

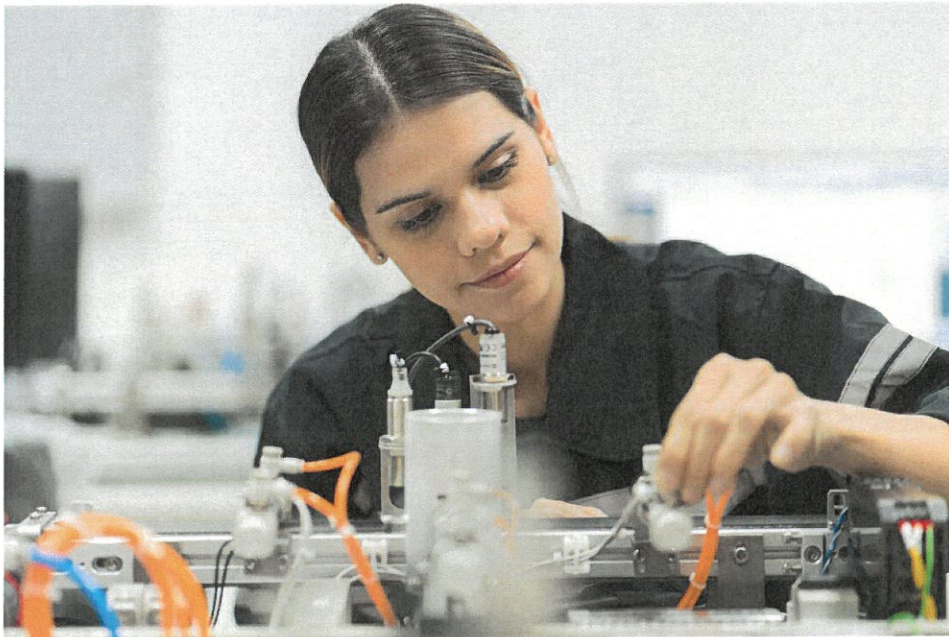
LEVEL 4 ASSESSMENT SPECIFICATION

Student name:	Jaden Chapman	Student ID number:	
Programme:	HNC Instrumentation Engineering		
Module:	Pneumatics and Hydraulics		
Module code:	PCEE4010	Contribution to Overall Mod assessment (%):	50%
Lecturer:	J Mowbray	Internal Verifier:	Jason Pointer
Assignment Title:	Pneumatics & Hydraulics Actuators and Design	Word count (or equivalent):	2000
Submission deadline:	09/05/24	Return date of provisional marks & written feedback:	07/06/24
Submission method:	All written assessments, where practical and possible, must be submitted via Turnitin unless otherwise instructed by the Lecturer. (Please DO NOT put this assessment specification into Turnitin or it will match many similarities with other students' submissions.) Alternative submission method (if applicable): Late submission of the assessment will result in a late penalty mark. Penalties for late submission: Up to one week late, maximum mark of 40%. Over one week late, 0%. Only the Extenuating Circumstances Panel may approve a change to submission dates.		
Academic honesty / referencing:	Academic honesty is required. In the main body of your submission you must give credit to authors on whose research and ideas your work is based. Append to your submission a reference list that indicates the books, articles, etc. that you have used, cited or quoted in order to complete this assessment.		

Module Learning Outcomes (from module syllabus)

1. Demonstrate an understanding of the construction, function and operation of pneumatic and hydraulic components, equipment and plant.
2. Demonstrate the skills to analyse, design pneumatic and hydraulic circuits.

Jaden Chapman



Pneumatics & Hydraulics Assignment 2

Lecturer: Jake Mowbray



*HNC programme title
be useful.*

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*Table of figures should be
after the Table of contents.*

*Sub-headings may be beneficial
for report structure.*

TASK DESCRIPTION

Introduction

The aim of this assignment is to provide an introduction of the key aspects of pneumatics and hydraulics actuators along with the designing of systems. The assignment will cover the following areas of pneumatics and hydraulics – construction of actuator, speed calculations and system design. This will be achieved through a calculations, research and design work. ✓

Task 1 – Actuator construction and operation

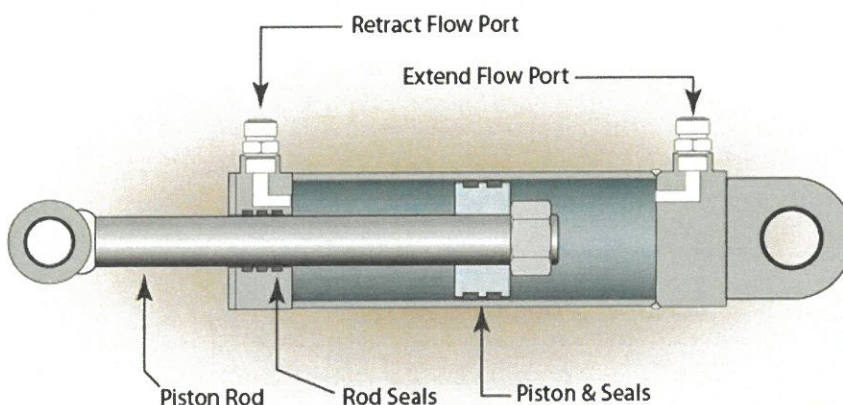
Produce a report explaining the construction and operation of the following types of actuators:

- Linear
- Rotary.

An actuator is a type of transducer that uses one form of energy to produce a mechanical motion. It receives either an electrical, hydraulic or pneumatic signal which is then converted to produce the mechanical movement. Actuators are found in application where force, torque or displacement is required and are capable of moving linearly and rotationally. As the names suggest, linear actuators move in a straight path whereas rotary actuators revolve around a fixed point either continuously or incrementally. ✓

The linear actuator is desirable when precise control is necessary. It consists of a piston rod that sits on roller screws, ball screws or lead screws and is what moves back and forth when a signal is received. In the case of a pneumatic linear actuator, airlines are used to provide air to the actuator resulting in the push/pull motion. Limit switches should also be installed so that the position of the rod can be determined by the user at all times. When the rod is not currently being sensed by either of the switches, it can be determined that the rod is travelling. ✓

Linear actuators can be either single or double acting depending on how many airlines are connected to the actuator. A double acting cylinder will most commonly have one airline at the base and one airline at the head resulting in the cylinder extending or retracting depending on which line is pressurised. ✓
Pneumatic valves are used to control the flow of the air based on whether the actuator needs to be extended or retracted. ✓



* This sounds like a mechanical actuator operated by a motor.

- NO references to validate this information.

← Where has this image been sourced?

