Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
January 2009

Technology and Design

Assessment Unit AS 3

assessing

Unit 3 – Systems and Control: Industrial and Commercial Practices

[ASV31]

WEDNESDAY 28 JANUARY, MORNING

ASV31

TIME

1 hour 30 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number on the Answer Booklet provided and on the A3 pro forma answer pages provided.
Answer **all three** questions.
Answers to questions **2(b)** and **3(d)** and **(e)** should be made on the A3 pro forma answer pages provided.

INFORMATION FOR CANDIDATES

The total mark for this paper is 60, including a maximum of 3 marks for quality of written communication.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
At the conclusion of the examination, attach the A3 pro forma answer pages securely to the Answer Booklet with the treasury tag supplied.

1 Three logic gates are shown in **Fig. 1(a)**.

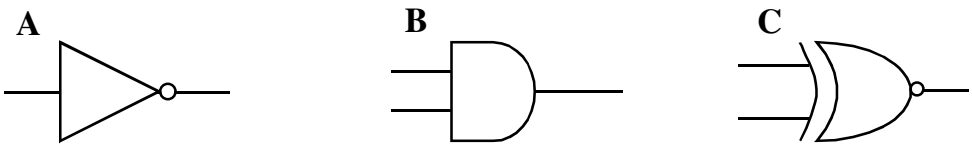

Fig. 1(a)

(a) Name the logic gates labelled **A**, **B** and **C** in **Fig. 1(a)**. [3]

(b) **Fig. 1(b)** shows a switch and resistor arrangement that could provide inputs to a logic circuit.

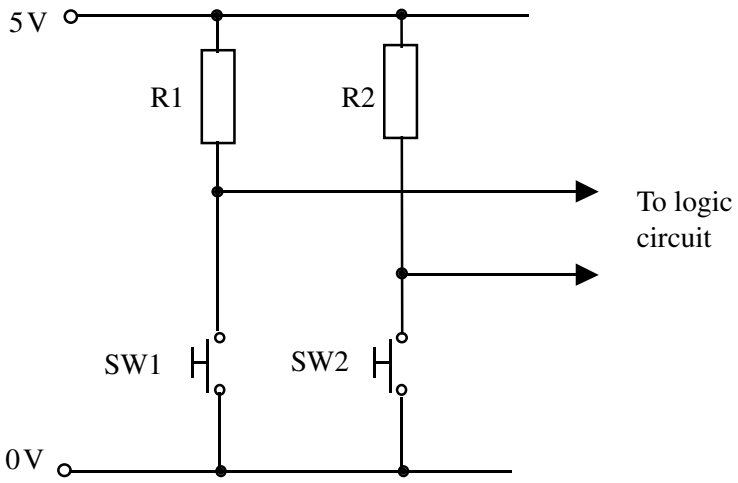

Fig. 1(b)

(i) Briefly explain the function of the resistors R1 and R2 as shown in **Fig. 1(b)**. [2]

(ii) Draw and label an SR flip flop based on logic gates and briefly explain its action. [4]

(c) A prototype light sensing circuit is shown in **Fig. 1(c)** which was found to respond to changes in the light conditions.

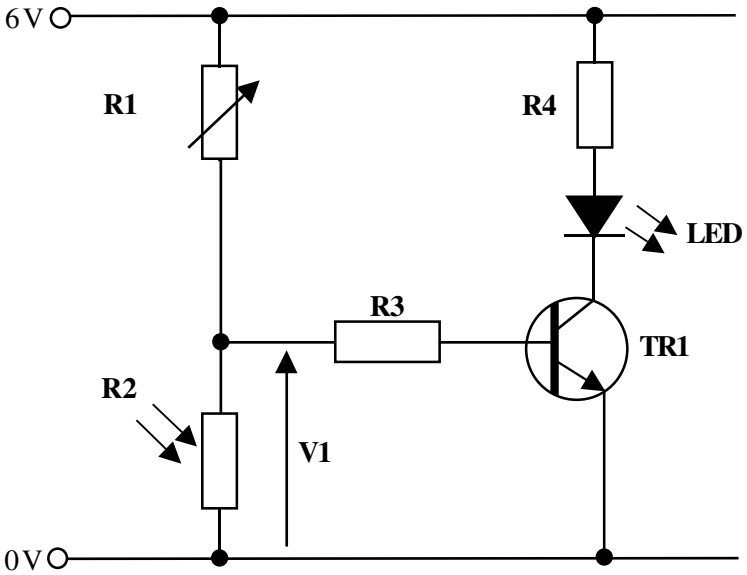

Fig. 1(c)

