



Coimisiún na Scrúduithe Stáit
State Examinations Commission

Junior Cycle Final Examination 2023

Engineering

Common Level

Friday 16 June Afternoon 1:30 - 3:00

120 marks

Examination Number

----------------------	----------------------	----------------------	----------------------	----------------------

Day and Month of Birth

----------------------	----------------------	----------------------	----------------------

For example, 3rd February is
entered as 0302

Centre Stamp

--

Instructions

Answer all questions.

Questions do not necessarily carry equal marks.

Write your answers in blue or black pen. You may use pencil and colouring pencils for sketches and diagrams only.

Write your answers in the spaces provided in this booklet. There is space for extra work at the end of this booklet. Label any such extra work clearly with the question number and part.

This examination booklet will be scanned and your work will be presented to an examiner on screen. Anything that you write outside of the answer areas may not be seen by the examiner.

Question 1

(a) A dash cam for use in a car is shown opposite.

(i) Outline one advantage of using a dash cam.

Advantage:

(ii) Outline one disadvantage of using a dash cam.

Disadvantage:

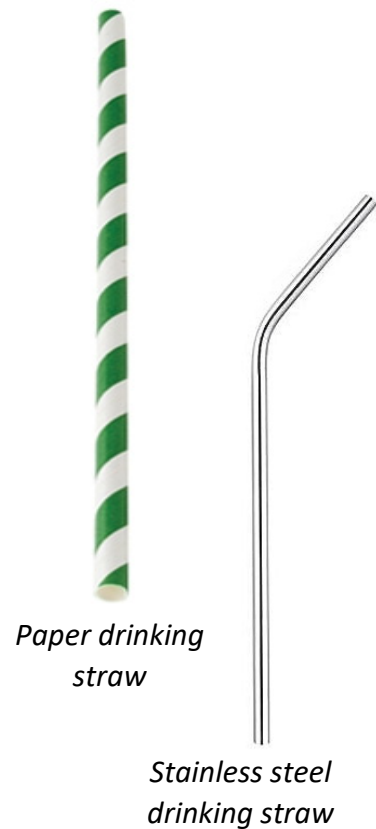


(b) (i) Select one of the drinking straws shown and explain how its use may impact negatively on the environment.

Selection:
Negative impact:

(ii) State two properties of stainless steel.

Property 1:
Property 2:



(c) A compression spring is used in the 2023 Junior Cycle Engineering Project, as shown.

- (i) Explain the meaning of the term compression.

Explanation:

Compression spring



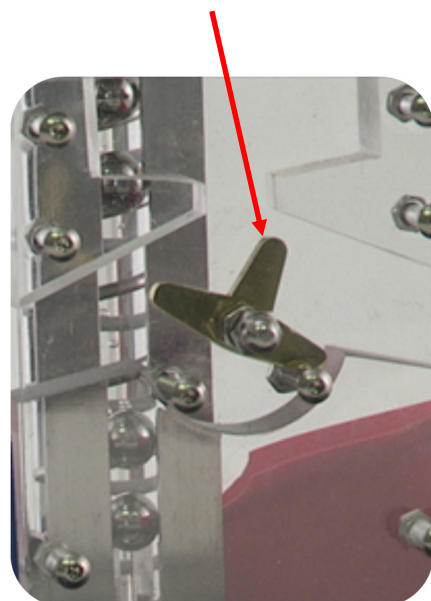
- (ii) Identify one other application of a compression spring.

Application:

- (iii) Describe the function of the separator mechanism shown in the operation of the 2023 Junior Cycle Engineering Project.

Description:

Separator mechanism



- (d) (i) Drones have an increasingly important role in smart farming.
State two applications for a drone in farming.

Application 1:

--

Application 2:

--



Drone

- (ii) Explain why 3D printing is suitable for the manufacture of drone parts.

Explanation:



*3D printed
drone parts*

- (e) (i) Tick the term which best describes the function of the pulley wheel in the gym machine shown.

Load	
Fulcrum	
Effort	



Pulley wheel

- (ii) Explain why a pulley wheel is used in the gym machine shown.

Explanation:

- (iii) Name two lathe processes used in the manufacture of the dumbbell bar shown.

Process 1:

--

Process 2:

--



Dumbbell bar

Question 2

Engineering and product design are central to the production of custom made (bespoke) furniture and products, such as the novelty table lamp shown.