Figure 1 – Diagram of a Linear Actuator

The rotary actuator is sought after when quick response time is desirable. They are made up of an output shaft, seals, bearings, gears and couplings to enable the shaft in rotating to its position decided by the controller. The feedback sensor is responsible for sending a signal back to the controller once it has reached the set position. One type of feedback device that is commonly used is a rotary encoder which delivers a digital output containing data regarding the position, speed and direction of the shaft. ✓
Pneumatics, hydraulics and electric are all ways in which motive force can be produced to result in a rotation. ✓

Similar to the linear actuator, a rotary actuator has inlet ports where air is delivered to the actuator via a solenoid valve for example, and this exerts a force onto either the piston, vanes or rack and pinion depending on which type of rotary actuator has been chosen for the application. ✓ Then, through a set of gears, levers, or pinions, the force is converted into torque resulting in the rotation of the output shaft. In the case of pneumatic configurations, outlet ports also known as exhausts are responsible for venting air when it is no longer needed to achieve an angular position. For hydraulic configurations, fluid is returned to the tank reservoir when it isn't required. ✓

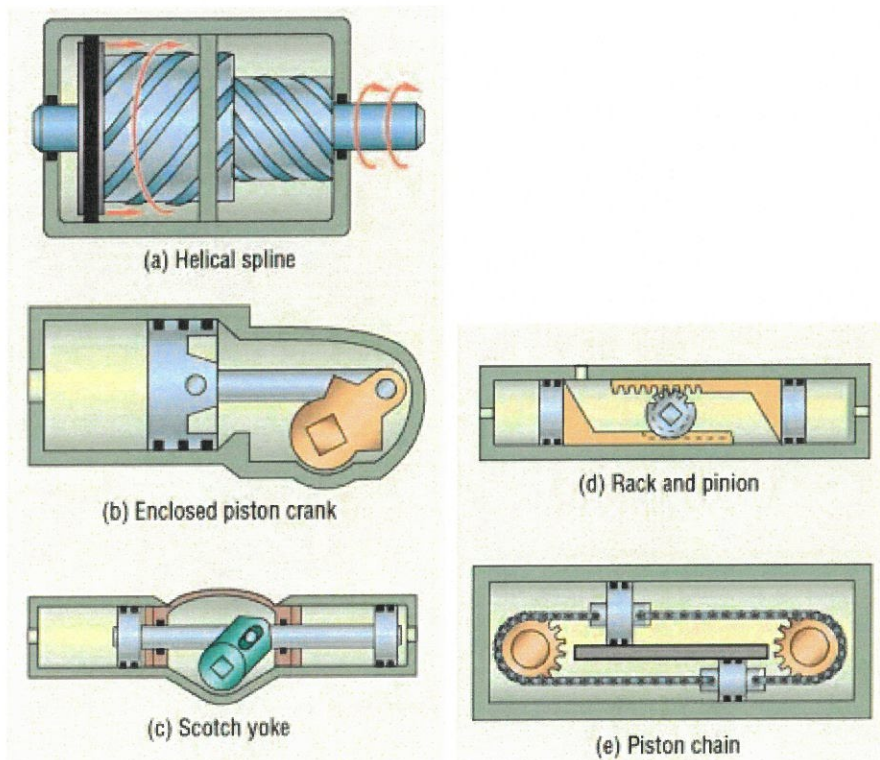


Figure 2 - Types of Rotary Actuators ✓

✓
Not all types have been referred to in the text.

Task 2 – Actuator calculations

A double acting hydraulic cylinder has a bore diameter D . The rod diameter is 60mm and the stroke length is S . The rod must produce a pushing force of 50kN. The flow rate available in both directions is Q .

Calculate:

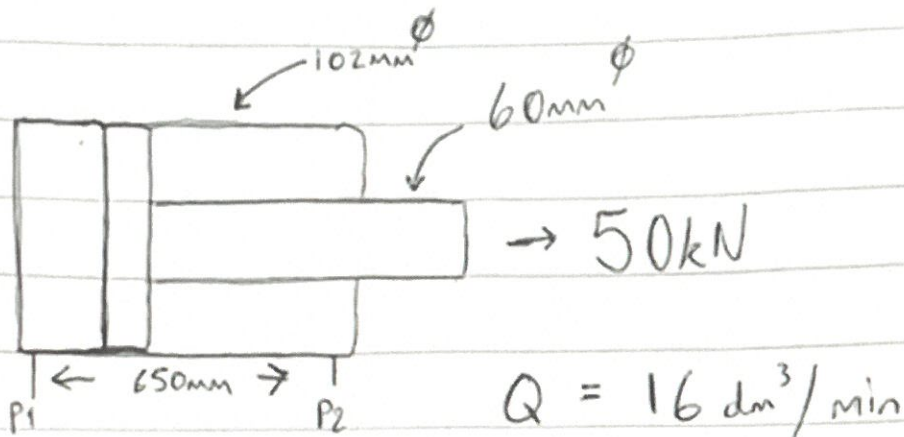
- The system pressure needed.
- The force with which it pulls, given the same pressure.
- The time taken to extend fully.
- The velocity on the outward stroke.
- The time taken to retract fully.
- The velocity on the inward stroke.
- The power transmitted on the outstroke given the cylinder is operating at capacity.

Table 1 – Values for calculations

Student Number	Values		
	D (mm)	S (mm)	Q (dm ³ /min)
1 (JC)	102	650	16
2 (KC)	125	525	20
3 (SD)	142	550	14
4 (PP)	155	450	12
5 (HR)	150	600	22



Task 2 - Actuator Calculations



$$a) P = F/A = \frac{50 \times 10^3}{\frac{\pi \times 0.102^2}{4}} = 6.12 \times 10^6 \text{ (MPa)} \checkmark$$

Brackets in wrong place.

$$b) F = P \times A = 6.12 \times 10^6 \times \left(\frac{\pi \times (0.102^2 - 0.060^2)}{4} \right)$$

$$= 44500 \text{ N} \times \frac{\pi \times (0.102^2 - 0.060^2)}{4}$$

$$32.7 \text{ kN.}$$

$$c) V = A \times S = \frac{\pi \times 0.102^2}{4} \times 0.65 \checkmark$$

$$= 5.31 \times 10^{-3}$$

$$\text{Time} = \frac{5.31}{16} = 0.33 \text{ min} \checkmark$$

$$= 15.37 \text{ secs} \times$$

$$0.33 \times 60 = 19.9 \text{ seconds.}$$

$$\frac{0.65}{19.9} = 32 \text{ mm/s.}$$

$$\begin{aligned} \text{d) } C &= \cancel{5} / \text{time} = 0.65 / 15.37 = 0.042 \text{ m/s} \\ &= 42 \text{ mm/s} \times \end{aligned}$$

$$\begin{aligned} \text{e) } V &= \left(\frac{\pi \times (0.102^2 - 0.06^2)}{4} \right) \times 0.65 \\ &= 3.47 \times 10^{-3} \end{aligned}$$

$$\begin{aligned} \text{Time} &= 3.47 / 16 = 0.22 \text{ min} \\ &= 13.2 \text{ secs} \checkmark \end{aligned}$$

$$\begin{aligned} \text{f) } C &= 0.65 / 13.2 = 0.049 \text{ m/s} \\ &= 49 \text{ mm/s} \checkmark \end{aligned}$$

$$\begin{aligned} \text{g) } \text{W.d.} &= 50 \times 10^3 \times 0.65 \\ &= 32500 \text{ J} \checkmark \end{aligned}$$