(i) State the name of the component **R1** in the circuit shown in **Fig. 1(c)** and briefly explain its purpose in the circuit. [2]

(ii) Describe the operation of the circuit when the light conditions change from bright light to darkness. [2]

(iii) Calculate the required resistance of **R1** in **Fig. 1(c)** to enable the voltage **V1** to equal a value of 4.2 Volts if the resistance of **R2** is 20 kΩ. [3]

(iv) The maximum LED current in **Fig. 1(c)** is limited at 20 mA when resistor **R3** is 10 kΩ. Calculate a suitable gain (h_{FE}) for the transistor **TR1**. (Assume **V1** is 4.2 V and Vbe is 0.6 V).

[3]

2 **Fig. 2(a)** shows various mechanical components assembled for testing.

(a) **(i)** Name the mechanical component used at **H**. [1]

(ii) State the direction of rotation at **E** if **A** rotates in a clockwise rotation. [1]

(iii) Calculate the velocity ratio from **A** to **I**. [3]

(iv) Calculate the output speed at **G** if the motor rotates at 480 rev/min. [4]

(v) During testing, the pulley belt between **F** and **G** was found to slip. Using an annotated sketch, name and draw a component which could be added to prevent the slippage. [3]

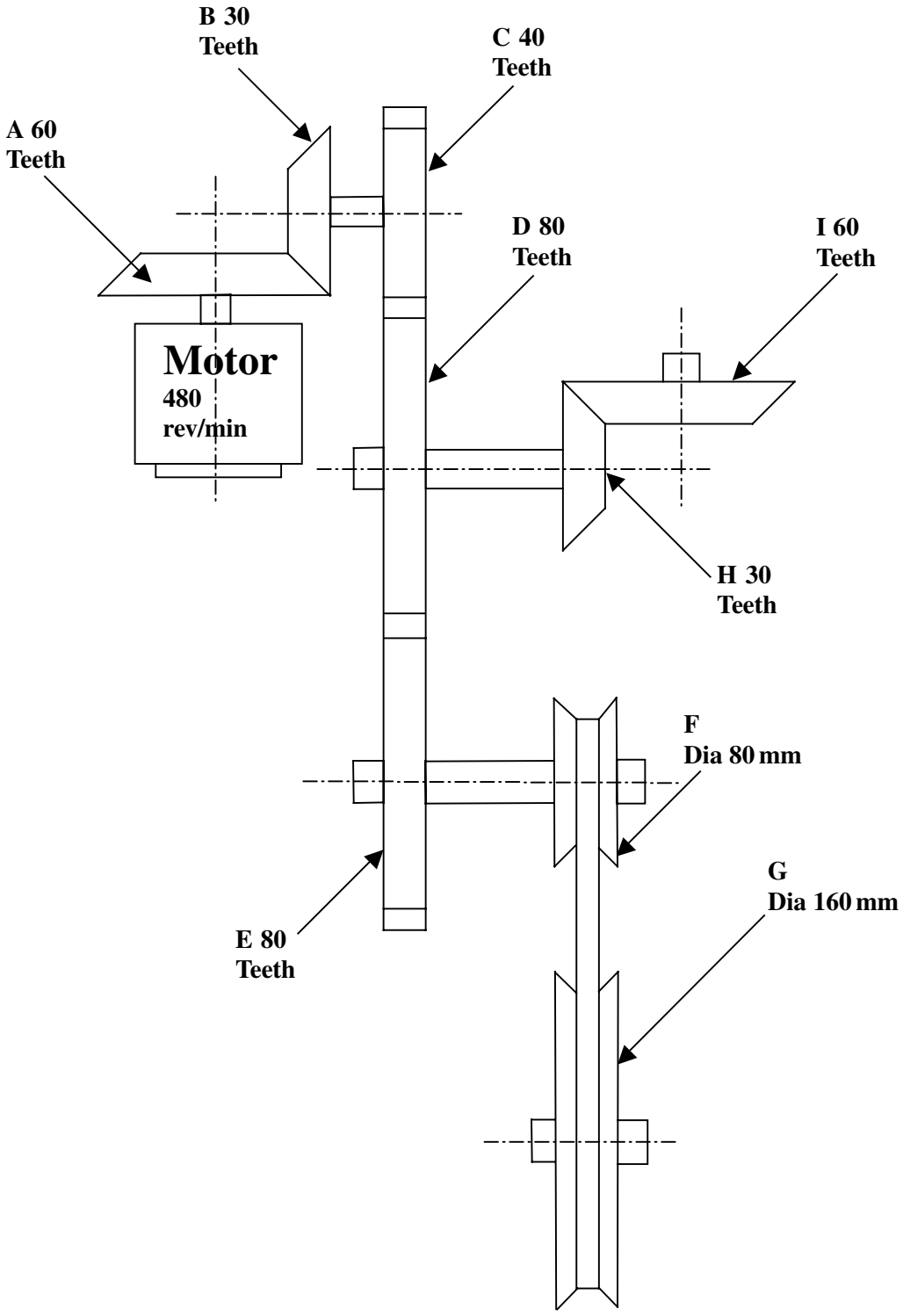

Fig. (2)(a)

(b) **Fig. 2(b)** shows part of a raising/lowering mechanism to be added to a camera tripod. On the pro forma provided (answer number **2(b)**), name and draw the mechanism to allow the lever handle to raise and lower the camera avoiding slippage. [4]

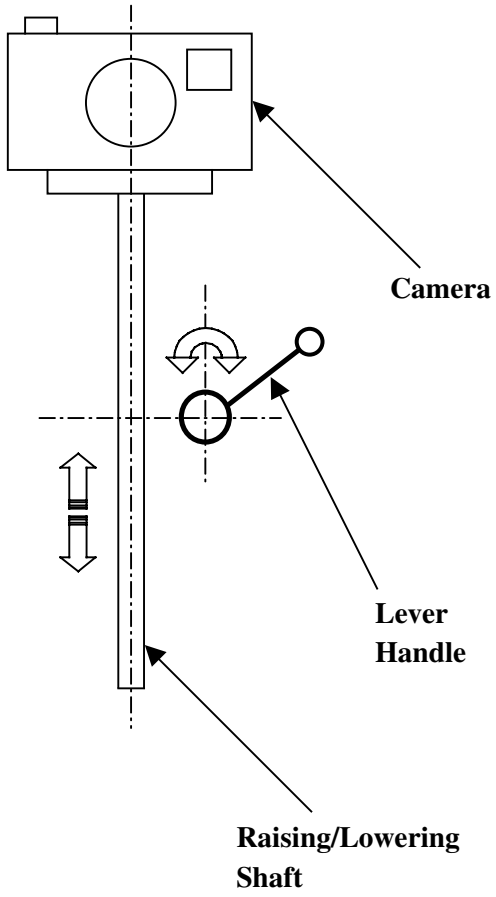

Fig. (2)(b)

(c) A mechanical system has an efficiency of 80% and a mechanical advantage of 4. Showing all calculations, determine the velocity ratio of the system. [3]

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(Questions continue overleaf)

3 **(a)** Name the following components as shown on **Fig. 3**:

(i) **X**. [1]

(ii) **Y**. [1]

(b) The compressed air supplied to these components has been prepared for use. Briefly describe the main function of **filter** and **lubricator** units. [2]

