9517/1
PHYSICS
Paper 1
D.T.E.
March/April 2011
3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN TEACHER EDUCATION

PHYSICS

Paper 1

3 hours

INSTRUCTIONS TO CANDIDATES

Write your name and index number in the spaces provided in the answer booklet.
Sign and write the date of the examination in the spaces provided in the answer booklet.
*This paper consists of **TWO** sections: **A** and **B**.*
*Answer **ALL** the questions in section **A** and any **THREE** questions in section **B** in the answer booklet.*
*All working **MUST** be clearly shown.*
*Non-programmable silent electronic calculators and **KNEC** mathematical tables may be used.*

The following constants may be necessary.

(i)	acceleration due to gravity	g	=	$9.8\ m/s^2$
(ii)	universal gas constant	R	=	$8.31\ J/mol.K.$
(iii)	Coefficient of thermal conductivity for cardboard	$K_{cardboard}$	=	$0.06\ Wm^{-1}K^{-1}$
(iv)	Coefficient of thermal conductivity for mica	K_{mica}	=	$0.25\ Wm^{-1}\ K^{-1}$
(v)	Linear expansivity of aluminium	$\lambda_{aluminum}$	=	$2.3 \times 10^{-6}\ (°C)^{-1}$
(vi)	Linear expansivity of brass	λ_{brass}	=	$1.9 \times 10^{-6}\ (°C)^{-1}$

This paper consists of 7 printed pages.

Candidates should check the question paper to ascertain that all the pages are printed as indicated and no questions are missing.

Turn over

SECTION A (55 marks)

*Answer **ALL** the questions in this section.*

1. Explain what is meant by "a perfect black body". (3 marks)

2. **Figure 1** shows the relationship between the emission power (intensity) and the wavelength in the spectrum of a black body for three widely separated temperatures.

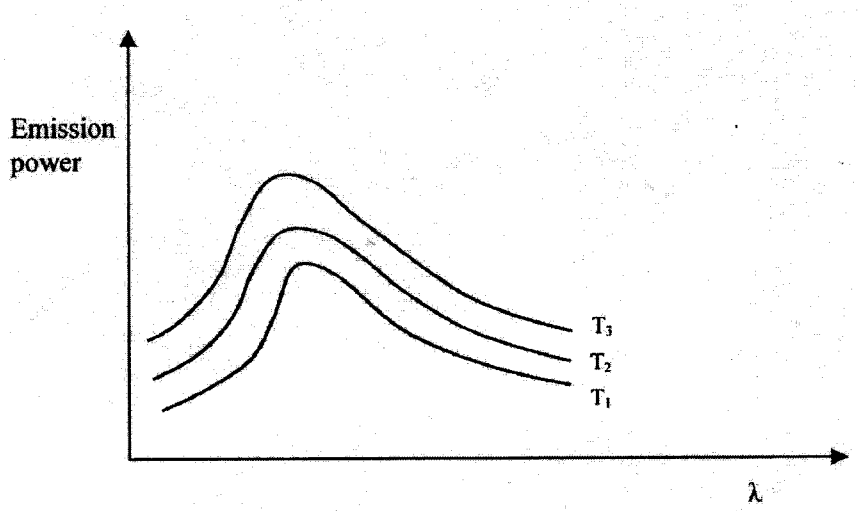

Figure 1

(a) How are the temperatures T_1, T_2 and T_3 related? (1 mark)

(b) What does the area under each curve represent? (1 mark)

(c) State the relationship between the temperatures and the wavelength of the peaks of the curves. (1 mark)

3. (a) Define the term couple as referred to in physics. (1 mark)

(b) **Figure 2** shows two forces of 16N each applied on opposite sides of a wheel.

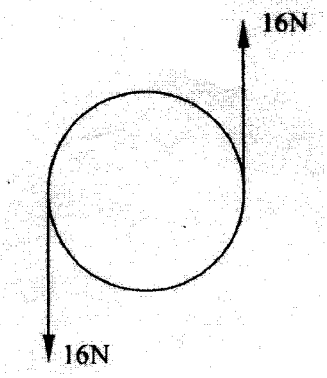

Figure 2

The radius of the wheel is 2.0m. The wheel makes six revolutions when the forces are applied. Determine the work done. (4 marks)

4. Show how the unit of force is defined from Newton's second law of motion. (3 marks)

5. Use Bernoulli's effect to explain why a canvas loosely covering a moving lorry bulges. (3 marks)

Use the following information to answer questions 6 and 7.

A block of mass 2.0kg is projected along a level surface at a speed of 1.5m/s. It moves a distance of 1.2m before coming to a stop.

6. Determine the retarding force. (4 marks)

7. Determine the coefficient of dynamic friction. (3 marks)

8. (a) What is meant by "gravitational potential"? (1 mark)

(b) Derive an expression for the work W done in moving a body of mass M radially outward from the earths surface to a distance r. (4 marks)

($r >> r_e$, m_e = mass of the earth and r_e = radius of the earth).