$$\text{power} = \frac{32.5 \times 10^3}{15.37} = 2114.5 \text{ watts}$$

$$\frac{32500}{19.9} = 1631.7 \text{ W.}$$

Task 3 – Circuit analysis

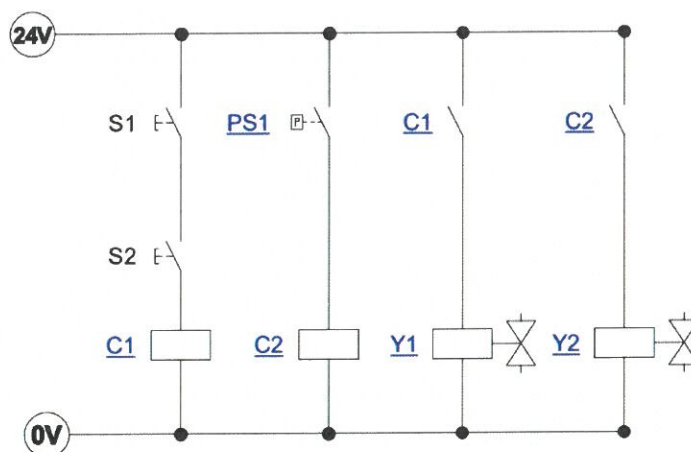
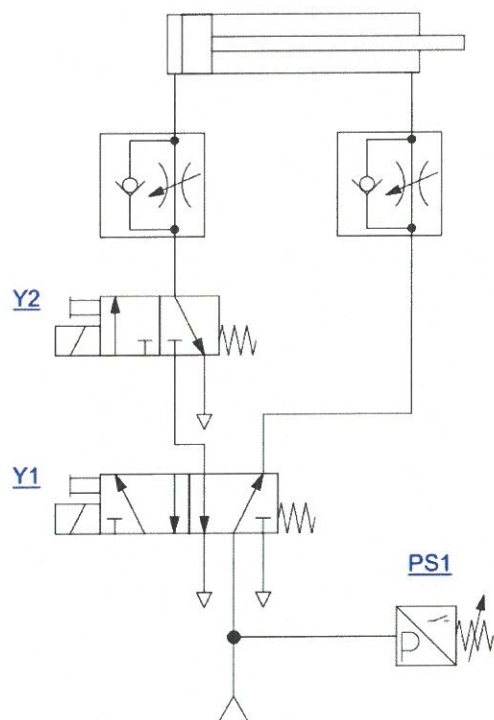
The figure below shows the circuit diagram of an electro-pneumatic system:

Produce a report explaining the full operation of the system which includes reference to each component and state the purpose of each component within the system.

As part of the report include an explanation of the construction and operation of a relay.

System supply pressure: 10bar

PS1 switching pressure: 9bar



Component List

Double acting cylinder.

Variable throttle valve with non-return valve x2

3/2 Way NC Valve.

5/2 Way Valve.

Exhausts.

Pressure source.

NO pressure switch.

When supply pressure is above 9 bar, PS1 contact is made resulting in C2 energising. This results in Y2 shuttle being positioned to direct airflow to the back of the cylinder. Both buttons labelled S1 & S2 need to be pushed at the same time made for C1 coil to be energised. Once C1 is energised, the shuttle inside Y1 will switch position to redirect airflow from the front of the cylinder to the back of the cylinder. Any air at the front of the cylinder will now be re-directed to the exhaust port.

When the pressure drops lower than 9 bar, the PS1 switch contact becomes open and results in C2 becoming de-energised. The shuttle inside of Y2 will move to prevent the air from flowing to the back of the cylinder, and instead air will be re-directed to the exhaust port. This is a safety feature in place to reduce the risk of the cylinder becoming stuck part-way through a stroke due to air pressure being too low.

+ very good.

- why have twin operation S1/S2?

As seen in the schematic above, relays consist of contacts and coils. Depending on how the circuit is configured, the energising of a coil could result in either the opening or closing of a contact and this will either prevent voltage from flowing through the circuit by breaking the path or allowing voltage through by making a path. ✓ Contacts can be normally open or normally closed and this describes their state when there are no external forces acting on them. In the case of the circuit above, the pressure switch is configured to be normally open meaning that when no pressure is applied to it, the coil will not be energised. ✓ In normal operation, the pressure supply is above the setpoint of the switch resulting in the contact closing and the coil being energised. As soon as the pressure drops below its setpoint, the contact becomes open and de-energises the corresponding coil. ✓

A relay is a solenoid that is configured to actuate switching contacts when its coil is energised. Its coil windings are wrapped around a soft iron core, and is configured in a way so that when an electromagnetic field is produced, an armature is pulled in. ✓ The armature is considered as a common terminal which is to be connected to external circuitry. The normally closed pin is in contact with the armature and the normally open pin is left to sit free so in the case of the coil energising, the armature will move and make contact with the normally open pin. ✓

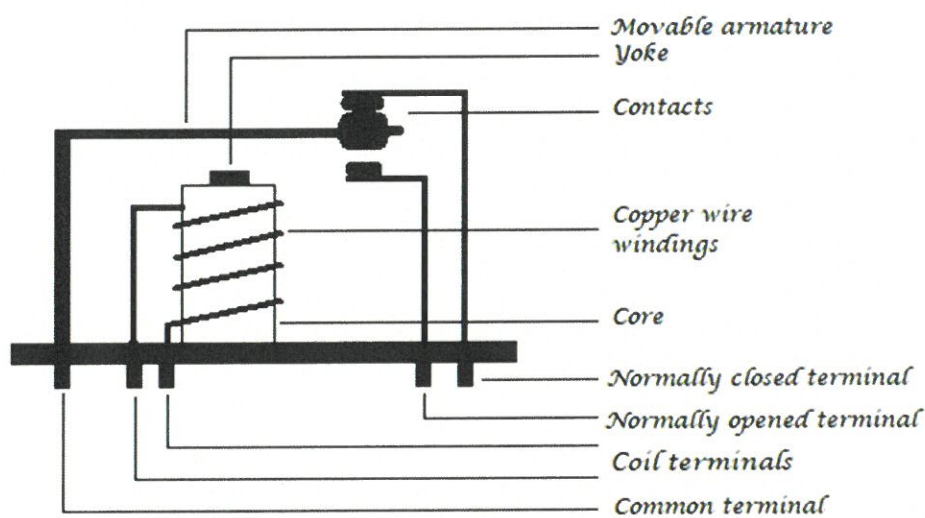


Figure 3 - Components of a Relay (ref?)

They're highly effective in the industry as they have the ability to control one electrical signal using another and are a necessity when working with systems that require the construction of logic functions to operate. ✓

Task 4 – Circuit design

You are tasked with designing two fluid power circuits to meet the following requirements:

For both systems you are to produce electro-pneumatic and hydraulic circuit diagrams, prove the designs using simulations and finally, build the systems to demonstrate correct operation.

Document your design and testing of the design in a written report.

- a) At the end of a conveyor section, boxes are to be detected then lifted by a pneumatic cylinder, then pushed onto a second conveyor by a second cylinder. On this installation it is vital that the second cylinder should not return until the first one has fully retracted.

