

CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International General Certificate of Secondary Education

MARK SCHEME for the October/November 2014 series

0445 DESIGN AND TECHNOLOGY

0445/43

Paper 43 (Systems and Control), maximum raw mark 50

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Section A

- 1 (a)** Effects of using a pulley are:
- Mechanical advantage if more than one pulley is used in the system
 - Allow 'mechanical advantage'
 - The load can be lifted using less effort
 - A greater length of rope passes through the hands of the user than the distance moved by the load.
- 2 × 1 marks for any two valid effects [2]
- (b) (i)** The mechanical advantage can be determined by:
- counting the lengths of rope that the load is divided between
 - counting the number of pulleys
 - dividing load by effort.
- 1 mark for suitable advantage [1]
- (ii)** The mechanical advantage is **6:1** [1]
- 2 (a)** Benefits of pneumatic tools could be:
- Compressed air can be stored easily
 - It is safe to use and in use compared to electricity
 - Compressed air is easily transported around a factory
 - Reduced level of pollution
 - It can be used in hazardous environments
 - Will provide reciprocating movement easily.
- 2 × 1 marks for valid benefits [2]
- (b)** Tool could be bench drill, hand drill, lifting / handling equipment, impact wrench, stapler, angle grinder, metal shears
- 1 mark for a valid choice of tool. [1]
- 3** Use of bevel gears, 1 mark
 Gears of same size, 1 mark
 Gears shown in correct relative positions on the shafts, 1 mark
 3 × 1 marks [3]
- 4 (a)** Reason for parallel connection could be:
- LEDs do not all go out if one breaks
 - Even spread of light
 - Not a high enough voltage for operating in series due to voltage drop across each LED.
- 1 mark for suitable reason. [1]
- (b)** Cathode can be identified by:
- Flat on the casing
 - Shorter cathode
 - Use of a multimeter
 - Trial and error in a breadboard.
- 2 × 1 marks for suitable methods [2]

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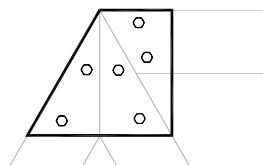
- 5 Stage of fitting should include:
- Identification of cathode / anode
 - Fitting into board
 - Bending legs to avoid any movement
 - Heat applied to both pad and track
 - Solder fed into joint
 - Joint allowed to cool
 - Excess leg cut off.
- Any four stages described either in notes or sketches, 4 × 1 marks [4]
- 6 (a) Adding simple or compound bends / curves will strengthen the body panels
Use of stiffened support bars at areas of high stress
Added layers, e.g. glass fibre, carbon fibre
Explanation with 2 points mentioned 2 marks
Allow 2 marks for one point fully explained [2]
- (b) Crumple zones are there:
- to protect occupants
 - to protect expensive parts of the vehicle
 - to absorb energy
 - to determine what happens to heavier parts such as engine in the event of an accident.
- 1 mark for a valid reason for using crumple zones [1]
- 7 Stress in a material is calculated by force (N) 1 mark
divided by cross sectional area (m²) 1 mark [2]
- 8 Adjustment is carried out by:
- Twisting the body of the adjuster to alter height
 - Loosening the adjuster to lower the bridge
 - Tightening the adjuster to raise the bridge
 - One end has left hand thread the other is a conventional right hand thread
 - Loosen or tighten locknuts.
- Any 3 valid points in description, 3 marks
Allow 2 marks for single point described in detail [3]

[Section A Total: 25]

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Section B

- 9 (a) (i) A moment is force [1] \times distance [1], or a turning force [1], 2×1 marks [2]
- (ii) $RZ \times 12 = (42 + 72)$, 1 mark
 $RZ = 114 / 12$, 1 mark
 $RZ = 9.5\text{kN}$, 1 mark
 $RY = 22 - 9.5 = 12.5\text{kN}$, 1 mark. [4]
- (iii) Suitable shape for gusset plate, 1 mark. All parts of joint covered 1 mark.
 At least two fixing points in each timber, 1 mark. 3×1 marks. [3]

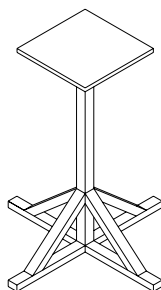


- (b) (i) Advantages of concrete:
- Hardens quickly into a range of shapes
 - Can be reinforced easily
 - High compressive strength
 - Building can be constructed faster than using brick
 - Not as likely to crack as brick when reinforced
 - Bed joints with brick have little tensile strength
 - Reduced labour / material costs.
- 2×1 marks for two advantages. [2]
- (ii) Steel reinforcing rods which are inherently strong in tension are inserted into concrete to provide tensile strength.
 Reinforcement can be placed under tension before concrete is poured, that is pre-stressed concrete. 2 marks for a clear explanation of reinforcement, 1 mark for use of steel rods but no mention of tensile strength. [2]
- (iii) Reasons given could include:
- Steel box section is lighter for lifting into position
 - Lighter and easier to store
 - Reduced weight will reduce transport costs
 - Higher tensile strength than concrete, better strength to weight ratio.
- Terms such as 'lighter' 'easier to use' must be justified for a mark.
 1 mark for each valid reason given. [2]

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- (c) (i) Stable in two directions, 2×1 marks. Functional design, 1 mark.
Details of joints / fixings, 1 mark.

[4]



- (ii) Equilibrium means that forces acting on a structure are balanced; clockwise moments are equal to anti-clockwise moments. 2×1 marks for two valid points mentioned.

[2]

- (d) (i) Explanation should include:

- Traditional joints will take longer to cut and increase the price of the furniture
- Composite materials are often used which do not benefit from the use of joints like the dovetail
- Composite boards are more stable so do not need the resistance to bending or warping given by traditional joints
- Plastics sections can be extruded or injection moulded giving consistent quality.