- (a) (i) The novelty table lamp shown has adjustable body parts. Outline one reason for this design feature.

Reason:

- (ii) Name the type of nut shown and explain why it is suitable for use on the novelty table lamp.

Name:
Explanation:



Novelty table lamp



Nut

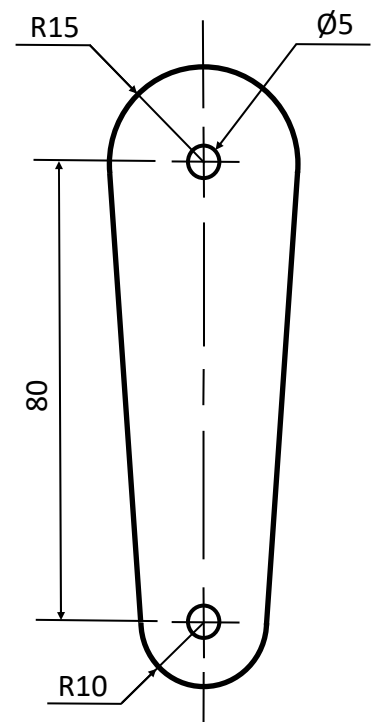
- (b) The body parts of the novelty table lamp shown are made from acrylic.

- (i) Calculate, in millimetres, the overall length and overall width of the acrylic body part shown.

Overall Length:
Overall Width:

- (ii) Describe how the profile of the acrylic body part may be accurately marked out.

Description:



*Dimensioned (mm)
acrylic body part*

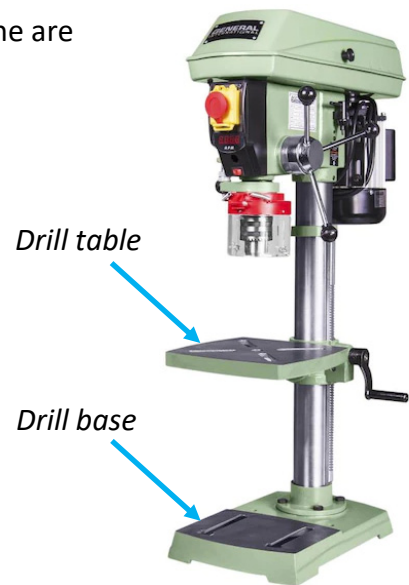
- (c) (i) Identify two safety precautions to be taken when drilling the acrylic body parts.

Safety precaution 1:

Safety precaution 2:

- (ii) Explain why the table and the base of a drilling machine are made from Cast Iron.

Explanation:



- (iii) Circle the correct alloy combination for Cast Iron.

Iron and carbon	Copper and zinc	Iron and chromium
------------------------	------------------------	--------------------------

- (iv) Match each safety sign shown to the correct category, by drawing a line.



Prohibited sign

Hazard / Warning sign

Safety condition sign

- (d) (i) The novelty table lamp often falls over when in use. Using a rendered sketch, design a base on which the lamp can be securely placed.

Rendered sketch of base design



- (ii) Identify a suitable material for the base you designed and outline one reason for the selection of this material.

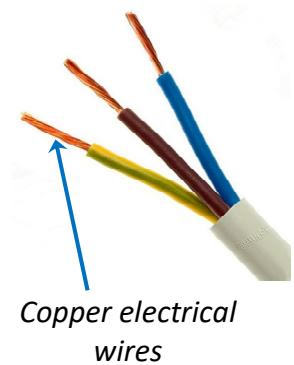
Material:
Reason:

- (e) (i) Explain why copper is used in the manufacture of the electrical wires shown.

Explanation:

- (ii) Circle the correct classification for copper.

Ferrous metal	Non-ferrous metal
----------------------	--------------------------

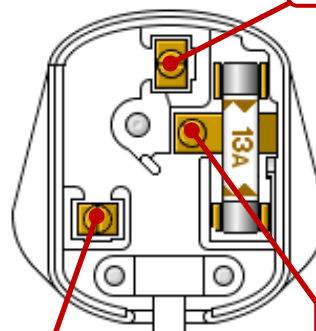
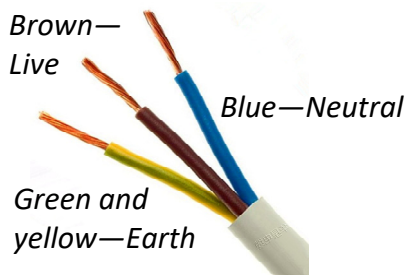


- (iii) Suggest one other suitable use for copper.