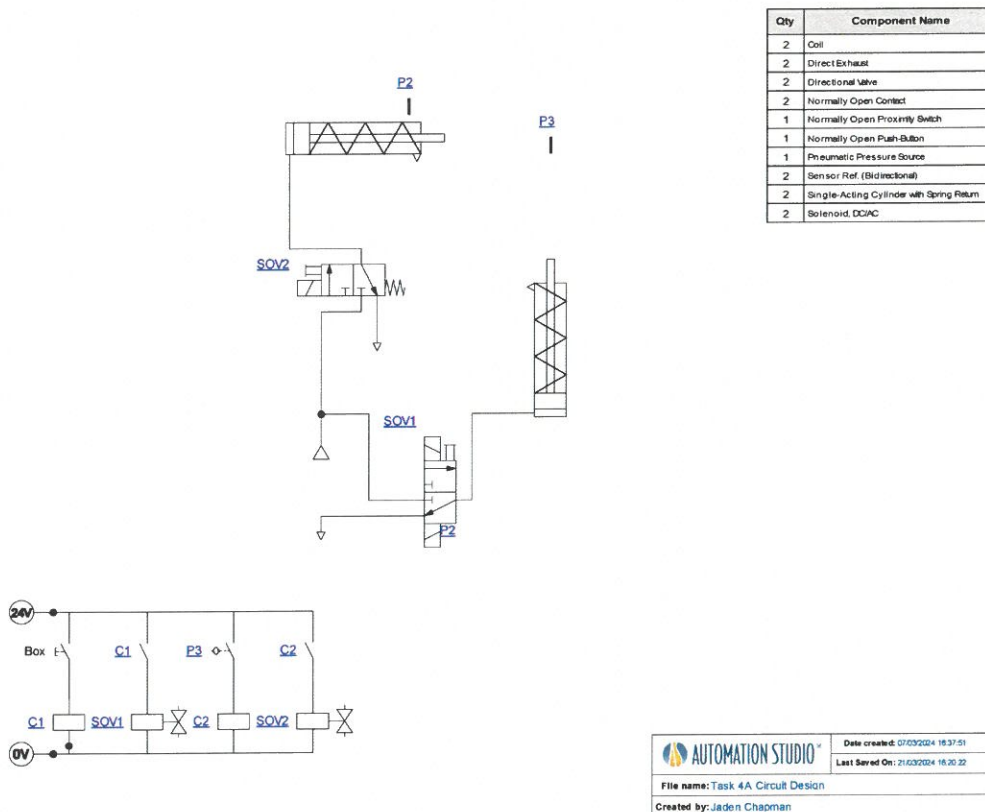


Figure 4 - Electro-pneumatic Circuit

Component List

3/2 Way Valve x2
Spring return cylinder x2
Exhausts.
Pressure source.
Sensor.

When a box is detected, the coil 'C1' will become energised subsequently closing the corresponding contact and sending a signal to 'SOV1' to switch position. This will not place air onto the cylinder causing it to extend. When the cylinder fully extends, the sensor 'P3' will detect this and energise the 'C2' coil. The normally open 'C2' contact will close when energised resulting in the shuttle inside 'SOV2' changing position directing air to the cylinder allowing it to extend.

When the 'P2' sensor detects that the cylinder has extended, this moves the shuttle inside 'SOV1' and vents the air via the exhaust causing the cylinder to retract. As it retracts and the cylinder is no longer detected by the 'P3' sensor, the 'P3' contact opens de-energising the 'C2' coil resulting in 'SOV2' shuttle switching position causing the air to vent via the exhaust.

The cylinders are spring return so do not require another inlet port to retract.

→ Only vent ports needed.

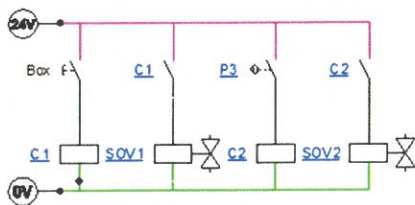
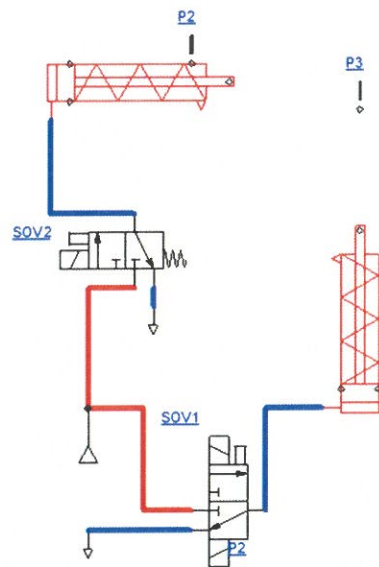


Figure 5 - Circuit with No Box Detected



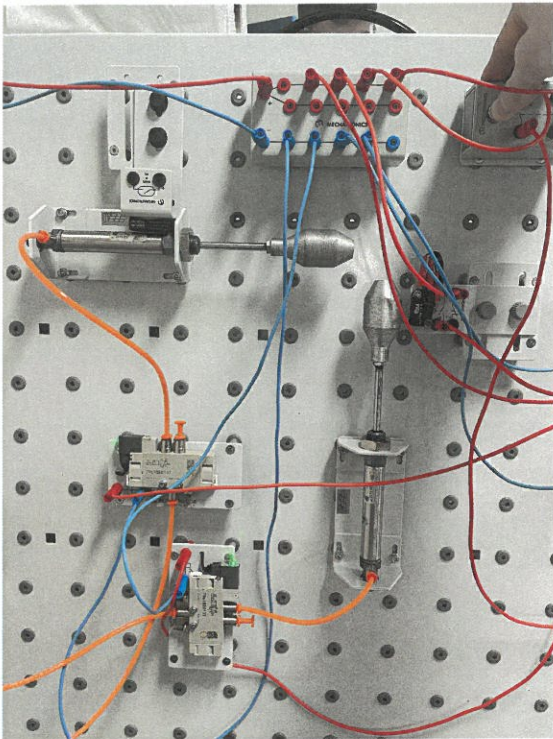


Figure 8 - Circuit with Box Detected

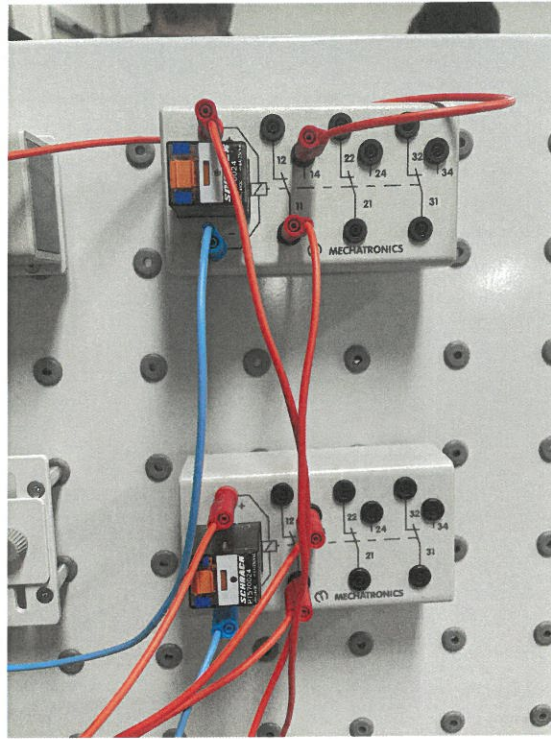


Figure 9 - Relay Configuration



- b) A power winch is to be driven by means of bi-directional hydraulic motor the rotation speed of the motor is to be controllable (adjustable) in both directions of travel.