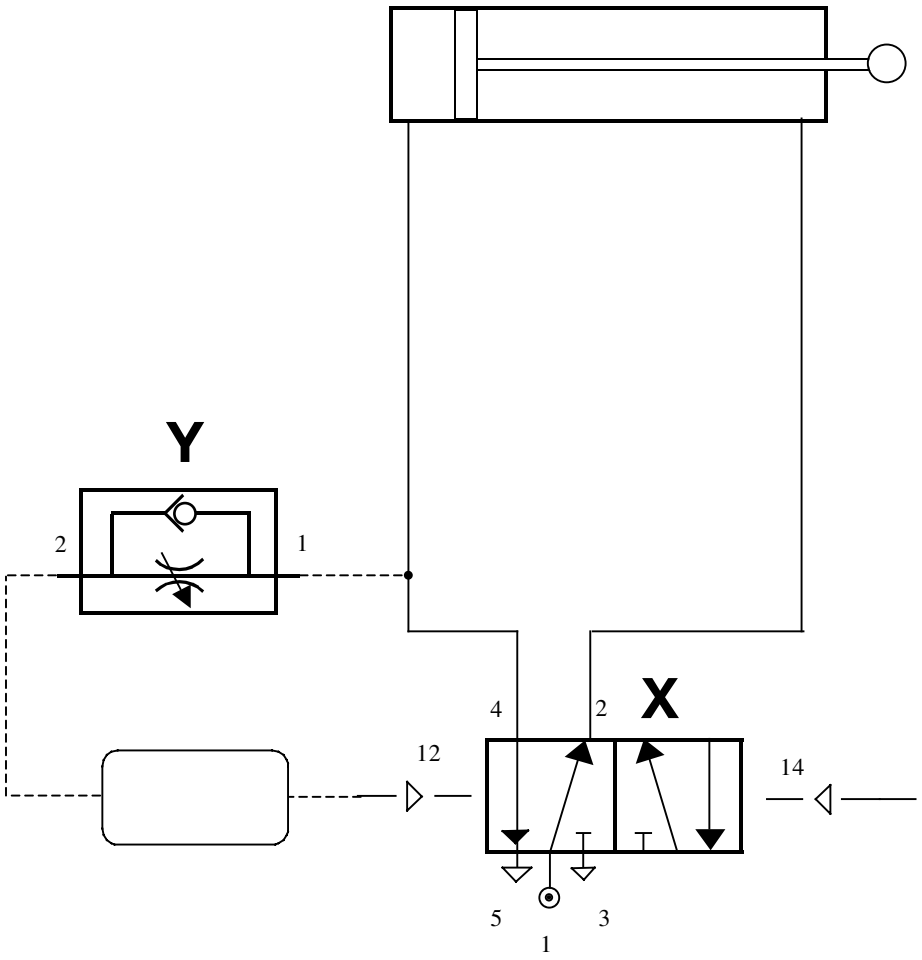
(c) Briefly describe how the double acting cylinder shown on **Fig. 3** instrokes following an outward stroke. [4]

(d) On the pro forma provided (answer number **3(d)** and **(e)**), complete the circuit enabling the double acting cylinder to go positive if either **A** or **B** or **C** is activated. [4]

(e) On the proforma provided (answer number **3(d)** and **(e)**), complete the circuit to enable the double acting cylinder to outstroke and instroke slowly. [3]

(f) The double acting cylinder with an air supply of 0.5 N/mm^2 is expected to produce a force of 1256.75 N during the instroke.

Calculate the piston area during the outstroke if the piston rod radius is 5 mm. Please assume $\pi = 3.14$. [4]



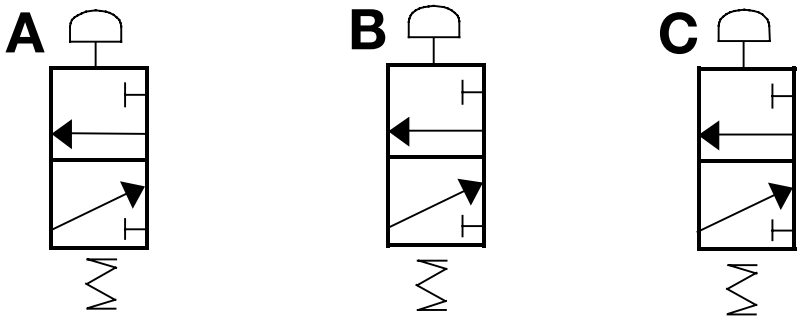


Fig. 3

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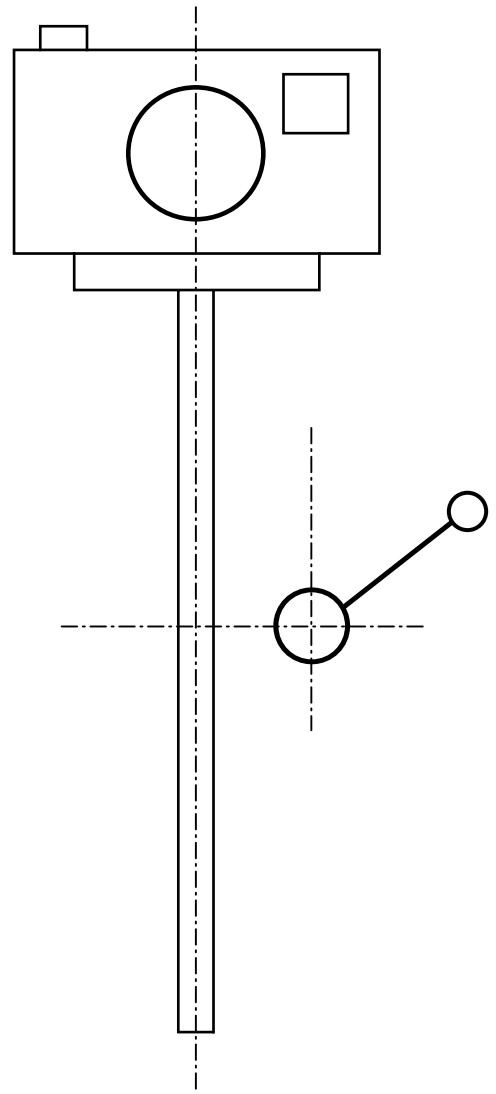

