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/583).

The primary role of assessment is to establish where individuals are in their learning so that teaching can be differentiated and further learning progress can be monitored over time.

Feedback that focuses on improving tasks, processes and student self-regulation is the most effective. Students engaging with feedback can take many forms including formal, informal, formative, summative, interactive, demonstrable, visual, written, verbal and non-verbal.

[What works best update 2020](https://education.nsw.gov.au/about-us/educational-data/cese/publications/research-reports/what-works-best-2020-update) (CESE 2020a)

### Differentiation

Differentiated learning can be enabled by differentiating the teaching approach to content, process, product, and the learning environment. For more information on differentiation go to [Differentiating learning](https://education.nsw.gov.au/teaching-and-learning/professional-learning/teacher-quality-and-accreditation/strong-start-great-teachers/refining-practice/differentiating-learning) and [Differentiation](https://education.nsw.gov.au/campaigns/inclusive-practice-hub/primary-school/teaching-strategies/differentiation).

When using these resources in the classroom, it is important for teachers to consider the needs of all students in their class, including:

* **Aboriginal and Torres Strait Islander students**. Targeted [strategies](https://education.nsw.gov.au/teaching-and-learning/aec/aboriginal-education-in-nsw-public-schools) can be used to achieve outcomes for Aboriginal students in K-12 and increase knowledge and understanding of Aboriginal histories and culture. Teachers should utilise students’ Personalised Learning Pathways to support individual student needs and goals.
* **EAL/D learners**. EAL/D learners will require explicit English language support and scaffolding, informed by the [EAL/D enhanced teaching and learning cycle](https://education.nsw.gov.au/teaching-and-learning/curriculum/literacy-and-numeracy/resources-for-schools/eald/enhanced-teaching-and-learning-cycle) and the student’s phase on the [EAL/D Learning Progression](https://education.nsw.gov.au/teaching-and-learning/curriculum/multicultural-education/english-as-an-additional-language-or-dialect/planning-eald-support/english-language-proficiency). In addition, teachers can access information about [supporting EAL/D learners](https://education.nsw.gov.au/teaching-and-learning/curriculum/multicultural-education/english-as-an-additional-language-or-dialect/planning-eald-support/english-language-proficiency) and [literacy and numeracy support specific to EAL/D learners](https://education.nsw.gov.au/teaching-and-learning/curriculum/literacy-and-numeracy/resources-for-schools/eald/enhanced-teaching-and-learning-cycle).
* **Students with additional learning needs**. Learning adjustments enable students with disability and additional learning and support needs to access syllabus outcomes and content on the same basis as their peers. Teachers can use a range of [adjustments](https://education.nsw.gov.au/teaching-and-learning/disability-learning-and-support/personalised-support-for-learning/adjustments-to-teaching-and-learning) to ensure a personalised approach to student learning. In addition, the [Universal Design for Learning Tool](https://education.nsw.gov.au/teaching-and-learning/learning-from-home/teaching-at-home/teaching-and-learning-resources/universal-design-for-learning) can be used to support the diverse learning needs of students using inclusive teaching and learning strategies and subject specific curriculum considerations can be found on the [Inclusive Practice hub](https://education.nsw.gov.au/campaigns/inclusive-practice-hub).
* **High potential and gifted learners**. [Assessing and identifying high potential and gifted learners](https://education.nsw.gov.au/teaching-and-learning/high-potential-and-gifted-education/supporting-educators/assess-and-identify#Assessment1) will help teachers decide which students may benefit from extension and additional challenge. [Effective strategies and contributors to achievement](https://education.nsw.gov.au/teaching-and-learning/high-potential-and-gifted-education/supporting-educators/evaluate) for high potential and gifted learners helps teachers to identify and target areas for growth and improvement. In addition, the [Differentiation Adjustment Tool](https://education.nsw.gov.au/teaching-and-learning/high-potential-and-gifted-education/supporting-educators/implement/differentiation-adjustment-strategies) can be used to support the specific learning needs of high potential and gifted students. The [High Potential and Gifted Education Professional Learning and Resource Hub](https://schoolsnsw.sharepoint.com/sites/HPGEHub/SitePages/Home.aspx) supports school leaders and teachers to effectively implement the High Potential and Gifted Education Policy in their unique contexts.