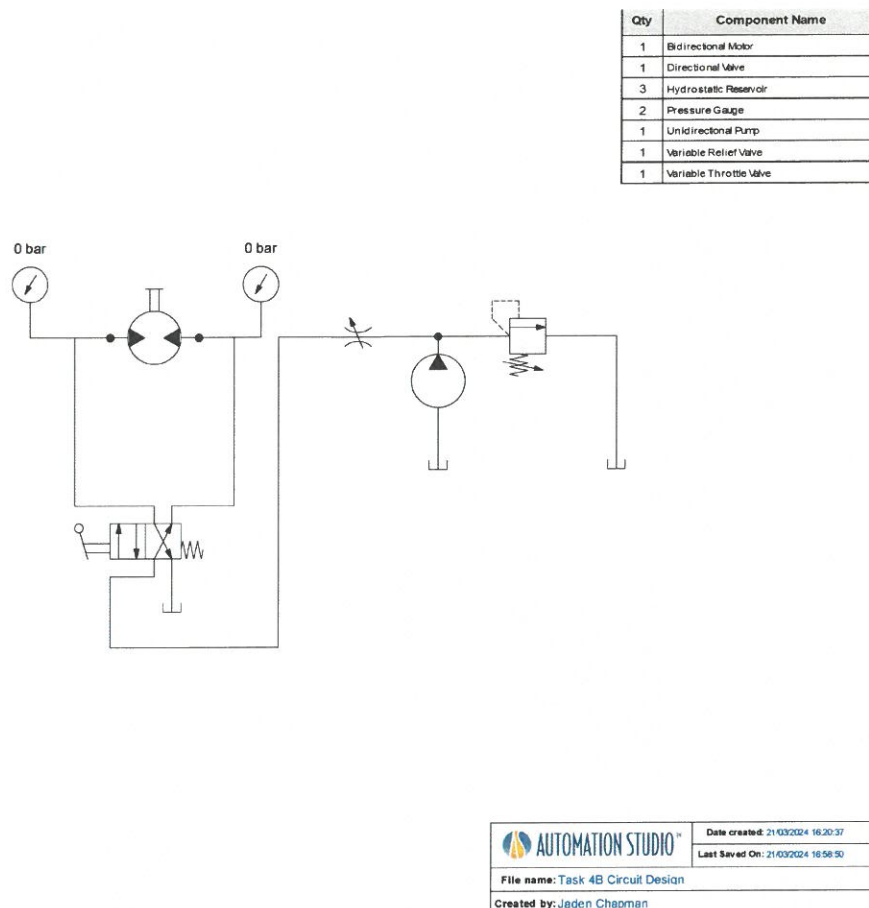


Figure 10 - Hydraulic Circuit

Component List

4/2 Way Valve.
 Lever.
 Reservoir.
 Bi-directional motor.
 Pump.
 Hydraulic pressure relief valve.
 Check Valve.
 Gauge x2

✓

During operation, a pump is used to transport hydraulic fluid from the tank reservoir through a check valve and to the 4/2-way control valve. The shuttle position inside the valve is controlled by a lever and this determines which way the motor turns the winch. There is also a pressure relief valve to direct hydraulic fluid back to the tank reservoir when necessary.

↪ To control motor RPM. ✓

In the first configuration below, hydraulic fluid is travelling through the system in a clockwise direction resulting in the bi-directional motor rotating clockwise. This can be observed on the gauges placed either side of the motor. After the fluid passes through the motor, it sent back to the tank reservoir via the exhaust.

✓

When the lever is pulled, the position of the shuttle inside the valve changes position re-directing the flow of hydraulic fluid. This results in the motor rotating in an anti-clockwise direction which can again be observed by the pressure gauges.

