3.5 POWER MECHANICS (447)

The 2013 KCSE examinations for Power Mechanics consisted of two papers namely Paper 1 (theory) and Paper 2 (Practical). The theory was worth 60% while practical was worth 40% of the final mark. The format and weighting of the two papers was the same as in the previous years.

General Candidates Performance

The candidate's performance statistics in the KCSE Power Mechanics examination since the year 2008 when the syllabus was revised are as shown in the table below.

Table 12: candidates overall performance in the years 2008 to 2013

Year	Paper	Candidature	Maximum score	Mean score	Standard deviation
2008	1		60	24.38	9.32
	2		40	25.49	6.88
	overall	**57**	**100**	**49.77**	**14.67**
2009	1		60	28.88	9.27
	2		40	27.05	4.15
	overall	**136**	**100**	**56.74**	**12.37**
2010	1		60	26.49	8.67
	2		40	26.34	5.24
	overall	**159**	**100**	**52.66**	**12.81**
2011	1		60	28.79	9.25
	2		40	27.74	4.10
	overall	**136**	**100**	**56.53**	11.69
2012	1		60	34.51	7.35
	2		40	30.74	3.08
	overall	**149**	**100**	**65.26**	**9.07**
2013	1		60	37.92	8.46
	2		40	28.61	3.19
	overall	**145**	**100**	**66.27**	**11.32**

From the table it can be observed that:

(i) The mean score improved from 65.26 the year 2012 to 66.27 in the year 2013.
(ii) The candidature decreased from 149 in the year 2012 to 145 in the year 2013.
(iii) The general performance has been increasing steadily since the year 2010.

3.5.1 Power Mechanics Paper 1 (447/1)

The questions which were reported to have been poorly performed have been analyzed with a view to pointing out candidates' weaknesses and propose suggestions on some remedial measures that would be taken in order to improve the performance in future. The questions for discussions include 3(b), 7(b), 8(b), 9(a), 10, 12, 15(a).

Question 3 (b)

(i) Sketch an adjustable spanner. (1 mark)
(ii) State where long nose pliers may be used in a small engine. (1 mark)

Weaknesses

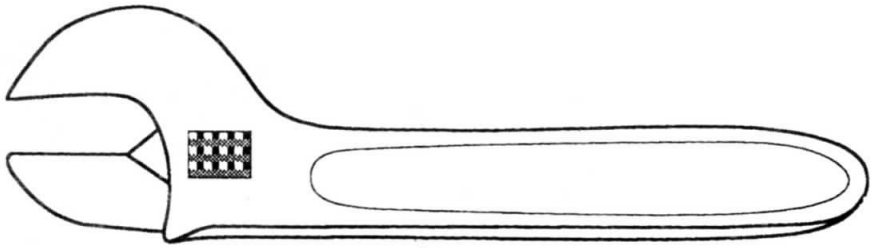
Most candidates could not sketch an adjustable spanner.

Advice to teachers

Teachers are advised to teach on drawing of various workshop tools and accessories.

Expected Responses

(i)



1mark

Adjustable spanner

(ii) **Uses of long nose pliers**
- Removing value retainer gudgeon pin circlip.
- Any other insertion in closed areas i.e. small clips and washers insertion.

Question 7 (b)

Explain the reason why modern vehicles are designed with collapsible steering columns. (2 marks)

Weaknesses

Candidates could not explain why modern vehicles are designed with collapsible steering columns.

Advice to teachers

Teachers are advised to teach on components of the steering system and their design requirements.

Expected Responses

Modern vehicles are designed with collapsible steering columns as a protective measure. The steering column is made of two parts which are fitted together in such a way that they can 'telescope' as the steering column collapses during a head-on collision, which throws the driver forward. In the process, the steering column will absorb the energy of this forward movement and reduce the possibility of injury.

Question 8

(b) Explain the following terms as used in drum brake operation:

(i) leading shoe;
(ii) trailing shoe. (2 marks)

Weaknesses

Most candidates could not differentiate between the leading shoe and the trailing shoe operations.

Advice to teachers

Teachers are advised to teach about various drum brake operation terms and their applications.

Expected response

(b) (i) 'Leading' shoe - it rotates in opposite direction to the brake disc. It provides 75% of the braking. √

(ii) 'Trailing' shoe - it rotates in same direction to the brake disc. It provides 25% the braking force. √

Question 9

(a) State the purpose of the ply-rating of a tyre. (2 marks)

Weaknesses

Most candidates did not know the purpose of ply rating a tyre.

Advice

Teachers are advised to teach on wheels and tyres comprehensively for the learners to understand the various types of tyres and their purposes.