Explanation that includes two points, 2 marks

Allow 2 marks for a single well explained point.

[2]

- (ii) Benefits of manufactured board will include:

- Larger sizes of board available
- Consistent quality
- Decorative finishes can be applied to the complete board
- Generally more stable than wide pieces of hardwood
- Shapes are possible using laminating techniques that would not be possible with a single board.

Any points relating to cost must be justified to gain a mark.

2×1 marks for valid benefits

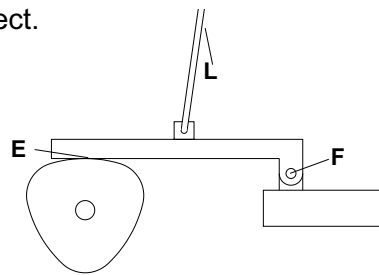
[2]

[Total: 25]

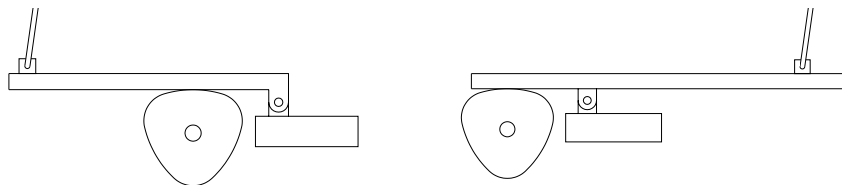
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- 10 (a) (i) Reasons for using a ratchet and pawl mechanism could include:
- 360° movement not possible due to restricted access
 - Hand does not need to be taken off the tool.
- 1 mark for a suitable reason. [1]
- (ii) Oscillating movement, [1] is converted to rotary movement, [1]. [2]
- (iii) Explanation will include:
- Screwdriver will need to be used to remove screw
 - Socket wrench will need to unscrew nut or bolt
 - On the woodwork brace it is sometimes necessary to unscrew the drill / bit when the full depth has been reached.
- 2 points included for 2 marks or 1 point well explained. [2]
- (iv) The **screwdriver** gives the least mechanical advantage, 1 mark. [1]

- (b) (i) The follower will rise and fall, 1 mark, three times, 1 mark.
In an oscillating movement, 1 mark.
2 marks for any two correct statements. [2]
- (ii) The lever is second order / second class, 1 mark. [1]
- (iii) 1 mark for each correct. [3]



- (iv) Position of follower relative to cam changed, [1]
Length of follower increased, [1]
Lever changed to a third order lever.
Allow first class lever though rise and fall will be reversed, [1]. [3]



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(c) (i) Belt drawn in top position, largest pulley on motor end, 1 mark. [1]

(ii) 1 mark for each correct, 3 × 1 marks. [3]

bearing type

main shaft	ball bearings
motor shaft	bronze plain bearing
pinion shaft	steel plain bearing

(iii) Lubrication is necessary to:

- Reduce friction between mating surfaces;
- To provide cooling effect;
- To prolong the life of the bearing
- Prevent corrosion.

2 × 1 marks for valid reasons. [2]

(iv) **Nylon** does not need lubrication, 1 mark.

Allow mark for phosphor bronze soaked in oil or vacuum / pressure loaded with oil [1]

(d) For prevention of rotation allow either a spline or a keyway, 1 mark

To prevent nut from coming loose allow spring washer, nyloc nut, castle nut and split pin or any other functional method, 1 mark

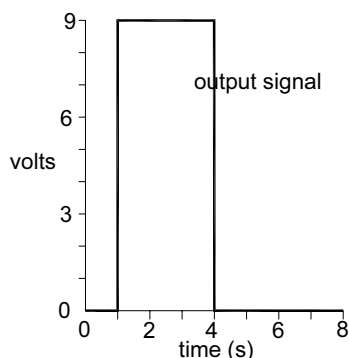
Allow the use of adhesive on the thread.

Clear communication either in notes or drawing, 1 mark. [3]

[Total: 25]

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- 11 (a) (i) The light level of natural light cannot be guaranteed, 1 mark, so a steady light source will increase reliability, 1 mark. [2]
- (ii) Switching voltage for TR1 will be approximately 0.6V; allow 0.5V – 0.9V [1]
- (iii) The LDR is exposed to the white LED light source, 1 mark.
The 1M Ω potentiometer will be adjusted so that the transistor / relay is just off, 1 mark.
The switch should then be tested by placing a finger between the LED light source and the LDR, 1 mark. [3]
- (iv) Casing to hold the LED and LDR in fixed position, 1 mark.
Sufficient room for finger to be placed between the two components, 1 mark
Functional design, 1 mark.
Details of fixing to wall or surface, 1 mark. [4]
- (b) (i) The two voltages are isolated by the relay, 1 mark. The relay coil and 9V circuit have no physical connection to the 18V relay contacts circuit, 1 mark. [2]
- (ii) The solenoid has a reciprocating action, 1 mark. [1]
- (iii) Use of 38 Ω from the multimeter, 1 mark.
 $I = 18 / 38$, 1 mark. $I = 0.47A$ or 474mA, 1 mark. [3]
- (c) (i) The IC can be orientated by using either the semicircle cut out or the dot, 1 mark.
Pin 1 is the top left hand pin when the IC is held with semicircle or dot to the top, 1 mark. [2]
- (ii) Amplitude 9V, 1 mark. Switch on at 1s and off at 4s 1 mark. [2]



- (iii) If the trigger pin remains low the output will re-trigger, 1 mark and will appear to be on permanently, 1 mark. [2]
- (d) The rotary switch has a number of poles available at terminals on end of switch, 1 mark.
There is one common terminal, 1 mark which is connected to each of the poles in turn, 1 mark. Allow marks for understanding shown. [3]

[Total: 25]