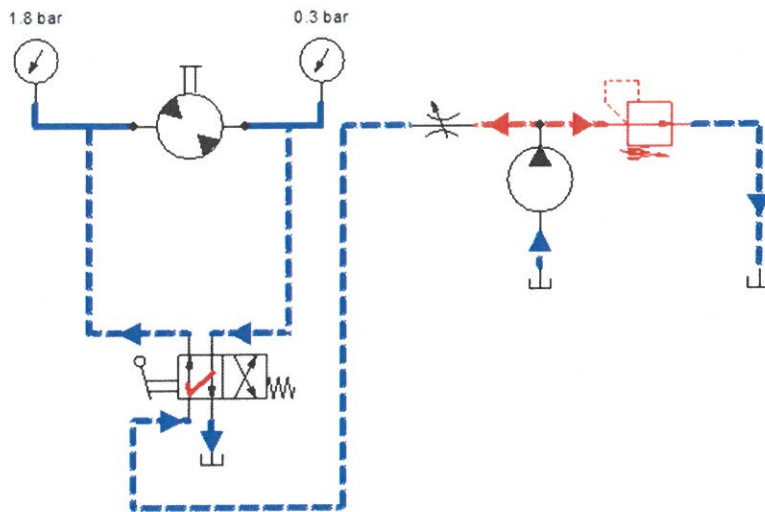


Figure 11 - Circuit Clockwise Configuration

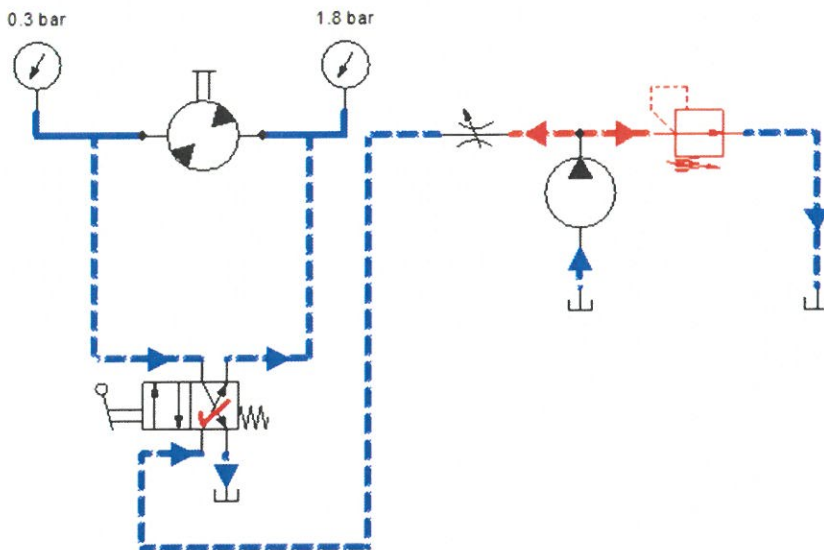


Figure 12 - Circuit Anti-Clockwise Configuration

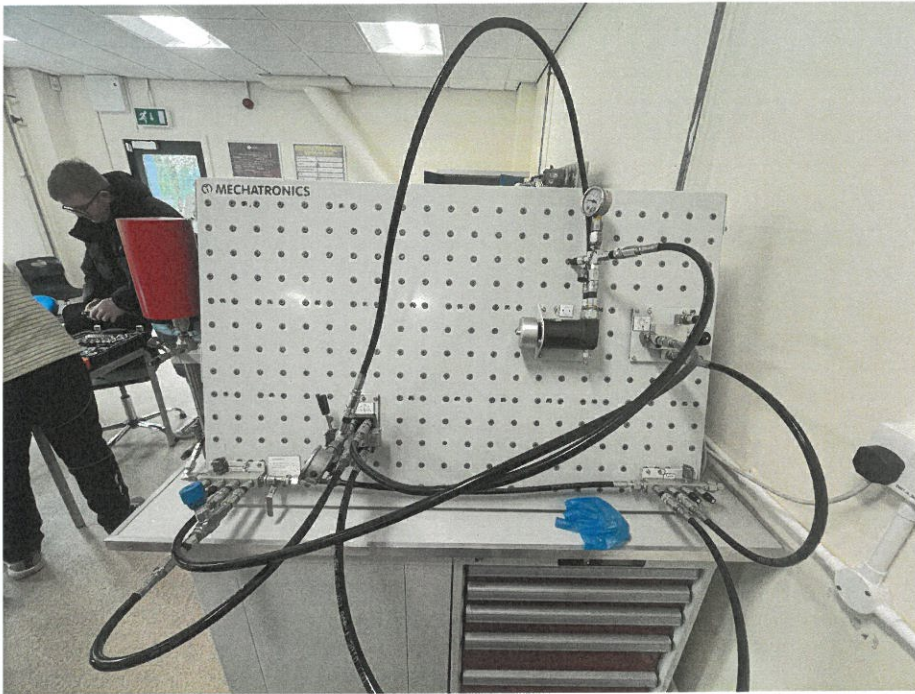


Figure 13 - Circuit Build

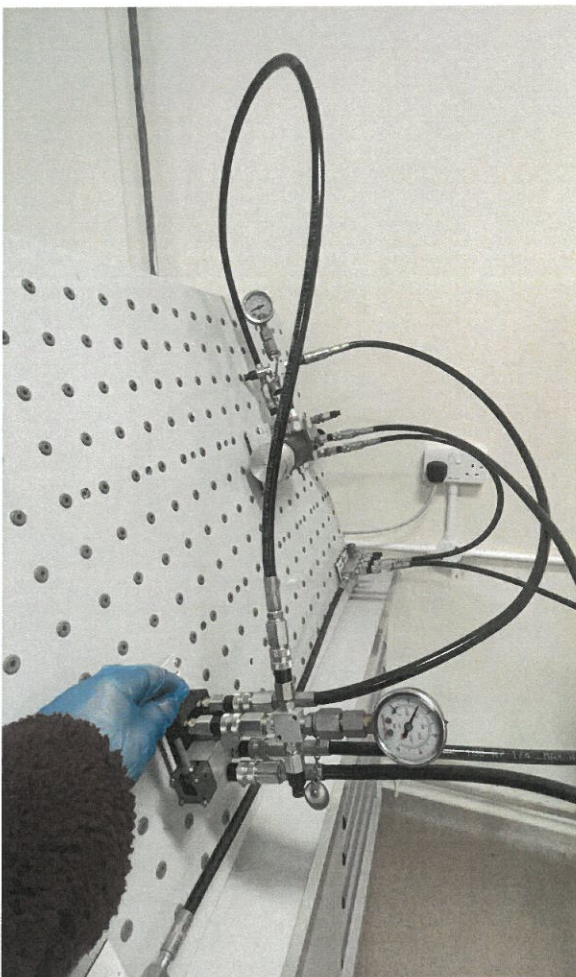
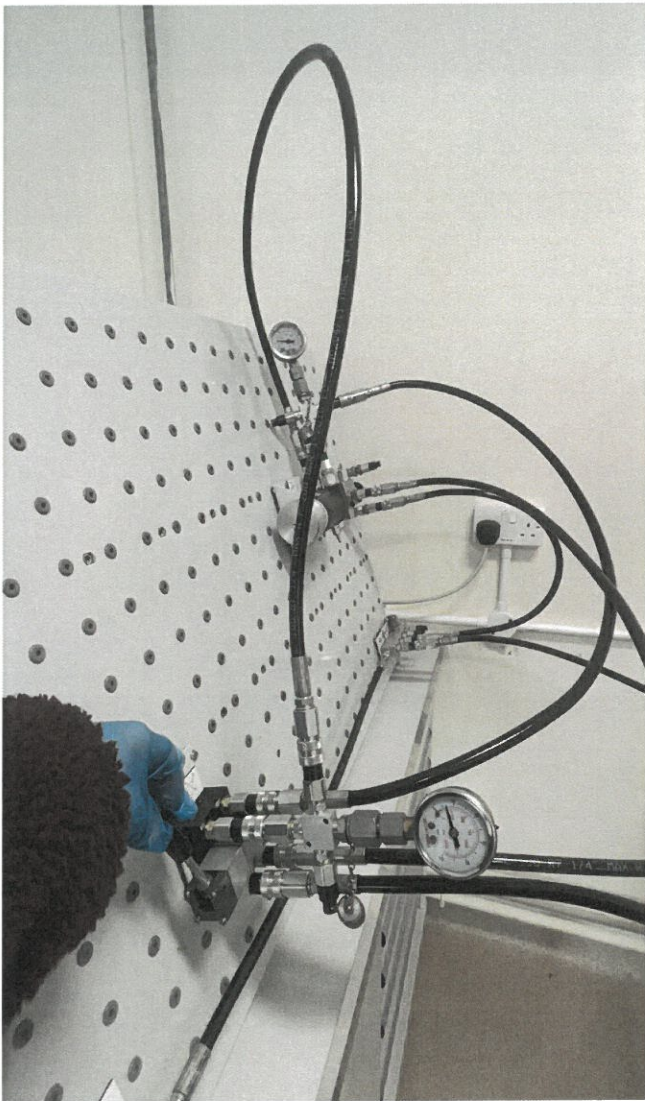


Figure 14 - Configuration 1



✓

Figure 15 - Configuration 2

Table of Figures

Figure 1 – CPI NJ, 2024. *What is a linear actuator?* [Online] Available at: [what-is-a-linear-actuator](#) Image Accessed: 07/05/24

Figure 2 - Power Motion Tech, 2012. *Engineering Essentials | Rotary Actuators* [Online] Available at: [Engineering Essentials: Rotary Actuators | Power & Motion](#) Image Accessed: 07/05/24

Figure 3 – Circuit Digest, 2017. *Relay Working, Types, Operation and Applications* [Online] Available at: <https://circuitdigest.com/article/relay-working-types-operation-applications> Image Accessed 06/05/24



This should be after table of contents, but referenced separately.

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Mariners Point Pro, 2024. *Rotary Actuator Types & Working Principles [Online]* Available at:

<https://marinerspointpro.com/rotary-actuators-types-working-principles/#:~:text=A%20rotary%20actuator%20consists%20of%20a%20motor%20and,that%20needs%20to%20be%20rotated%20like%20a%20valve>. Accessed: 07/05/24

Thomas Net, 2021. *All About Rotary Actuators [Online]* Available at: <https://www.thomasnet.com/articles/machinery-tools-supplies/rotary-actuators/> Accessed: 07/05/24

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no in-text references.