Use:

--

- (iv) Insert the correct wire colour for each plug terminal shown.



Colour:

Colour:

Colour:

- (f) State two advantages associated with upcycling to produce bespoke / unique products like the table lamp shown.

Advantage 1:

Advantage 2:



Bespoke table lamp

Question 3

The Wello Family E-Trike is a hybrid electric vehicle designed for transporting passengers and cargo in urban areas.

This E-Trike has a built-in rechargeable battery and solar panels on the roof to provide power to the motor that assists the user while pedalling.



Wello Family E-Trike

- (a) The following four terms are associated with the design and engineering of E-Trikes.

Solar power	Cargo	Hybrid vehicle	Carbon footprint
-------------	-------	----------------	------------------

Complete the table below by inserting the most suitable term next to the description of the term.

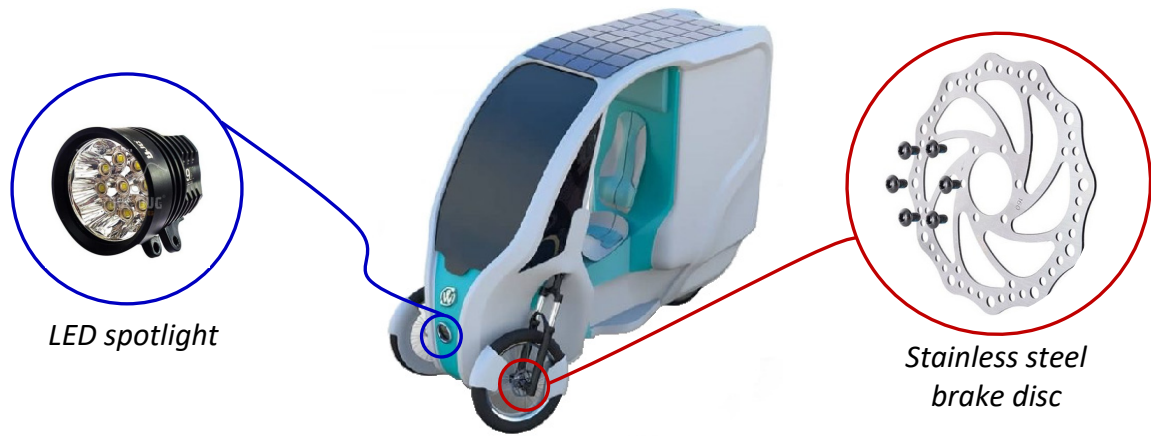
Term	Description of Terms
	A vehicle that uses two or more distinct types of power.
	Freight or goods carried by a ship, aircraft, or other vehicle.
	A measure of the amount of carbon dioxide released into the atmosphere by your activities over a particular period.
	Heat radiation from the sun converted into electrical power.

- (b) State two advantages of using the E-Trike for travel in urban areas.

Advantage 1:

Advantage 2:

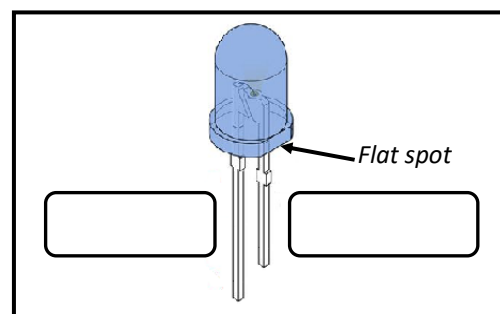
(c)



(i) Explain the meaning of the term LED.

Explanation:

(ii) Label the positive leg and negative leg of the LED shown.



(iii) Outline two advantages of using LED lights over traditional light bulbs.

Advantage 1:

Advantage 2:

(iv) Outline two reasons for the holes in the design of the brake disc shown above.

Reason 1:

Reason 2:

- (v) Outline one advantage of using Allen screws in the assembly of the stainless steel brake disc.

Advantage:



- (vi) Explain why adhesives may be applied to an Allen screw when assembling a brake disc.