Pro forma answer page
(answer number 2(b))

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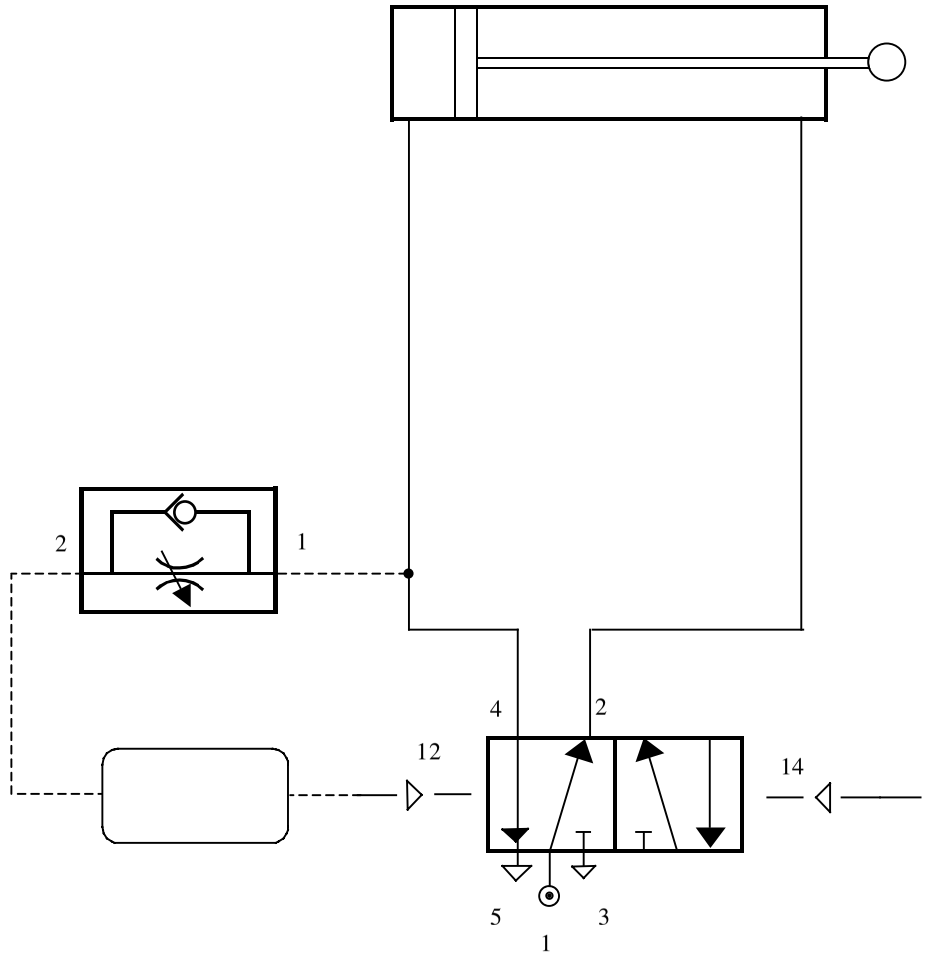

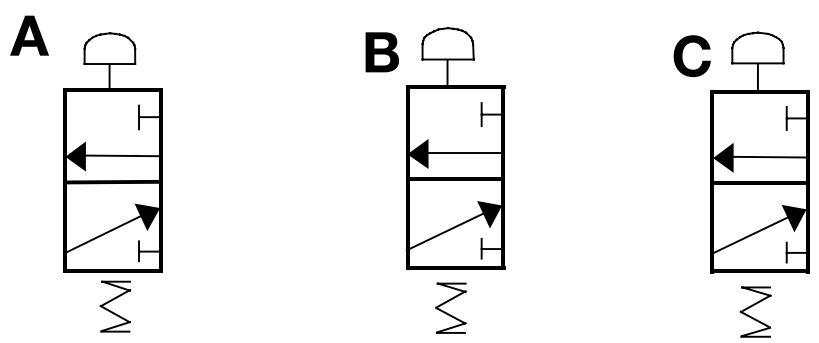

Pro forma answer page
(answer number 3(d) and (e))