GUIDANCE FOR STUDENTS IN THE COMPLETION OF TASKS

NOTE: The guidance offered below is linked to the five generic assessment criteria overleaf.

1. Engagement with Literature Skills

Your work must be informed and supported by scholarly material that is *relevant* to and *focused* on the task(s) set. You should provide evidence that you have accessed an appropriate *range* of sources, which may be academic, governmental and industrial; these sources may include academic journal articles, textbooks, current news articles, organisational documents, and websites. You should consider the *credibility* of your sources; academic journals are normally highly credible sources while websites require careful consideration/selection and should be used sparingly. Any sources you use should be current and up-to-date, mostly published within the last five years or so, though seminal/important works in the field may be older. You must provide *evidence* of your research/own reading throughout your work, using a suitable referencing system, including in-text citations in the main body of your work and a reference list at the end of your work.

Guidance specific to this assessment: *You must provide evidence of individual research in the principles of pneumatics and hydraulics actuators. You should use a number of references, from a variety of sources including textbooks, academic journals and academic based websites. Do not use less credible sources, for example internet sites such as Tutor2U and Wikipedia.*

The Harvard system of referencing must be employed to evidence research. Give credit to respected authors on whose work your discussion is based; this avoids accusations of plagiarism and reflects the breadth of your research. Your use of in-text citations and the reference list at the end of the report will be closely examined to ensure that you are conforming to referencing convention. An extensive reference list and good use of in-text citations will earn marks, limited references and errors in citations will result in a loss of marks.

2. Knowledge and Understanding Skills

At level 4, you should be able to demonstrate knowledge of the underlying concepts and principles associated with your area(s) of study. *Knowledge* relates to the facts, information and skills you have acquired through your learning. You demonstrate your *understanding* by interpreting the meaning of the facts and information (knowledge). This means that you need to select and include in your work the concepts, techniques, models, theories, etc. appropriate to the task(s) set. You should be able to explain the theories, concepts, etc. to show your understanding. Your mark/grade will also depend upon the *extent* to which you demonstrate your knowledge and understanding.

Guidance specific to this assessment: *Your report should show you have gained knowledge of the principles of the designing of pneumatics and hydraulics systems and the operation of linear and rotary actuators. Based on your knowledge of pneumatics and hydraulics systems, select appropriate theories and calculation methods to cover all tasks within the assignment. All formulas and working must be shown and clearly layout.*

4. Practical Skills

At level 4, you should be able to apply the basic underlying concepts and principles to evaluate and interpret these within the context of your area of study. You should be able to demonstrate how the subject-related concepts and ideas relate to real world situations and/or a particular context. How do they work in practice? You will deploy models, methods, techniques, and/or theories, in that context, to assess current situations, perhaps to formulate plans or solutions to solve problems, or to create artefacts. This is likely to involve, for instance, the use of real-world artefacts, examples and cases, the application of a model within an organisation and/or benchmarking one theory or organisation against others based on stated criteria.

Guidance specific to this assessment: *Show the ability to a suitable designs of pneumatics and hydraulics systems using the correct software.*

5. Transferable Skills for Life and Professional Practice

Your work must provide evidence of the qualities and transferable skills necessary for employment requiring the exercise of some personal responsibility. This includes demonstrating: that you can communicate the results of your study/work accurately and reliably, and with structured and coherent arguments; that you can initiate and complete tasks and procedures, whether individually and/or collaboratively; fluency of expression; clarity and effectiveness in presentation and organisation. Work should be coherent and well-structured in presentation and organisation.

Guidance specific to this assessment: *Your work should be well organised and presented in a professional manner.*

Writing style: *All writing should be academic in style, formal, focused, concise and subject specific. You should write in the third person. For example, rather than 'I found...' you should say something like 'It was evident...'. Do not use contractions (for example, it's should be it is), and avoid slang and clichés (such as o' if you pay peanuts, you get monkeys'). Be concise, do not belabour points. You do not have to use 'big' words or long sentences; the aim is to be understood. A writing style that is clear, simple and direct usually works well. Edit your work to ensure your writing style is 'tight'.*

Presentation: *The report should be word processed. All graphs, charts and figures in the main body must be clearly labelled and referenced beside or beneath. Where possible they should not be on separate pages but should be incorporated within the text. Ensure there are no spelling errors by spellchecking your work. Also undertake a grammar check in Word, and it may help you to ask somebody to proof-read your work to identify errors.*

References: *Alphabetical list of authors and their work cited in the report. Use the Harvard system of referencing. Appendices: where relevant. Avoid 'padding'*

Essential Resources:

- *Resources listed on the Moodle/Teams HNC Hydraulics and Pneumatics Page.*
- *The student handbook essential reading list, available in LRC.*

STUDENT FEEDBACK FORM

This section details the *extent* to which the assessment criteria are demonstrated by you, which in turn determines your mark. The marks available for each category of skill are shown. Lecturers will use the space provided to comment on the achievement of the task(s), including those areas in which you have performed well and areas that would benefit from development/improvement.

Generic Assessment Criteria	Marks available	Marks awarded
1. Engagement with Literature Skills	20	
2. Knowledge and Understanding Skills	50	
3. Cognitive and Intellectual Skills	0	
4. Practical Application Skills	20	
5. Transferable Skills for Life and Professional Practice	10	

Assessment Mark (Assessment marks are subject to ratification at the Exam Board. These comments and marks are to give feedback on module work and are for guidance only until they are confirmed.)

Late Submission Penalties (tick if appropriate)

Up to 1 week late (40% Max)
Over 1 week late (0%)

%

GENERIC ASSESSMENT CRITERIA

Level 4

In accordance with the Framework for Higher Education Qualifications, at the end of Level 4 students will be expected to have demonstrated knowledge of the basic underlying concepts and principles of a subject, and an ability to evaluate and interpret these within the context of that area of study. They should be able to present, evaluate and interpret qualitative and quantitative data in order to develop lines of argument and make sound judgements in accordance with basic theories and concepts of their subject(s) of study. They will have learned how to evaluate different approaches to solving problems, and will be able to communicate the results of their study/work accurately and reliably, and with structured and coherent arguments. They will be able to undertake further training and develop new skills within a structured and managed environment and will have the qualities and transferable skills necessary for employment requiring the exercise of some personal responsibility.