Expected response

(a) **Purpose of ply-rating of a tyre**.
It indicates the load range √ and inflation limit √ of the tyre.2 x 1 = 2 marks

Question 10

Sketch a dipped beam light path having an offset filament and label its parts. (3 marks)

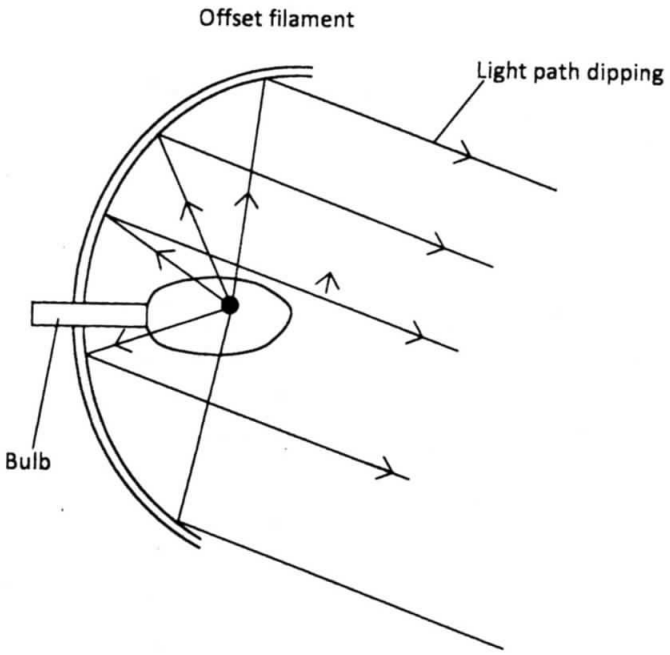
Weakness

Most of the candidates were unable to sketch a dipped beam light path with offset filament.

Advice

There is need for teacher to emphasize on drawing of various lighting component operation circuits.

Expected response



Question 12

Figure 3 shows a component of the power transmission system of a motor vehicle.

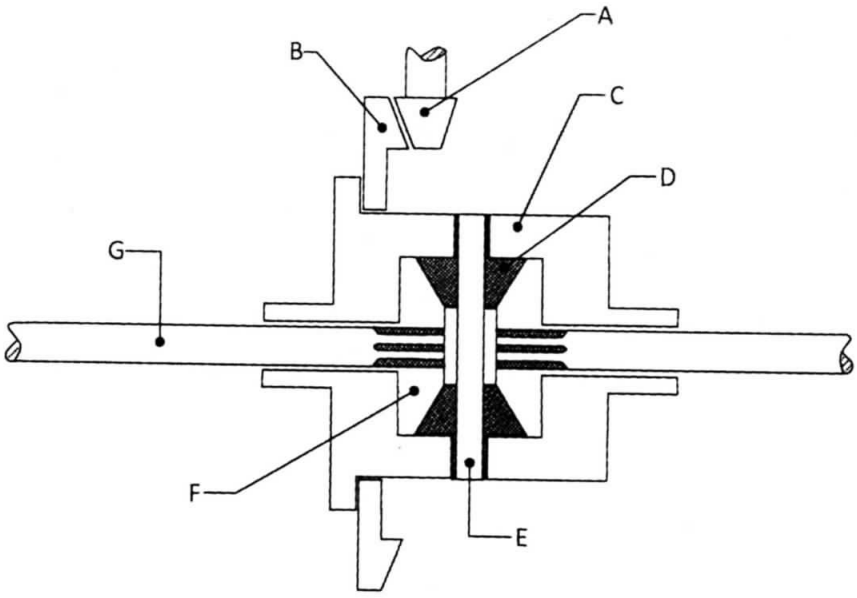


Figure 3

(a) Name the component. ($\frac{1}{2}$ mark)

(b) Name parts labelled **A** to **G**. ($3\frac{1}{2}$ marks)

(c) Explain how the component operates. (11 marks)

Weaknesses

Most candidates did not know the various operational requirements of the differential unit and more so in cornering.

Advice

Teachers are advised to teach on operation of a differential unit in three stages i.e straight, cornering and no traction situations.

Expected response

Solution

(a) Differential unit

(b) A - Pinion/ or propeller shaft
B - Crown wheel
C - Differential casing
D - Planet wheel or differential pinions
E - Spider shaft
F - Sun wheel or side gears
G - Half shaft

(c)

- When vehicle is running straight propeller shaft turns the ring gear pinion (1) shaft. The pinion turns the ring gear, which in turn revolves the differential casing (1). When the casing turns, the differential pinion shaft turns with it(1). As the differential pinions are mounted on this shaft, they are forced to move with the case(1). Being meshed with the axle side gears, the pinions will pull the axle side gears along with them. Therefore, when the car is moving straight, the ring gear is spinning. The differential unit is moving like a solid unit(1) because there is no movement between the teeth of the pinions and the axle side gears(1).