Explanation:



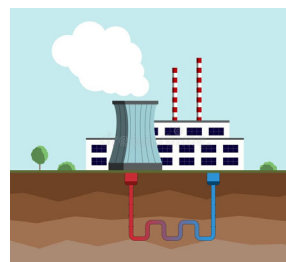
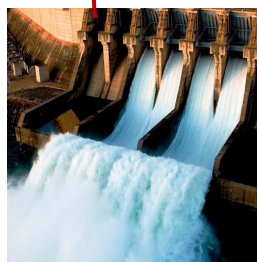
- (d) The E-Trike is fitted with a pneumatic shock absorber. Explain the term *pneumatic*.

Explanation:



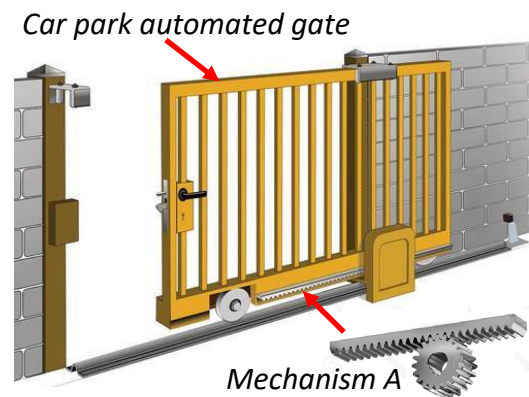
- (e) Match the renewable energy source to the correct diagram for that source. The first match is completed for you.

Wind energy	Geothermal energy	Hydro energy	Biomass energy
-------------	-------------------	--------------	----------------



Question 4

Engineering electronic control systems are frequently used at car parking facilities in towns and cities.



- (a) (i) Identify two advantages of using an automated electric gate system.

Advantage 1:

--

Advantage 2:

--

- (ii) The gate, shown above, is made from steel. Suggest a suitable finish which may be applied to the gate to help prevent corrosion.

Finish:

--

- (iii) Circle the correct name for *mechanism A* shown above.

Pulley and belt	Crank and slider	Ratchet and pawl	Rack and pinion
------------------------	-------------------------	-------------------------	------------------------

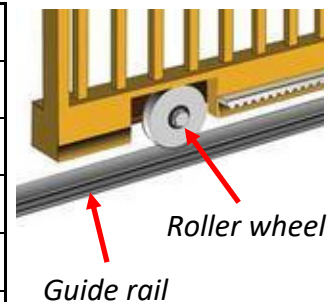
- (iv) Suggest one other suitable application for *mechanism A*.

Application:

--

- (v) Explain why the surfaces of the roller wheel and the guide rail are heat treated.

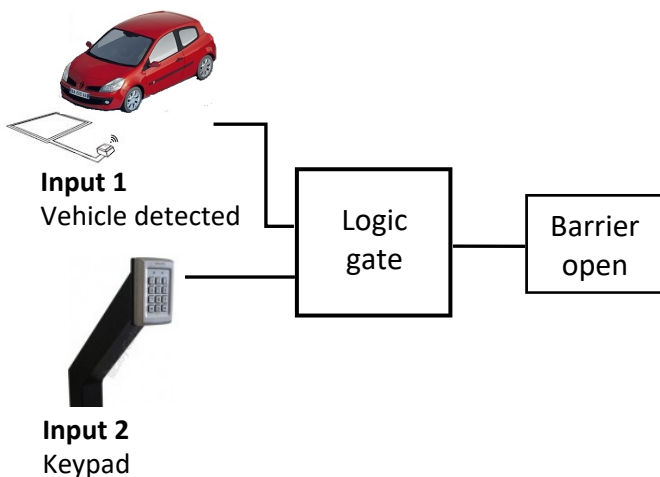
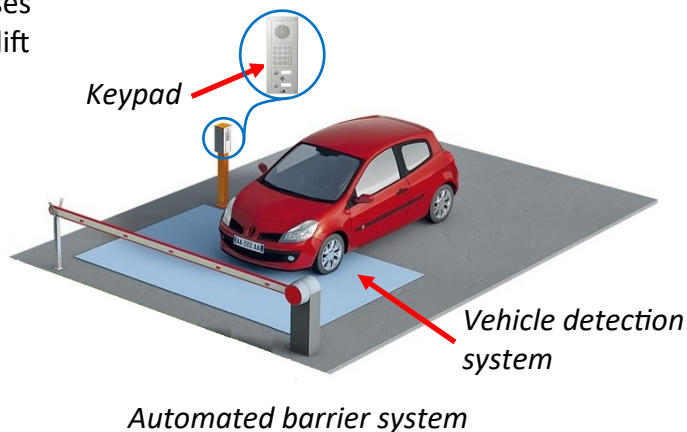
Explanation:



- (b) The automated barrier system shown uses a digital logic gate. The barrier will only lift when the vehicle is detected and the keypad is used.

