



GCE AS/A Level – LEGACY

0980/01



MATHEMATICS – M1
Mechanics

TUESDAY, 19 JUNE 2018 – AFTERNOON

1 hour 30 minutes

ADDITIONAL MATERIALS

In addition to this examination paper, you will need:

- a WJEC pink 16-page answer booklet;
- a Formula Booklet;
- a calculator.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Answer **all** questions.

Take g as 9.8 ms^{-2} .

Sufficient working must be shown to demonstrate the **mathematical** method employed.

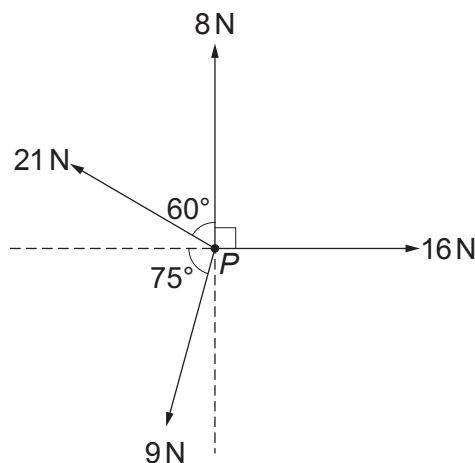
INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

1. (a) A lift, of mass 1200 kg, is moving upwards. Find the tension in the lift cable when the lift is moving with
- an acceleration of 2 ms^{-2} ,
 - constant speed. [4]
- (b) A person of mass M kg stands in a lift which is moving downwards with an acceleration of 3 ms^{-2} . The reaction of the floor of the lift on the person is 442 N. Determine the value of M . [3]

2. The diagram shows four horizontal forces of magnitude 16 N, 9 N, 21 N and 8 N acting at a point P . Directions are as shown in the diagram.



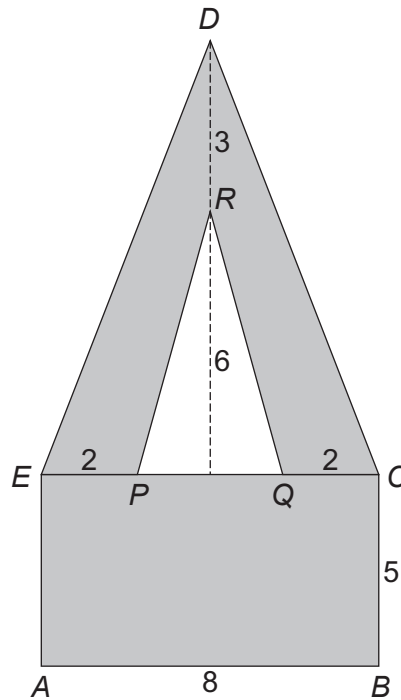
Calculate the magnitude of the resultant of the forces acting at P . Determine the angle the resultant makes with the 8 N force. Give your answers correct to one decimal place. [8]

3. A uniform rod AB is resting in horizontal equilibrium on two smooth supports at P and Q . The length of the rod is 2 m and its mass is 24 kg. Supports P and Q are such that $AP = 0.3$ m and $PQ = 1.1$ m. A person of mass 36 kg stands on the rod at the end A . Find the magnitude of the reactions at P and at Q . [7]
4. Two particles P and Q , of masses 3 kg and 5 kg respectively, are attached one to each end of a light inextensible string which passes over a smooth peg. Initially, the particles are held at rest with the string just taut and with both hanging parts of the string vertical. The particles are then released from rest.
- Find the magnitude of the acceleration of P and the tension in the string. [7]
 - What assumption does the word 'light', in the description of the string, enable you to make in your solution? [1]
 - What assumption does the word 'smooth', in the description of the peg, enable you to make in your solution? [1]

5. When a cricket ball of mass 0.16 kg reaches a batsman it has horizontal velocity 12 ms^{-1} . It is driven straight back such that, as it leaves the bat, it has horizontal velocity 20 ms^{-1} .
- (a) Find the impulse exerted by the bat on the ball. [2]
- (b) Given that the bat and the ball were in contact for $\frac{1}{8}\text{ s}$, find the average force between the bat and the ball. [2]
6. A raindrop A falls freely from rest from the top of a cliff. After it has fallen a distance 0.1 m , a second raindrop B begins to fall from rest from the top of the same cliff. The height of the cliff is 40 m .
- (a) Find the velocity of A at the instant B begins to fall. [3]
- (b) Find the velocity of A at the instant it reaches the ground. [2]
- (c) Calculate the distance between the raindrops when the first raindrop A hits the ground. [7]
7. Two small smooth spheres A and B , of equal mass and equal radii, are moving in the same straight line and in the same direction. The speed of A is 4 ms^{-1} and the speed of B is 2 ms^{-1} . The spheres collide directly. After collision, their directions of motion remain unchanged, but the speed of A is $v\text{ ms}^{-1}$ and the speed of B is $1.4v\text{ ms}^{-1}$.
- (a) Calculate the value of v and the coefficient of restitution between the spheres. [6]
- (b) After colliding with A , sphere B collides with a smooth vertical wall which is perpendicular to its direction of motion. The coefficient of restitution between B and the wall is 0.6 . Determine the speed of B after the collision with the wall. [2]
- (c) Given that after colliding with A , sphere B collides with the wall 5 seconds later, find the time that elapses between B colliding with the wall and its second collision with A . [3]
8. A particle of mass 10 kg is at rest on a rough plane inclined at an angle α to the horizontal. When a force of magnitude 98 N , acting **upwards** parallel to a line of greatest slope of the plane, is applied to the particle, it is on the point of moving up the plane. When a force of magnitude 49 N , acting **downwards** parallel to a line of greatest slope of the plane, is applied to the particle, it is on the point of moving down the plane. Find $\sin\alpha$ and the coefficient of friction between the particle and the plane. [9]

TURN OVER

9. The diagram shows a lamina $ABCDE$, made of uniform material. It consists of a rectangle $ABCE$ and an isosceles triangle ECD with $ED = DC$. An isosceles triangle PQR , with $PR = RQ$, is removed. Dimensions, in cm, are as shown in the diagram.



Find the distance of the centre of mass of the lamina $ABCDE$ from

(a) AE ,

[1]

(b) AB .

[7]

END OF PAPER