All students need to be challenged and engaged to develop their potential fully. A culture of high expectations needs to be supported by strategies that both challenge and support student learning needs, such as through appropriate curriculum differentiation.

### About this resource

All curriculum resources are prepared through a rigorous process. Resources are periodically reviewed as part of our ongoing evaluation plan to ensure currency, relevance, and effectiveness. For additional support or advice contact the Teaching and Learning Curriculum team by emailing secondaryteachingandlearning@det.nsw.edu.au.

**Alignment to system priorities and/or needs**:

This resource aligns to the School Excellence Framework elements of curriculum (curriculum provision) and effective classroom practice (lesson planning, explicit teaching).

This resource supports teachers to address [Australian Professional Teaching Standards](https://educationstandards.nsw.edu.au/wps/portal/nesa/teacher-accreditation/meeting-requirements/the-standards/proficient-teacher) 5.1.2, 5.5.2

This resource has been designed to support schools with successful implementation of new curriculum, specifically the NSW Department of Education approved elective course, iSTEM © 2021 NSW Department of Education for and on behalf of the Crown in right of the State of New South Wales.

The resource is produced to assist schools with promoting and implementing the course for the first time. As the course may be taught by teachers from a range of key learning areas, the resource is designed to support teachers from a variety of KLA expertise.

**Department approved elective course**: iSTEM

**Course outcomes**: ST5-4, ST5-8

**Author**: Curriculum Secondary Learners

**Publisher**: State of NSW, Department of Education

**Resource**: Assessment resource

**Related resources**: Further resources to support iSTEM can be found on the Department approved elective courses webpage including course document, sample scope and sequences, assessment materials and other learning sequences.

**Professional Learning**: Join the [Teaching and Learning 7-12 statewide staffroom](https://education.nsw.gov.au/teaching-and-learning/curriculum/statewide-staffrooms) for information regarding professional learning opportunities.

**Consulted with**: Aboriginal Outcomes and Partnerships, Inclusion and Wellbeing, and EAL/D.

**Reviewed by**: This resource was reviewed by Curriculum Secondary Learners and by subject matter experts in schools to ensure accuracy of content.

**Creation date**: 3rd March 2023

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**Evidence Base**:

The range of assessment strategies outlined in the advice encourages ‘a variety of assessment methods each lesson to check for students’ understanding and inform what should be taught next’ (CESE 2020a:22). The assessment strategies outlined are student-centred, providing ‘students with opportunities to reflect on their progress to inform future learning goals’ (CESE 2020a:22).

The assessment strategies outlined provide teachers important information about whether students learned what they intended. Wiliam (2013) claims ‘the term formative should apply not to the assessment but to the function that the evidence generated by the assessment actually serves’.

## References

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NESA holds the only official and up-to-date versions of the NSW Curriculum and syllabus documents. Please visit the NSW Education Standards Authority (NESA) website <https://educationstandards.nsw.edu.au/> and the NSW Curriculum website [https://curriculum.nsw.edu.au/home](https://aus01.safelinks.protection.outlook.com/?url=https%3A%2F%2Fcurriculum.nsw.edu.au%2Fhome&data=05%7C01%7CCaitlin.Pace1%40det.nsw.edu.au%7C9c2c1a9f59c94d2df30708dafa7edb23%7C05a0e69a418a47c19c259387261bf991%7C0%7C0%7C638097720042599463%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=SYVPECiogUlm2Ck2OkCJ8LGVJ3ZUXn%2Bm5%2F%2FbO4ocGOM%3D&reserved=0).

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