(i) The keypad is a(n):

Type of device	Tick correct answer
Input device	☐
Output device	☐
Process device	☐



The following information is relevant to activate the automated barrier system.

No vehicle detected = Logic Level 0
 Vehicle detected = Logic Level 1
 Keypad code incorrect = Logic Level 0
 Keypad code correct = Logic Level 1

(ii) Name the logic gate which is most suitable to activate the automated barrier system.

Name:

(iii) Draw the symbol for this logic gate and complete the Truth Table.

Logic Gate Symbol	Input 1	Input 2	Output
	1	0	0

- (c) (i) Using a rendered sketch, design a suitable bracket for the keypad shown.

The bracket you design should include:

- A method to securely hold the keypad
- A method to permanently attach the bracket to the floor.

Rendered sketch of bracket



- (ii) Identify two other applications where a keypad may be used.

Application 1:

Application 2:

(d) The automated barrier system contains circuits with various resistors.

(i) State the value of the resistors shown.



Red, Red, Red

Resistance value		Ω
------------------	----------------------	----------



Brown, Black, Orange

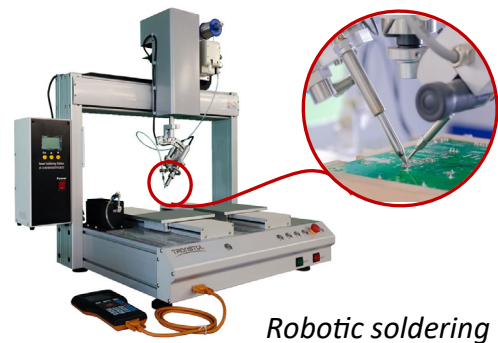
Resistance value		Ω
------------------	----------------------	----------

Colour	Value
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Grey	8
White	9

(ii) State one advantage and one disadvantage of using robotic technology in industrial soldering.

Advantage:

Disadvantage:



Robotic soldering

(iii) Circle the correct alloy combination for soft solder.

Copper and tin	Lead and tin	Copper and zinc	Iron and carbon
-----------------------	---------------------	------------------------	------------------------

(iv) Outline one advantage of using ribbon cable when wiring electronic devices.

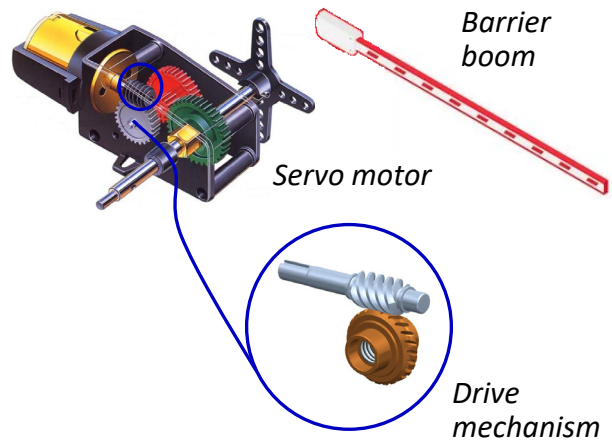
Advantage:



Ribbon cable

- (e) (i) Explain why a servo motor is suitable to control a barrier boom, as shown.

Explanation:

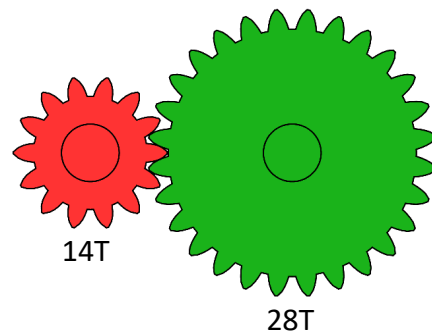


- (ii) Name the drive mechanism, shown above, used in the servo motor gearbox.