- When vehicle is taking a turn. The outer wheel has to move a greater radius than the inner wheel and must therefore be speeded to take the same time as the inner wheel(1). As the inner wheel is slowed when vehicle is turning, this increases resistance of its sun wheel(1). The spider shaft is still being turned end over end at the crown wheel speed, and as the inner sun wheel slows the planet wheels are forced to rotate (or(1)walk) on the spider shaft and about the inner sun wheel. In so doing, the speed of the outer sun and the outer road wheel is

increased in the same proportion as the speed of inner sun is reduced(1). The torque is still divided equally(1) between the two half shafts but their speeds are different.

- When one wheel slips while the other is stuck to the ground.
  - The casing continues spinning the pinions but they will merely walk around (1) the stopped axle gear and impart the torque(1) to the spinning axle.

Question 15

(b) Sketch a sectional diagram of a disc brake assembly and label six parts. (12 marks

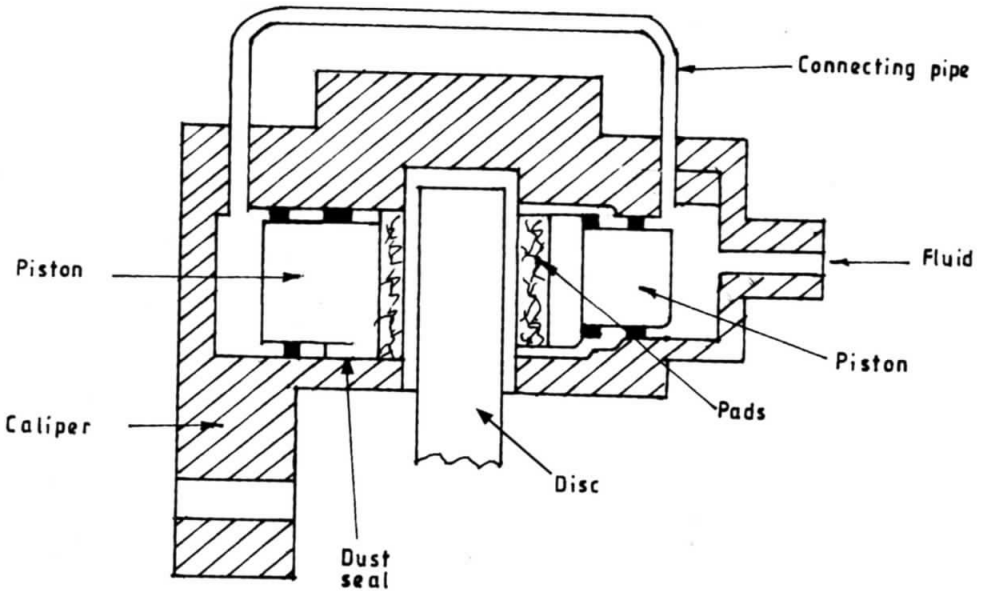
Weaknesses

Most candidates could not sketch a sectional assembly of disc brake.

Advice to teachers

Teachers are advised to emphasize on sketching the sectional views of the braking system.

Expected response



3.5.2 Power Mechanics Paper 2 (447/2)

The paper had 10 equally weighted compulsory exercises. It tested competencies in the following areas:

- Drawing the sectional view of a mechanical fuel pump and labeling four parts
- Metal fabrication skills on scoop using given materials
- Measuring and inspecting the torsion spring for free play or damage on a multi-coil clutch disc.
- Identification of measuring tools, stating their accuracy and where they are used.
- Connection of twin headlight parallel circuit in parallel controlled by a single switch.
- Identification of tools and fasteners and stating their use.
- Demonstration of checking the roundness of a camshaft using a dial gauge.
- Carrying out a compression test on a single cylinder engine and recording the space provided.
- Identifying parts on a vehicle provided, their defects and possible effect on the vehicle performance.
- Dismantling a given fuel pump, checking the service condition of each part and assembling the pump.

Despite the exercises being fairly done by most of the candidates the following challenges were observed:

(i) Most candidates unable to draw a functional pump

(ii) Most candidates were unable to cut accurately the material and solder to the expected standard.

(iii) Some candidates did not know the accuracy of various measuring tools and their areas of application.

Advice to teachers

1. Teach all topics in the syllabus including drawing and sketching of tools and equipment used in Power Mechanics
2. Train the students on skills of fabricating various objects which involve marking, soldering, drilling and bending.
3. Teach the students on precision tools accuracy and areas of application for each tool.