CAMBRIDGE INTERNATIONAL EXAMINATIONS

International General Certificate of Secondary Education

MARK SCHEME for the October/November 2012 series

0445 DESIGN AND TECHNOLOGY

0445/41　　　　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 should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge will not enter into discussions about these mark schemes.

Cambridge is publishing the mark schemes for the October/November 2012 series for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level components and some Ordinary Level components.

Section A

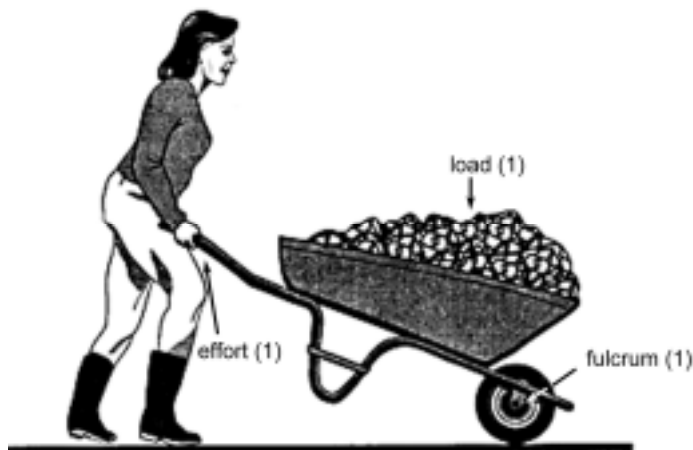1   Roof truss / crane / scaffold / fence / ladder

   Spider's web / bird (skeleton) / tree / nest   [1]

2   **(a)** Rectangular (1)

   (b) 'I' Section (1)

   (c) 'U' Section (1)

   (d) Circular tube (1)   [4]

3   **(a)** Framework **A**   [1]

   (b) Redundant   [1]

4   Effort (1) load (1) fulcrum (1)   [3]

5   How a mechanism / machine reduces the effort (1) needed to perform a task (1), making work
   easier for the operator (1) calculated by load / effort (1)

   Any three individual points included or two points clearly explained   [3]

6 (a) Sprocket and chain

(b) Reduced slip / positive drive action / longer working life than a belt and pulley.

(c) Reduce friction / smoother operation / reduce wear and tear   [1]

7 (a) Compact, thus timer physically smaller / easier to assemble; allow other valid benefits   [1]

(b) Light emitting diode (LED)   [1]

(c) Benefit: available in different colours / shapes / sizes / intensities / robust / low power / long
life; allow other valid benefit.   [1]

Drawback: may not alert user if out of sight / limited angle of view; allow other valid
drawbacks.   [1]

8 Sketch and label a circuit symbol for a relay.

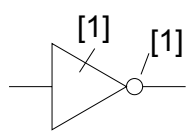Accept any recognisable relay symbol.

Coil shown (1) output connections (1)
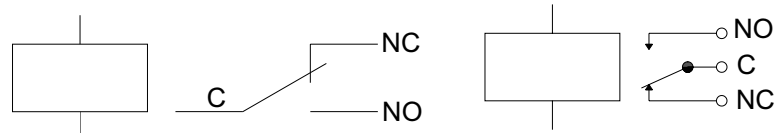
[2]

9 Outline correct (1) Negation circle (1)

Accept NAND or NOR configured correctly.   [2]

[Total: 25]

Section B

10 (a)

INPUT (1) *light Sensor*	→	PROCESS *transistor amplifier (1)*	→	OUTPUT light device (1)

Allow other methods of amplifying current, e.g. Op amp   [3]
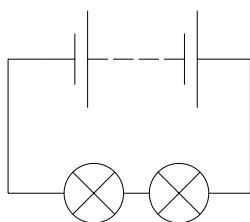
(b) (i) Light dependent resistor **(LDR)**, accept phototransistor or photodiode.   [1]

(ii) Use of **P = IV** (1)