Name:

- (iii) If the driver gear, shown opposite, has 14 teeth and the driven gear has 28 teeth, tick the correct gear ratio for this gear train.

Gear ratio	Tick correct answer
1:2	☐
2:1	☐
1:4	☐



- (iv) Calculate how fast the driven gear turns, in RPM, if the driver gear rotates at 40 RPM.

Calculation
--

Acknowledgements

Question 1 images (Accessed: February 2023)

<https://www.walmart.ca/en/ip/armor-all-universal-hd-dashboard-camera-black>
<https://cdn.shopify.com/s/files/1/2505/9528/products/Steel-Reusable-Straw>
<https://www.commercialdroneprofessional.com>
<https://encrypted-tbn0.gstatic.com/images>
<https://cdn.shopify.com/s/files>

Question 2 images (Accessed: September 2022)

<https://m.media-amazon.com/images/I/51-smoV-jGS.jpg>
<https://m.media-amazon.com/images/S/aplus-media/vc>
https://media.nisbets.com/asset/core/prodimage/large_new/w300_sign.jpg
<https://static.vecteezy.com/system/resources/previews/original/no-entry-for-people-icon-free-vector.jpg> <https://img.safetysignsupplies.co.uk/highres/WE67-L15-V-xl.png?status=user-zoom>
<https://sc04.alicdn.com/kf/H28086e3564ad4325a1ed9aa9b6784dddJ/.png>
<https://h2g2.com/oldblobs/white/3403054.gif>
https://m.media-amazon.com/images/I/81MazGCpigL._AC_SL1500_.jpg

Question 3 images (Accessed: October 2022)

<https://www.electrichunter.com/sites/default/files/field/image/Wello-Family-a-compact-electric-tricycle>
<https://www.dugdugmotorcycles.com/wp-content/uploads/2020/10/Dug-Dug-HJG-L9X-9-LED-Fog-Light-for-all-motorcycles-3-510x502.jpg>
https://tredz.azureedge.net/prodimg/64172-188610_1_Zoom.jpg
https://cdn.shopify.com/s/files/1/1818/5247/products/SO7380_M10x35BlkHeroNOLOGO_800x.jpg?v=1622581557
https://ae01.alicdn.com/kf/H166456f3d3a14db0a16a970a354374451/Bike-Brake-Disc-Rotor-160Mm-Stainless-Steel-Road-Bike-Disc-Brake-Accessories-With-48Mm-Flange-Diagonal.jpg_Q90.jpg_.webp
https://www.valmet.com/globalassets/energy/biomass/hpg1011_dalkia-img_7575-1200x630.jpg
https://www.ayvaz.com/v2/images/sektorler/hydropower_energy2.jpg
<https://thumbs.dreamstime.com/b/geothermal-energy-concept-eco-friendly-geothermal-energy-generation-power-plant-geothermal-energy-concept-eco-friendly-geothermal-104104267.jpg>
<https://encrypted-tbn0.gstatic.com/images>

Question 4 images (Accessed: October 2022)

<https://5.imimg.com/data5/JR/QE/MY-2556403/sliding-gates-500x500.jpg>
<https://tiso-blockers.com/images/stories/virtuemart/product/boom-barrier-april-2017.jpg>
<https://rc-resources.dotnous.com/vehicles/VOLKSWAGEN/detail/dr-24158.png>
<https://www.tronstol.com/uploads/image/20210506/15/soldering-robot-machine1.jpg>
<https://image.shutterstock.com/image-photo/automated-technology-industrial-robotic-electronic-260nw-1945770676.jpg>
<https://www.electricaltechnology.org/wp-content/uploads/2019/05/Construction-of-Servo-Motor-768x543.jpg>

Material may have been adapted, for the purpose of assessment, without the author's/authors' prior consent.

Do not write on this page

Copyright notice

This examination paper may contain text or images for which the State Examinations Commission is not the copyright owner, and which may have been adapted, for the purpose of assessment, without the authors' prior consent. This examination paper has been prepared in accordance with *Section 53(5) of the Copyright and Related Rights Act, 2000*. Any subsequent use for a purpose other than the intended purpose is not authorised. The Commission does not accept liability for any infringement of third-party rights arising from unauthorised distribution or use of this examination paper.

Junior Cycle Final Examination – Common Level

Engineering

Friday 16 June

Afternoon 1:30 - 3:00