9. A tennis ball is struck above the ground such that it leaves the racket horizontally with a speed of 40.0 m/s. The ball hits the ground at a horizontal distance 30m from the racket. Determine the height of the tennis ball above the ground just as it leaves the racket. (5 marks)

10. (a) Define resonance. (1 mark)

(b) State the difference between free oscillations and damped oscillations. (2 marks)

11. A ray of light travelling through a pool of water is incident on a horizontal air/water boundary. Its speed in water is 2.2×10^8 m/s. Determine the maximum angle which the beam can make with the vertical plane for the light to escape into the air with a speed of 3.0×10^8 m/s. (5 marks)

12. **Figure 3** shows the B-H curve for a certain ferromagnetic material placed in a toroid.

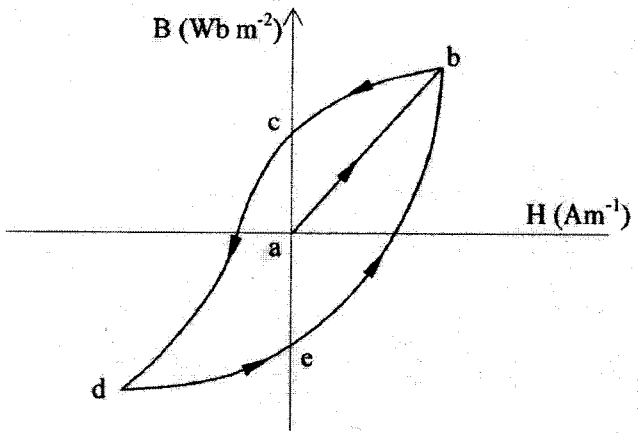

Figure 3

Explain how the curve is generated. (5 marks)

13. **Figure 4** shows a piston in a reservoir of oil.

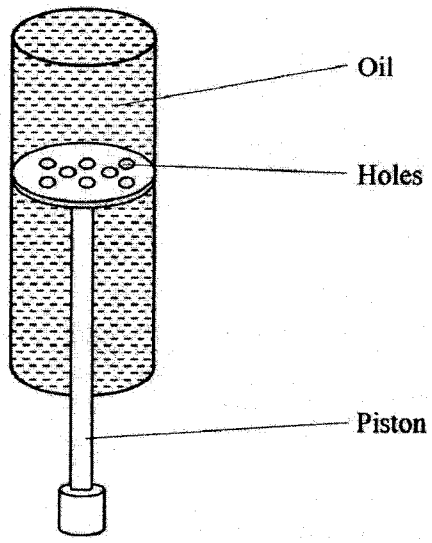

Figure 4

Explain how the system works in order to function as a shock absorber. (4 marks)

14. **Figure 5** shows a small stone of weight W tied on a string. It moves in a vertical circle with a constant speed V.

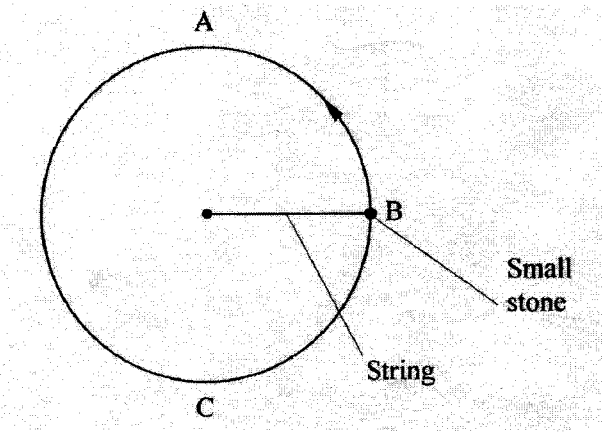

Figure 5

(a) In each case, write an expression for the forces acting on the particle at points A, B and C. (3 marks)

(b) The string snaps when the stone is at point B, describe the subsequent motion of the stone. (1 mark)

SECTION B (45 marks)

*Answer any **THREE** questions in this section.*

15. (a) What is meant by each of the following processes as applied in thermodynamics:
(i) Adiabatic, (1 mark)
(ii) Isothermal, (1 mark)
(iii) Isochoric, (1 mark)
(iv) Isobaric. (1 mark)

(b) One mole of an ideal gas at a temperature of 51°C occupies a volume of 5 litres. The gas is expanded at constant pressure until the volume doubles. Determine:
(i) the value of the constant pressure, (4 marks)
(ii) the final temperature after the process, (3 marks)
(iii) the work done during the expansion. (4 marks)

16. (a) Define thermal conductivity of a material. (1 mark)

(b) **Figure 6,** shows a composite material made of cardboard and mica. The dimensions are indicated on the diagram. One end is at a temperature of 100°C and the other at 0°C.