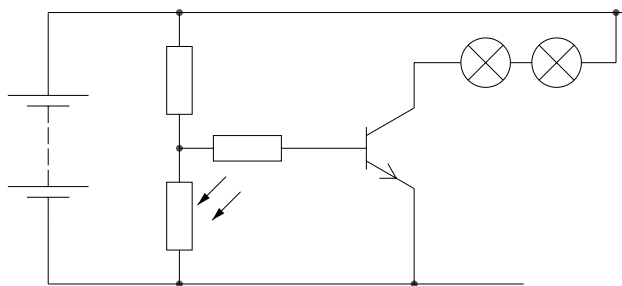$P = 60 \times 10^{-3} \times 4.5 = \mathbf{0.27}$ (1) **W** (1) or

$P = 60 \times 4.5 = \mathbf{270}$ (1) **mW** (1)   [3]

(iii) Lamps in series (1) indication of battery position (1)   [2]

(iv) Appropriate circuit / arrangement up to 3 marks.

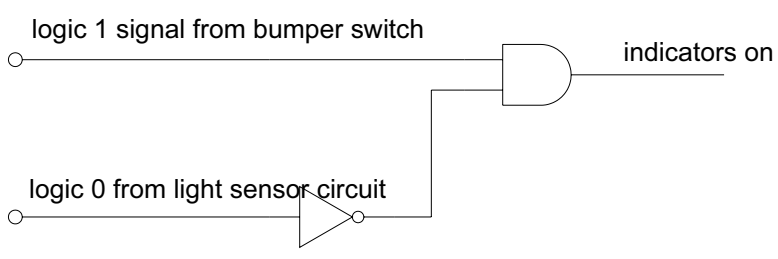Correct symbols up to 2 marks.   [5]

(c) (i) Appropriate switches could be ptm switch, ptb switch, microswitch, reed switch.   [2]

(ii) Correct symbol   [1]

(d) (i) Inputs correct 2 x 1 marks NOT gate (1) AND gate (1) output indicated (1)

(ii)

logic 1 signal from bumper switch

indicators on

logic 0 from light sensor circuit

Inputs (1) labels to inputs (1) outputs (1) 3 x 1 marks   [3]

| Bumper switch	Light sensor	Indicator
0	0	0
0	1	0
1	0	1
1	1	0

[Total: 25]

11 (a) (i) Try out mechanisms to see if they satisfy the specification / prevent waste of materials if the mechanism does not work / trial and error of sizes of parts / easier than with resistant materials.

1 mark each for suitable reasons   [2]

(ii) Meccano / technical Lego / CAD.   [1]

(iii) Parallel motion (1) or Pantograph (1)   [1]

(iv)   [2]

card

moving pivot (1)

paper fasteners

fixed pivot (1)

card base
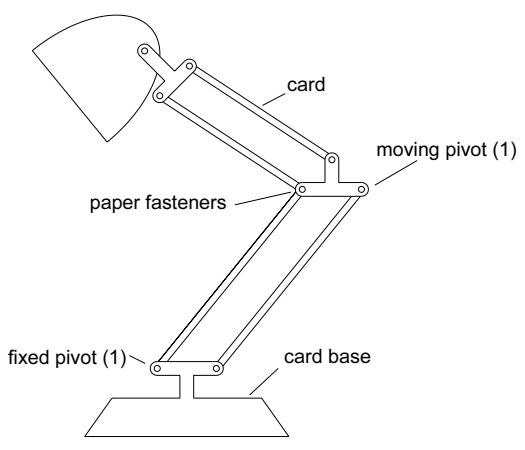
(b) (i) the head: **reciprocating**

the tail: **oscillating**

(ii) Reciprocating movement limits controlled (1)

Guides for reciprocating movement (1)

Fixed pivot for oscillating movement (1)

Joint between oscillating lever and reciprocating rod functional (1)

