UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

International General Certificate of Secondary Education

MARK SCHEME for the May/June 2012 question paper

for the guidance of teachers

0445 DESIGN AND TECHNOLOGY

0445/42 Paper 4 (Systems and Control), maximum raw mark 50

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

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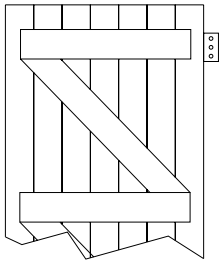
Section A

1 **(a)** The shed door would sag/drop (1) so that it would change shape to a parallelogram (1) the door would not open/close properly (1) [

(b) 2 × diagonal braces correctly orientated
Diagonal(s) unsuitable position (1)



[2]

2 Gusset plate [1]

3 The material is behaving elastically (1)
It will return to its original shape when loading is removed (1)
Extension proportional to load (1) Reference to Hookes Law (1)
Any two correct points 2 × 1 marks. [2]

4 **(a)** Worm is input; wormwheel is output [1]

(b) 32:1 [1]

5 Sketch of different sized spur gears (2) same size (1)
Converting rotary motion to reciprocating motion (1) [3]

6 For equilibrium ACW Moments = CW moments
Therefore 1 m x 800 N = X × 200 N (1)
Thus 800 Nm /200 N = X (1)
X = 4 m (1) [3]

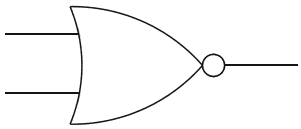
7 First figure 7 (1)
Second figure 5 (1)
Multiplier of 100 (1)
7500 (Ω) or 7.5 k Ω
Allow 7.5 K or 7K5 [3]

8 Slide Switch (1) DPDT switch (1) Appropriate sketch showing 2 reeds (1) [2]

9 Electrolytic capacitor must be connected according to its polarity (1) or it could e damaged (1) Working voltage must not be exceeded (1).

Any two correct points. [

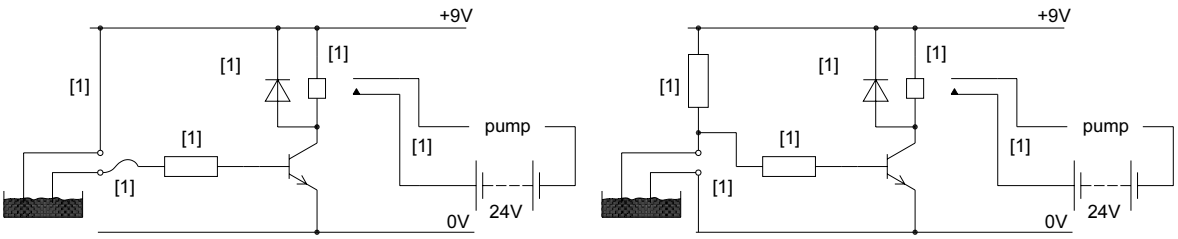
10 Outline shape correct (1)
Negation circle on output (1)



[2]

Section B

11 (a) (i)



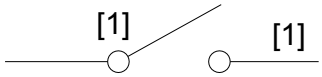
[6]

(ii) Soldered [1]

(iii) Moisture (1) sensor/transducer or detecting probes (1) [2]

(iv) Variable resistor/potentiometer/Darlington pair/op amp (1)
Sketch of hardware or circuit symbol (1) [2]

(b) (i)



[2]

(ii) Slide switch/rocker switch/rotary switch. [1]

(iii) It only stays 'on' when depressed (1) activating the circuit only momentarily (1) [2]

(c) Voltage is reduced when resistors form a potential divider (1)
Reference to Ohms law (1)
Potential divider can be formed with output transducer (1)
Any two relevant points 2 × 1 marks, [2]

(d) Operation of relay:-
Electricity passes through coil (1) causing an electromagnetic force (1) that draws together the switch contacts (1) allowing electricity to flow though the switch (1) coil and contacts are isolated (1) 3 × 1 marks [3]

(e) (i) Potential divider [1]

(ii) For R_1
$V_1 = I \times R_1$ $V_1 = 0.001 \times 3000 = 3V$ (1)
$V_2 = V_{total} - V_1 = 9 - 3 = 6V$ (1)
$V_2 = I \times R_2$ $R_2 = V_2/I = 6/0.001 = 6\ k\Omega$ (1) [3]

12 (a) (i) First class/first order.

(ii) Labelled appropriately (1) x 3 load – fulcrum - effort

(iii) By lengthening the arm (1) from pivot to ball holder (1)
Reduce distance (1) from load to fulcrum (1) 2 x 1 marks.
Allow raising fulcrum height, wrapping rubber band around twice using stronger band. [2]

(b) (i) For equilibrium RR = RL
1000 mm x E = 200 mm x 400 N (1)
200 x 400 N/1000 mm = E (1)
E = 80 N (1) [3]

(ii) The force acting in pin B is Shear [1]

(c) (i) Rotational/Rotary [1]
Oscillation (either way around) [1]

(ii) P Pear (1) Cam (1) [2]

Q Lever (1) Follower(1) [2]

(iii) Two appropriate examples:
Intermittent switching; moving parts on toys 2 x 1 marks [2]

(d) (i) Steering of vehicles, adjustment on pillar drill table or other suitable. [1]

(ii) Ratio = 1 : 10 (1)
1m/10 (1) = 100 mm (1) [3]

(e) (i) Movement is smoother (1) so less effort needed (1)
Friction is reduced (1) easier to move (1) efficiency is increased (1).
Any two points in the explanation. [2]

(ii) Oil or grease. [1]

13 (a) (i) Shackle: Tension

Bolt: Double (1) Shear (1)

(ii) Elasticity [1]

(b) The curve of the shackle (1) allows stress to flow round the shackle (1) this stops stress concentration points (1) that cause failure. [3]

(c) (i) Enables a rope/cable to be passed through the shackle (1)
easily and quickly (1). [2]

(ii) Name: Welding [1]
Example: Joining members in a framework for a trailer chassis [1]

(d) Brace or triangulation (1) for increasing rigidity/stability (1) [2]

(e) A member that has no structural purpose (1) so that if it were removed the integrity of the structure would not be compromised (1) plus appropriate sketch (1). [3]

(f) (i) Stress= compressive force/cross-sectional area (1)
250 N/mm^2 = C/4 mm^2 (1)
C = 250x4 N = 1000 N (1) [3]

(ii) Strain is the change in length (1) of a sample due to an external force (1)
divided by the length (1), before the force is applied. [3]

(iii) Change in length = 30-29.94 = 0.06 mm (1)
0.06/30 (1)
Strain = 0.002 (1). [3]