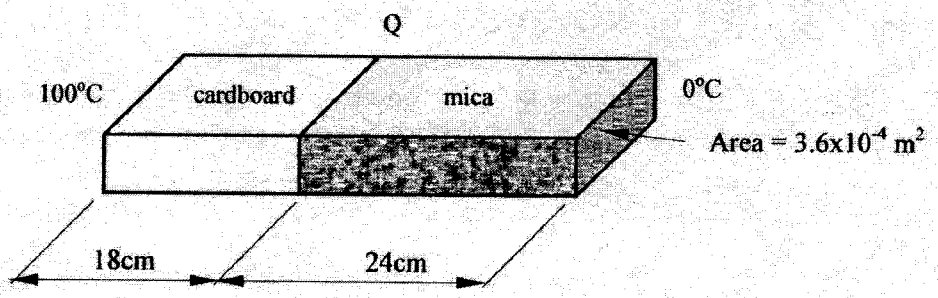

Figure 6

Determine;

(i) their boundary temperature θ in °C, (5 marks)

(ii) the rate of flow of heat through the composite material. (3 marks)

(c) **Figure7** shows a brass rod and an aluminium rod attached to immovable walls and resting on rollers. At a temperature of 28°C, the gap between the free ends of the rods is 1.5×10^{-3}m.

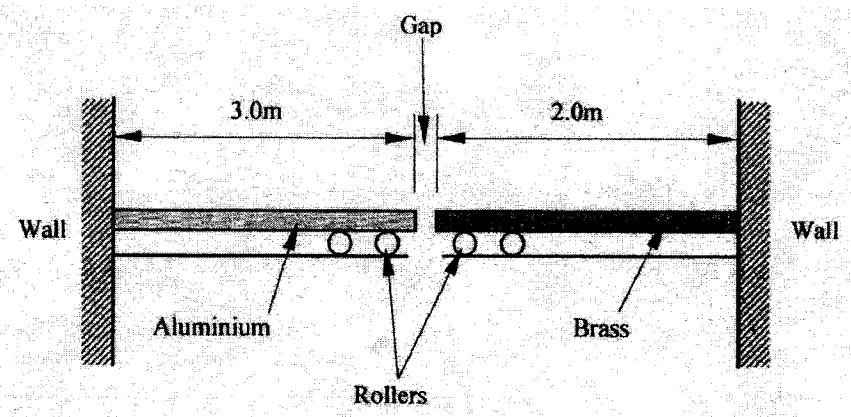

Figure 7

Determine the temperature at which the gap will be closed. (6 marks)

17. (a) A liquid drop is released on a semi-spherical saucer pan so that it oscillates with simple harmonic motion. The period T of the vibration of the drop in the saucer pan depends on the radius r of the drop, the density ρ of the liquid and the surface tension γ whose dimension is MT^{-2}. Derive an expression for the periodic time in terms of r, ρ and γ. (9 marks)

(b) (i) What is meant by "angular momentum" of a rigid body? (1 mark)

(ii) A uniform disc is mounted on an axle of radius 0.04m. A string tied to the axle is pulled with a constant force of 30N causing the axle to rotate. The moment of inertia of the system is $2.0 kgm^2$. Determine the angular acceleration of the disc. (5 marks)

18. (a) What is meant by the following:

(i) Elasticity, (1 mark)

(ii) Stiffness. (1 mark)

(b) A metallic rod of cross-sectional area $2cm^2$ is stretched by a force of 4.0×10^3N. It is found that a rod of length 50cm stretches by 0.10mm. Determine Young's Modullus for the material. (5 marks)

(c) (i) State the work energy theorem. (1 mark)

(ii) **Figure 8** shows a block of mass 3.0kg placed at a height of 0.75m above a spring. It is then allowed to drop freely and strike the spring. The mass sticks to the spring and both come to rest after compression.

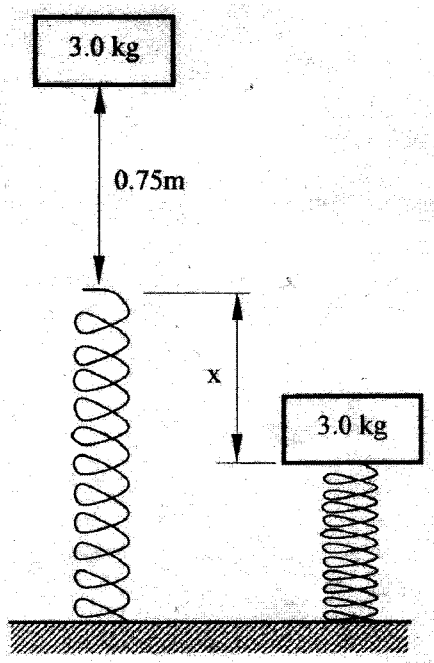

Figure 8

Determine the compression x of the spring (spring constant = 2.0×10^3 N/m). (7 marks)

19. (a) How many atoms are there in a Face Centred Cuboid (FCC) structure? (2 marks)

(b) Determine the packing efficiency of the Face Centred Cubic structure. (8 marks)

(c) Derive an expression for the pressure at a point inside a liquid in terms of the density ρ of the liquid and the depth h of the point below the surface. (5 marks)