Quality of communication (1) [5]

pin and slot to control
head movement (1)

guides (1)

fixed pivot (1)

functional joint between
lever and head (1)
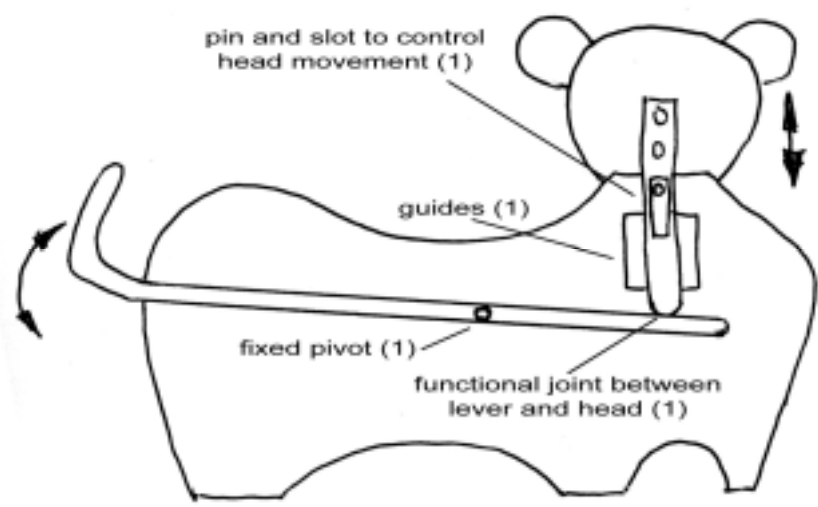
(c) (i) Tension [1]

(ii) Compression [1]

(iii) VR = Number of pulleys = **2** or **2:1** [1]

(d) (i) Efficiency = MA / VR x 100% [1]

(ii) MA = Efficiency x VR / 100% (1)

MA = 90 x 2 / 100 = **1.8** (1) [2]

(e) Ropes stretching / pulleys need lubrication / friction [1]

(f) Choice of method: – Toothed belt / V Belt system / Jockey pulley (1)

Allow Gearing – Sprocket and chain

Accurate sketch of all parts of chosen method (2)

Functional method used (1)

Labels (1)   [5]

[Total: 25]

12 **(a) (i)**
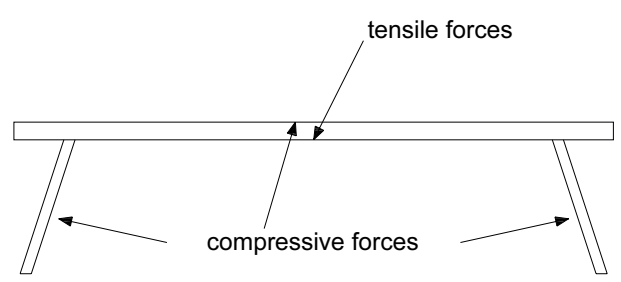
[3]

(ii) The addition of the side pieces (1) increases the rigidity of the section (1); this enables it to withstand bending more effectively (1).   [3]

(iii) The wider base gives the foot stool more stability (1); this means that it will not tip over (1).   [2]

(b) (i) Show bracing / triangulation / increase rigidity   [2]

(ii) Appropriate joining method used

Fixing to horizontal tubes (1)

Fixing to vertical tubes (1)

Temporary fastenings used e.g. bolts (1)   [3]

(iii) Spread the load (1) prevent sinking into ground (1) increase stability (1), include at least 2 points for 3 marks   [3]

(iv) Pressure = I 000 N / 150 mm x 150 mm (1)

Pressure = 0.044 N / mm^2 (1)   [2]

(v) Nut and bolt   [1]

(vi) Any appropriate use e.g. fence frame, metal shelf frame etc.   [1]

(c) (i) Shell

(ii) The edges have a flange added (1)

Drawings / labels (1)

Adding ribs that run across the beam of the hull (1)

Drawings / labels (1) [4]

[Total: 25]