Level 5	Category	FAIL 0-29%	MARGINAL FAIL 30-39%	SATISFACTORY (3 rd / Pass)	GOOD (2.2 / Pass)	VERY GOOD (2.1 / Merit)	EXCELLENT (1 st / Distinction)	EXCEPTIONAL (1 st / Distinction)
	Engagement with literature (including reading, referencing, academic conventions and academic honesty)	Little or no evidence of reading and/or reliance on inappropriate sources. Views and findings mostly unsupported and non-authoritative. Referencing conventions used incoherently or largely absent.	Poor engagement with essential reading. No evidence of wider reading. Reliance on inappropriate sources, and/or indiscriminate use of sources. Heavily reliant on information gained through class contact. Inconsistent and weak use of referencing.	Engagement with a limited range of mostly relevant and credible sources but with some reliance on information gained through class contact. Some omissions and minor errors. Referencing conventions evident though not always applied accurately or consistently.	Engagement with an appropriate range of literature, including sources retrieved independently. Some over-reliance on texts rather than other sources. Referencing may show minor inaccuracies or inconsistencies.	Engagement with a wide range of literature, including sources retrieved independently. Selection of relevant and credible sources. Generally sound referencing, with no/very few inaccuracies or inconsistencies.	Engagement with an extensive range of relevant and credible literature. Consistently accurate application of referencing.	Engagement with literature (including reading, referencing, academic conventions and academic honesty)
	Knowledge and understanding (Knowledge of the basic underlying concepts and principles of a subject.)	Major gaps in knowledge and understanding of the basic underlying concepts and principles of the subject matter. Inclusion of irrelevant material. Substantial inaccuracies.	Gaps in knowledge of the basic underlying concepts and principles, with flawed or superficial understanding. Some significant inaccuracies and/or irrelevant material.	Limited knowledge and understanding of the basic underlying concepts and principles within the subject area. Some elements may be missing.	Knowledge of the basic underlying concepts and principles is accurate with a good understanding of the field of study but lacks depth and/or breadth.	Competent knowledge of the basic underlying concepts and principles. Exhibits very good understanding.	Excellent knowledge and understanding of the basic underlying concepts and principles of the subject.	Exceptional, detailed knowledge and understanding of the basic underlying concepts and principles

Level 5	Category	FAIL 0-29%	MARGINAL FAIL 30-39%	SATISFACTORY (3 rd / Pass)	GOOD (2.2 / Pass)	VERY GOOD (2.1 / Merit)	EXCELLENT (1 st / Distinction)	EXCEPTIONAL (1 st / Distinction)
Cognitive and intellectual skills (Evaluate underlying concepts and principles of a subject and interpret qualitative and quantitative data in order to develop lines of argument and make sound judgements.)		Wholly or almost wholly descriptive work. Little or no evaluation of the underlying concepts and principles. Failure to develop arguments, leading to illogical or invalid judgements. Minimal or no use of evidence to back up views.	Largely descriptive work, with superficial evaluation of the underlying concepts and principles. Weak interpretation of data, flawed development of arguments and judgements. Information accepted uncritically, uses generalised statements made with scant evidence and unsubstantiated opinions. Ideas sometimes illogical and contradictory.	Limited attempt at evaluation of the underlying concepts and principles, tending towards description. Can interpret qualitative and quantitative data but with some errors. Some evidence to support emerging arguments and judgements but these may be underdeveloped or with a little inconsistency / mis-interpretation.	Good evaluation of the underlying concepts and principles. Can interpret qualitative and quantitative data, with minor errors. An emerging ability to use evidence to support the argument. Mostly valid arguments and logical judgements.	Sound evaluation of the underlying concepts and principles. Can interpret qualitative and quantitative data accurately. Ability to devise arguments using evidence to make mostly appropriate and valid judgements.	Excellent evaluation of the underlying concepts and principles. Can interpret qualitative and quantitative data accurately and with some insight. Excellent ability to devise arguments using evidence and make appropriate and valid judgements.	Exceptional evaluation of the underlying concepts and principles based evidence. Outstanding interpretation of qualitative and quantitative data. Exceptional ability to devise arguments using evidence and make wholly appropriate and valid judgements.
	Practical skills (Different approaches to solving problems in particular contexts.)	Limited or no use of taught, basic methods, materials, tools and/or techniques. Little or no appreciation of the context of the application. Very weak evidence of different approaches to problem-solving in particular contexts.	Rudimentary application of taught, basic methods, materials, tools and/or techniques but without consideration and competence. Flawed appreciation of the context of the application. Weak evidence of different approaches to problem-solving in particular contexts.	An adequate awareness and mostly appropriate application of basic methods, materials, tools and/or techniques. Basic appreciation of the context of the application. Can identify problems in particular contexts and propose basic alternative approaches or solutions though there may be errors.	A good and appropriate application of basic methods, materials, tools and/or techniques. Clear appreciation of the context of the application. Good evidence of different approaches to problem-solving in particular contexts and proposes mostly appropriate solutions.	A very good application of a range of basic methods, materials, tools and/or techniques. Very good consideration of the context of the application. Very good evidence of different approaches to problem-solving in particular contexts and proposes appropriate solutions.	An advanced application of a range of taught, basic methods, materials, tools and/or techniques. The context of the application is well considered, and insightful. Excellent evidence of different approaches to problem-solving in particular contexts and proposes appropriate solutions.	Exceptional levels of application and deployment skills in particular practical contexts. Outstanding identification of problems in particular contexts and formulation of wholly appropriate, thoughtful solutions / different approaches.
	Transferable skills for life and professional practice (Communicate the results of their	Work is poorly structured, disorganised, inaccurate and/or confusingly expressed. Very weak use of	Work is poorly presented in a disjointed manner. It is loosely, and at times incoherently, structured, with information and ideas	Mostly ordered presentation and structure in which relevant ideas / concepts are reasonably expressed. Work may	Mostly coherent, organised and accurate work, in a suitable structure and is for the most part clearly expressed. Can	Work is accurate, coherent, fluent, well-structured and organised. Can work effectively independently as part of a team,	Work is coherent, very fluent and is presented professionally. Can work effectively independently and/or as part of a	Work is accurate, exceptionally coherent, very fluent and presented well. Can work effectively independently and/or as part of a team,

Level 5	Category	FAIL	MARGINAL FAIL	SATISFACTORY (3 rd / Pass)	GOOD (2.2 / Pass)	VERY GOOD (2.1 / Merit)	EXCELLENT (1 st / Distinction)	EXCEPTIONAL (1 st / Distinction)
	study/work accurately and reliably, and with structured and coherent arguments; the qualities needed for employment requiring the exercise of some personal responsibility within a structured and managed environment.)	0-29% language and/or very inappropriate style. Failure to work effectively individual or as part of a group. Little or no evidence of the skills for employment requiring the exercise of some personal responsibility.	30-39% often poorly expressed. Weak use of language and/or inappropriate style. Flawed approach to individual or group work, meeting only partial obligations to others. Limited evidence of the skills for employment requiring the exercise of some personal responsibility.	40-49% lack coherence and/or accuracy in places. Can work as part of a group, meeting most obligations to others but perhaps with limited involvement in group activities. Demonstrates the basic skills for employment requiring the exercise of some personal responsibility, with some areas of minor weakness.	50-59% work effectively independently and/or as part of a team, with clear contribution to group activities. Demonstrates the skills for employment requiring the exercise of some personal responsibility, with just occasional minor weakness.	60-69% with very good contribution to group activities. Demonstrates very good skills for employment requiring the exercise of some personal responsibility, with just occasional minor weakness.	70-84% team, with an excellent contribution to group activities. Demonstrates excellent skills for employment requiring the exercise of some personal responsibility with an appetite for further development.	85-100% with an exceptional contribution to group activities. Demonstrates exceptional skills for employment requiring the exercise of some personal responsibility with an appetite for further development.